Report on residential real estate and financial stability in the EU, Section 1. on Structural features of residential real estate markets

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ESRB

December 2015

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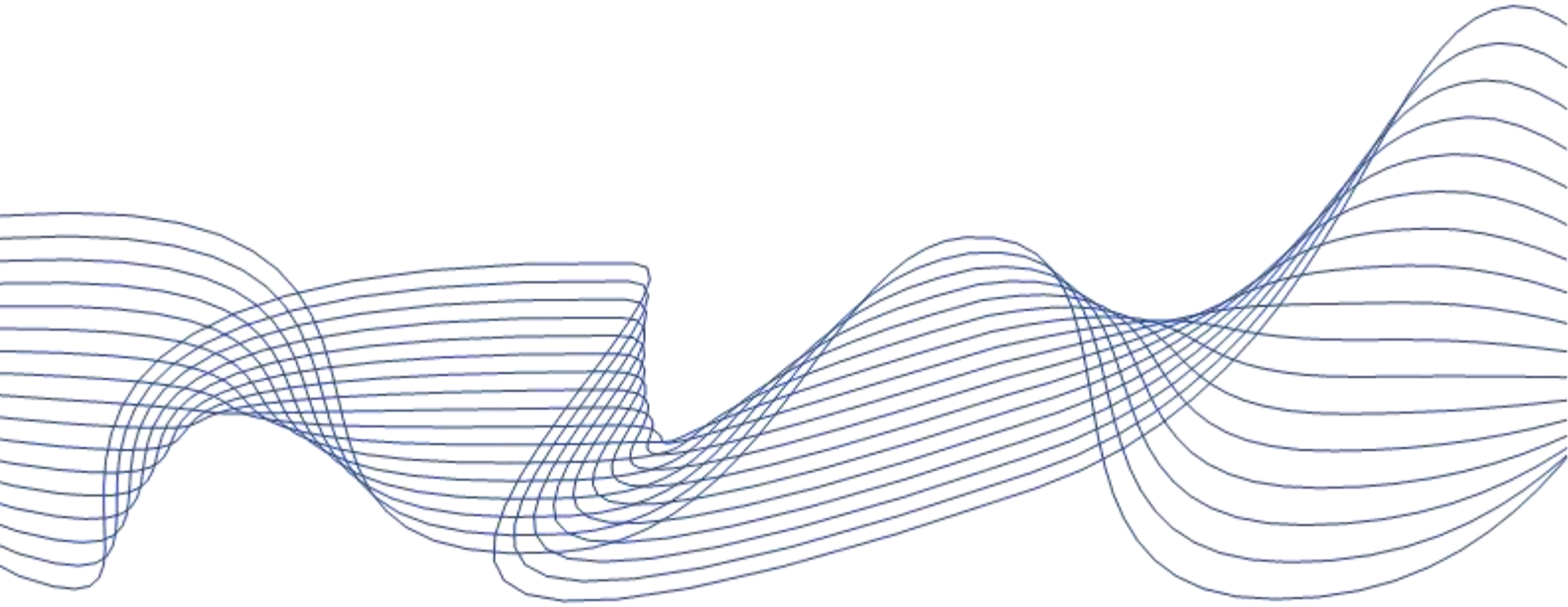

ESRB
European Systemic Risk Board
European System of Financial Supervision

Executive summary

The report investigates how structural features of, and cyclical developments in, residential real estate (RRE) markets in the EU may affect financial stability and how related risks can be addressed. The report is structured in four main sections covering: (i) an analysis of the structural features of RRE markets in Europe, (ii) the historical experience in Europe as regards financial stability risks emerging from the real estate sector, (iii) an investigation into the possible role of structural features of RRE markets in such risks, and (iv) the policy instruments that can be used to address the risks stemming from residential property markets.

i) Analysis of the structural features of RRE markets

The structural features of RRE markets can be usefully grouped into demand-side, supply-side and institutional factors. Demand-side factors include household income, credit availability and interest rates, home ownership rates, and demographic factors. Supply-side elements encompass factors such as residential investment, housing construction and construction costs. Institutional factors include housing taxes and subsidies, mortgage contract features (e.g. variable vs. fixed rate contracts), as well as foreclosure and insolvency procedures.

The report shows how EU Member States differ widely in terms of these structural features. For example, in the Netherlands and Estonia, housing taxes decrease the marginal cost of acquiring a house, while in France and Greece they increase the costs substantially; in Sweden the average mortgage maturity is more than 40 years, while in Hungary it is only 15 years.

ii) Historical experience of RRE markets and financial stability risks

The report develops a conceptual framework of how the housing market, real economy and financial sector are interlinked. Tight links tend to reinforce feedback loops between the financial sector and the real economy. Structural features of national RRE markets may further amplify or dampen the transmission channels.

Several indicators relevant for a financial stability analysis of RRE markets are explored conceptually and empirically. An existing ESRB database is used to identify real estate-related banking crises, with the report also exploring several measures of the depth of a crisis. The report identifies possible indicators that might be particularly relevant during the build-up of financial stability risks in RRE markets and investigates how they behaved prior to the recent financial crisis. Different indicators may be useful depending on the phase of the real estate cycle. Possible early warning indicators of a real estate boom include cyclical indicators of credit and/or real estate prices, combined with their corresponding structural indicators (such as bank credit-to-GDP and price-to-rent ratios); relevant indicators for the bust phase include decreases in loan supply and house prices, and rising non-performing loans and bankruptcy rates. Finally, the similarities and differences between the most recent crisis and the real estate-related banking crises of the 1990s are explored.

The analysis of real estate indicators has highlighted that comparable high-quality data on some key metrics for financial stability monitoring and policy-making are still not available. The

expert group therefore recommends that harmonised definitions of key indicators, such as LTV, LTI, DTI and DSTI, be developed, at least for monitoring and cross-border comparison purposes. These harmonised indicators should not prevent national authorities from continuing to use indicators based on their own definitions to accommodate national specificities.

An analysis of the time-series behaviour of key cyclical real estate-related indicators around crisis events leads to some interesting conclusions. Crises tend to be preceded by lower funding costs, better access to credit, rising debt levels and an underestimation of risks. Risks and vulnerabilities accumulate in the form of external imbalances, booming construction activity, excessive bank credit growth, higher private sector leverage, and overvalued RRE prices.

iii) Structural features of RRE markets and financial stability risks

The analysis points to sharp differences across countries both in the incidence and depth of RRE-related crises. The report provides a first analysis of the potential interplay between structural and cyclical features of European RRE markets and financial stability risks using both graphical and econometric analysis. Structural market features may increase vulnerabilities before real estate-related banking crises and can exert an amplifying or dampening effect when the crisis materialises. However, the role of structural features of real estate markets in shaping the real estate cycle and how they affect financial stability is difficult to assess.

The report finds preliminary empirical evidence that structural features do matter for financial stability. Initial results highlight the role of structural features, such as high LTV ratios, a favourable tax treatment of housing and high levels of bank leverage, in increasing the vulnerability of countries to real estate-related distress events. Empirical work suggests that high shares of new lending granted at a variable rate, by contrast, are associated with a lower probability of upcoming distress, though this result is likely to depend crucially on the evolution of the interest rate environment.

While structural market features may indirectly influence cyclical developments in the build-up phase, they are likely to directly influence the depth of a crisis. Imbalances and structural developments during the upturn phase are perhaps more likely to affect resilience to a negative shock, rather than influencing the likelihood of that shock occurring. Future research would be needed to analyse more closely the depth of real estate-related banking crises, and the role of cyclical and structural characteristics in shaping the impact of crises.

iv) Policy instruments to address financial stability risks

Real estate macroprudential instruments can be grouped into those tackling three "stretches", notably relating to borrowers' income, the underlying collateral backing loans and banking system resilience. In recent years, instruments related to income stretch (LTI and DSTI caps, affordability requirements, amortisation requirements), collateral stretch (LTV caps, amortisation requirements), and banking system stretch (sectoral capital requirements) have been introduced in a number of Member States.

The report provides guidance on the design and use of instruments drawing both on analytical work and emerging experience across countries. A careful design of instruments is crucial for enhancing their effectiveness and avoiding any potential unintended consequences. The report discusses specific detailed design features of each instrument such as the definition of variables and

exemptions and suggests ways to deal with potential pitfalls in the use of instruments. It also discusses the trade-offs between fixing and adjusting instruments over the financial cycle. While fixing instruments may create a more predictable environment for the targeted institutions and minimise the risk of inaction bias and implementation lags, it carries the risk that the settings of instruments do not keep pace with new market developments and may create a "comfort zone" for policy-makers. Member States' implementation of measures differs along most dimensions, and the only relatively recent introduction of measures in most cases means that the evidence for determining "best practice" is still relatively scarce.

A combination of instruments seems likely to be the most suitable response to vulnerabilities stemming from excessive credit growth and leverage related to RRE lending. In this way, different channels through which systemic risks may build up or unfold can be addressed and any circumvention of the rules is made more difficult. Capital-based instruments may be the most effective in directly enhancing resilience, whereas restrictions related to income and collateral stretches are comparatively more effective in curbing the financial cycle. Income stretch instruments are likely to be the most constraining in the build-up phase, whereas a collateral buffer also contributes to system resilience in a downturn. In practice, a combination of instruments, even if not applied simultaneously, is the rule rather than the exception, in particular for collateral and income stretch instruments.

When deciding on the appropriate level of an instrument, a range of different potential calibration methods can be used, potentially in combination. These might range from practical exercises benchmarking experience against other countries to more academic approaches. Expert judgement is likely to be needed given the complexity involved in fully grasping the systemic risks and the uncertainty surrounding the likely impact of the instruments.

Finally, policies influencing structural characteristics of RRE markets themselves might positively contribute to financial stability. The apparent role of structural characteristics of markets in explaining different crisis experiences across countries also points to a broader policy conclusion: that rather than tackling emerging cyclical imbalances in markets through macroprudential intervention, policies influencing structural characteristics of RRE markets might positively contribute to financial stability. This might be a useful topic for further work.

Contents

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List of abbreviations

AUROC	Area under the receiver operating curve
BTL	Buy to let
CCB	Countercyclical capital buffer
CHF	Swiss franc
CRD IV	fourth Capital Requirements Directive
CRE	Commercial real estate
CRR	Capital Requirements Regulation
DSGE	Dynamic stochastic general equilibrium (model)
DSR	Debt service ratio
DSTI	Debt service-to-income (ratio)
DTI	Debt-to-income (ratio)
EAD	Exposure at default
EBA	European Banking Authority
ECB	European Central Bank
ESCB	European System of Central Banks
ESRB	European Systemic Risk Board
EU	European Union
FPC	Financial Policy Committee
FSA	Financial Services Authority, Financial Supervision Authority
FX	Foreign exchange
GFCF	Gross fixed capital formation
HDSR	Household debt service ratio
HH	Household
IRB	Internal ratings-based (approach)
IWG	Instruments Working Group
LGD	Loss given default
LTI	Loan-to-income (ratio)
LTV	Loan-to-value (ratio)
MCB	Mortgage covered bond
MLV	Mortgage lending value
NFC	Non-financial corporation
NPE	Non-performing exposure
NPL	Non-performing loan
OOH	Owner-occupied housing
PD	Probability of default
RMBS	Residential mortgage-backed security
RRE	Residential real estate
RW	Risk weight
SDW	Statistical Data Warehouse
SSM	Single Supervisory Mechanism
VAT	Value added tax

Countries

BE	Belgium	**HR**	Croatia	**PL**	Poland
BG	Bulgaria	**IT**	Italy	**PT**	Portugal
CZ	Czech Republic	**CY**	Cyprus	**RO**	Romania
DK	Denmark	**LV**	Latvia	**SI**	Slovenia
DE	Germany	**LT**	Lithuania	**SK**	Slovakia
EE	Estonia	**LU**	Luxembourg	**FI**	Finland
IE	Ireland	**HU**	Hungary	**SE**	Sweden
GR	Greece	**MT**	Malta	**UK**	United Kingdom
ES	Spain	**NL**	Netherlands	**NO**	Norway
FR	France	**AT**	Austria	**US**	United States

Section 1
Structural features of residential real estate markets[1]

This section presents an overview of the structural features of residential real estate markets across EU Member States, noting some major changes between the pre-crisis (2007-08) and post-crisis period (2012-13). Section 1.1 reviews the importance of housing market developments for the wider economy. Section 1.2 describes a range of supply and demand characteristics that may help to explain house price dynamics across countries. Section 1.3 discusses the role of institutional factors with a particular focus on taxation and the structure of national mortgage markets. Section 1.4 concludes with the results of a statistical clustering exercise of EU countries based on their structural features.

1.1 The importance of housing markets for the economy

Real estate plays a significant role in the economy and can have a material influence on developments in the financial system. The growth of advanced economies has always required substantial investments in infrastructure, including capital expenditures on RRE and CRE. In addition, the rise in households' disposable income over the past decades has led to an increased demand for owner-occupied housing. The associated need for long-term financing of construction, development and the subsequent resale of real estate has typically been met by bank loans. In fact, a large fraction of the global growth in bank balance sheets over the past decades has been attributed to increased mortgage lending (Jorda et al., 2014). As such, developments in real estate markets have been significant drivers of the evolution of the financial system (ECB, 2009).

The systems to meet housing demand differ significantly across Member States, but generally encompass rental (both privately and socially provided) and owner-occupied housing. Housing satisfies a fundamental human need and has wide social effects, which translates into a high politicisation of the sector.

Price changes translate into shifts in the value of the housing stock, which represents a significant proportion of the fixed assets in an economy (ECB, 2009; Iacoviello, 2011). As a consequence, developments in the housing sector can affect the valuation of a broad range of financial assets and may, through a financial accelerator mechanism, cause systemic problems in the financial sector and affect the whole economy. In particular, exposures to the real estate sector have extended beyond the banking system, with for example mortgage-backed assets being sold to investors in other sectors. On the other hand, the financial sector itself may also be an important source of tensions and volatility in the residential sector.[2]

1 Prepared by a team coordinated by Karin Wagner (Oesterreichische Nationalbank)/Alexander Schmidt (Deutsche Bundesbank) and comprising Calliope Akantziliotou (Bank of Greece), Jelena Cirjakovic (Banka Slovenije), Marine Dujardin (Banque de France), Gerard Kennedy (Central Bank of Ireland), Jacek Laszek (Narodowy Bank Polski), Adriana Lojschova (European Central Bank), Krzysztof Olszewski (Narodowy Bank Polski), Peter Pontuch (European Commission), Piotr Sliwka (Komisja Nadzoru Finansowego, C.S.Wyszynski University), and Jakob Winstrand (Sveriges Riksbank).

2 See the cases of the US subprime crisis and Sweden in the 1990s.

Possible changes in household and firm behaviour are additional interaction channels that go beyond the financial system. Households' expenditure on housing services typically accounts for 15-35% of their income.[3] Additionally, the large wealth effects of house price changes can affect the borrowing capacity of private households and will influence their consumption-saving decisions (HM Treasury, 2003 and Case et al., 2012[4]), and the strength of this effect might depend on the structure of the credit market (ECB, 2003). On the other hand, fluctuations in housing demand will influence activity, particularly the construction sector. While the housing construction sector usually contributes on average 3-6% of GDP, it has a large cyclical component and can reach double-digit values during boom periods and much lower in busts.[5] Therefore, the macroeconomic effects of developments in the RRE market have to be considered as well.

1.2 House price dynamics and their determinants

The empirical literature on the determinants of house prices is vast. It explores a broad set of determinants – considered in this section – including:

- **demand-side determinants:** household income; credit availability and interest rates; ownership rates and the rental market; demographic factors;
- **supply-side determinants:** residential investment, housing construction and construction costs.

1.2.1 Demand-side determinants

1.2.1.1 Disposable income

Disposable income is typically positively correlated with house prices. Algieri (2013) examines real house prices in Germany, France, Italy, Spain, the Netherlands, the UK and the US from 1970 to 2010 and finds that long-run per capita income elasticity varies between 0.64 (Germany) and 1.69 (UK). Similarly, Claussen (2012) states that 62% of the rise in house prices in Sweden since 1996 can be explained by the increase in real disposable income, with household real financial wealth accounting for only 8%. Hiebert and Roma (2010) also stress the important role of income differentials in explaining city-level house price dispersion in Germany, France and the US.

1.2.1.2 Credit availability and interest rates

Credit availability and interest rates are found to be key determinants of house prices, but there is no clarity on the size of the impact. Increases in interest rates may lead to a fall in housing demand, and short-term falls in prices (e.g. Xu and Tang, 2014) – with the ultimate price adjustment

3 Source: EU SILC.

4 Based on US data, Case et al. (2012) calculate that an increase in real housing wealth – comparable to the pre-crisis period from 2001 to 2005 – would push up household spending by a total of about 4.3%. A decrease in real housing wealth comparable to the crash period from 2005 to 2009 would lead to a drop of about 3.5%.

5 E.g. Spain and Ireland during the mid-2000s (source: Eurostat).

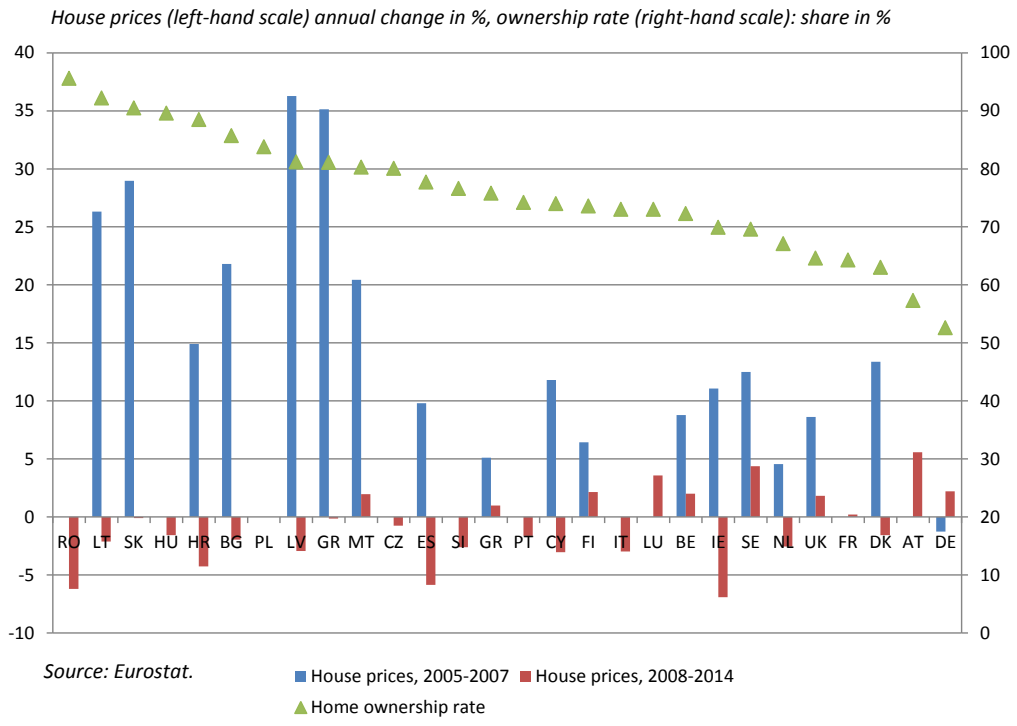
depending on the response of housing supply to price falls (HM Treasury, 2003). In addition, an increase in long-term interest rates may make other fixed income assets more attractive relative to residential property investment, reducing the demand for the latter, which in turn lowers house prices (Adams and Roland, 2009).

1.2.1.3 Home ownership rates and the importance of rental markets

Higher disposable income and lower interest rates improve home affordability and influence the choice of owning or renting real estate. Empirically, there is a link between home ownership rates and average house price changes. Chart 1 suggests that countries with high home ownership rates experienced larger increases in house prices in the run-up to the global financial crisis, while prices tended to fall more sharply thereafter.

Chart 1
Home ownership rates and average house price changes in the periods 2005-07 and 2008-14 by country[6]

(percentage)



Source: Eurostat and EU SILC.
Notes: The house price index is calculated as the average of house price indices for the period 2005-07.

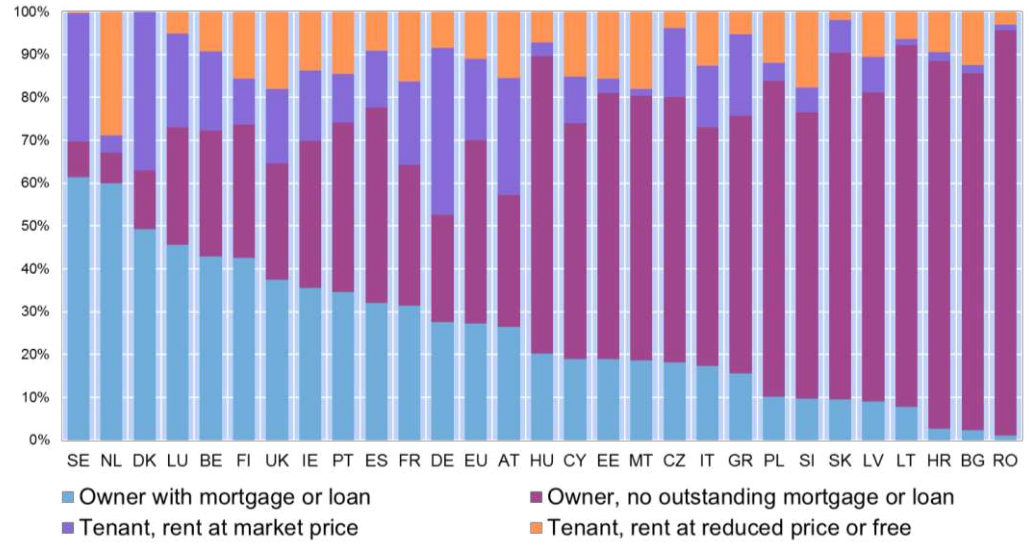
The link between ownership rates, the rental market share and rental market regulation might come from the fact that balanced ownership and rental markets may be a stabilising factor for property markets. Ownership rates vary substantially – from 53% in Germany to 90% in Lithuania. Differences in ownership rates may in turn be explained by different structural features such as tax

6 The house price index is calculated as the average of house price indices for the period 2005-07. Source: Eurostat and EU SILC.

incentives, the cost of owner-occupying vs. renting (price-to-rent ratio), demographics and factors associated with the transition to a market economy (for central and eastern European countries). The share of rented dwellings has decreased since the 1980s in most Member States (ECB, 2003). Nevertheless, in some countries the private rental sector remains large. Furthermore, the size of the social rental sector plays a crucial role and can be highly influenced by policy-makers. The share of social housing differs a lot across Europe – while it is quite high in SI, EE, MT and FI (around 17%), it is low in some countries such as SE, DK and NL. These latter countries are also those providing some form of mortgage interest tax relief as a means of encouraging home ownership (see Section 1.3.1.1). They are also those with the highest share of owners holding a mortgage or a loan in the EU.

Chart 2
Tenure choice
Distribution of population by tenure status, 2013

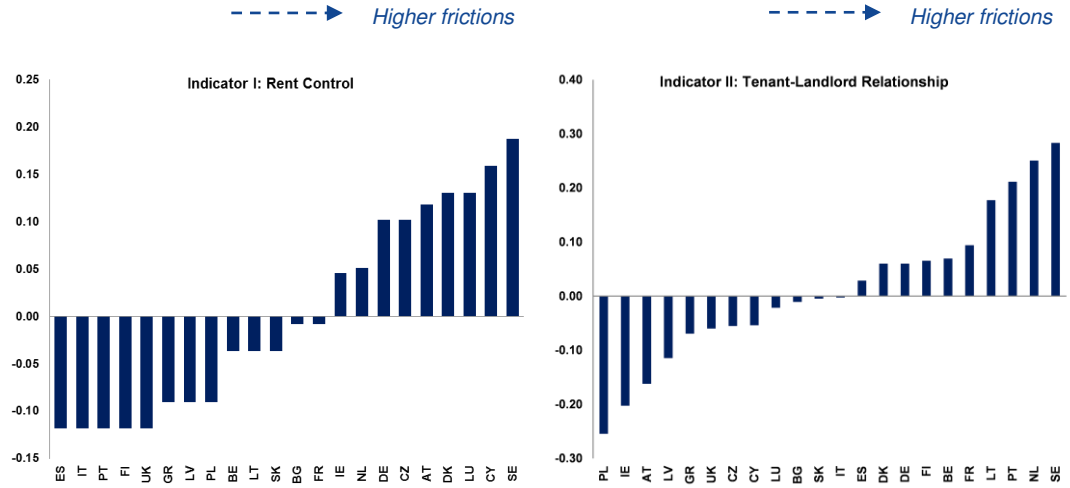
(percentage)



Source: Eurostat, NL 2012, Statistics Netherlands

Rental markets are subject to various frictions. Cuerpo et al. (2014) constructed an indicator reflecting the degree of regulation in the rented housing market (Chart 3). Factor analysis identifies two dimensions in rental market regulation. The first reflects frictions in rent-setting (e.g. rent controls), the second, frictions affecting the tenant-landlord relationship (e.g. rules about deposit requirements, eviction rules and duration of contracts).

Chart 3
Composite indicator of regulatory frictions of rent control and tenant-landlord relationships, 2013



Source: Calculations based on Cuerpo et al. (2014).
Notes: The indicators refer to the private segment of the rental market. Data for CY represent the housing segment of pre-2000 dwellings.

1.2.1.4 Demographics and migration

Demographic factors and migration can have a strong impact on the aggregate demand for housing. A key indicator is the household formation rate, which depends on the age composition and behavioural aspects of the population, and varies over time and regions. Demographic as well as behavioural factors usually have a nationwide impact, but can have strong regional biases, which might give rise to regionally different house price dynamics.

Growth in the number of households is affected by migration. In turn, there tends to be a close link between migration (from abroad and inter-regional) and employment opportunities. Moreover, income differentials increase the relative attractiveness of certain regions, which fuels additional demand for housing in such areas. The importance of this demand channel in part depends on residential mobility. For example, Caldera, Sánchez and Andrews (2011) find for OECD countries that lower transaction costs, more responsive housing supply, lower rent controls and tenant protection, as well as higher current income, tend to increase residential mobility. Chan (2001) and Ferreira et al. (2010) find that after a housing bust, highly leveraged households are typically less mobile due to low or negative housing equity.

As such, (expected) income differentials and migration effects can give rise to strong supply and demand imbalances, in particular in urban and metropolitan areas where, as a result, house prices tend often to grow much more strongly than in the rural areas.

1.2.2 Supply-side influences

Residential investment, housing construction activity and construction costs can have a significant effect on house prices. Over recent decades, housing investment has grown rapidly in many countries, with low interest rates being one of the driving factors. If house prices rise faster than construction costs, it can be rational for individuals or construction companies to invest in new dwellings. The extent of this supply effect can differ depending on national regulations and the availability of specialised workers (Giuliodori, 2004). For example, booms in housing investment have been responsible for increased employment, with the construction sector accounting for more than 20% of all employment gains since 2000 in the US, FR, ES, DK, NO, SE, IE and GR (OECD, 2007). Chart 4 (right panel) shows that countries with negative house price changes had to deal with stronger declines in residential investment and more pronounced increases in unemployment. Hence, changes in house prices can generate significant spillover effects, affecting the wider macroeconomy.

Chart 4
Changes in house prices, residential investment and unemployment

(percentage)

Source: Eurostat

1.2.2.1 Housing supply price elasticity

The dynamics of house prices are affected by the price elasticity of housing supply. In areas with low supply responsiveness, house prices tend to increase more after a positive demand shock than in areas with high supply responsiveness (Andrews et al., 2011). With high supply responsiveness the risk of overbuilding increases, which might amplify a fall in housing prices if demand subsequently weakens (Glaeser et al., 2008). Supply responsiveness tends to vary across geographical areas, depending on physical and regulatory factors. For example, estimates by Caldera et al. (2011) of the long-run price elasticity of new housing supply in OECD countries vary between 0.146 and 2.014 (Table 1). Similarly Murphy (2004) explores the impact of planning restrictions on housing supply. The author lists various studies from the UK and US showing that post-war estimates suggest a value for the long-run elasticity of supply between 0 and 1 for the UK, where planning restrictions are generally tight, and between 6 and 13 for the US, where planning restrictions are generally loose (Meen, 1996; Malpezzi and MacLennan, 2001; White and Allmendiger, 2003).

Housing supply is usually more inelastic in the short run than in the long run. For example, Bacon et al. (1998) find that house completions are relatively unresponsive to price changes in the short run compared with in the long run. For the same reasons that it can vary between countries (Gattini and Ganoulis, 2012), supply responsiveness can also differ between regions within countries (Saiz, 2010; Bacon et al., 1998). Such differences could be a factor explaining the geographically divergent responses of house prices to demand shocks. Chart 4 shows levels of residential investment, which in the EU was on average 5.7% of GDP pre-crisis and 3.5% post-crisis. The left panel shows that the change from pre-crisis to post-crisis quite clearly corresponds to house price changes.

Table 1

Estimates of long-run price elasticity of new housing supply, average residential investments in % of GDP and construction cost index for new residential buildings

Country	Estimates of long-run price elasticity of new housing supply*	Average residential investments in % of GDP**	Average construction cost index, new residential buildings***
AT	0.234	4.9	85.2
BE	0.315	5.7	95.5
BG		2.8	88.6
CH	0.146		99.7
CY		7.9	83.6
CZ		3.4	91.9
DE	0.428	6.0	94.9
DK	1.206	4.6	87.9
EE		3.6	91.3
ES	0.452	8.0	83.3
FI	0.988	5.7	88.7
FR	0.363	5.8	89.2
GR		7.4	90.5
HU		3.6	88.5
IE	0.631	7.1	97.2
IT	0.258	5.1	87.0
LT		2.5	93.4
LU		2.9	94.1
LV		2.7	85.0
MT		4.9	94.2
NL	0.186	5.2	94.0
NO	0.486		89.6
PL	0.442	1.5	91.7
PT		5.6	93.5
RO		1.6	77.8
SE	1.381	3.1	82.6
SI		3.4	82.9
SK		2.7	79.1
UK	0.395	4.6	78.7
US	2.014		

* *Estimates of the long-run price elasticity of new housing supply where new supply is measured by residential investment. Source: Caldera Sánchez and Johansson (2011)*

** *Average residential investment in % of GDP, 1995-2014, where available. Source: Eurostat*

*** *Average construction cost index, new residential buildings 1995-2014, where available. Source: Eurostat.*

1.2.2.2 The role of expectations

Expectations of future prices are also an important house price determinant. In times of turmoil with large negative shocks to house prices, pessimistic house price expectations may arise, which can increase the possibility of longer and more pronounced boom-bust periods, given the effect self-fulfilling expectations can have on house prices (ECB, 2009).

1.3 Institutional factors

House price developments can also be affected by a broad set of institutional and other regulatory factors. For instance, the political system can influence the housing market through social housing policies and rental market regulation or affect the responsiveness of housing supply to demand shocks through construction regulation (Gyourko and Molloy, 2014). On the other hand, government regulations can influence housing demand, e.g. via tax policies (see Section 1.3.1). The availability of credit as well as the institutional features of mortgage markets (see Section 1.3.2) might be additional factors affecting housing demand.

1.3.1 Housing taxes, subsidies and transaction costs

Taxes can be a key factor in shaping incentives for the housing and mortgage market. Property-related taxes can have a direct effect on private agents' incentives for choosing a particular housing tenure (ownership vs. renting), may affect how transactions are financed (extent and type of borrowing), and may affect the supply of housing assets to the market. Empirical literature points to the importance of housing-related taxation for house prices (Kuttner and Shim, 2013).

Most taxes affect housing markets via the demand channel, acting on the cost of buying, owning, financing or selling the asset. Measures affecting the property owner are reviewed in the first part of this section. However, taxation may also have an impact through other channels, such as taxation of construction activity or taxation of rental incomes, which may in part also affect housing supply; these measures are discussed in the second part of the section.

1.3.1.1 Taxation measures affecting home ownership demand

It is important to assess the tax treatment of housing holistically, as different tax measures may affect households' incentives in various ways. As well as considering the impact of housing taxes relative to other investments, housing taxation needs to be considered also from the angle of its effect on borrowing as it modifies the effective cost of financing through mortgage interest tax relief.

Moreover, leveraging of other investments is usually less easy to achieve. All these factors can create a further bias towards taking on a high level of mortgage debt.[7]

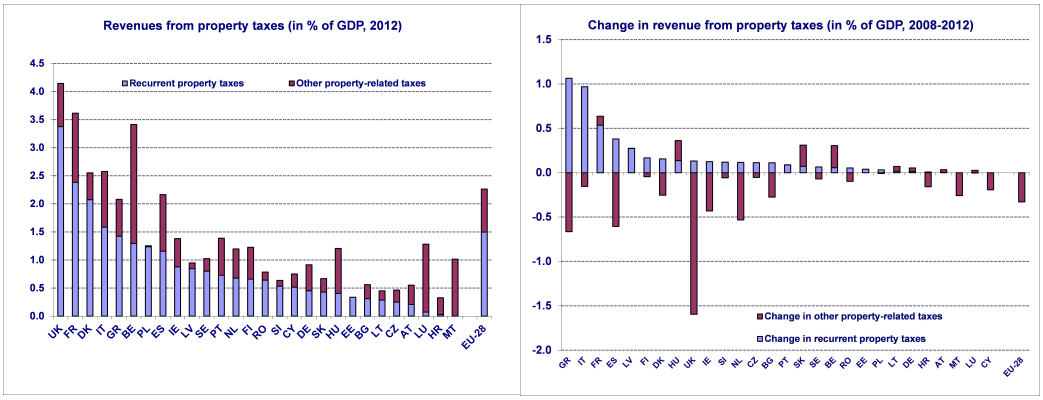
Recurrent property taxation

Recurrent property taxes are typically payable by the house owner and therefore increase the cost of home ownership. By acting on the incentives to own a house, these taxes can have a significant effect on broader housing market dynamics.[8] Recurrent property taxes are usually levied on the value of the property, in practice the cadastral value. At present, the economic importance of this revenue source is relatively small. This is in most cases a result of tax rates being low and/or the cadastral values being outdated and not representative of the market value of the assets (OECD, 2011). A few Member States (e.g. NL and LU for principal residences) tax so-called imputed rents, i.e. dwelling services enjoyed by an owner-occupier from their asset.

For the EU as a whole, revenue from recurrent property taxes remained fairly stable between 2002 and 2011. Average revenues as a share of GDP are estimated between 1.2% and 1.3% of GDP and only in 2012 was there an upward shift to 1.5% of GDP. In 2012, recurrent property taxes ranged across countries from 0% to 3.4% of GDP. Due to policy changes in some euro area countries in 2013 and 2014 recurrent property taxes have increased further (Table 2), showing a shift of the tax burden to recurrent property tax.[9] Other property-related taxes[10] – affected strongly by housing market valuations – moderately increased up to 2008, decreased afterwards and in 2012 stood at a lower level than in 2002. For the EU as a whole, adding other property-related taxes to the recurrent property taxes, average revenue as a share of GDP in 2012 amounted to 2.1% of GDP.

Chart 5
Revenues from property taxes as a % of GDP, 2012 and 2008-12

(percentage)



Source: Eurostat

7 See for instance Krelove (2012).

8 In some cases, the recurrent property tax is instead payable by the resident of the dwelling, especially when this tax is intended to finance the provision of local services.

9 Garnier et al. (2014).

10 Other related property taxes include various taxes such as transaction-based taxes and taxes on inheritance, gifts and other property items.

Table 2
Property tax changes adopted from mid-2013 to mid-2014

	Statutory rates	Base or special regimes
Increase	GR, IE, IT, CY LT, NL, RO	CY, ES, HR, UK
Decrease	GR, IT	EE, LV, MT

Source: European Commission (2014a)
Notes: The table encompasses property tax changes implemented or adopted from mid-2013 to mid-2014 including temporary changes. Property tax measures are reported individually and are not consolidated based on their budgetary impact. If the initial measure was a temporary property tax reduction for a given period, the decision to extend this measure is reported as a decrease and vice versa.

Transaction-based property taxation

Transaction-based housing taxes lead to a one-off cost at the moment of the transaction, thus increasing the cost of home ownership. Unlike recurrent taxes, however, they also have the effect of discouraging transactions. This might lead to a less efficient allocation of the housing stock, and may hamper labour mobility (Johansson et al., 2008). There is significant heterogeneity across Member States in transaction tax rates (Table 3). At one end, Belgium has a rate well above 10%, while at the other end several countries do not apply any transaction taxes.

Table 3
Tax rates on real estate transactions, 2014

Tax level	Country
≥10%	BE
5-9%	DE, FR, ES, LU, HR, IT, MT, PT*, UK*
<5%	AT, GR, IE*, NL, SI, FI, CZ, DK, LV, PL, SE, HU
None	EE, SK, BG, LT

Source: European Commission (2014a)
** indicates a progressive or multiple rate structure; no rate indicated for RO. The top rate in UK of 7% applies to properties above GBP 2 million. In IT some rates may apply to cadastral values rather than transaction values. Moreover, a 2% rate applies to the main residence of first-time buyers. In DE the rate is set by the federal states ("Länder") with rates ranging from 3.5% to 6.5% and a median rate of 5%. In PL a 2% rate applies to the sale of immovable property, which is VAT exempt. CY has suspended the application of the transfer tax (levied at progressive rates, with a top rate of 8%) until 2016. In IE a multiple rate structure is in operation, with 1% on properties valued up to EUR 1 million and 2% on the balance above this.*

Capital gains taxes on housing

Capital gains taxes may favour housing investments over other types of investment. Some Member States exempt principal residences from capital gains taxes; others grant an exemption from capital gains taxes (or a reduction thereof) after a certain holding period. Such an exemption is typically not granted to other types of investment. Finally, some countries enable the capital gains tax liability to be deferred. Recent reforms in this area include the introduction of capital gains taxes in Greece, as well as in the UK for non-residents.

Mortgage interest tax relief

Several Member States provide some form of mortgage interest tax relief to encourage home ownership. Table 4 shows that ten Member States had granted some tax relief to mortgage holders as of 2013, with two of them, SE and NL, being in the highest category. Mortgage interest tax relief can be compatible with a neutral tax system, provided that imputed rents and capital gains are appropriately taxed, i.e. identically to other investment returns. However, this is rarely the case, leading to biased incentives towards debt-financed housing investment. This tax advantage might be capitalised into house prices.[11]

Table 4
Extent of mortgage interest tax relief for new mortgages, 2013

Mortgage interest tax relief	Country
None	AT, CY, FR, DE, IE, HU, IE, LV, LT, MT, PL, PT, RO, SK, SI, ES, UK
Bounded and limited	BG, CZ, EE, IT, LU
Bounded	BE, DK, FI
High or unbounded	NL, SE

Sources: European Commission and OECD

Several reforms to mortgage interest tax relief have taken place in the recent past. For example, ES, GR, IE and PT discontinued mortgage interest tax relief on new mortgages from 2013 (PT one year earlier). More gradual and/or moderate reductions of tax deductibility have been adopted in EE, DK, FI and NL (in the latter case together with linking deductibility with the requirement to amortise fully loans over a 30-year maturity).

Assessing overall tax incentives for home ownership

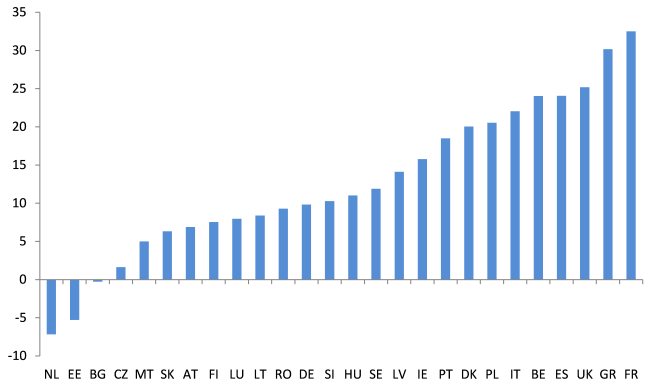
It is useful to assess the overall effect of taxation on incentives for house purchase using an aggregate indicator. For this purpose, one can use the estimated contribution of housing taxation to the marginal cost of investing in owner-occupied housing, as developed by the European Commission (2014) based on Poterba (1992) and Poterba and Sinai (2008). Chart 6 shows that the contribution of housing taxes to the marginal cost of owner-occupied housing investment in 2014 ranged from -7% of the cost (i.e. taxation reduces the actual cost of housing investment) to +33% of the cost (i.e. taxation increases the cost of housing investment). Compared with the pre-crisis period, significant reductions in the tax support for owner-occupation have been implemented in CZ, DK, ES, FI, GR, IT and PT, which means that they would be positioned further to the left in that earlier period.[12] The chart therefore confirms the very heterogeneous role played by taxation as regards its contribution to the overall cost of investment in housing.

11 Ibid.

12 See also the evolution of a simpler aggregate indicator in European Commission (2014b).

Chart 6

Contribution of housing taxes to the marginal cost of owner-occupied housing (% of the cost before housing taxes), 2014



Source: European Commission (2014a)

1.3.1.2 Other taxes affecting the housing market

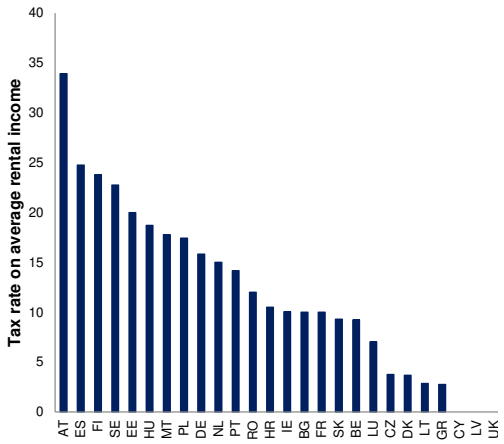
Taxation of rental income

Taxation of rental income affects the incentives to supply housing assets on the rental market. Too high tax rates relative to other investments may discourage the provision of this tenure type. This may lead to reduced housing construction if rental dwellings are a significant part of the housing market. On the other hand, too low tax rates on rental assets may lead to overinvestment at the expense of other types of investment. Chart 7 compares the tax incentives for renting a dwelling using the Global Property Guide's estimated tax rate applicable to a non-resident small private investor.[13] The higher end of the distribution of EU Member States is represented by AT, ES, FI and SE. UK, LV, CY, GR and LT are at the lower end of the distribution with very low rental taxation.

13 Only a calculation for non-residents is available from this data source.

Chart 7
Tax rate on average rental income

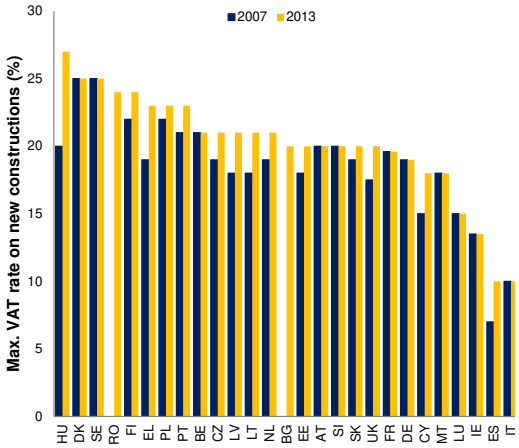
(percentage)



Source: Global Property Guide.
Note: Calculated for comparable annual rental income for personally directly owned property by non-residents with no other local income and no mortgage financing.

Chart 8
Highest VAT rates applicable to new construction

(percentage)



Sources: European Commission.

Value-added tax on construction work

VAT rates applicable to the construction of new buildings can affect housing supply. Depending on the elasticity of demand, changes in the level of VAT on construction can impact quantities and pass through into the price of new dwellings and thereby indirectly affect the price of existing dwellings. VAT rates for new construction vary markedly across the EU. The lowest rates as of 2013 were in IT, ES and IE, whereas the highest rates were observed in HU, DK, SE, RO and FI. In the recent period there has been a general tendency towards increases in the VAT rate on new construction.

1.3.2 Characteristics of national mortgage markets

This section examines the structural features of mortgage markets in the EU, with an emphasis on the situation before and after the financial crisis. The main cross-country differences and similarities are also highlighted. Mortgage markets play a major role in housing markets, since owner-occupied housing constitutes a household's largest financial outlay, and generally requires extensive debt financing in the form of a mortgage. In addition, increased deregulation and a greater focus on efficiency have seen housing finance markets change dramatically in recent decades (Andrews and Caldera Sánchez, 2011).

1.3.2.1 Outstanding mortgage lending and flows

The stock of mortgage loans to households across the EU stood at just over EUR 6 trillion, equivalent to 45% of EU GDP, at the end of 2013 (Table 5). This was approximately 25% higher than the 2008 figure, which accounted for 37% of GDP. While the value of outstanding mortgages increased between the outbreak of the crisis and 2013, the year-on-year rate of growth in the stock had begun to slow as of late 2010, turning negative in mid-2013.[14] This may have been a symptom of household deleveraging and the steady flow of mortgage redemptions, as well as lower levels of gross mortgage lending compared with the immediate pre-crisis years.

The growth in mortgage markets varied significantly across countries in the years from 2008 to 2013 (Chart 9). Some countries experienced increases in mortgage lending (e.g. UK, CY, BE, SE and GR), while mortgage markets in a handful of Member States contracted noticeably (IE, DK, LV and EE).

Mortgage lending is particularly concentrated in the larger economies. Cumulatively UK, DE, FR and ES accounted for almost two-thirds of the stock of outstanding EU mortgages in 2013 (Table 5). By contrast, the 13 smallest mortgage markets combined made up 2.5% of the total.

1.3.2.2 Mortgages and household lending

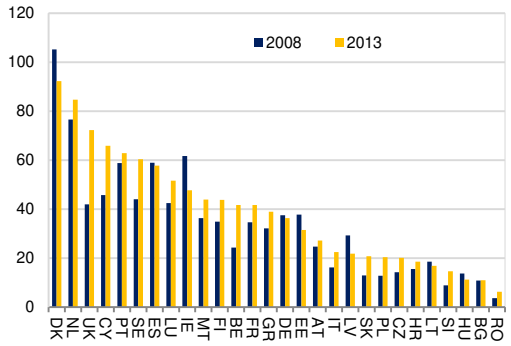
Household participation in national mortgage markets is heterogeneous across the EU. Home ownership rates are generally higher in many of the EU's newest Member States (see Section 1.2.1), but properties there tend to be owned outright rather than with a mortgage. Data presented in Chart 2 show that no more than 10% of households in those countries held a mortgage in 2013. At the opposite end of the scale, at least 40% of households in the Benelux and Nordic countries were servicing a mortgage on their homes.

Mortgage lending tends to account for a large portion of household debt in northern and western European countries, whereas a number of central and eastern European countries lie at the lower end (Chart 10). Post-communist policies aimed at privatising dwellings, whereby occupants of state-owned apartments were given the opportunity to purchase their dwelling at advantageous terms, may help explain the latter. Data for end-2013 show that mortgage lending made up over 85% of total household loans in NL, DK, UK and EE, whereas for RO, BG, HR and HU the figure was less than 50%. The fraction of total household lending accounted for by mortgages has not changed much in the majority of countries since the financial crisis.

14 According to ECB Statistical Data Warehouse (SDW) data, the year-on-year rate of growth in the stock of lending for house purchases was up 9.4% in November 2010, but down 1.6% in July 2013.

Chart 9
Household mortgage lending: 2008 vs. 2013

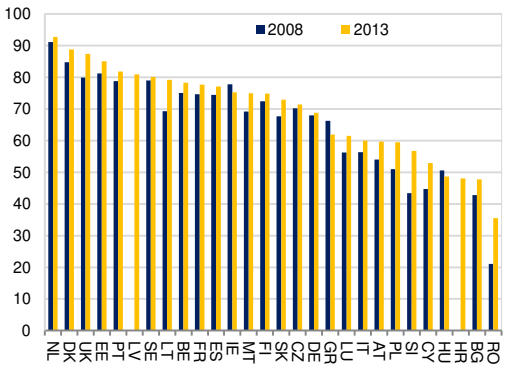
(percentage of GDP)



Sources: ECB (SDW), Eurostat and national authorities.

Chart 10
Household mortgage lending as a percentage of total household loans: 2008 vs. 2013

(percentage)



Sources: ECB (SDW), Eurostat and national authorities.

1.3.2.3 Mortgage interest rate types and foreign currency mortgages

Prevailing interest rate type

Interest rate arrangements on mortgages across the EU vary widely. In most countries borrowers can choose either fixed or variable rate mortgages. The crisis appears to have had little impact on preferences as far as outstanding mortgages are concerned (Table 5). The fixed rate system, whereby interest rates are locked in for a period of at least five years, has traditionally been favoured in DE, DK, NL, FR and BE. In other Member States, variable interest rate loans tend to dominate. In these markets, interest rates can be adjusted periodically within a 12-month period (depending on the contract), with refinancing/interest rate adjustments normally based on the interbank rates for the corresponding maturity (ECB, 2009).[15]

The proportion of new mortgage lending at variable rates can be quite fluid depending on factors such as the rates on offer and borrowers' expectations of future interest rates. The most obvious change between the pre- and post-crisis periods is in GR, where the share of variable rate loans in new mortgage lending increased from 28% to 96%. Other countries showing a significant, albeit less dramatic, increase in the share of new variable rate mortgages are IT, AT, SI and LT, whereas HU, ES and UK present the opposite evolution.

15 In some countries, variable rate loans may also be linked to other reference rates (T-bills, prime rates, swap rates, or LIBOR for countries where some housing loans are denominated in a foreign currency).

Foreign currency mortgages

In markets where mortgage loans are provided in a foreign currency (FX), unhedged households can be exposed to exchange rate risk[16]**.** In general, FX mortgages are more common in central and eastern European markets. Data from 2007 show that 90% of the outstanding stock of housing loans in RO was denominated in a foreign currency (ECB, 2009). Other countries where the share was relatively high (37% to 55%) were BG, HU and PL, while levels were also significant in some Baltic States (EE and LV) and euro area member countries (GR, CY, AT and SI).

FX loans remain a major feature of post-crisis EU household lending in some Member States.[17] At end-2013, approximately 70% of outstanding household loans in LT were denominated in a foreign currency, while the shares in RO and HU were approximately two-thirds and a half respectively; the share in BG, PL and AT was over 20%. In contrast, for the majority of other EU Member States the share of foreign currency household lending was less than 5%.

Loans denominated in Swiss francs (CHF) are especially popular in a number of Member States. In HU they account for 60% of total household lending, and in PL and AT they make up one-quarter of household borrowing. The exchange rate of the CHF vis-à-vis the local currency may increase the risk of these loans (see the case study on FX mortgages in PL in Annex 1).

1.3.2.4 Loan-to-value ratios, mortgage maturities and method of redemption

Average LTV ratios

Cross-country LTV comparisons are hampered by the variety of definitions and ways of compiling data across Member States. Depending on the country, LTV ratios are based on the outstanding stock of mortgages, LTV ratios are recorded at the time of loan origination or LTV ratios are exclusively those applicable for first-time buyers or owner-occupied housing (Table 5).

The CRD IV defines high LTV lending as lending where the loan accounts for more than 80% of the value of the underlying collateral. Average LTV ratios for six of the sample countries at hand (NL, FI, AT, FR, UK and CY) were at or above this level in 2013, while eight others (PL, LT, RO, DE, GR, IE, SK and SE) were above the sample average of 70%. LTV ratios were the lowest in EE, SI, CZ, ES, HU and IT, with average values of below 60%.

In the majority of countries (18 out of 27), average LTV ratios have fallen since the financial crisis. In the markets where the typical LTV has declined, the average decrease has been around 11 percentage points.

16 The actual FX risk depends on the volatility of the underlying FX rate (note that Bulgaria has a fixed exchange rate vis-à-vis the euro).

17 Based on ESRB data showing (i) FX loans as a share of total household loans and (ii) CHF loans as a share of total household loans.

Loan maturity and amortisation

Longer-dated mortgage products can be obtained in the EU.[18] Member States were surveyed on maximum mortgage maturities in 2013. 30-year mortgage terms were available in BE, HR, DK and LU; terms of 35 years were available in IT and IE. CY, EE, LV and LT had a 40-year maximum, while SE was the market with the longest reported mortgage maturity at 54 years.

In most Member States, mortgages are repaid over a period of 20 to 30 years (Table 5). SE not only has the maximum mortgage maturity available, it also has the longest average mortgage maturity (around 41 years). Typical mortgages in HU appear to be the shortest at 15 years, while average maturities are also less than 20 years in FR, SI and LV.

Amortising mortgages (the repayment of monthly instalments made up of capital and interest payments) was the most common repayment arrangement in the majority of countries in the pre-crisis period (ECB, 2009). Post-crisis data on the percentage of non-amortising (in the first year) new mortgages were received from a small number of countries (HU, LU, NL, PT, SE and NO). The differences between these countries are large. In LU, for instance, 6% of new loans are originated on a non-amortising basis in the first year of the mortgage, compared with 46% in SE. In general, a smaller percentage of these loans are being originated in the current environment, particularly in NL, where they have gone from accounting for over one-third of new loans to less than 10%.

18 Pre-crisis data from 2007 show that mortgages of up to 40 years were offered in BE, IE, GR, IT, LU, RO, EE, LT, LV and MT and 50-year housing loans could be obtained in ES, FR, SE and PT. In a limited number of cases, 60-year mortgages were available (in FI), though they accounted for a very small market share (ECB, 2009).

Table 5

Selected mortgage loan characteristics (2013)

Country	Value of outstanding residential mortgage loans (EUR mn) *	Prevailing type of interest rate on all newly issued mortgages **	Share of variable rate mortgages in newly issued mortgages ***	Average LTV ratios for newly issued residential mortgages (%) ****	Typical mortgage maturities (years) *****
UK	1,457,248	V	22.6	75.0	24.6
DE	1,019,370	MF	16.0	(75)	(30.0)
FR	881,742	LF	6.9	83.8	18.6
ES	606,380	V	67.9	57.5	22.7
NL	544,416	LF	23.2	88.7	29.7
IT	361,565	V	79.8	58.3	21.9
DK	233,499	LF	31.7	96.0	30.0
SE	263,300	S	60.2	70.9	41.2
PT	106,592	V	91.6	64.4	29.0
BE	164,723	LF	6.8	62.3	20.0
FI	88,314	V	97.0	70.4	21.6
AT	87,622	V	80.0	(70.5)	-
IE	83,403	V	85.0	67.7	26.4
PL	80,663	V	100.0	79.2	26.3
GR	71,055	V	95.9	73.0	-
CZ	31,686	SF	37.9	-	-
LU	23,389	V	68.8	62.5	20.6
SK	15,304	-	-	71.0	-
HU	11,246	V	52.7	57.8	15.0
RO	9,107	V	93.0	75.7	24.5
HR	8,059	-	-	-	-
EE	5,901	V	97.0	50.5	22.6
LT	5,892	V	81.0	78.0	21.0
SI	5,307	V	98.5	55.0	18.5
LV	5,073	-	96.8	65.4	16.2
BG	4,515	-	-	63.1	-
MT	3,302	V	-	70.0	-
EU 28	6,178,673				

Sources: ECB (SDW), Expert Group on Real Estate questionnaire and ESRB Handbook on Operationalising Macro-prudential Policy in the Banking Sector.

* *Lending for house purchases data from the SDW for all countries except UK, DK, NL, BE, RO, LT, GR and SI, which were provided by national authorities.*

** *Similar to ECB (2009), "V" represents mortgage loans with variable interest rates extended at floating rates or with an initial period of rate fixation of up to 1 year. If the interest rate on the majority of outstanding mortgages in a country is longer than 1 year, the loans are considered fixed and are further broken down into "SF" = short-term fixed (over 1 year and less than 5 years initial rate fixation), "MF" = medium-term fixed (over 5 years and less than 10 years initial rate fixation), or "LF" = long-term fixed (over 10 years initial rate fixation).*

*** *EMF (Hypostat), ECB and national authorities. Data for Italy refer to Q1 2014.*

**** *LTV data were collected via a questionnaire circulated by the Expert Group on Real Estate. Data for DK are approximated by total debt relative to home value of the median first-time buyer in 2012 and thus also include any other debt not secured by the home as collateral. Data for UK and NL cover only mortgages for owner-occupier housing. Data for GR, SK and MT are sourced from Chapter 3 of the "ESRB Handbook on Operationalising Macro-prudential Policy in the Banking Sector". Data for FI and BG refer to mortgages issued in Oct. 2014 and Q4 2013 respectively. Data for DE are a best estimate based on various non-representative data sources. Data for AT are a best estimate based on EBA stress tests.*

***** *Typical maturity data were collected via a questionnaire for the purpose of this report. German data are a best estimate.*

1.3.2.5 The importance of refinancing through asset-backed securities

Housing loans in a number of EU Member States are financed directly via specific instruments such as mortgage covered bonds (MCBs) and RMBS[19] (ECB, 2009). The use of covered bonds as a funding instrument had been a well-established practice in countries such as DE and DK, before increasing in popularity amongst mortgage lenders in other European countries in the early 2000s. At the end of 2013, five countries (DK, ES, SE, FR and DE) accounted for three-quarters of the MCB market.

The value of the MCB market has grown steadily since the financial crisis, reaching EUR 1.8 trillion in 2013, up from EUR 1.3 trillion in 2008, although a strong decline in gross issuance in recent years has yielded negative net issuance (Bindseil, 2015). While the list of countries where the issuance of MCBs is popular has remained relatively unchanged, there have been some notable developments. For instance, in IT the market increased to almost 20 times its 2008 size. Similarly, the FI, AT and GR markets were also substantially bigger. There were four countries where the value of outstanding MCBs fell in the period 2008-13. The largest declines were in DE and UK, which were down by EUR 17 billion and EUR 13 billion respectively (Chart 11).

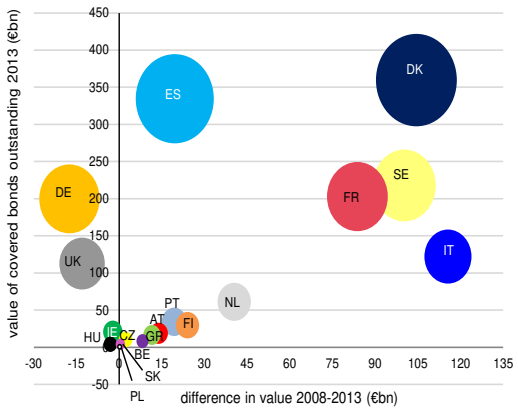
Securitisation is an alternative mortgage funding technique, but its development has not been universal across the EU due to differences in national legal structures and banking cultures. Prior to the financial crisis, the issuance of RMBS was particularly common in countries where there was a strong demand for mortgages (UK, NL, ES, IT, IE and BE). Together, these countries accounted for over 90% of the EUR 1.1 trillion of outstanding RMBS in 2008, with 43% made up by the UK market alone.

The value of outstanding mortgage securitisations has been falling across Europe since 2010, reaching approximately EUR 860 million by the end of 2013. Nevertheless, RMBS remain a significant feature of mortgage markets in NL, IE and BE[20].

19 The main difference between MCBs and RMBS is that the former are retained on an institution's books. Thus, should the assets in the cover pool be insufficient to cover investor claims, the issuer of a covered bond may be required to add assets to the cover pool to meet any shortcomings. In contrast, losses in an RMBS asset pool are typically borne by the security holder rather than the issuer.

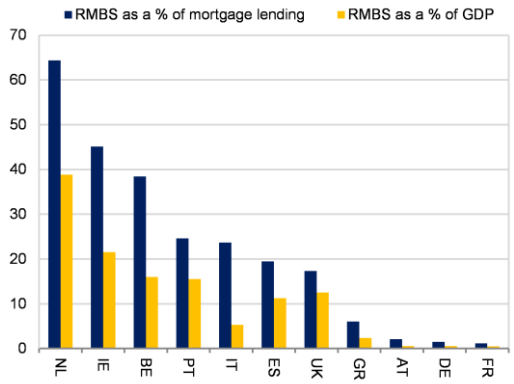
20 Most RMBS in Belgium are self-financed and therefore remain on banks' balance sheets.

Chart 11
National mortgage covered bond markets (2013)



Sources: ECB and EMF (Hypostat).
Note: Size of circle represents the share of total mortgage covered bonds accounted for by each country.

Chart 12
Scale of the outstanding residential mortgage-backed securities market (2013)



Source: Association for Financial Markets in Europe (AFME).

1.3.2.6 Foreclosure and insolvency procedures

Bankruptcy and foreclosure procedures are important for bad debt resolution and provide information on the degree of consumer protection and bank recourse. There are marked differences in the typical duration of foreclosures – which can be considered as a proxy for the efficiency of the procedure.[21] The average time needed to complete the process across Member States was just over two years, ranging from a minimum of two months in Finland to a maximum of 132 months in Cyprus (ECB, 2009) (Table 6). The most common foreclosure method is the judicial procedure.

A cross-country comparison of personal insolvency rules is hindered by the limited availability of information for some countries and other important differences - such as the requirement to seize assets or future income. Nonetheless, a broad assessment can be made based on predominantly qualitative information from the questionnaire used for the purpose of this report. While personal insolvency procedures for individual debtors have a long history in AT, FR, NO, BE, DE, CZ, DK, NL, LV, EE, UK and SE, they have been recently introduced in IE, IT, LT and SI. Conversely, in HR, FI, GR, HU, PL and RO individual debtors are not eligible for a personal insolvency procedure (Chart 13). Despite ongoing attempts to attain global convergence in the design of personal bankruptcy regulations, significant differences still exist.

21 The duration of foreclosure procedures (in months) refers to the average duration taken for the completion of the foreclosure procedure, including the completion of court proceedings, the sale of the asset and the distribution of proceeds to the creditors.

Table 6
Foreclosure procedures: pre- & post-crisis

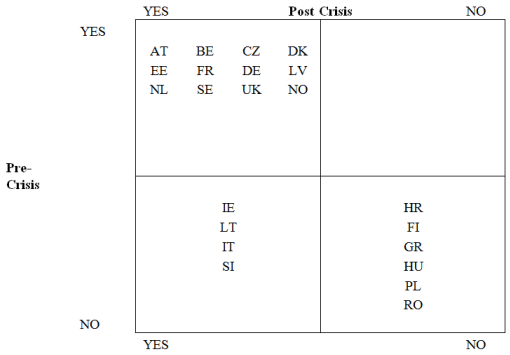
(months)

data available for	2007
CY	132
IT	56
MT	38
GR	24
PT	24
FR	20
BE	18
IE	18
LU	12
DE	10
AT	10
ES	8
NL	6
FI	2

Source: Data from 2007: (ECB 2009)

Source: Data from 2007: EMF, European Commission and National Authorities. Data from 2012 is sourced from the National bank of Belgium

Chart 13
Availability of personal insolvency procedures: pre- & post-crisis



Sources: Own questionnaire.

1.4 Clustering of countries based on their structural features

Clustering analysis can be used to illustrate how countries might be grouped based on similarities in the structural characteristics of their housing and mortgage markets. Clustering is a method of grouping whereby subjects within a cluster share broadly similar characteristics, while differences between clusters are maximised. This statistical method is purely data-driven and requires complete data for all variables used. It is not aimed at identifying clusters of countries to imply *ex ante* ordering according to risk levels or the propensity to undergo a crisis. It is possible that some clusters with different structural set-ups may exhibit comparable levels of risk.

The work on clustering has some limitations as noted below. But the group decided to report on its work for two reasons. First, it is a promising approach which can simplify analytical work on links between structural characteristics and housing market dynamics. Brief references to clusters are therefore included in Section 2 on real estate developments and Section 4 on instruments. Given the data limitations and consequent uncertainties about the robustness of clustering results, the approach is not used in the empirical work of Section 3. Second, since the clustering technique has been used in previous empirical work in this area (including by the BIS), the group was of the view that it was worthwhile to report on its findings to support any future work by the ESRB in this area.

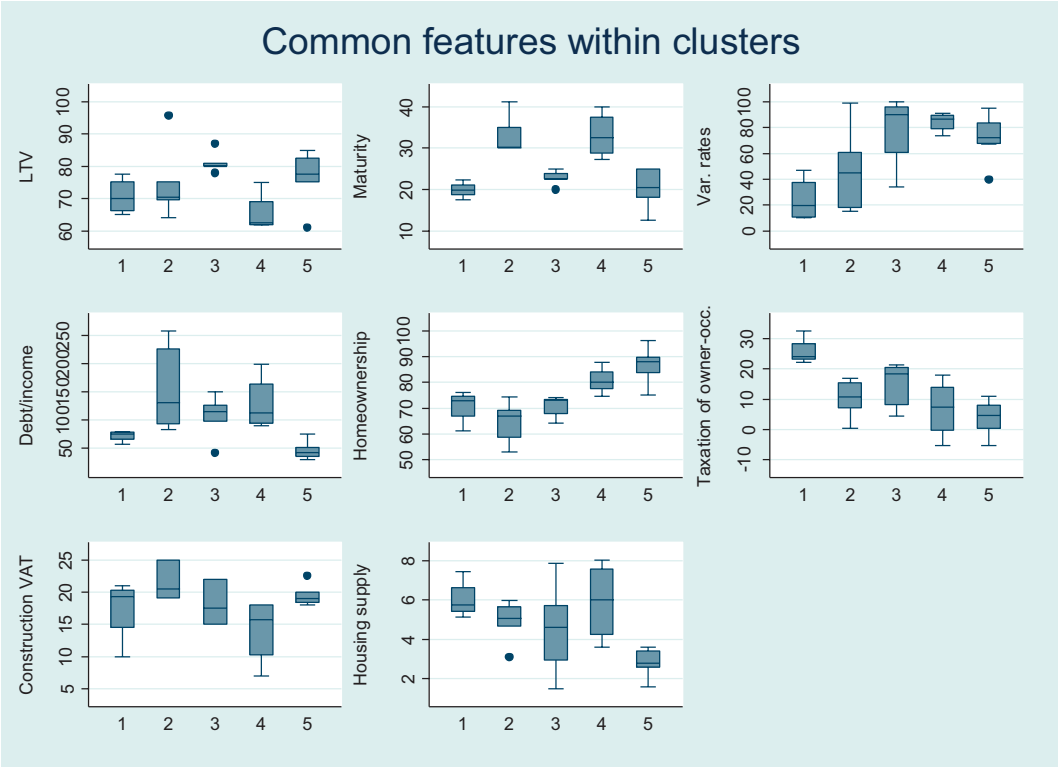
Variables in the clustering exercise were chosen with two criteria in mind. First, these variables should be relevant structural drivers of housing markets. Second, data availability should be complete or quasi-complete. The selected variables were the household gross debt-to-income ratio, home ownership rates, residential investment (in % of GDP), the contribution of housing taxes to the marginal cost of owner-occupied housing, the highest VAT rates applicable to new construction, the typical LTV

typical maturity of mortgage loans. Since this methodology requires complete information for all variables used, missing data were imputed using an approach described in Annex 2.

The clustering procedure is inspired by the approach of Tsatsaronis and Zhu (2004). Initial variables were converted to binary variables (0/1 values) according to whether the variable is above or below a threshold level. The median value was used as the threshold. The clustering is implemented using Ward's method and a distance measure suited for binary data (matching measure).

The clustering was performed for the pre-crisis period and five clusters were identified[22] (see boxplot in Table 7).

Chart 14
Boxplots of five clusters, pre-crisis characteristics



22 Within a cluster, a high variance might occur due to the relatively low number of variables in comparison to the number of clusters. Nevertheless, countries in the same cluster may be quite different.

Table 7
Means of variables in each cluster, pre-crisis characteristics (2007/2008)

(% per year)

		LTV-Ratios	Gross-debt-to-income	Home-owners	Contribu-tion of taxes to marginal cost of housing	Highest VAT to new construc-tion	Share of variable-rated mortgage loans	Residen-tial invest-ment in % of GDP	Typical maturity of loans
Cluster 1	GR, IT, FR, BE	70.7	72.0	70.8	25.6	17.4	24.0	6.0	19.9
Cluster 2	AT, PT, SE, DK, NL, DE	74.2	153.5	64.8	10.2	21.5	47.1	4.9	32.7
Cluster 3	LU, PL, CY, FI, UK	81.2	106.1	70.6	14.5	18.3	76.1	4.5	22.8
Cluster 4	EE, IE, ES, MT	65.5	128.7	80.7	6.8	14.1	84.5	5.9	33.1
Cluster 5	CZ, SK, HU, RO, SI, BG, LT, LV	77.0	45.5	86.8	3.9	19.4	72.8	2.8	20.6

Cluster 1 countries tend to have mid-range LTVs and shorter loan maturities. Indebtedness and home ownership are lower. Taxation is high on home ownership, while VAT on construction is moderate. Higher housing supply and a limited share of variable rates are further characteristics.

Cluster 2 countries show high indebtedness, likely related to longer maturities, while LTVs are moderate. Owner-occupier taxation is moderate, while VAT on construction is higher.

Cluster 3 countries have somewhat higher indebtedness, likely driven by higher LTVs, while maturities are mid-range. Taxation on home ownership as well as VAT on construction are somewhat higher.

Cluster 4 countries show high indebtedness jointly with longer maturities, while the LTVs are lower. This is combined with high home ownership, whereas taxation on both home ownership and construction is low. The share of variable rate loans is high.

Cluster 5 countries, essentially covering central and eastern European countries, show low household indebtedness despite quite high LTVs. This could be signalling a concentration of indebtedness in a smaller part of the population. The maturities are rather short. Low taxation on home ownership goes hand in hand with high home ownership. Housing supply is low.

As a last step, the clustering is complemented with a qualitative assessment of the likely changes in cluster membership in the post-crisis period. Moderate changes in structural features do not seem to suggest a change in cluster for most countries. There are three possible exceptions. For EE, the shortening of typical maturities, reduction of household indebtedness, and increase in construction VAT indicate a move to cluster 5. In the post-crisis period, LV shows an increase in taxation of home ownership and construction, as well as in the share of variable rates, bringing it closer to cluster 3. Finally, the reduction in LTVs and increased construction VAT in UK could lead to a move to cluster 1. The following table summarises the variables' means in each cluster. For ES, a substantial tightening in the tax treatment of real estate (evidenced by increasing VAT rates and the elimination of exemptions for house purchases) and a large share of variable rate mortgages (which was found to decrease the probability of financial distress) suggest a situation perhaps closer to cluster 2.

Table 8

Means of variables in each cluster, post-crisis characteristics (2012/2013)

		LTV-Ratios	Gross-debt-to-income	Home-owners in %	Contribution of taxes to marginal cost of housing	Highest VAT to new construction	Share of variable-rated mortgage loans	Typical maturity of loans
Cluster 1	GR, IT, FR, BE	69.4	84.1	71.4	27.2	18.4	47.4	19.9
Cluster 2	AT, PT, SE, DK, NL, DE	72.1	158.9	64.3	10.0	22.2	54.3	29.2
Cluster 3	LU, PL, CY, FI, UK	77.7	121.7	73.3	16.6	20.0	74.3	22.9
Cluster 4	EE, IE, ES, MT	61.7	125.9	77.7	9.9	15.4	78.0	24.9
Cluster 5	CZ, SK, HU, RO, SI, BG, LT, LV	65.2	45.4	86.7	7.6	21.8	72.8	18.8

This simple exercise reveals some commonalities in the structural features of housing markets across countries. However, the analysis also reveals that a non-negligible degree of heterogeneity remains between countries within a given cluster. In part, this might be due to the absence of other important variables, such as the share of non-amortisable loans, or differences in definitions and data coverage. While the results of the cluster analysis should be taken as an illustration of a potential avenue for future work, the results so far imply that country-level differences need to be duly recognised when developing macroprudential policies.

Section 2
Historical experience in the EU of financial stability risks related to the real estate sector[23]

This section describes the time-series characteristics of a large number of indicators related to European RRE markets, focusing on how developments in this sector have affected financial stability. Section 2.1 establishes a conceptual framework mapping potential channels between RRE developments and financial stability. It identifies key indicators[24] to analyse transmission channels and maps them to the different phases of the financial and economic cycle. Drawing on this framework and indicators, Section 2.2 presents a detailed graphical analysis of the time-series characteristics of RRE markets in the EU. Section 2.3 goes on to explore the characteristics of real estate-related crises in terms of length and depth.

2.1 Channels between residential real estate developments and financial stability: conceptual framework

2.1.1 General framework

The most recent and past financial crises have demonstrated that developments in the RRE market may have severe repercussions on the financial system and the real economy.[25] The importance of housing in households' wealth, the contribution of construction activity to GDP growth, and the fact that investment in housing is typically bank-financed, imply that developments in RRE markets can have a significant impact on other economic sectors.

The tight links between the RRE market, the household and production sectors as well as the financial sector may reinforce potential adverse feedback loops between the financial sector and the real economy. Depending on the role of housing for the different economic sectors, the interactions between the RRE market and key macroeconomic agents may differ, and important two-way effects may exist (Chart 15). Households and construction firms represent the demand and supply sides of the housing market. As noted in Section 1, they are key determinants of house price developments which, in turn, have a significant impact on their balance sheets and affect their consumption and investment decisions. To the extent that both supply and demand for housing depend on the availability of credit, the financial sector also plays a key role in housing market developments. In turn, house price dynamics can have an impact on the stability of the financial system, given their effects on collateral values and on banks' credit risk.

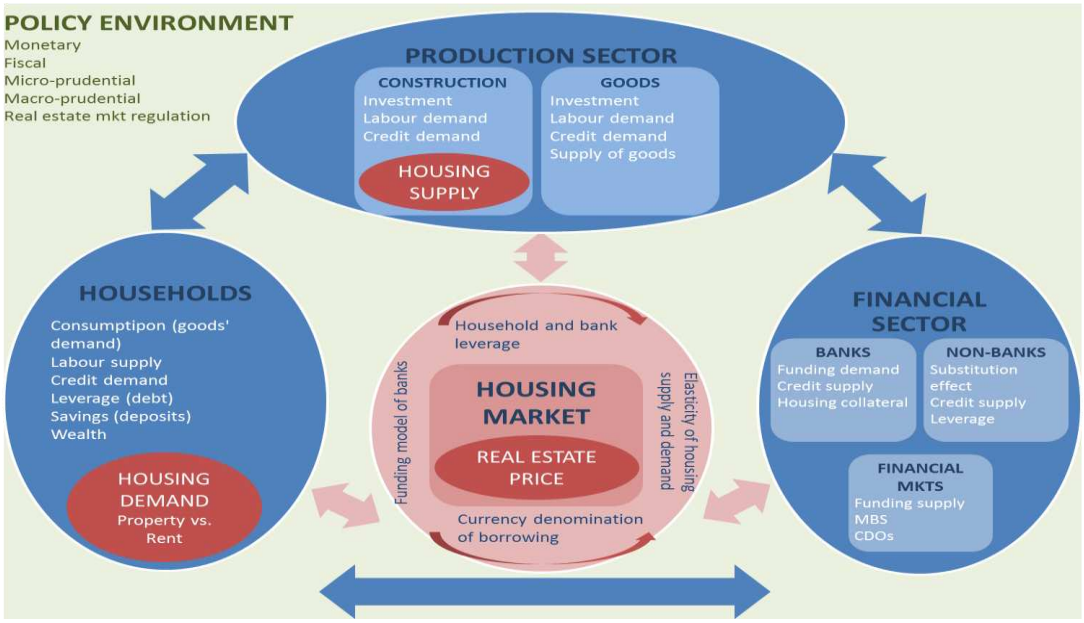
23 Prepared by a team coordinated by Florentine Hopmeier/Victor Savin (European Commission) and comprising Rita Basto (Banco de Portugal), Wanda Cornacchia (Banca d'Italia), Sándor Gardó (European Central Bank), Darius Kulikauskas (Lietuvos bankas), Mara Pirovano (Nationale Bank van België/Banque Nationale de Belgique) and Hanna Putkuri (Suomen Pankki – Finlands Bank).

24 The ESRB Occasional Paper No. 8 by Ferrari, Pirovano and Cornacchia (2015) on "Identifying early warning indicators for real estate-related banking crises" served as a basis for this section.

25 See e.g. World Economic Forum (2015) for country case studies, Reinhart and Rogoff (2009) for global evidence, and Mian and Sufi (2014) for the recent US subprime crisis.

These interactions imply that risks originating in the real estate sector can have a systemic impact and a pro-cyclical nature. Financial system vulnerabilities tend to accumulate during the upswing phase of the cycle. Perceived lower credit risk and easier access to finance contribute to rapid credit expansion and to increased demand for housing, putting upward pressure on house prices. The resulting higher collateral values further favour the demand for, and supply of, credit. These self-reinforcing dynamics can result in speculative bubbles. In contrast, during the downturn phase, tighter credit conditions, higher risk aversion and corrections in house prices may impact the resilience of financial institutions and depress economic conditions.

Chart 15
Nexus between the housing market and the economy



The transmission of risks originating in the real estate sector can be amplified by structural features such as those set out in Section 1. Factors such as the elasticity of housing demand and supply, the importance of private sector FX debt and the heavy reliance of banks on short-term wholesale funding can reinforce the effect of the feedback loop between real estate price fluctuations and the real economy. Furthermore, banks' funding models can have a large impact on the stability of the financial sector and on its sensitivity to changes in the macrofinancial environment.

This warrants a more detailed examination of the interlinkages between the relevant economic sectors and the structural characteristics which may affect the various transmission channels (Chart 15). In general, real estate risks are transmitted to other sectors of the economy through changes in house prices, which affect households' and firms' balance sheets and banks' exposures to these sectors. The underlying drivers of RRE prices are the factors affecting demand and supply.

Demand for RRE is mainly driven by households. Housing serves two main functions: first, it satisfies the basic need for shelter and, second, it constitutes an asset in which available wealth is invested. The choice of purchasing a property is strongly influenced by factors such as households' disposable income

and the availability of funding, but also by the available alternative, i.e. the rental market. Therefore, as discussed in Section 1, rental market regulation, the flexibility of rental contracts, judicial protection of owners and tenants and the rental price are also important in shaping the demand for home ownership. Given the importance of housing for households' wealth, house price variations are accompanied by a significant wealth effect.

Real estate developments and mortgage loan conditions affect consumption. For most households, a mortgage loan is necessary to purchase a home. In addition, as houses are used as loan collateral, changes in prices can also have an impact on access to credit. The resulting wealth effect can affect consumption, with a significant macroeconomic impact. The fact that mortgage debt is often the main liability of households creates a tight feedback loop between households and the financial sector. Changes in credit conditions can have an important income effect with implications for overall consumption.

Construction provides a major contribution to investment and growth. The flexibility of the construction sector to adjust to changing market conditions in the expansionary phase of the credit cycle may determine the impact of rising housing demand on house prices. During an upturn, an elastic (inelastic) housing supply might contain (strengthen) the rise in house prices. During a downturn, an eventual excess of supply may amplify the house price correction. Like households, construction firms rely on credit to finance their activities, which may add to the financial sector's overall exposure to the real estate sector. A drop in house prices and its effect on the value of collateral and on the rate of default in the construction sector can therefore undermine the resilience of financial institutions.

The financial sector is therefore exposed to credit risk. This can crystallise in the event of a rise in non-performing loans. In this case, as mortgage loans are collateralised with houses, a decrease in house prices can lead to higher LGDs.

The policy and regulatory framework can have a significant impact on the interplay between the RRE market and the economy. Monetary policy, by setting the reference interest rate, affects banks' funding costs and, thereby, credit conditions. Fiscal policy influences the real estate market through the tax regime for immovable property, as discussed in Section 1. The prudential policy framework (either micro- or macroprudential) determines the resilience of financial institutions to adverse shocks and can have an impact on the credit cycle and on banks' lending standards.

2.1.2 Mapping indicators to the different stages of the cycle

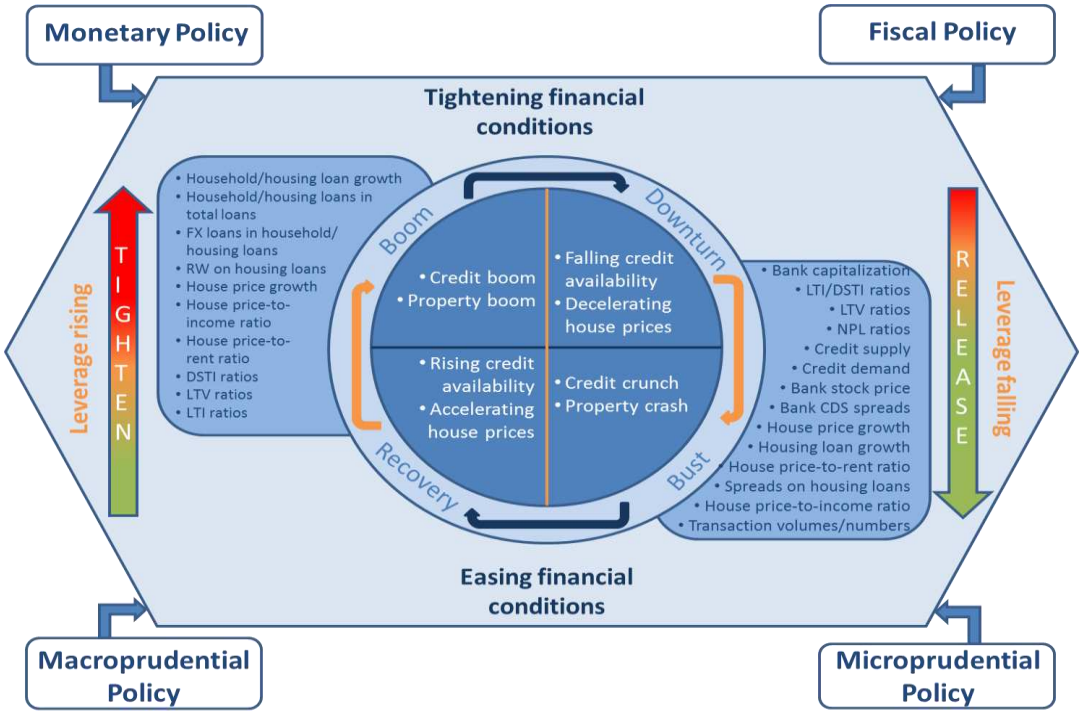
To gauge the need for macroprudential policy intervention, policy-makers need to rely on relevant information, including a reliable set of indicators. These indicators should help to identify the build-up of systemic risks and/or to assess the banking system's shock-absorption capacity.[26] Furthermore, indicators can play an important role in determining whether and when to tighten or release available macroprudential instruments, as discussed in Section 4. They may also help to identify the most suitable macroprudential instrument(s) under given circumstances.

To allow for a proper assessment, the indicator set used needs to be comprehensive, combining data from the macroeconomic, credit, real estate, banking and structural areas, in

26 See Wolken (2013).

both time-series and cross-sectional dimensions. The usefulness of different indicators may vary with the phase of the economic, financial and real estate cycle (Chart 16), depending on whether they are early warning, coincident or lagging in nature. In general, the set of indicators used to guide the implementation or the tightening of instruments differ from those useful when deciding upon the release or removal of macroprudential instruments. In the latter case, lagging indicators (e.g. non-performing loans, debt service ratio) may be more important.

Chart 16
Phases of the economic, financial and policy cycle and selected related indicators



2.1.2.1 The boom phase

Several indicators from different sectors of the economy may signal exuberant developments. A typical upturn/boom phase is characterised by robust macroeconomic expansion (GDP and employment growing), strong credit growth accompanied by a surge in consumer, real estate and other asset prices, as well as a general increase in leverage.

A formal analysis is needed to identify the best early warning indicators. Drehmann et al. (2011), IMF (2014a, 2014b) and Wolken (2013) identify the indicators that may be useful in different phases of the crisis to guide the use of macroprudential instruments. With a specific focus on the real estate sector, ESRB Occasional Paper No. 8[27] applies several statistical techniques to select the indicators with the best early warning properties in the run-up to real estate-related banking crises. This set of variables seeks to maximise the probability of correctly identifying an upcoming crisis, while minimising the probability of issuing false alarms. Table 9 illustrates the ten best early warning indicators identified

27 Ferrari, Pirovano and Cornacchia (2015).

in the above-mentioned paper, together with the threshold values above which a "warning" signal is issued.

Table 9
The ten best early warning indicators of a crisis

Indicator	Threshold	Probability of missing a crisis	Probability of issuing a false alarm
Nominal RRE price-to-income gap (1)	13.975	0.35	0.12
Nominal RRE price-to-rent gap (1)	6.950	0.26	0.24
Nominal RRE price gap (2)	5.24	0.28	0.23
Real RRE price gap (2)	13.86	0.42	0.08
Real NFC credit growth	11.02	0.38	0.18
Nominal total credit-to-GDP gap (2)	6.46	0.20	0.31
Real total credit growth	6.76	0.14	0.42
Nominal HH credit to GDP gap (2)	2.77	0.25	0.33
Nominal bank credit-to-GDP gap(2)	2.91	0.17	0.42
Real bank credit growth	8.78	0.28	0.30

(1) The gap is calculated as the deviation from the mean
(2) The gap is calculated as the deviation from the backward-looking trend with lambda = 400,000.

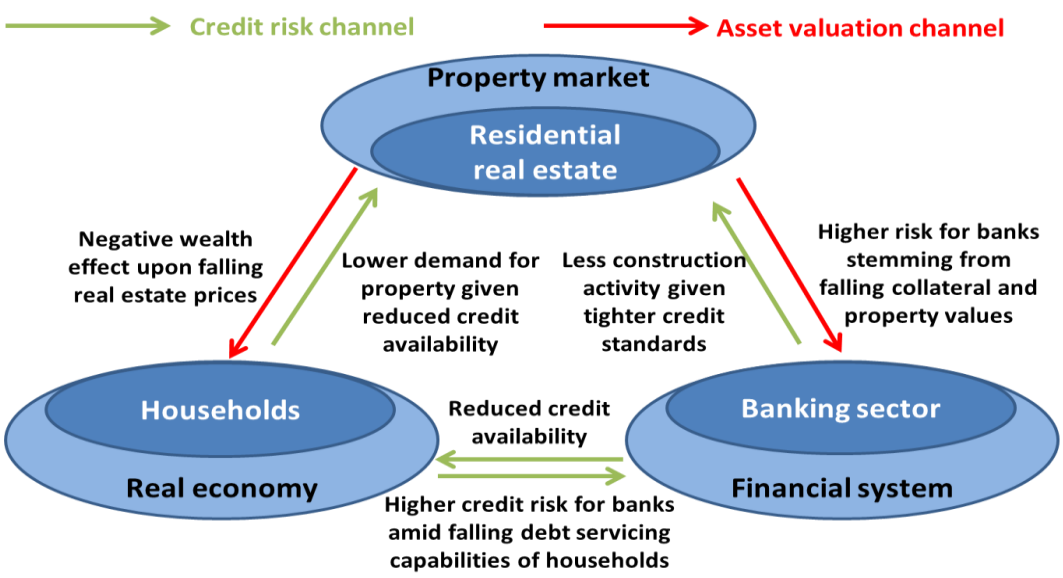
The indicators best signalling the imminent occurrence of a real estate-related banking crisis relate to excessive developments in RRE prices and credit. When indicators are combined in a bivariate or trivariate setting, the best combinations are a structural indicator of real estate price overvaluation (RRE price-to-rent ratio) combined with cyclical indicators of excessive cyclical credit or real estate price developments.[28] These results are broadly confirmed within an econometric setting, controlling for wider macrofinancial indicators such as inflation and the level of short-term money market rates. Here, the best-performing early warning model includes variables such as credit growth (both broad credit and sectoral credit to households and non-financial corporations), the level of total, bank and household credit-to-GDP ratio as well as the RRE price-to-rent ratio.

2.1.2.2 The bust phase

Asset valuation and credit risk channels best explain the linkages between the housing market and financial stability in a downturn/bust phase (Chart 17).

28 The representatives of some countries, in particular France, call into question the use of the price-to-rent ratio as a measure of overvaluation.

Chart 17
Transmission channels in a downturn phase



Source: Based on MAS (2011).

Asset valuation channel: A steep fall in house prices implies a decrease in the value of property. For households owning a property, this means that their perceived wealth decreases and, to the extent the property is mortgaged, this also renders their debt burden larger and more difficult to manage. Also, a decline in RRE prices makes investment in housing less attractive and will thus lead to reduced construction activity. For banks, the fall in collateral value, and thus the liquidating value that banks can obtain in case of a default, increases the risk of RRE lending. In addition, banks' profitability could be adversely affected as provisions and impairment charges increase on mortgage loans.

Credit risk channel: A steep fall in house prices may induce households to curb their consumption given the perceived negative wealth effect. This can adversely affect the production sector, which faces lower demand and therefore reduces employment and investment. Thus, borrowers in both the household and production sectors become riskier: the increase in unemployment (and thus fall in wage income) coupled with a rise in corporate defaults reduce banks' asset quality. Therefore, banks will curtail their lending activity and impose more stringent credit standards on both households and non-financial corporations, since borrowers' PDs increase.

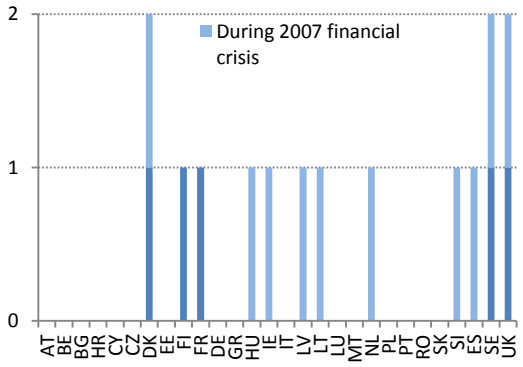
2.2 Effects on the economy

Developments in the real estate sector affect the economy through various channels. A sharp decrease in RRE prices leads to a fall in consumption and construction activity. Lower house prices have an effect on banks' balance sheets due to banks' exposure to mortgage credit and any investment fund holdings. Given the negative income effect, an increasing number of households become unable to service their debt, leading to an increase in NPLs. The losses incurred by banks result in a further decline in lending, also beyond the real estate sector, and thus hamper overall

economic activity. In addition, the drop in construction activity may lead to higher unemployment and lower growth. In cases where taxes from construction-related activity make up a large share of fiscal revenue, government finances would be adversely affected as well. The negative wealth effect on households sets in motion a downward spiral of falling RRE prices. As indebted households suffer from falling income and increasing unemployment, they curtail spending on both consumption goods, perhaps in part to seek to avoid defaulting on their borrowing, and housing. As the demand for housing falls, RRE prices are reduced even further.

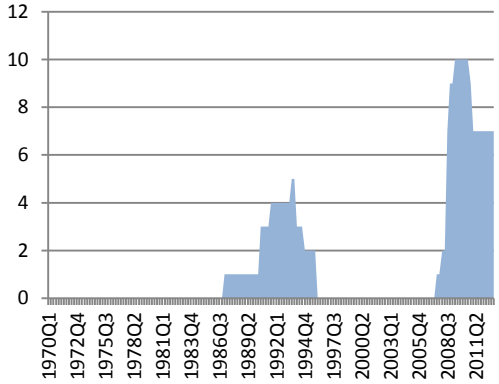
In recent years, several Member States have experienced banking crises stemming from the real estate sector. In the context of earlier work on real estate instruments by the IWG, a database on real estate-related banking crises was compiled for the EU Member States. 16 countries did not experience any real estate-related banking crisis, while nine of the remaining 12 experienced one crisis and three (DK, SE, UK) two crises, resulting in altogether 15 real estate-related banking crises (Chart 18). These crises mostly occurred in the early 1990s and during the recent global financial crisis (Chart 19). Real estate-related crises can vary according to the real estate segment they originate from, i.e. residential, commercial or both. In the dataset at hand, only two crises are classified as "only residential real estate-related", while the remaining ones are labelled as "both residential and commercial".

Chart 18
Number of real estate-related crises by country



Source: Survey by the IWG Work Stream on Real Estate Instruments

Chart 19
Number of countries in a real estate-related crisis per period



The ESRB database builds on the ESCB Heads of Research (HoR) Group's banking crises database. The latter defines a banking crisis as one with significant signs of financial distress in the banking system as evidenced by bank runs on relevant institutions or losses (NPLs above 20% or bank closures affecting at least 20% of banking system assets) or significant public intervention with the aim of avoiding the realisation of losses in the banking system. The HoR database was narrowed down by the IWG Expert Group on CCBs by (i) excluding crises that were not systemic, (ii) excluding systemic banking crises that were not associated with a domestic credit/financial cycle, and (iii) adding periods where domestic developments related to the credit/financial cycle could well have caused a systemic banking crisis had it not been for policy action or an external event that dampened the financial cycle. The resulting database was further adjusted on the basis of the expert judgement of members of the IWG

Work Stream on Real Estate Instruments, in order to reflect only systemic banking crises stemming from the real estate sector.

The ESRB database is an important source of information for this section. It allows for an analysis of developments in key variables in the run-up to crisis events and during tranquil periods. In the next sections, the time-series evolution of a wide set of indicators for the sample of EU Member States is examined, using data from public databases (ECB, OECD, BIS, Eurostat) or data from ad hoc requests for the purpose of this report.[29] Since the literature on the 1980s/1990s real estate-related crises is vast, the focus here is mainly on the most recent crisis. However, a short review on the 1980s/1990s crises is presented in Box 2. In the charts below, periods of real estate-related banking distress are represented by grey shaded areas.

2.2.1 Housing market developments

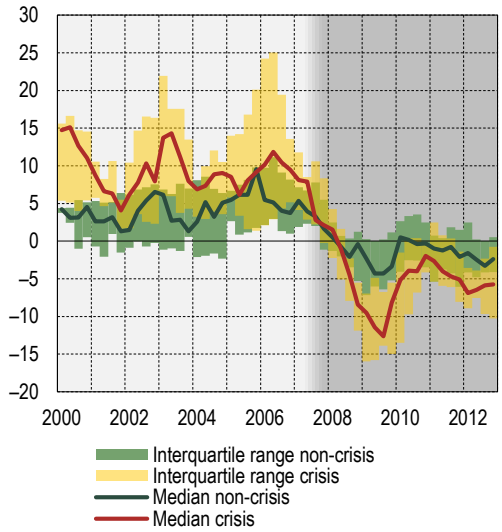
RRE price growth: House price movements can have an impact on credit, consumption and overall economic activity through their effect on collateral, household wealth and the profitability of real estate investments. House price dynamics depend on factors affecting demand and supply conditions. The deviation of house prices from these fundamentals can signal speculative bubbles. RRE prices are pro-cyclical. During a boom, demand for housing is stimulated by rising employment and wages and wider access to credit. By contrast, downturns negatively impact real estate prices as demand for housing from new buyers is low and the probability that borrowers will default on their existing mortgages increases. These developments may be reinforced by increased foreclosures, as more and more properties are put on the market by banks to recover defaulted loans.

Chart 20 depicts the median growth rate of RRE prices in countries which experienced a crisis in conjunction with the global financial turmoil and in those that did not. In the run-up to the global financial crisis, both crisis and non-crisis countries tended to experience positive growth in RRE prices, but this was more pronounced in the former group. When the crisis hit, RRE prices were strongly affected, reverting to negative growth in both groups of countries. The real estate price drop was more pronounced in countries directly hit by the turmoil: the median real estate price growth for these countries at the peak of the crisis settled at -12%.

29 Use is also made of indicators compiled in the context of an earlier data collection exercise led by the IWG Expert Group on CCBs, which also underlies the analysis presented in ESRB Occasional Paper No. 8 (2015).

Chart 20
Evolution of real RRE prices (annual growth rate)

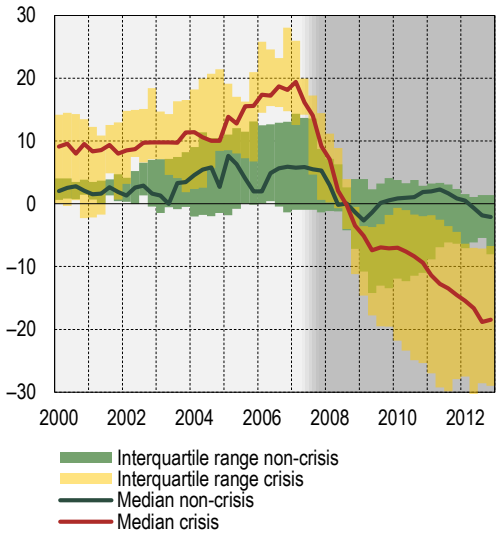
(percentage)



Source: OECD data and own calculations.

Chart 21
Evolution of the RRE price-to-income gap (deviation from trend)

(percentage)



Sources: OECD data and own calculations.

RRE price-to-income ratio: This indicator measures how RRE prices relate to households' disposable income, thus conveying information about housing affordability. Data on the real estate price-to-per capita disposable income ratio is provided by the OECD, in the form of an index based in 2010. The comparability of the raw index across countries is limited as indexing the ratio to the same base year for different countries assumes that all countries simultaneously reached a situation of equilibrium.[30] Therefore, Chart 21 depicts the evolution of the RRE price-to-income gap, defined as the deviation of the index from its backward-looking trend.[31] This indicator is pro-cyclical. It increases prior to a crisis as house prices grow faster than average per capita disposable income, and reverts abruptly after the onset of the crisis. Furthermore, it shows more pronounced upswings in the run-up to real estate-related turmoil in crisis countries compared with the non-crisis peers.

RRE price-to-rent ratio: This indicator is useful to assess whether the growth in RRE prices in an upturn makes investing in real estate more profitable.[32] The indicator, constructed by the OECD by dividing the index of nominal house prices by the index of nominal rental prices, is a measure of the relative cost of purchasing a real estate property versus renting it. An increase of this index is inversely related to the incentive to purchase a real estate asset. For occupants, renting the property becomes more preferable as rental prices fall relative to purchase prices, but for buy-to-let investors, the income they receive by renting out the property falls relative to the acquisition price. When using the indicator, conclusions have to be drawn with caution. First, due to its simplicity, the equilibrium level of the ratio is sensitive to structural changes. Second, when the rental market is small or highly inefficient (e.g. owing to rent

30 In addition, ratios based on index series do not allow for the quantification of actual valuation levels in interpretable units (Dujardin, Kelber and Lalliard, 2015).

31 The gap is obtained by subtracting from the series its long-term trend, computed with a Hodrick-Prescott (HP) filter with a parameter lambda set to 400,000.

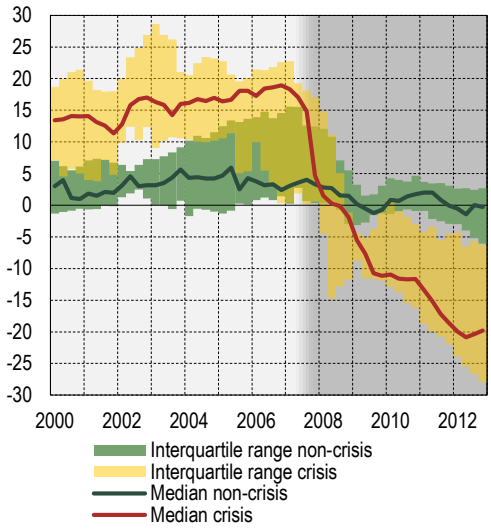
32 The theoretical basis for the use of this ratio lies in the housing market no-arbitrage condition, introduced by Poterba (1984).

regulation), the ratio may not be stationary. Third, an apparent appreciation in purchase or rental prices may reflect the higher quality of such dwellings. Finally, with regard to the price-to-income ratio, issues arise related to the choice of base year and the quantification of actual valuation levels when comparing the raw index.

Chart 22 shows the evolution of the RRE price-to-rent gap, expressed as a percentage deviation of the ratio from its backward-looking trend.[33] The difference in the median evolution of the price-to-rent gap between crisis and non-crisis countries is significant. In the run-up to the crisis, the ratio grew considerably above trend values in countries directly hit by the 2008 financial crisis, reaching its peak in 2007. Since the onset of the crisis, the indicator has reverted back to values significantly below trend in crisis countries. Furthermore, after the initial impact of the crisis, crisis countries exhibited negative gaps for a protracted period. In non-crisis countries, the evolution of the index is very different: in fact, the median of the gap lies well below that for crisis countries in the run-up to the crisis, and does not show any abrupt reversal since the beginning of the turmoil.

Chart 22
RRE price-to-rent gap (deviation from trend)

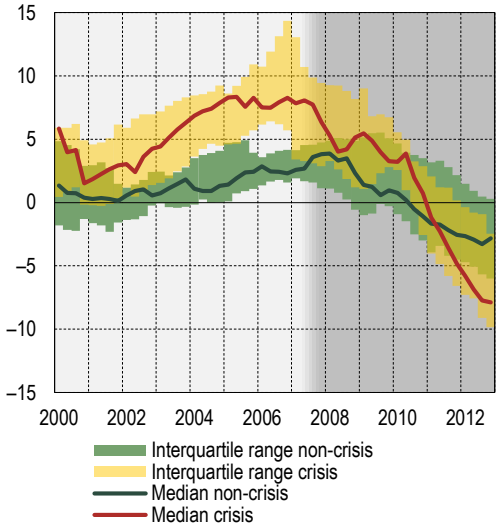
(percentage)



Source: OECD data and own calculations.

Chart 23
Household credit-to-GDP gap

(percentage)



Sources: OECD data and own calculations.

33 The data have been sourced from the OECD. The raw index is based in 2010, and the backward-looking trend has been computed using an HP filter with parameter lambda equal to 400,000.

2.2.2 Households

Household credit-to-GDP gap: This indicator is defined as the deviation of the household credit-to-GDP ratio from its long-term trend. High levels indicate excessive growth in credit to households in relation to GDP growth and a potential build-up of excessive leverage. This variable has generally been higher and reached its peak before the onset of the crisis in crisis countries (Chart 23). However, several non-crisis countries have also registered a positive household credit-to-GDP gap before other countries' crises. Developments not markedly different between crisis and non-crisis countries suggest a common component in RRE prices and credit cycles.

Gross debt-to-income ratio of households: This indicator is defined as total liabilities divided by gross disposable income, with the latter adjusted for the change in the net equity of households in pension fund reserves. The indicator provides information on the extent to which debt can be paid back from the flow of income rather than the stock of assets, and thereby about households' potential need to deleverage.[34] Households with high ratios are more sensitive to shocks and therefore more likely to default should these shocks materialise.[35]

Debt levels are very heterogeneous across countries (Chart 24), ranging from around 50% (IT, SK, SI, PL, LT) to around or even above 200% (DK, IE, NL) in 2012. For newer EU Member States, debt levels remain relatively low despite a sharp increase post-2004 which can be explained by a "catching up" effect. Also, in most other EU economies, household debt rose substantially prior to the global financial crisis, which can be explained by factors such as low interest rates and financial deregulation. Further cross-country heterogeneity can be explained by structural features of domestic real estate markets, as outlined in 0. Since the bulk of household debt is composed of mortgage debt, cross-country patterns for mortgage debt resemble those for total household debt.[36] It is noteworthy that the countries with the highest mortgage debt-to-income ratios[37] (Chart 25) were among those which experienced the deepest real estate-related crises (see Section 2.3.2). This confirms the important role of household leverage as an amplifier during real estate crises.

34 Statistics Paper Series, No. 2, ECB, April 2013.

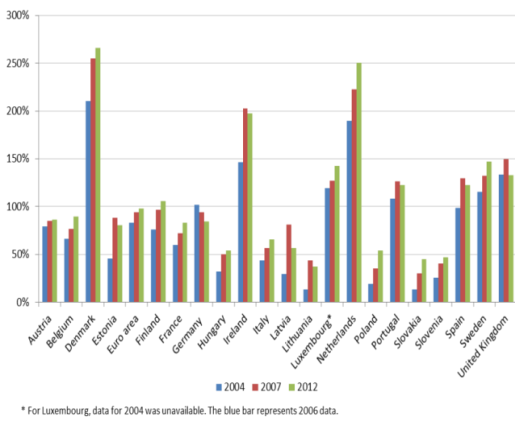
35 Mian and Sufi (2014) highlight the role of excessive household debt in the US financial crisis and recession.

36 *Statistics Paper Series*, No. 2, ECB, April 2013.

37 Computed as total outstanding residential loans over the disposable income of households by the European Mortgage Federation.

Chart 24
Household gross debt-to-income ratio

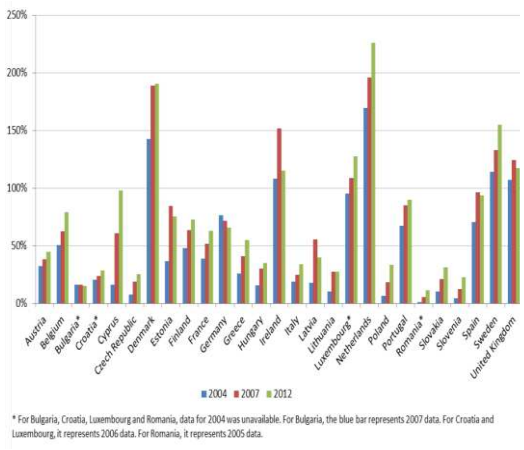
(percentage)



Source: Eurostat.

Chart 25
Household mortgage debt-to-income ratio

(percentage)



Source: Hypostat (2014).

Household debt service ratio (HDSR): This ratio measures the debt servicing burden of households. The ratio used here results from ECB calculations and is computed following the technique used by Drehmann and Juselius (2012). Debt service costs (i.e. the aggregate credit stock multiplied by the average lending rate) are divided by income, taking into account the average remaining maturity of the stock. The indicator conveys information on bank policies on lending for housing purposes: in an upturn, banks tend to grant loans with high HDSRs, since rising levels of income and wealth sustain the debt servicing capacity of borrowers. However, high HDSRs inherited from good times can be dangerous in a downturn, since they make households more vulnerable to income shocks. Moreover, countries with higher HDSRs face potentially more severe second-round effects as households have to reduce consumption to a larger extent to service debt after an income shock.[38] Therefore, this indicator might be useful to explain why some countries experienced a real estate-related crisis, while others did not, in spite of similar pre-crisis developments in RRE prices and credit. In fact, countries registering rapid credit and RRE price growth but characterised by lower HDSRs are less sensitive to negative income shocks and less subject to severe second-round effects.

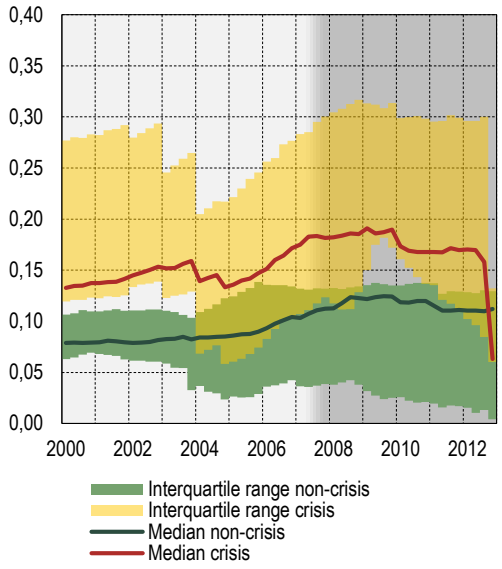
Chart 26 presents the evolution of median HDSRs[39] in crisis and non-crisis countries. In crisis countries, the ratio exhibits a rising pattern before the onset of the crisis. Since borrowing for house purchase is usually characterised by long maturities and amounts that are multiples of households' annual income, the ratio tends to decrease only slowly after the crisis onset. Furthermore, after the onset of the crisis both the numerator and the denominator of the ratio decreased. While the turmoil negatively affected household income, the easing of monetary policy put downward pressure on the

38 Drehmann and Juselius (2012) also find that a debt service ratio (DSR) tends to increase rapidly 1-2 years prior to a systemic banking crisis and to fall off in its wake. Furthermore, a higher DSR significantly increases the severity of a recession as measured by the relative fall in output from the peak to the following trough.

39 The HDSR data series were obtained from the dataset used for ESRB Occasional Paper No. 5 entitled "Operationalising the countercyclical capital buffer: indicator selection, threshold identification and calibration options", June 2014.

average lending interest rate. Moreover, for the majority of non-crisis countries, the ratio stood well below the median level reached by crisis countries even several years after the stress period.

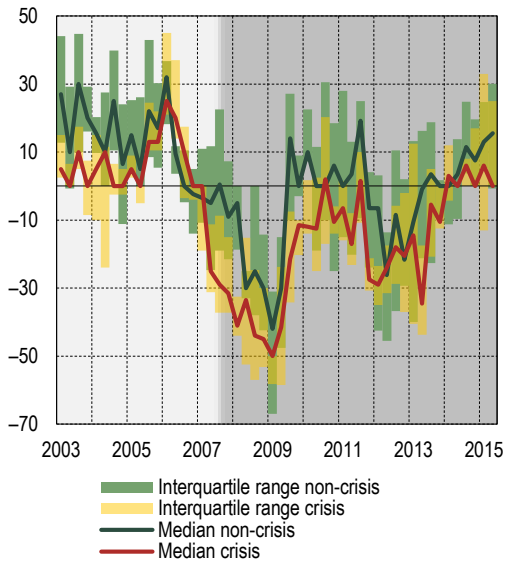
Chart 26
Household debt service ratio



Sources: BIS and ECB data and own calculations.

Chart 27
Changes in household loan demand for house purchase

(percentage)



Sources: ECB and own calculations.

Household loan demand: The evolution of household demand for loans for house purchase follows similar patterns for both crisis and non-crisis countries (Chart 27). From 2003 to early 2007 loan demand followed a slightly increasing trend for most countries, which reversed after 2007, when loan demand by households fell by up to 80% (in particular in PL, NL and FR). After a recovery phase starting in 2010 with non-crisis countries recovering faster and better than crisis countries, demand dropped again in early 2012. Although demand has been increasing overall since then, most likely driven by the low interest rate environment, the latest data (Q1 2015) show a diverging trend between crisis and non-crisis countries, with household loan demand following a clear upward trend for non-crisis countries, while demand remains weak for crisis countries.

2.2.3 Financial sector

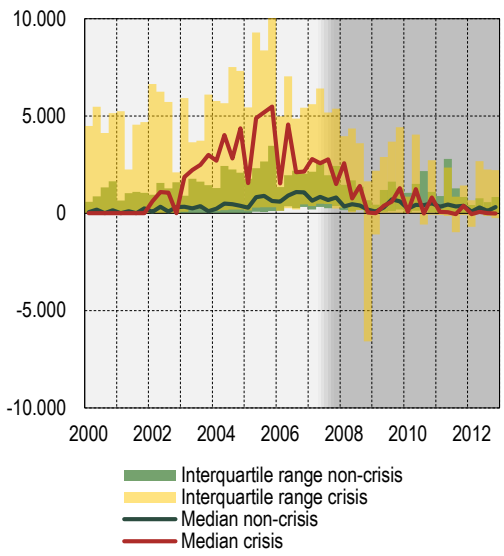
Flow of household loans[40]**:** The evolution of mortgage loans to households follows a similar pattern for most crisis countries: a steady increase prior to the global financial crisis followed by a sharp drop after the outbreak (Chart 28). This pattern may be explained by loose credit standards amid abundant funding, increasing house prices and rising housing demand, with the drying-up of global liquidity and banks' increasing risk aversion ultimately leading to a bursting of the bubble. The flow of new mortgage loans remained muted for several years thereafter given both demand-side (e.g. deteriorating income and

40 ECB SDW (balance sheet indicators).

employment prospects, debt servicing problems) and supply-side (e.g. higher risk aversion, falling collateral values) factors. Countries with a predominance of floating rate mortgages and relatively short-term fixed rate mortgages (e.g. UK, NL) may be exposed to a higher degree of cyclicality given their sensitivity to interest rate changes.

Chart 28
Flow of mortgage loans to households

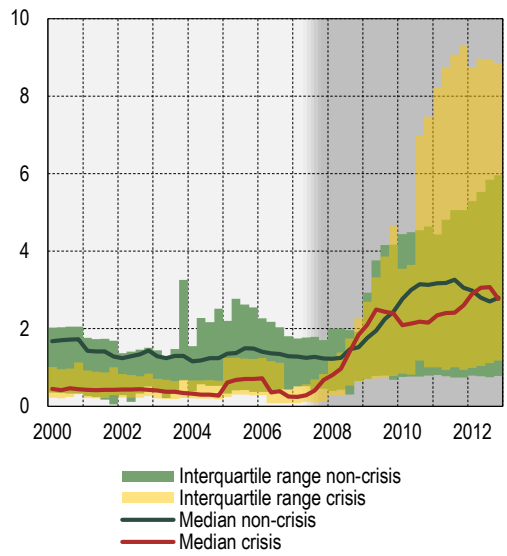
(EUR millions)



Sources: ECB data and own calculations.

Chart 29
Evolution of stock of household residential mortgage non-performing loans

(percentage)



Source: Own collection and calculations.

Household residential mortgage non-performing loans: Both the stock and flow of NPLs increase following a real estate-related crisis (see Section 2.3.2), albeit with some time lag as some households may have recourse to financial buffers to cope with the immediate impact of the crisis (Chart 29). Given the systemic nature of the recent crisis, NPLs have also increased in countries which did not experience a real estate-related crisis. However, NPL figures should be interpreted with caution, since there was until recently no commonly agreed definition for NPLs. Also, there is very limited availability of data regarding breakdowns of NPLs by loan purpose, but, in general, delinquency rates for consumer credit tend to rise faster than those for housing loans; moreover, loans denominated in foreign currencies may tend to be more vulnerable given often unhedged positions.

Risk weights for residential mortgage loans used by IRB banks: According to EBA data on a sample of banks, median RWs for residential mortgage loans steadily increased in the pre-crisis years, to reach their maximum in 2008 (Chart 30) reflecting mainly banks' higher risk perception. Since 2008, RWs have been decreasing again. However, it is worth noting that the cross-country dispersion of RWs is high across all LTV buckets, indicating that banks apply different RWs to mortgages with similar LTVs (Chart 32). This holds in particular for 2012, when RWs for the LTV bucket 85-100% ranged from

8% to 101%. The charts below – in particular the one showing country-specific RWs (Chart 31) – should, however, be interpreted with caution given data limitations.[41]

Chart 30
Median risk weight by LTV bucket

(percentage)

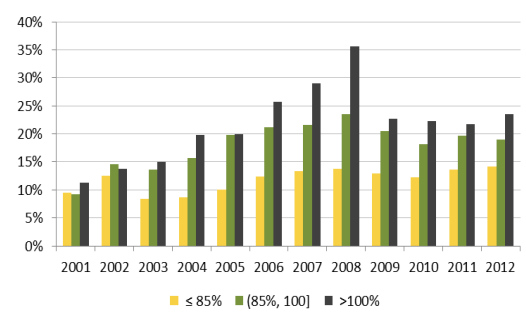


Chart 31
Median risk weight by country across all LTV categories

(percentage)

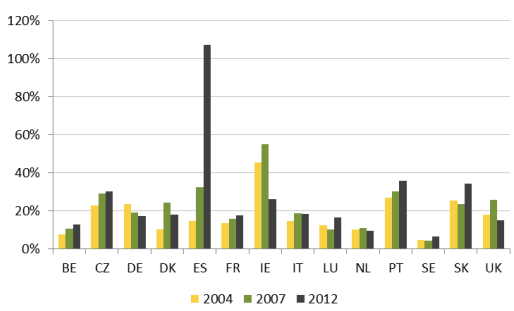
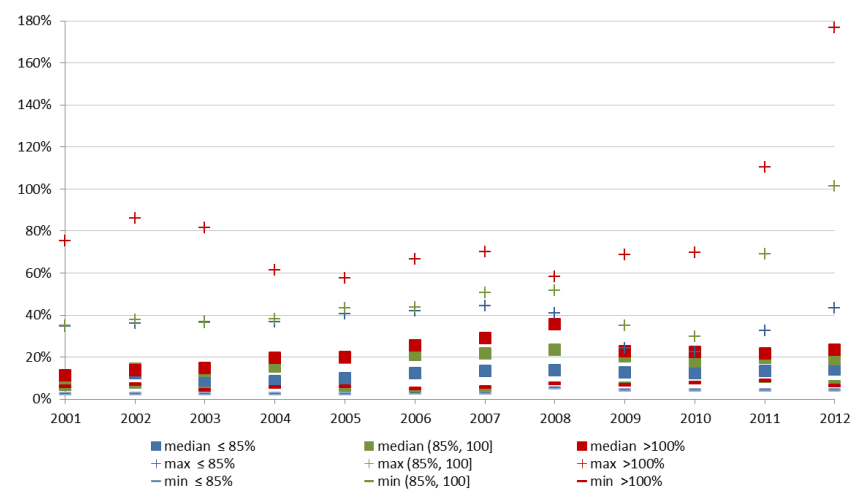


Chart 32
Median, minimum and maximum risk weight by LTV bucket

(percentage)



Loan-to-value ratios: LTV ratios show a wide dispersion across the EU, as well as very different trends. While for some countries the LTV ratio has increased over time, for others it has fallen gradually (Table 10). However, these trends should be treated with caution given the data issues highlighted in Box 1. It should also be taken into account that the LTV indicator may lose its information

41 Data on RWs for residential mortgage loans, aggregated by country, have been received from the EBA. The sample includes 43 banks across 14 different jurisdictions and each bank has portfolios from up to ten countries. The EBA report highlights the use of different definitions for similar concepts. Sometimes they reflect country-specific features, but overall the definitions are usually bank-specific.

content when it is used as a macroprudential instrument.[42] Section 4 discusses cases where countries have introduced a binding LTV limit.

Table 10
LTV ratio on new residential mortgage loans

(%)

	2007	2010	2013		2007	2010	2013
AT	-	-	70.5 (1)	**IE**	62.9	69.2	67.7
BE	68.6	64.6	62.3	**IT**	64.4	61.1	58.3
BG	-	63.4	63.1 (2)	**LT**	80.3	76.6	78.0
CY	-	-	-	**LU**	-	67.2	62.5
CZ	-	-	-	**LV**	-	68.9	65.4
DE	-	-	75.0 (3)	**MT**	-	-	70.0 (8)
DK (4)	95.0	93.0	96.0 (5)	**NL (9)**	75.7	83.8	88.7
EE (6)	54.0	56.2	50.5	**PL (10)**	-	77.1	79.2
ES	63.5	57.5	57.5	**PT**	68.9	65.8	64.4
FI	-	-	70.4 (7)	**RO**	-	69.3	75.7
FR	78.0	83.5	83.8	**SE**	68.6	71.0	70.9
GR	-	-	73.0 (8)	**SI (11)**	61.0	57.0	55.0
HR	-	-	-	**SK**	-	-	71.0 (8)
HU	-	66.0	57.8	**UK (9)**	80.3	73.3	75.0

(1) Best estimate based on EBA stress tests.
(2) Data refer to the fourth quarter.
(3) Best estimate based on various non-representative data sources.
(4) Total debt relative to the home value of the median first-time buyer, i.e. including debt not secured by the home as collateral.
(5) 2012 data.
(6) Calculation of the average LTV includes mortgage loans to households for buying, building or renovating residential property.
(7) October 2014 data, based on ad hoc survey.
(8) Data sourced from Chapter 3 of the "ESRB Handbook on Operationalising Macro-prudential Policy in the Banking Sector".
(9) Owner-occupied housing data.
(10) LTV of new mortgage loans for first-time home buyers.
(11) Up to 2011, the LTV ratio refers to new housing loans backed by real estate collateral (survey data). From 2012 onwards, the LTV ratio refers to new housing loans secured by all collateral, not only by real estate collateral. 86% of total collateral is real estate collateral.

Box 1
Data limitations

A number of the indicators used in this section have limitations that need to be kept in mind in the analysis of the data.

NPLs: NPLs are typically calculated as the ratio of the stock of NPLs to total loans, and can be computed for RRE and CRE. Cross-country analysis of NPL ratios is hindered by:

- **the heterogeneous definition of NPLs across countries:** the methods used to identify NPLs differ in terms of the taking into account of the value of the collateral and guarantees received.

42 See Goodhart, C.W.L. (1984).

Some banking groups do not classify as impaired those NPLs for which, considering the collateral and guarantees available, they do not expect to book losses in the future. By contrast, other groups identify impaired positions exclusively on the basis of the borrower's creditworthiness, even when ample collateral and guarantees are available, with the result of higher NPL ratios.

- **the length of credit recovery procedures:** the length of credit recovery procedures varies considerably across countries; this could extend the period during which NPLs remain on banks' balance sheets and push up the NPL ratio.

On 21 October 2013 the EBA published its technical standards for non-performing exposures and forbearance. The category of NPEs includes all loans classified as "impaired" and "defaulted" under IAS 39 and the CRR, whether or not they are backed by collateral or guarantees. The supervisory definition of default includes exposures more than 90 days past-due. The classification follows the debtor approach, meaning that all exposures to a debtor should be recognised as impaired when at least one of them is recorded as non-performing. At the end of December 2014 the first harmonised NPEs were collected through the new FINREP (reporting framework for financial information) templates with data referring to September 2014. Through the new templates, comparable NPL data should be available from September 2014 onwards.

As a result the analysis in this report on the NPL ratio for the past years is affected by the following weaknesses: (i) the NPL ratio does not reflect the current trend in credit quality, since it is a ratio of two stock values. The flow of NPLs in relation to the stock of loans at the end of the previous quarter would have been a better indicator, if only it had been available for a significant number of countries; and (ii) since the data were collected based on national definitions of NPLs, the cross-country comparability is limited.

LTVs: As already highlighted in the ESRB Handbook (Box 3.4, p. 70), the analysis of the LTV ratio is constrained by:

- **difficulties in obtaining data:** most national authorities rely on surveys, since there is no available database. Some authorities are not able to provide any data. The table presented in the ESRB Handbook on the LTV ratio for residential mortgage loans was a first major effort at the European level to fill this data gap;
- **significant heterogeneity in the underlying statistics** with regard to LTV definitions and the methodologies for collecting and aggregating the data.

Moreover, if a borrower has more than one loan and these loans are with several banks, the LTV is difficult to calculate in a correct way. Similar problems arise for the LTI, DTI and DSTI indicators.

For the purposes of this report, new LTV data have been collected. For countries that were not able to provide 2013 LTV data, country aggregates based on a sample of banks (available from the 2014 EBA stress-test results) have been used.

The LTV ratio is an important indicator not only because it provides information on the stance of lending policies, but also because macroprudential actions have been undertaken in a number of countries using the LTV ratio as an instrument. Therefore, the lack of data on LTV ratios and the heterogeneity of the definitions of LTV ratios across countries limit the extent to which this indicator can be used as an input to evaluate the emergence of systemic risk, as well as the comparability of the

implementation of macroprudential policy actions across countries (see Section 4). Seeking more complete and harmonised information on this indicator across countries should therefore be a priority for the future.

Additional data gaps include: construction sector NPLs, covered bond yields and RWs.

It is therefore recommended that harmonised definitions of key indicators, such as LTV, LTI, DTI and DSTI ratios, be developed at least for monitoring and cross-border comparison purposes. Similarly to the credit-to-GDP gap for the countercyclical capital buffer[43], these harmonised indicators should not prevent national authorities from calculating analogous indicators using their own definitions tailored to national market specificities. Harmonised definitions would at least provide a common basis for comparing information across banks and countries. The Anacredit project could provide the building blocks for the aforementioned harmonised and comparable key indicators, but this will in principle only be the case for the euro area countries.

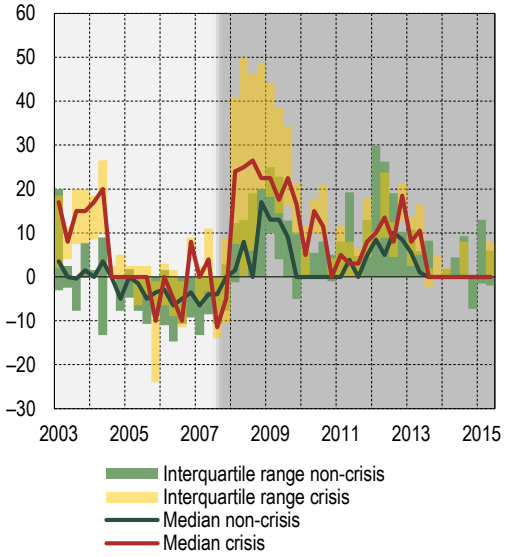
Lending standards for mortgages: The variation of lending standards for mortgages provides insights into banks' risk perception and the supply of loans (Chart 33). Lending standards gradually eased from 2003 to 2007, reflecting benign market conditions and low risk perceptions. Following the onset of the crisis in 2008, lending standards tightened for all countries, albeit with varying intensity. The tightening was particularly strong for crisis countries (PT, ES, IE) and less pronounced in non-crisis countries. After a short easing phase from 2010 to early 2012, standards tightened again with the onset of the sovereign debt crisis. Since then, lending standards have remained tight without easing back to pre-crisis levels.

Interest rate spread on mortgages: Interest spreads - the difference between the interest rates on mortgage loans and banks' cost of funding - steadily decreased from 2003 until the outbreak of the crisis (Chart 34). This may be due to increased competition and benign financing conditions, in part reflecting an underestimation of risks. Following the bursting of the credit and real estate bubbles in many countries, spreads on mortgages increased sharply, reflecting higher funding costs as well as increased risk aversion. This was true for all countries, but crisis countries appear to have been affected even more.

43 See Recommendation of the ESRB of 18 June 2014 on guidance for setting countercyclical buffer rates, (ESRB/2014/1), OJ C 293, 2.9.2014. In particular, Recommendation B requires authorities to measure and publish, on a quarterly basis, a standardised credit-to-GDP gap ratio; the recommendation nevertheless allows authorities to use additional measures of the credit-to-GDP gap if the standardised one does not adequately reflect the specificities of national economies. In this case, national authorities are requested to justify the need to deviate from the standardised credit-to-GDP gap.

Chart 33
Variation of lending standards for mortgages (diffusion index)

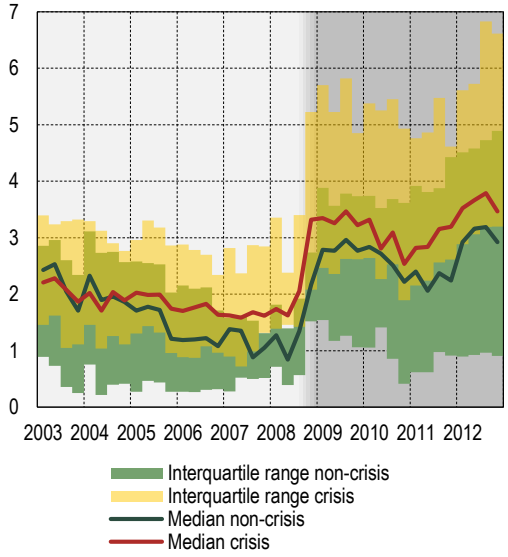
(percentage)



Sources: ECB and own calculations..

Chart 34
Spread on mortgages

(percentage points)



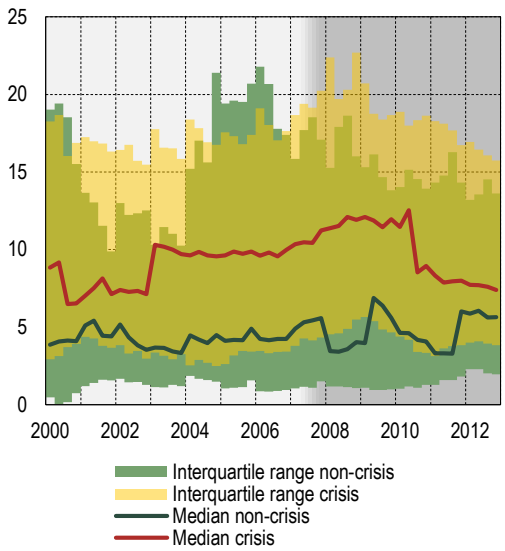
Sources: ECB and own calculations.

Share of loans granted in foreign currency: Excessive foreign currency lending may cause significant systemic risks in the event of unexpected downward exchange rate pressures. The share of loans granted in foreign currencies was overall higher for crisis countries than for non-crisis countries (Chart 35), and it increased after the start of the crisis. For some non-euro area countries (HU, LT, BG[44], PL, RO), the share of loans granted in foreign currency soared from already high levels irrespective of whether these countries experienced a real estate crisis or not. While higher shares of foreign currency lending cannot, in themselves, be associated with higher probabilities of real estate-related crises, they can amplify the depth of crises, mainly through the effect of exchange rate fluctuations on the debt burden. Annex 1 discusses the Polish experience with foreign currency loans.

44 Bulgaria has a fixed exchange rate regime vis-à-vis the euro.

Chart 35
Share of total loans granted in foreign currency

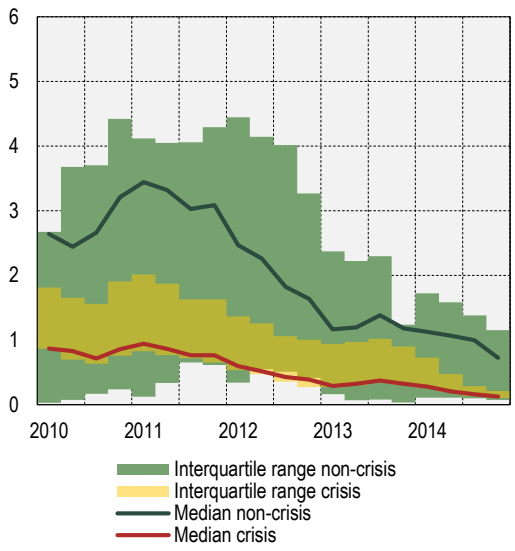
(percentage)



Sources: ECB and own calculations.

Chart 36
Evolution of covered bond yields (5-year tenor)

(percentage)



Sources: Bloomberg, Datastream and own calculations.

2.2.4 Production sector

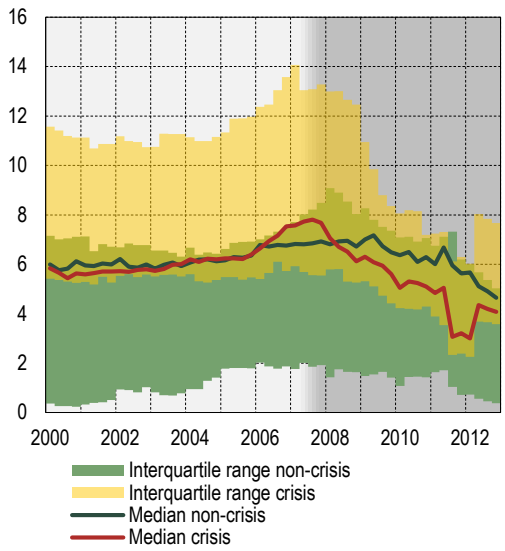
Contribution of the construction sector to GDP:[45] The flexibility of the construction sector to adjust to market conditions may be important in explaining why some Member States did not register a strong increase in house prices, despite a significant increase in the demand for mortgages and for housing. In the run-up to crisis events, the contribution of the construction sector to aggregate economic activity typically increased (Chart 37). For example, in ES and IE the construction sector experienced a protracted boom until it peaked at 12% and 11% of GDP, respectively, in 2006. In LV and HU the construction boom happened more swiftly, within just two years. In countries that did not suffer a real estate crisis - except for BG and RO - the construction boom was far less pronounced, with stable or slightly increasing values of the ratio.

Contribution of dwellings to gross fixed capital formation: The evolution of this indicator shows the increase in construction activity in an economic upturn (Chart 38). This is particularly noteworthy in ES and IE, while the upward trend in other real estate-related crisis countries (i.e. FI, DK, LV, SI) is of minor magnitude. In non-crisis countries this indicator is much smoother on average, albeit with a great divergence across countries.

45 Further details on the construction sector are presented in the twin ESRB Report on Commercial Real Estate and Financial Stability in the EU.

Chart 37
Evolution of the construction sector's value added

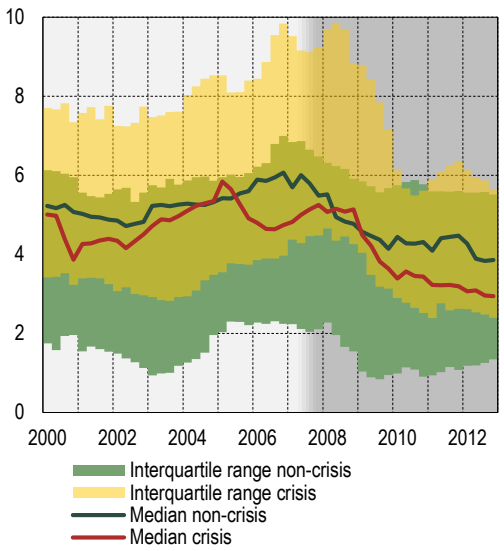
(percentage of GDP)



Sources: Eurostat data and own calculations.

Chart 38
Evolution of GFCF dwellings

(percentage of GDP)

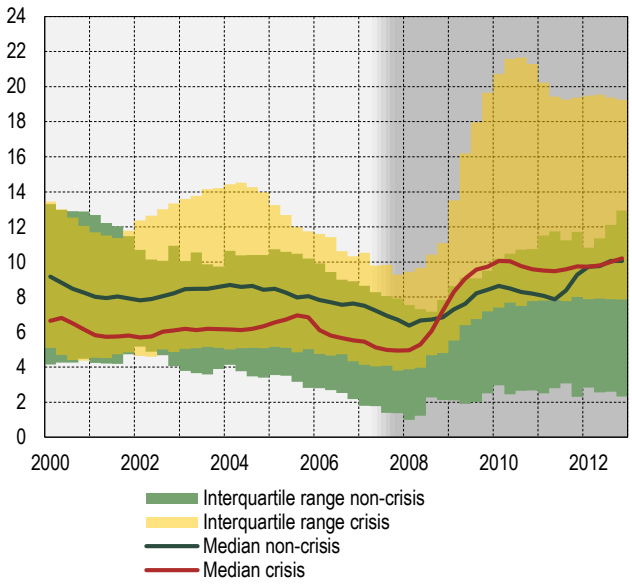


Sources: Eurostat, national authorities and own calculations.

Unemployment rate: Unemployment rates dropped in the run-up to the crisis, led by the overall economic boom (Chart 39). While differences in unemployment rates across the EU also depend on country-specific labour market structures, fluctuations tend to be more indicative of the position of a country in the economic cycle. While most countries' unemployment rate remained fairly stable until 2007, ES, LV and LT experienced more pronounced decreases in unemployment, reaching record lows in 2007. In non-crisis countries, with the exception of the central and eastern European economies which were undergoing a period of important structural transformation, unemployment rates did not drop so significantly in the run-up to the recent crisis.

Chart 39
Unemployment rate

(percentage)



Sources: Eurostat data and own calculations.

2.3 Length and depth of real estate-related banking crises

2.3.1 Characteristics of real estate-related banking crises in the EU

Several Member States experienced episodes of real estate-related banking distress which not only differ in the timing of their occurrence, but also in the length and severity of their effects on the economy. This section explores the characteristics of these crises and relates several indicators to their depth and impact on countries' economic performance. Table 11 provides a detailed overview of the real estate-related crisis periods and their length as reported in the previously mentioned real estate crisis database. The dataset identifies crises which occurred in the 1990s (Box 2) or during the recent global financial crisis.

Table 11

Real estate-related banking crises in the EU

Country	Start of crisis	End of crisis	Real estate-related	Number of crisis quarters
Austria				-
Belgium				-
Bulgaria				-
Croatia				-
Cyprus				-
Czech Republic				
Denmark	Q1 1987	Q4 1993	CR	28
	Q3 2008	Ongoing	CR	19
Estonia				-
Finland	Q3 1991	Q4 1995	CR	18
France	Q3 1993	Q4 1995	CR	10
Germany				-
Greece				-
Hungary	Q3 2008	Ongoing	CR	19
Ireland	Q3 2008	Ongoing	CR	19
Italy				-
Latvia	Q4 2008	Q3 2010	CR	8
Lithuania	Q4 2008	Q4 2010	CR	9
Luxembourg				-
Malta				-
Netherlands	Q3 2008	Ongoing	CR	19
Poland				-
Portugal				-
Romania				-
Slovakia				-
Slovenia	Q1 2008	Ongoing	R	21
Spain	Q2 2009	Q1 2013	CR	16
Sweden	Q3 1990	Q4 1993	CR	14
	Q3 2008	Q4 2010	R	10
United Kingdom	Q3 1990	Q3 1994	CR	17
	Q3 2007	Ongoing	CR	23

Source: Survey by the IWG Work Stream on Real Estate Instruments for the work related to Chapter 3 of the "ESRB Handbook on Operationalising Macro-prudential Policy in the Banking Sector" (2014).
Notes: R = purely RRE crisis; C = purely CRE crisis; CR = RRE and CRE crisis. The table provides a snapshot as at mid-2013, i.e. when the survey of the IWG Work Stream on Real Estate Instruments was conducted. Accordingly, the status of countries with "ongoing" real estate crises might have changed since then, i.e. the crisis may have ended in those countries.

Box 2

The 1990s real estate-related crises: stylised facts and comparison with the 2008 crisis

According to the ESRB database on real estate-related banking crises in the EU, five countries (DK, FI, FR, SE and UK) experienced a real estate-related banking crisis in the late 1980s and early 1990s. The earliest real estate-related crisis occurred in Denmark, lasting for seven years from Q1 1987. Subsequently, Sweden and the United Kingdom experienced a crisis which started in both countries in Q3 1990. While in Sweden it lasted for two and a half years, in the UK it lasted for three years longer. Finland and France experienced real estate crises starting in Q3 1991 and Q3 1993,

respectively, and lasting for four and a half and two and a half years. Norway, a non-EU country, also experienced a banking crisis at around the same time (1988-93) as the other Nordic countries.[46]

There are significant similarities and differences between the recent crisis and the crises of the early 1990s in the Nordic countries, France and the UK. In terms of the similarities, both crisis episodes are characterised by typical credit and asset price cycles and the materialisation of vulnerabilities in real estate markets. Both crisis periods were also preceded by increased cross-border capital inflows, lower funding costs and better access to credit. This was spurred by financial market deregulation in the early 1980s and financial innovation and integration in the early 2000s. Risks and vulnerabilities accumulated in the form of external imbalances, booming construction activity, excessive bank credit growth, higher private sector leverage, higher debt service burdens and overvalued RRE prices (see charts below).

The 1990s crises were less synchronised than the recent crisis with respect to their start and duration. The outbreak of these crises varied from 1987 in Denmark to 1993 in France, while the recent financial crisis affected almost all countries simultaneously. Furthermore, in the 1990s corrections in RRE markets preceded a wider economic crisis for some countries. In Finland, for example, the drop in RRE prices started around six quarters before the start of the crisis. The length and end date of the crises has also shown some variation (e.g. in Denmark the crisis lasted seven years, while in Sweden it lasted three and a half years).

The 1990s crises were, in part, triggered by country-specific factors. For example, a diverse range of shocks hit the Nordic countries: the loss of the Soviet export markets (FI), the exchange rate mechanism currency crisis (FI, SE) and energy prices (NO).[47] By contrast, the onset of the recent crisis was triggered by a common shock with a global systemic impact.

The costs and severity of the crises varied. The 1990s crises in Finland, Sweden and Norway were among the most severe ones in advanced economies prior to the recent crisis, while the crises in Denmark, France and the UK were comparatively milder.[48] With the exception of Finland, where real GDP dropped by 10% over the period 1991-93,[49] the costs of the 1990s crises were less severe in terms of output losses compared with the recent crisis. However, with the exception of Denmark, the cumulative fall in nominal RRE prices was much larger and the bank credit-to-GDP ratio was much higher during the 1990s crises than during the recent crisis (Table 12). The costs in terms of unemployment were broadly similar in the two crisis episodes. The costs in terms of financial sector support are difficult to estimate, but were substantial in both episodes. In Denmark the two largest insurance companies and a number of smaller banks collapsed, and the central bank had to guarantee the deposits of the second-largest bank. The Finnish banking sector received capital injections from the government.

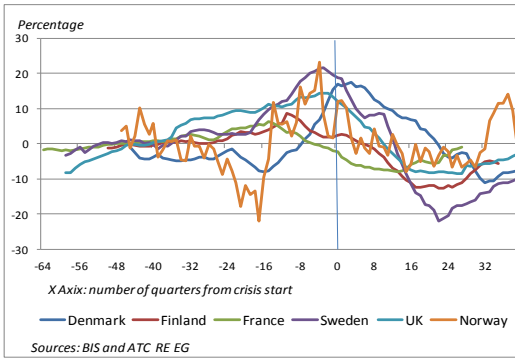
Another difference between the two episodes is related to the pace of economic recovery, in particular for Finland, Sweden and the UK where real GDP growth rates had rebounded strongly already by 1994 (to 3.9% in FI, 4.1% in SE and 4.5% in UK). By contrast, economic activity in the hardest-hit countries remained relatively muted in the aftermath of the recent crisis.

46 Moe, Solheim and Vale (eds.) (2004).
47 World Economic Forum (2015).
48 Reinhart and Rogoff (2009).
49 OECD data.

Finally, the 1990s crises were more regional with limited cross-border effects. In the 1990s the behaviour of most variables showed more marked differences between crisis and non-crisis countries. In the wake of the recent crisis, higher credit growth and rising RRE prices, and a fall thereafter, were observed in most of the non-crisis countries as well. This may be due to the fact that broader and deeper financial markets have reinforced the linkages and contagion risks between the financial sector and the real economy both within and across countries.

Chart 43
Bank credit to the private sector-to-GDP gap

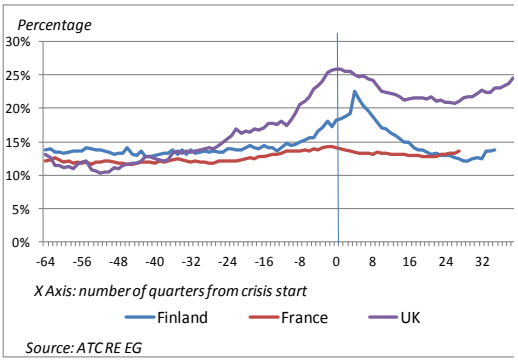
(percentage)



Sources: BIS and Expert Group on Real Estate.

Chart 42
Debt service ratio

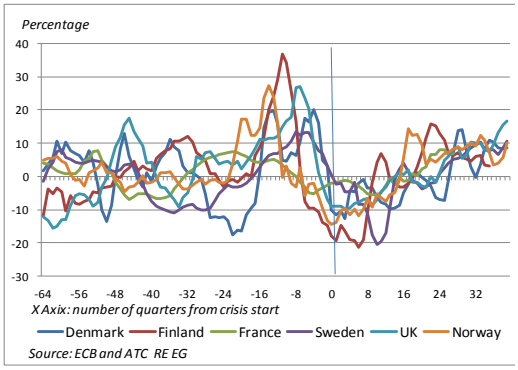
(percentage)



Source: Expert Group on Real Estate

Chart 41
Real RRE prices (annual growth rate)

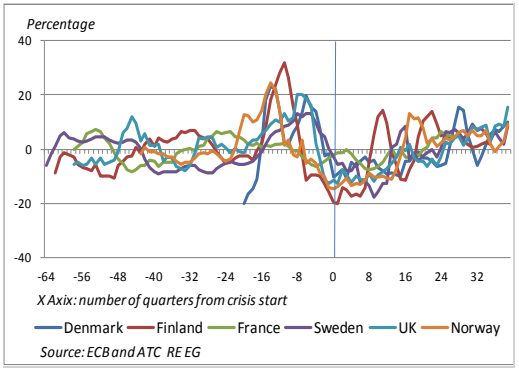
(percentage)



Sources: ECB and Expert Group on Real Estate.

Chart 40
Price-to-income ratio (annual growth rate)

(percentage)



Sources: ECB and Expert Group on Real Estate.

In the context of the recent global crisis, ten Member States reported a real estate-related banking crisis starting between Q3 2007 and Q2 2009. While many Member States labelled the recent financial crisis as "real estate-related", the global nature of the recent crisis has to be taken into account. The crisis had its roots in the collapse of the US subprime mortgage market but quickly spilled over to many countries worldwide, the real estate markets of which were negatively affected by the sudden drying-up of liquidity in financial markets and the contraction of credit and economic activity.

Against this backdrop, many Member States reported a banking crisis in the context of the global crisis, even if not specifically related to real estate. In addition to the countries reporting a real estate-related banking crisis described earlier, four countries (CY, FR, GR, PT) signalled a banking crisis that coincided with the global financial turmoil, while 12 countries reported banking crises occurring earlier than the global financial crisis. Six countries (AT, BE, LU, MT, PL, SK) did not report any crisis for the observation period.

There are important differences across countries concerning both the length and depth of real estate-related crises. While countries such as LV, LT and SE overcame the crisis within two years, in other countries (e.g. DK, HU, IE, NL, SI[50] and UK) the crisis lasted much longer and was often still ongoing when the crisis database was compiled in 2013. The length and depth of real estate-related crises can also be gauged by looking at indicators of economic activity and real estate prices.

During the latest crisis, countries which did not experience any sort of banking crisis or those which faced a non-real estate-related crisis also saw downward corrections in real estate prices. For example, Poland, without experiencing any type of crisis, registered 13 quarters of house price contraction, while in Greece, where the banking crisis was not classified as real estate-related, property prices have dropped for over four years. This illustrates the tight links between the financial sector and the housing market, as well as the extent to which adverse events in the banking sector can quickly spill over to the real estate sector, or vice versa. Furthermore, countries that experienced a real estate-related crisis suffered a more protracted period of GDP loss. But even those countries that did not report a real estate-related banking crisis (e.g. HR, IT, PT) or any sort of distress event (e.g. BE) incurred real GDP losses, albeit of much shorter length. One notable exception to this general pattern is Sweden during the 2007-13 crisis period, which exhibited positive developments in both real estate prices and in other macroeconomic indicators. This may be explained by the inherently non-domestic nature of the crisis in Sweden: in this country, banking distress was caused by Swedish-based international banks suffering from credit losses on residential real estate in foreign countries (namely, Denmark and the Baltic countries).

2.3.2 Measuring the depth of real estate-related banking crises

Selected indicators during crisis periods can provide insights into the depth of real estate-related crises (Table 12).[51] On average, countries which experienced a real estate-related crisis suffered significant losses in the real economy and the housing and financial sectors. Losses experienced during the most recent crisis also exceed those suffered during the earlier crisis period in the 1990s.

RRE prices generally decreased. This occurred in crisis countries during both the earlier and the latest crisis periods but for the recent crisis the decline was much more pronounced (-7.3% vs. -2.9%). In the earlier crisis period, all crisis countries experienced falls in RRE prices, ranging from -1.6% (FR, UK) to -6.5% (FI). During the real estate-related stress periods coinciding with the global financial

50 The real estate sector in Slovenia experienced a crisis accompanied by a significant fall in real estate prices in the last years, but the roots of the banking crisis were not purely real estate-related, as they also involved the corporate sector. Household indebtedness and stocks of non-performing loans remained low throughout the crisis and up to now.

51 Crisis periods are divided according to whether a crisis occurred during the 1990s or in conjunction with the recent global financial crisis. Averages of indicators pertaining to crisis countries are computed over the period from the first to the last crisis quarter specific to each country. To provide a means of comparison, averages for non-crisis countries are computed over the broad crisis periods of crisis countries, including all quarters since the start of the earliest crisis (Q1 1987 and Q3 2007, respectively) up to the last crisis quarter in the period considered (Q4 1995 and Q1 2013, respectively).

crisis, average decreases in RRE prices in crisis countries were larger than in other countries. While countries like IE, LV and LT saw double-digit decreases in house prices (peaking at -27.7% in LV), in other countries the average correction was less pronounced (e.g. DK, NL, SI, ES). Due to direct contagion or indirect transmission, even countries where the turmoil was not related to real estate developments experienced decreases in RRE prices, most notably RO (-10.2%), GR (-4%) and to a smaller extent IT (-0.2%).

Real estate activity declined. In both crisis periods, crisis countries experienced larger declines in real estate activity than countries not affected by real estate-related turmoil (Table 12). During the recent crisis, the number of housing starts settled at an average of 43.5 thousand units in crisis countries, compared with 64.1 thousand units in countries not affected by real estate-related turmoil. As a consequence of the stronger decrease in demand, the contribution of dwellings to GDP decreased in crisis countries: on average, over the recent crisis, gross fixed capital formation of dwellings settled at 4% in crisis countries versus 4.7% in non-crisis countries.

Banking sector asset quality deteriorated. Crisis events impact the banking sector mainly through increased default rates, lower collateral values and increased loan loss provisions. While banks' asset quality was severely affected in real estate-related crisis countries, most notably in LV and IE (Table 12), NPLs to households increased considerably in non-crisis countries as well (e.g. BG, GR, IT). As a result of heightened credit risk and mounting credit losses, as well as of the overall drying-up of market liquidity, credit granted by the banking sector broadly decreased (Table 12), despite sometimes considerable public capital injections. While real estate crisis countries such as HU, IE, LV, LT and ES saw the largest contraction in credit, negative growth in bank credit (expressed as a percentage of GDP) was also experienced by non-real estate-related crisis countries (e.g. BE).

Table 12

Average of selected indicators during real estate-related crisis periods

Country	Nominal RRE price growth		Housing starts (thousands of units)		GFCF dwellings (percentage of GDP)		NPLs of households (outstanding)		Bank credit to GDP growth		Corporate bankruptcies		Real GDP growth		Consumption growth	
	1990s crisis	2008 crisis	1990s crisis	2008 crisis	1990s crisis	1990s crisis	1990s crisis	1990s crisis	2008 crisis	2008 crisis	2008 crisis	2008 crisis	1990s crisis	2008 crisis	1990s crisis	2008 crisis
Austria	n.a.	5.2%	47.29	n.a.	5.7	4.5	n.a.	n.a.	4.9%	0.9%	2.0%	1.6%	2.8%	0.8%	6.9%	3.1%
Belgium	7.4%	3.7%	42.09	44.37	5.8	5.9	n.a.	1.1%	5.7%	-2.8%	0.8%	1.3%	3.8%	0.6%	6.4%	3.1%
Bulgaria	n.a.	n.a.	n.a.	20.80	n.a.	n.a.	n.a.	9.0%	n.a.	n.a.	n.a.	n.a.	-1.1%	1.2%	n.a.	5.5%
Croatia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	3.7%	23.1%	2.9%	n.a.	n.a.	n.a.	-1.4%	n.a.	1.5%
Cyprus	n.a.	n.a.	7.26	8.55	7.1	6.4	n.a.	n.a.	10.4%	8.7%	n.a.	n.a.	n.a.	0.5%	n.a.	3.5%
Czech Rep.	n.a.	2.7%	19.22	34.10	2.5	4.0	n.a.	2.5%	1.7%	6.5%	n.a.	5.0%	n.a.	0.7%	n.a.	4.8%
Denmark	-2.2%	-4.5%	18.47	13.86	3.5	4.4	n.a.	0.4%	2.4%	-0.6%	n.a.	1.2%	1.1%	-1.0%	4.1%	1.5%
Estonia	n.a.	n.a.	0.80	3.17	2.4	3.8	n.a.	2.9%	n.a.	-0.5%	n.a.	0.1%	2.5%	0.4%	n.a.	2.6%
Finland	-6.5%	2.9%	40.70	27.50	4.9	6.5	n.a.	0.5%	-4.3%	4.2%	0.8%	0.2%	0.0%	-0.2%	-0.7%	3.7%
France	-1.6%	1.3%	316.16	369.68	5.4	6.2	n.a.	1.2%	-2.6%	3.0%	n.a.	1.6%	1.6%	0.5%	3.4%	1.8%
Germany	3.7%	2.8%	551.19	n.a.	7.1	5.4	n.a.	n.a.	3.9%	-0.1%	n.a.	n.a.	1.3%	0.9%	7.2%	2.3%
Greece	n.a.	-4.0%	96.56	55.85	n.a.	4.6	n.a.	10.6%	-0.5%	1.8%	n.a.	n.a.	n.a.	-3.9%	n.a.	2.3%
Hungary	n.a.	n.a.	39.92	22.54	7.8	3.8	n.a.	n.a.	-13.0%	-2.1%	n.a.	n.a.	n.a.	-1.3%	n.a.	-0.8%
Ireland	5.3%	-13.7%	12.56	3.47	5.2	3.7	n.a.	12.1%	5.3%	-9.7%	27.8%	66.0%	n.a.	-1.3%	n.a.	-2.7%
Italy	9.6%	-0.2%	n.a.	n.a.	5.7	5.5	n.a.	5.0%	5.9%	2.4%	n.a.	0.2%	1.3%	-1.2%	0.0%	1.0%
Latvia	n.a.	-25.7%	n.a.	1.52	1.7	2.7	n.a.	12.8%	n.a.	-3.3%	n.a.	3.2%	-10.6%	-11.0%	n.a.	-11.3%
Lithuania	n.a.	-16.7%	n.a.	10.18	2.3	2.7	n.a.	5.2%	6.0%	-4.3%	n.a.	0.9%	n.a.	-6.2%	n.a.	-6.7%
Luxembourg	n.a.	2.8%	3.27	3.82	3.4	3.5	n.a.	1.5%	2.0%	6.1%	n.a.	2.6%	n.a.	0.2%	n.a.	2.8%
Malta	n.a.	n.a.	6.61	n.a.	n.a.	3.3	n.a.	n.a.	14.1%	4.3%	n.a.	n.a.	n.a.	1.8%	n.a.	3.7%
Netherlands	6.3%	-2.9%	n.a.	n.a.	5.6	5.0	n.a.	1.0%	5.1%	2.0%	0.3%	0.3%	2.9%	-0.6%	6.3%	0.4%
Poland	n.a.	n.a.	122.86	159.50	n.a.	n.a.	n.a.	1.8%	-4.5%	13.3%	n.a.	n.a.	n.a.	3.6%	n.a.	5.8%
Portugal	10.0%	0.8%	n.a.	22.33	7.4	3.6	n.a.	1.7%	4.2%	1.3%	n.a.	6.9%	n.a.	-0.9%	n.a.	0.0%
Romania	n.a.	-10.2%	n.a.	n.a.	n.a.	n.a.	n.a.	3.2%	n.a.	12.7%	n.a.	0.9%	n.a.	1.1%	n.a.	2.4%
Slovakia	n.a.	3.3%	5.49	19.40	1.2	2.4	n.a.	n.a.	n.a.	7.0%	n.a.	n.a.	-2.1%	2.8%	n.a.	7.2%
Slovenia	n.a.	-0.9%	6.17	5.50	3.4	3.4	n.a.	2.5%	28.1%	4.3%	n.a.	7.7%	4.6%	-1.2%	n.a.	2.0%
Spain	13.9%	-6.5%	243.91	178.80	4.6	6.6	n.a.	2.9%	4.6%	-4.8%	n.a.	0.1%	n.a.	-1.3%	7.2%	-0.3%
Sweden	-2.5%	3.8%	40.22	24.10	n.a.	n.a.	0.3%	0.1%	-1.7%	5.6%	2.3%	0.8%	n.a.	0.1%	n.a.	3.1%
United Kingdom	-1.6%	0.9%	198.78	131.20	3.1	3.5	4.5%	1.9%	0.1%	-0.5%	0.7%	0.2%	1.6%	-0.1%	4.4%	0.1%

Table 12

Average of selected indicators during real estate-related crisis periods

Country	Nominal RRE price growth		Housing starts (thousands of units)		GFCF dwellings (percentage of GDP)		NPLs of households (outstanding)		Bank credit to GDP growth		Corporate bankruptcies		Real GDP growth		Consumption growth	
	1990s crisis	2008 crisis	1990s crisis	2008 crisis	1990s crisis	1990s crisis	1990s crisis	1990s crisis	2008 crisis	2008 crisis	2008 crisis	2008 crisis	1990s crisis	2008 crisis	1990s crisis	2008 crisis
Average in RRE crisis countries	-2.9%	-7.3%	122.9	43.5	4.3	4.0	2.4%	4.3%	-1.2%	-1.3%	1.3%	8.9%	1.1%	-2.4%	2.8%	-1.5%
Average in non-RRE crisis countries (b)	8.0%	0.9%	80.3	64.1	4.6	4.7	n.a.	3.4%	5.9%	4.2%	7.7%	2.0%	0.5%	0.4%	5.7%	3.2%

countries reporting real estate-related banking crises

countries experiencing a non-real estate-related banking crisis

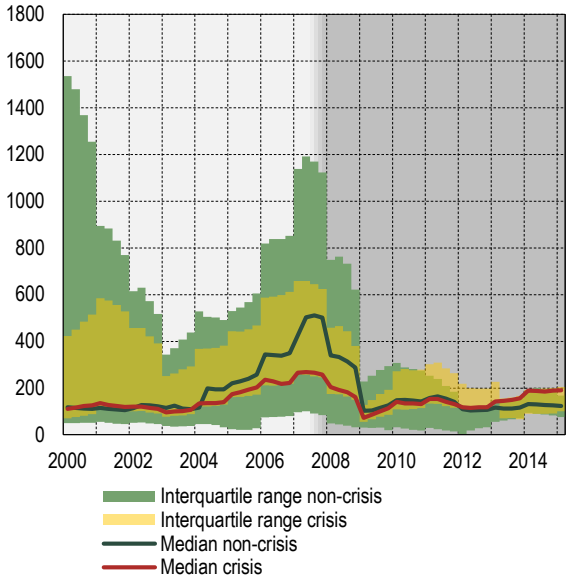
countries not experiencing any type of crisis in the time sample considered

(a) Cells pertaining to countries reporting real estate-related banking crises are pink shaded; cells referring to countries experiencing a non-real estate-related banking crisis are coloured in purple; light blue cells refer to countries not experiencing any type of crisis in the time sample considered.
(b) Non-crisis countries are countries that did not report the occurrence of a real estate-related banking crisis. Averages of indicators pertaining to crisis countries are computed over the period from the first to the last crisis quarter specific to each country. To provide a means of comparison, averages for non-crisis countries are computed over the broad crisis periods of crisis countries, including all quarters since the start of the earliest crisis (Q1 1987 and Q3 2007, respectively) up to the last crisis quarter in the period considered (Q4 1995 and Q1 2013, respectively).

Bank stock prices were rising during the build-up phase of the crisis but started to drop sharply in mid-2007 (Chart 44). The increases and decreases of bank valuations in the market followed a similar pattern across countries but the magnitudes differed. There is no major difference in developments between crisis and non-crisis countries. Hence, the behaviour of this indicator seems to be related not only the situation in the real estate market but also to the general financial and economic conditions.

Chart 44
Bank stock prices

(index, 1 January 2012 = 100)



Sources: Bloomberg data and own calculations.

Real estate-related banking crises have significant spillovers to the real economy. Table 12 presents the average impact of the crisis on the production sector (corporate bankruptcies), real GDP and consumption.

On average, both crisis and non-crisis countries saw an increase in bankruptcies during the recent crisis (8.9% on average in crisis countries and 2% in non-crisis countries), but with significant cross-country variation. Among the crisis countries, IE experienced the highest average corporate bankruptcy rate during the crisis (66%), followed by SI (7.7%) and LV (3.2%). However, the global financial crisis severely affected the production sector of other European countries too. In PT, the average bankruptcy rate settled at 6.9%.

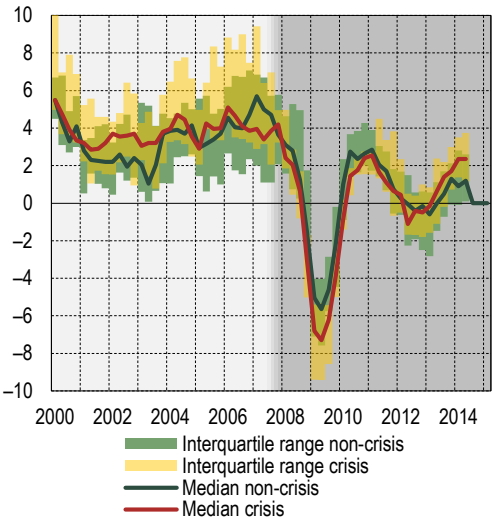
Real GDP registered large declines (Chart 45). During the latest crisis period, in crisis countries real GDP, on average, declined by 2.4%, compared with the 0.4% average real GDP growth in countries without a real estate-related crisis. However, the global financial crisis led to significant real GDP losses also in economies where the banking crisis was not related to the real estate sector (e.g. GR, HR, IT).

During the 1990s crisis, not one crisis country registered negative real GDP growth over the crisis period. In the more recent crisis, some heterogeneity across countries can be observed. Furthermore, the severity of the crisis impact appears directly proportional to the economic expansion preceding the onset of the real estate turmoil. Countries experiencing a strong economic and consumption boom seem to face costlier crises. In this context, the complex nature of the most recent crisis has to be kept in mind, as well as the country-specific factors that might have amplified its impact. Countries not reporting the occurrence of any type of banking crisis all report, on average, low positive real GDP growth rates.

A similar pattern can be observed for consumption. Countries facing real estate-related banking crises experienced, on average, lower consumption growth than their peers. However, while in the recent episode crisis countries suffered, on average, a decrease in consumption of -1.5% (compared with +3.2% in non-crisis countries), in the 1990s episode crisis countries on average saw +2.8%, with only FI registering a contraction in consumption of -0.7%.

Chart 45
Real GDP growth

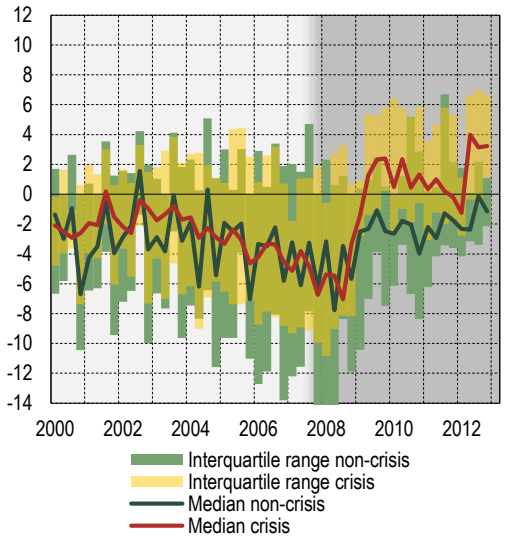
(percentage)



Sources: Eurostat and own calculations.

Chart 46
Current account balance

(percentage of GDP)



Sources: Eurostat and own calculations.

In the run-up to real estate-related crisis events, countries tend to exhibit pronounced negative current account balances (Chart 46). This implies a financing of the shortage of domestic savings with foreign savings. Protracted periods of reliance on foreign funds, particularly significant in the Baltic countries, HU, ES and IE, were later accompanied by a stronger impact of the downturn. At the same time, countries where domestic banks engage in cross-border lending or where lending is performed by subsidiaries in other jurisdictions can be exposed to contagion from negative real estate-related developments in other countries (e.g. Sweden during the latest crisis episode).

State aid given to the financial sector is another indicator signalling the depth of a crisis. Given the systemic nature of the 2008 crisis, many financial institutions in the EU received government support. Member States that experienced a real estate-related crisis are among those with the highest state aid provided to the financial sector. In IE and ES, for instance, recapitalisation and asset relief measures peaked at 25% and 6% of GDP, respectively. Guarantees on liabilities and liquidity measures were particularly important for IE, NL and UK.

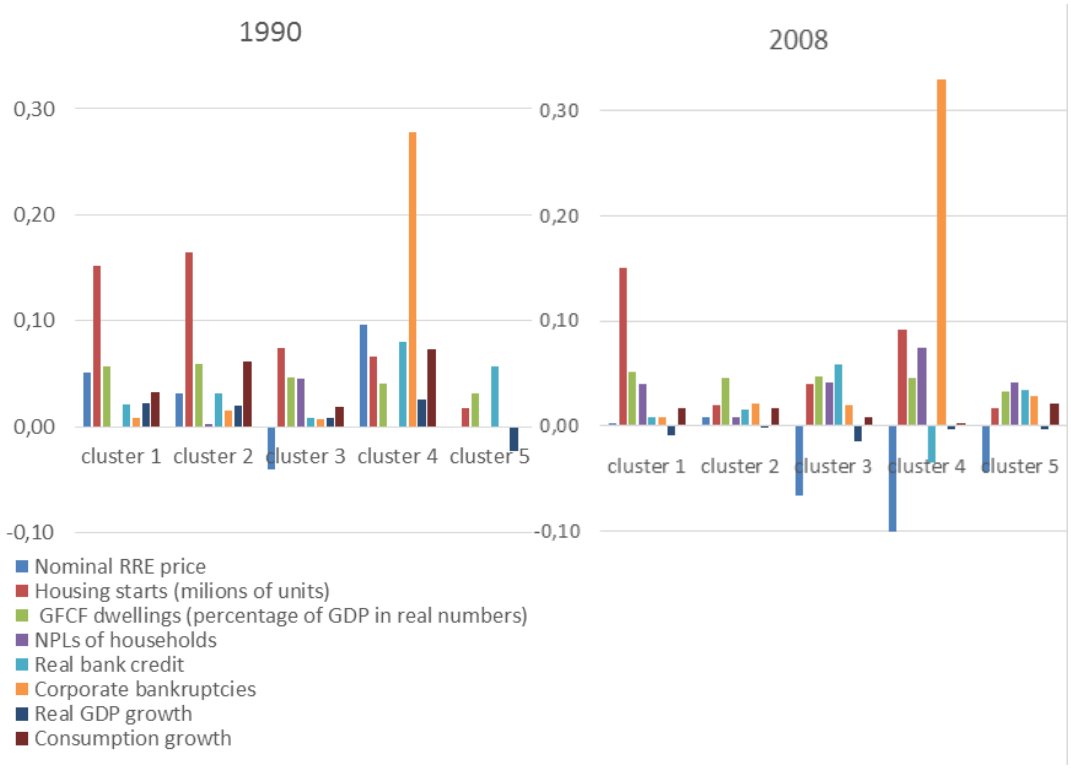
The clustering analysis of Section 1 also provides some interesting insights as regards the role of structural features of countries in the depth of a real estate crisis. Chart 47 suggests that, on average, countries belonging to cluster 4 experienced the deepest real estate crisis, with the strongest fall in RRE prices and the bank credit-to-GDP ratio, as well as the highest share of corporate bankruptcies and of NPLs of households. Despite being characterised, on average, by low LTVs compared with the other clusters, countries in cluster 4 are characterised by low pre-crisis taxation on housing and construction VAT (the latter being the lowest across clusters), the largest share of new loans granted at a variable rate and the longest loan maturity (see Table 7 in Section 1).

Cluster 2, on the other hand, seems to be the one which experienced the smallest losses from the recent real estate-related crisis: countries in this cluster exhibit, on average, positive RRE price growth during the crisis period, as well as the lowest levels of household NPLs and low corporate bankruptcies. Countries in cluster 2 present very different structural characteristics than cluster 4: a higher contribution of taxes to the marginal cost of housing is accompanied by the highest average level of VAT on construction and by a lower share of variable rate mortgage loans in new lending. While average loan maturities are not substantially higher, cluster 2 presents the lowest average share of homeowners in the economy (64.8% compared with 80.7% in cluster 4). It is interesting to note that both clusters include countries which experienced real estate-related banking crises: while cluster 2 includes DK, NL and SE, cluster 4 comprises ES and IE. This seems to suggest that underlying structural features are important in affecting the resilience of countries to distress events and can act as amplifying channels for negative shocks.

The insights drawn in this section suggest that both cyclical developments experienced in the run-up to real estate-related crises and structural features of real estate markets might have played a role in shaping the depth of downturns. To better characterise these relationships, further analytical work focused on exploring the characteristics influencing the depth of real estate-related crises would be highly desirable.

Chart 47

Indicators describing the depth of the 2008 real estate crisis by cluster of countries



Note: Values on the y-axis refer to the specific unit of each indicator, as indicated in the legend: while for indicators representing growth rates or shares the numbers on the y-axis refer to values within the [-1;1] interval (i.e. a value of 0.3 represents 30%), housing starts are expressed as millions of units (i.e. the value 0.3 refers to 300,000 units).

Section 3
Links between national market characteristics and real estate risks[52]

3.1 Structural market features and financial stability risks: a general framework

While Section 1 and Section 2 examine structural and cyclical features of RRE markets in the EU, this Section aims at bringing the two dimensions together and linking them to financial stability risks. The interplay between structural and cyclical features of real estate markets and the build-up of risk is, however, not straightforward.

First, while structural features influence financial stability, there may be differences in how and where these effects materialise. Some features may act only indirectly through their effect on other structural variables, while others may have a more direct impact. For example, the tax deductibility of mortgage interest affects the incentives for mortgage financing and thereby households' debt service ratio, which in turn is likely to influence PDs and the losses incurred by banks; in this case the debt service ratio has a direct effect on financial stability, while tax deductibility has an indirect effect. Furthermore, features such as interest rate sensitivity influence house price dynamics in the short term, while other features, such as the level and quality of residential investment, have a longer-term impact on the demand for and supply of housing (Tsatsaronis and Zhu, 2004).

In addition, structural features can both increase vulnerabilities before a crisis and amplify the severity of a downturn. However, the specific role of structural features in the different phases of the cycle is not clear-cut. There are features that may both mitigate and amplify risks, depending on the state of the cycle. Indeed some structural features may increase the probability of a crisis occurring but reduce the impact of the crisis, or vice versa. For instance:

- There are mixed views on the impact of the share of loans granted at floating versus fixed interest rates. While the prevalence of new floating rate loans may be viewed as amplifying the link between property prices and interest rates and hence increasing risks to financial stability, when the crisis occurred, countries like the UK were able to reduce mortgage foreclosures and the drop in consumption by lowering interest rates owing to the high portion of floating rate loans. Indeed, monetary policy tends to transmit quicker through the financial system when variable rate mortgages are prevalent.
- Non-recourse lending may increase strategic defaults once the crisis has materialised, but on the other hand it may also encourage better borrower screening and a milder decline in lending standards pre-crisis. Strategic default may also lower borrowers' incentives to maintain their properties, given that they can more easily walk away in case of declining house prices (IMF, 2011), which can mean that the negative externality of foreclosure is higher than it is with no strategic default.

52 Prepared by a team coordinated by Wanda Cornacchia (Banca d'Italia) and comprising Marine Dujardin (Banque de France), Mara Pirovano (Nationale Bank van België/Banque Nationale de Belgique), Peter Pontuch (European Commission), Piotr Sliwka (Polish Financial Supervision Authority, C.S.Wyszynski University) and Rhiannon Sowerbutts (Bank of England).

Notwithstanding the difficulty in establishing a clear link between structural features of RRE markets and financial stability risks, several studies provide empirical evidence. A recent case study (Schneider and Wagner, 2015) analysing the housing market in Germany, Austria and Switzerland suggests that well-developed and regulated rental markets, low home ownership ratios and conservative lending standards can have a mitigating impact on financial stability risks, as these factors contribute to the stability of housing prices. By contrast, IMF (2011) finds that high government involvement in housing finance and high household leverage tend to exacerbate house price swings and mortgage credit growth, having a negative effect on financial stability.

The relationship between housing finance and financial stability can in large part be explained by the feedback loops between the housing market and the real economy. The importance of these feedback loops is often directly tied to the features of the mortgage contracts (Tsatsaronis and Zhu, 2004). For example, as underlined by the lead-up to the 2007 financial crisis, mortgage equity withdrawal is a potential amplifier of the loop between house prices and consumption as households may "use their houses like an ATM". The features of the mortgage contracts may also expose households to specific risks which are likely to indirectly impact banks and possibly financial stability: the use of FX mortgage loans increases the exchange rate risks borne by borrowers (IMF, 2011), while the length of mortgage contracts exacerbates the refinancing risk. The use of floating mortgage rates results in an increase of short-term interest rates' influence on house prices. From a lender's perspective, the accounting practices governing mortgage contracts may directly influence his/her appetite for exposure to real estate: while historical methods may exercise a countercyclical influence, methods based on current valuations may amplify the link between property prices and credit growth, resulting in mutually reinforcing imbalances.

3.2 Empirical assessment of the links between structural market features and financial stability risks

This section presents a graphical and econometric analysis on the interplay between structural real estate/mortgage market features and financial stability risks. The analysis builds on recent findings on early warning indicators for real estate-related banking crises presented in ESRB Occasional Paper No. 8[53].

3.2.1 Assessing the predictive power of early warning indicators

The Occasional Paper applies a signalling approach in both a non-parametric and a parametric setting to evaluate the predictive power of potential early warning indicators. This evaluation is performed on the basis of the trade-off between correctly predicting upcoming crisis events and issuing false alarms. The paper relies on data on real estate-related banking crises presented in Section 2. The dependent variable considered in the analysis, following the early warning literature, is a dummy indicator equal to 1 in periods that precede the onset of real estate-related banking crises by 5 to 12 quarters. The variable therefore identifies the time horizon preceding banking crises related to real estate, relevant to a policy-maker for the (potential) timely activation of macroprudential instruments.

53 Ferrari, S., Pirovano, M. and Cornacchia, W. (2015), "Identifying Early Warning Indicators for Real Estate-related Banking Crises", *Occasional Paper Series*, No. 8, ESRB.

Potential early warning indicators pertaining to the structural and cyclical dimensions of credit and house price developments, the macroeconomy, the construction sector and financial markets are considered, relying on quarterly data spanning from 1970 (where available) until 2013.

The paper finds a superior signalling performance for a multivariate logit model featuring real total credit growth, the bank credit-to-GDP ratio, the price-to-rent ratio, the nominal three-month money market rate and inflation as explanatory variables. This model presents the best signalling performance in terms of AUROC (area under the receiver operating curve) and, in the following sections, is used as a starting point to gauge the importance of structural characteristics of European real estate markets/mortgage loans either in the emergence of vulnerabilities leading to banking crises or in influencing the depth of banking crises.

3.2.2 Data on structural market indicators

Structural cross-country differences arise not only on a cross-sectional basis but also over time (e.g. the share of floating rate mortgages can differ across countries and significantly over time). However, limited data availability on the variables of interest is a serious impediment to analysis. Unfortunately, time-series information on structural real estate and mortgage market features is rather scarce. Section 1 identified several indicators related to important characteristics of European RRE markets as well as indicators related to lending standards. However, this information is largely unavailable at a quarterly frequency and does not cover a sufficient number of time periods.

Two alternative approaches have therefore been followed to exploit the available information on the structural characteristics of real estate markets.

Under the first approach, time series on two structural variables, namely bank leverage[54] and the debt service ratio, are used to analyse the role of structural features. More specifically, to facilitate the interpretation of the graphs but also of marginal effects and interaction terms in the econometric analysis, dummy variables representing the quartiles of the indicators' cross-country distribution are computed. Given structural differences in the levels of bank leverage across countries, the quartiles for this indicator are computed based on a series obtained by subtracting the country-specific mean from the original indicator and constructing quartiles based on deviations from the country-specific mean.[55] In the econometric analysis these dummies, as well as their interaction with real total credit growth, are then added to the baseline logit model.

Table 13 presents descriptive statistics on the explanatory variables featured in the reference logit model, as well as the two structural real estate indicators.

54 Bank leverage is defined as total assets divided by capital and reserves, and it is sourced from the ECB's SDW.

55 For the debt service ratio, the quartiles have not been constructed based on the deviation from the country-specific mean since, compared with leverage, the cross-country differences are less dependent on underlying structural factors.

Table 13
Descriptive statistics on panel data

Variable		Mean	Std. dev.	Minimum	Maximum	Observation	
Real total credit growth	overall	6.021	8.997	-29.045	84.756	Total	3104
	between		4.631	2.440	25.457	Countries	25
	within		8.275	-35.599	65.320	T	124.16
Bank credit to GDP	overall	75.550	37.288	5.767	271.097	Total	2983
	between		31.182	30.824	179.684	Countries	25
	within		26.227	7.735	174.757	T	119.32
Price to rent (dev. from mean)	overall	0.000	21.436	-67.555	85.214	Total	2228
	between		0.000	0.000	0.000	Countries	21
	within		21.436	-67.555	85.214	T	106.095
Three-month money market rate	overall	7.246	5.384	0.000	36.740	Total	2901
	between		2.553	3.604	13.842	Countries	24
	within		4.928	-4.220	32.324	T	120.875
Inflation	overall	6.781	12.447	-6.005	303.279	Total	3497
	between		4.787	2.883	24.632	Countries	25
	within		11.735	-18.054	285.428	T	139.88
Debt service ratio	overall	0.187	0.160	0.010	1.078	Total	2844
	between		0.132	0.060	0.742	Countries	25
	within		0.059	-0.027	0.524	T	113.76
Bank leverage	overall	15.186	5.763	5.000	50.000	Total	1229
	between		4.984	7.486	25.190	Countries	25
	within		2.999	5.836	39.995	T	49.16

Under the second approach, pre-crisis observations for a range of real estate and mortgage market structural characteristics presented in Section 1 are used to construct a set of dummy variables. In particular, for the graphical analysis four variables have been constructed for each structural indicator, based on the quartiles of its cross-country distribution. In Table 14 for each country a value of 1, 2, 3 or 4 indicates that the structural indicator belongs to the first, second, third or fourth quartile of its cross-country distribution.

Table 14
Graphical analysis: quartile indicators related to pre-crisis (2007-08) structural characteristics

Country	Average LTV ratios for residential mortgages LTV	Gross debt-to-income (%) Debtinc	Contribution of housing taxes to the marginal cost of owner-occupied housing Taxmarg	Highest VAT rates applicable to new construction conVAT	Share of variable rate mortgage loans in new lending (%) varmort	Typical maturity of mortgage loans (years) matur
AT	1	2	2	3	2	3
BE	1	2	4	4	1	1
CY	3	3	3	1	2	2
CZ	4	1	1	2	1	2
DE	2	3	2	2	1	3
DK	3	4	3	4	2	3
EE	2	2	1	1	3	4
ES	1	4	3	1	4	3
FI	4	3	1	4	4	2

Table 14

Graphical analysis: quartile indicators related to pre-crisis (2007-08) structural characteristics

Country	Average LTV ratios for residential mortgages LTV	Gross debt-to-income (%) Debtinc	Contribution of housing taxes to the marginal cost of owner-occupied housing Taxmarg	Highest VAT rates applicable to new construction conVAT	Share of variable rate mortgage loans in new lending (%) varmort	Typical maturity of mortgage loans (years) matur
FR	3	2	4	3	1	1
GR	2	2	4	2	1	1
HU	2	1	3	3	4	1
IE	1	4	2	1	3	3
IT	1	1	4	1	2	2
LT	3	1	1	1	2	2
LU	4	3	2	1	4	1
LV	4	2	2	1	3	2
MT	1	3	1	1	3	4
NL	4	4	1	2	1	3
PL	3	1	4	4	4	2
PT	2	3	3	4	4	4
SE	1	4	3	1	4	4
SI	1	1	1	3	3	1
SK	3	1	2	2	3	1
UK	3	4	4	1	1	2

Note: The same caution on data as in the cluster analysis of Section 1 applies here.

For each structural indicator, dummy variables indicate whether a country exhibits low or high values, based on whether the indicator falls above or below a selected percentile of its cross-country distribution. In Table 15 the dummy indicators equal 1 when the value of the respective indicator stands above the 66th percentile of the cross-country distribution (or below the 33rd percentile for indicators for which lower values imply potentially less conservative practices[56]). As we want to check early warning indicators, we take the indicators of Section 1 referring to the pre-crisis period (more precisely, to the years 2007 and 2008). As these data are likely not to apply to the 1990s pre-crisis period, we restrict the sample to consider only the most recent crisis period.

56 While a value of 1 of the dummies "LTV", "debtinc", "varmort" and "matur" implies that a country exhibits values for the indicator above the 66th percentile, a value of 1 of the dummy variables "taxmarg" and "convat" imply that the indicator value lies below the 33rd percentile of the cross-country distribution.

Table 15

Econometric analysis: dummy indicators related to pre-crisis (2007-08) structural characteristics

Country	Average LTV ratios for residential mortgages Cluster	Gross debt-to-income (%) debtinc	Contribution of housing taxes to the marginal cost of owner-occupied housing Taxmarg	Highest VAT rates applicable to new construction conVAT	Share of variable rate mortgage loans in new lending (%) varmort	Typical maturity of mortgage loans (years) matur
AT	0	0	0	0	0	1
BE	0	0	0	0	0	0
CY	1	1	0	1	0	0
CZ	1	0	1	0	0	0
DE	0	0	0	0	0	1
DK	0	1	0	0	0	1
EE	0	0	1	0	0	1
ES	0	1	0	1	1	0
FI	1	0	1	0	1	0
FR	0	0	0	0	0	0
GR	0	0	0	0	0	0
HU	0	0	0	0	1	0
IE	0	1	0	1	1	1
IT	0	0	0	1	0	0
LT	1	0	1	0	0	0
LU	1	1	0	1	1	0
LV	1	0	0	0	0	0
MT	0	0	1	0	1	1
NL	1	1	1	0	0	1
PL	1	0	0	0	1	0
PT	0	1	0	0	1	1
SE	0	1	0	0	0	1
SI	0	0	1	0	0	0
SK	1	0	1	0	0	0
UK	0	1	0	1	0	0

Note: The same caution on data as in the cluster analysis of Section 1 applies here.

In the econometric analysis for both approaches, the left-hand-side variable, namely the dummy indicator identifying the relevant pre-crisis horizon, counts 120 pre-crisis observations for the 25 countries considered.

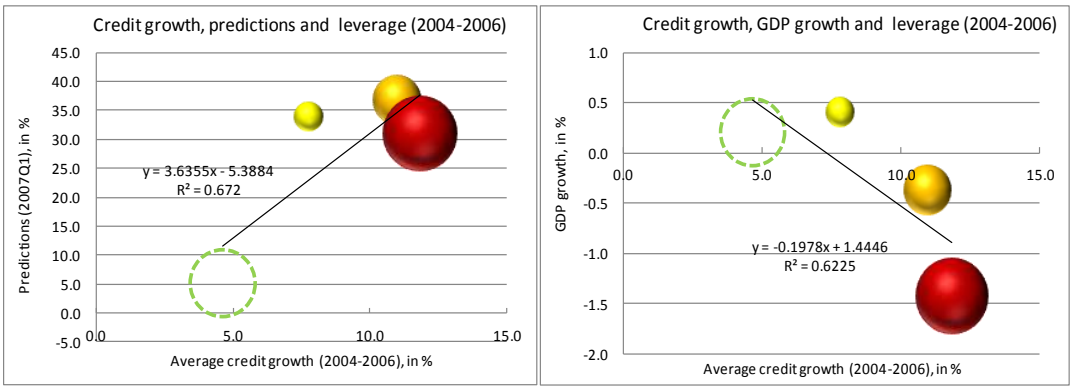
3.2.3 Graphical analysis

Bubble charts are used to gauge the importance of structural market features in the emergence and depth of crises. Bubble charts are a variation of scatter charts in which the data points are replaced with bubbles and an additional dimension of the data is represented in the size of the bubbles. In the following charts, values on the x-axis represent the average real total credit growth over the pre-crisis period (2004-06), while values on the y-axis represent alternatively the predictions of the "reference" logit model or the real GDP growth during the 2008 crisis (Table 12 in Section 2). Finally,

green, yellow, orange and red bubbles represent respectively the group of countries whose value of the structural variable considered lies in the first, second, third and fourth quartile of their cross-country distribution (see Table 14 for individual country data).

The higher the average credit growth in the pre-crisis period, the higher the probability of a real estate-related banking crisis (Chart 48). This positive relationship is amplified by the level of the bank leverage ratio[57] in the pre-crisis period: countries with the highest values for the bank leverage ratio (red bubble) are in the upper-right corner of the chart, whereas countries with a bank leverage ratio below its mean (green dashed bubble) are in the lower-left corner. Similarly, the higher is average credit growth in the 2004-06 period, the higher the GDP contraction during the 2008 crisis. This is all the more true, the higher the bank leverage ratio in the pre-crisis period.

Chart 48
The effect of the bank leverage ratio (2004-06) on the probability of upcoming real estate distress and on the depth of the crisis

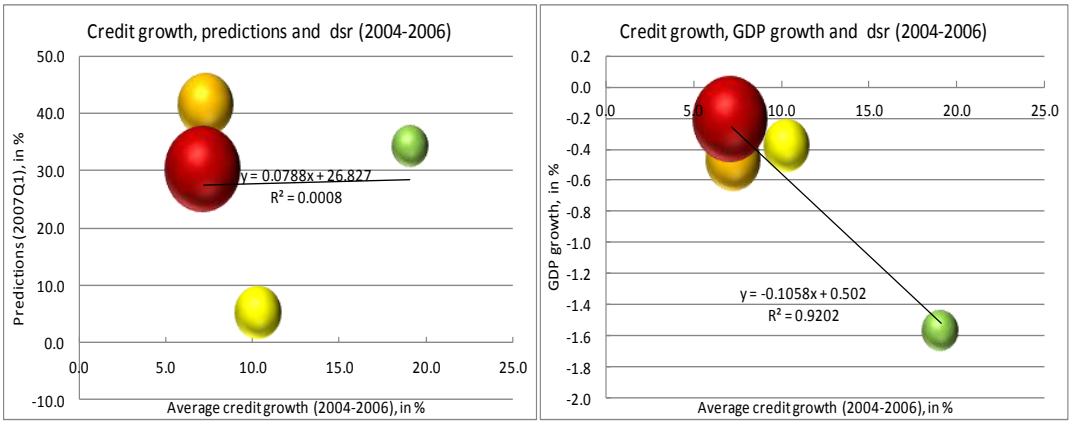


Households' debt service ratio levels in the pre-crisis period do not seem to influence the probability of upcoming real estate-related banking crises (Chart 49). Although Member States with a high level of their debt service ratio (red bubble) experienced lower average credit growth in the pre-crisis period than countries with a very low debt service ratio (green bubble), the prediction of upcoming real estate distress is almost the same for the two groups of countries. Similarly, regarding the depth of the crisis, the debt service ratio level does not seem to explain the relevant GDP contraction - on the contrary, countries with a high debt service ratio experienced a mild contraction compared with countries with a low debt service ratio.

57 As indicated in Section 2.2, the quartiles of the bank leverage ratio are calculated in terms of their deviation from the country-specific mean.

Chart 49

The effect of households' debt service ratio (2004-06) on the probability of upcoming real estate distress and on the depth of the crisis



High LTV levels seem to amplify the vulnerability to real estate-related banking crises and the GDP contraction that follows (Chart 50[58]). Debt-to-income levels and loan maturity, by contrast, do not seem to have any relevant effect either on the prediction of a real estate-related crisis or on the depth of the crisis (Chart 51 and Chart 54).

Housing taxation appears to be an important policy tool to mitigate the vulnerability to real estate-related banking crises and the GDP contraction that follows (Chart 52). Indeed, the higher the contribution of housing taxes to the marginal cost of owner-occupied housing and the VAT rates applicable to new construction, the lower the average credit growth in the pre-crisis period and consequently also the prediction of real estate distress and the GDP contraction during the crisis.

The share of variable rate mortgage loans in new lending seems to have an amplifying effect on the vulnerability to real estate-related banking crises and the GDP contraction that follows. This is the case as long as the share is within a medium level, i.e. the third quartile (Chart 53). At high levels of the share of variable rate mortgage loans in new lending, the vulnerability to real estate-related banking crises and consequently also the GDP contraction seem instead to be mitigated, as explained in Section 3.1.

58 Chart 50 to Chart 50 are based on the quartiles of structural variables in the pre-crisis period presented in Table 14.

Chart 50

The effect of the LTV ratio on the probability of upcoming real estate distress and on the depth of the crisis

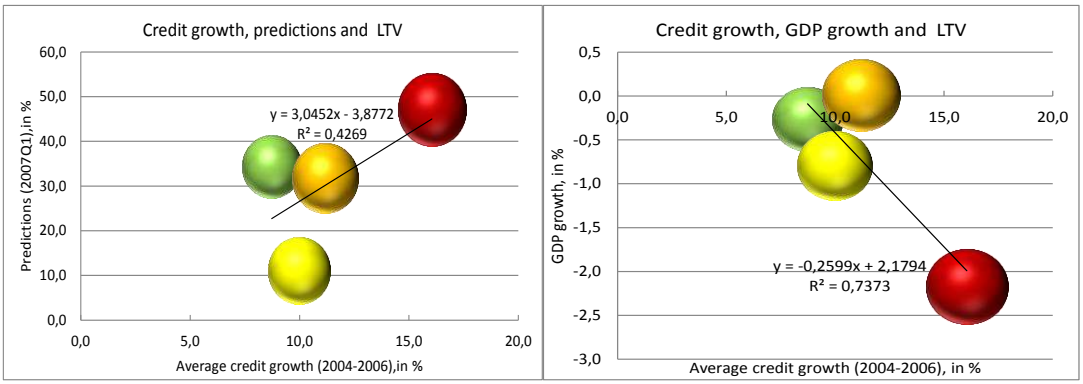


Chart 51

The effect of households' DTI ratio on the probability of upcoming real estate distress and on the depth of the crisis

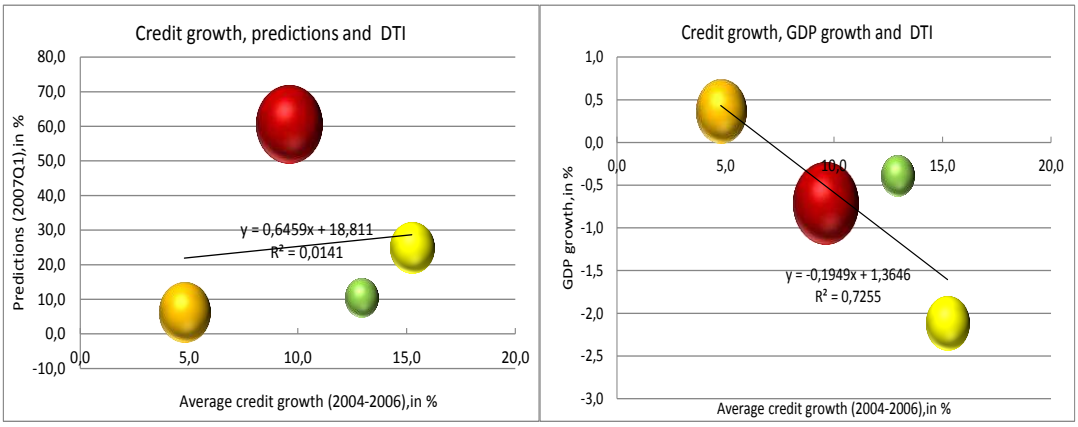


Chart 52

The effect of housing taxes on the probability of upcoming real estate distress and on the depth of the crisis

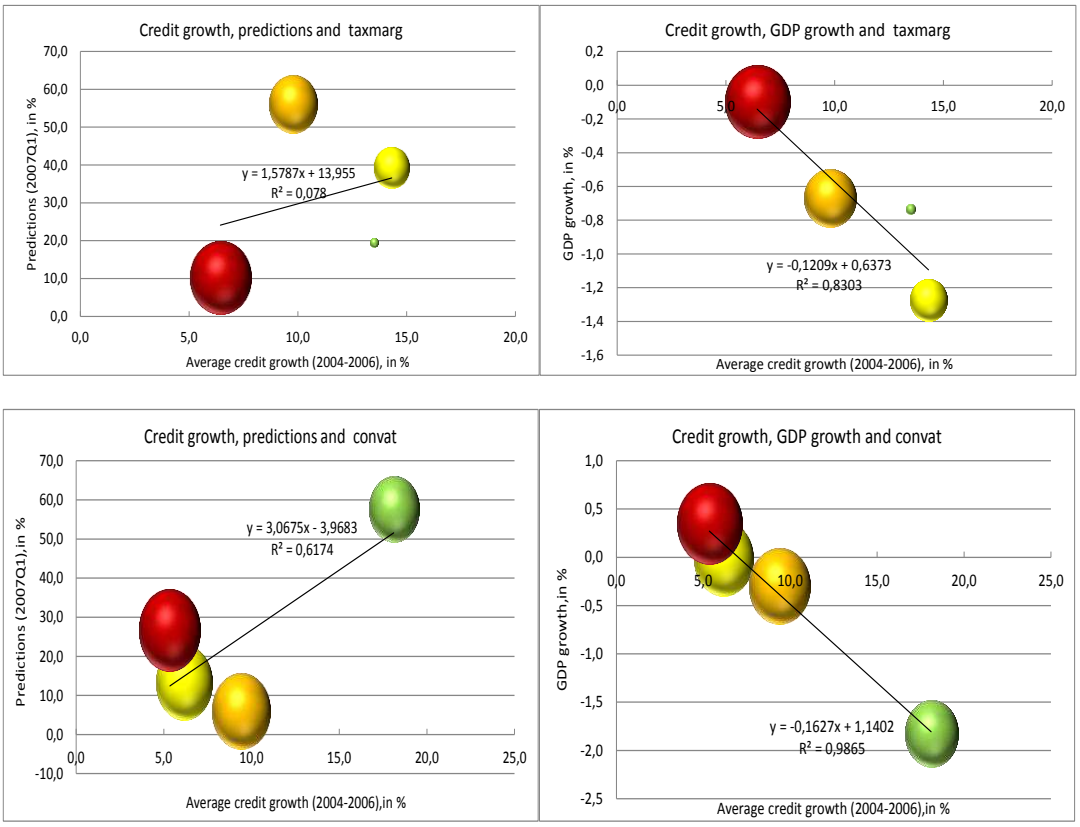


Chart 53

The effect of the share of variable rate mortgage loans in new lending on the probability of upcoming real estate distress and on the depth of the crisis

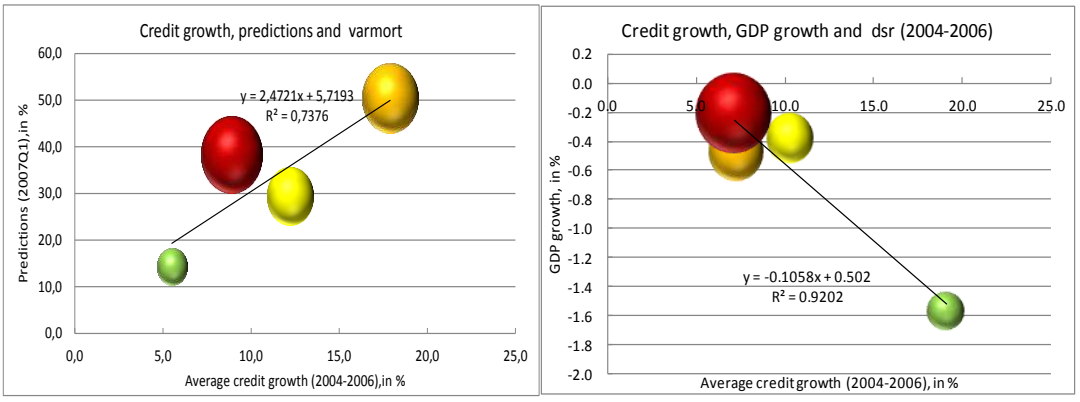


Chart 54

The effect of households' debt service ratio (2004-06) on the probability of upcoming real estate distress and on the depth of the crisis

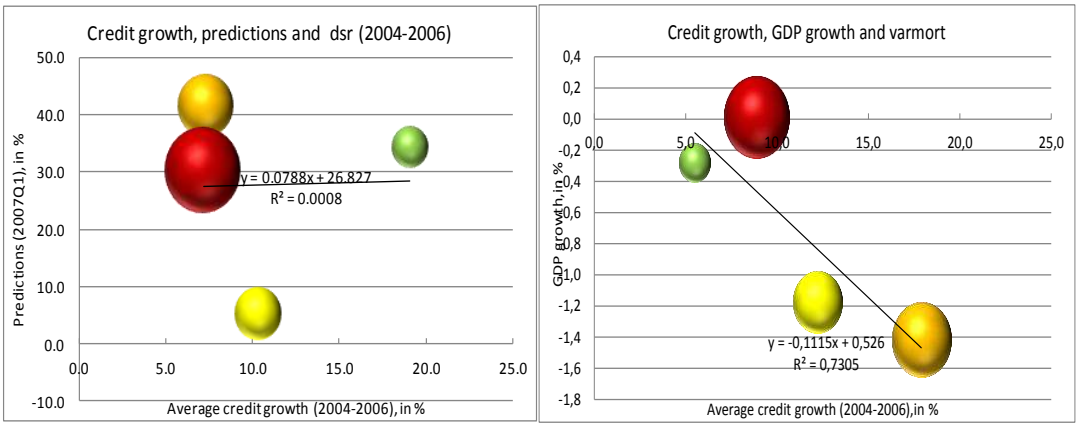
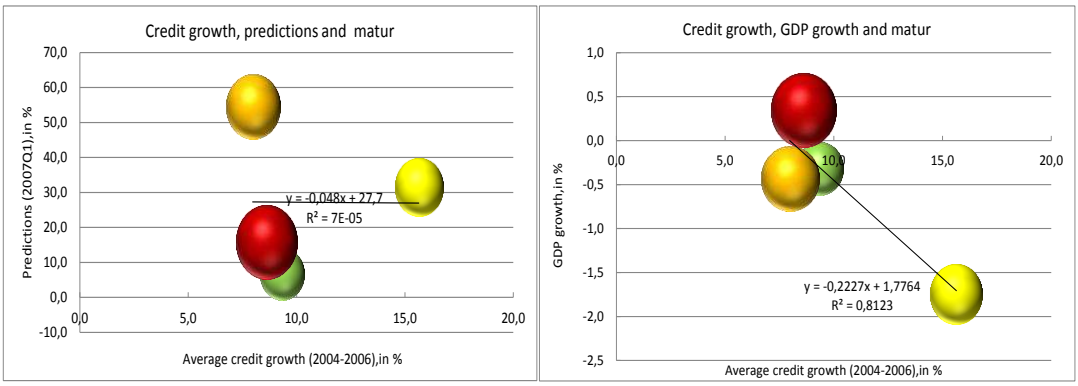


Chart 55

The effect of maturity on the probability of upcoming real estate distress and on the depth of the crisis



3.2.4 Econometric analysis: methodology and preliminary results

This section aims at providing an econometric underpinning to the insights resulting from the graphical analysis in the previous section. More specifically, it aims at answering two questions. First, do some structural features of real estate markets increase countries' vulnerability in the run-up to real estate-related banking crises? Second, do such structural features reinforce/dampen cyclical developments in the build-up phase?

To this end, the reference logit model of ESRB Occasional Paper No. 8 is used as a starting point. It is then augmented with one structural indicator and its interaction with the most cyclical indicator related to real estate in the model, i.e. real total credit growth. The sign and statistical significance of structural and cyclical real estate market characteristics' marginal effects are then used to answer the two questions at hand. More specifically, the average marginal effect of real

total credit growth and of the structural indicator allows us to gauge their marginal contribution in explaining the probability of forthcoming distress events related to the real estate sector.

The marginal effect of real total credit growth provides information on the extent to which structural market features reinforce cyclical developments in the run-up to a real estate-related crisis. A positive and statistically significant marginal effect of real total credit growth at high levels of a structural indicator implies that such a structural feature reinforces the effect of the cyclical dynamics. Box 3 briefly illustrates the econometric model as well as details of the calculation and an interpretation of marginal effects and interaction terms in non-linear models.

Box 3

Econometric estimation methodology

The starting point of the analysis is the reference logit model resulting from ESRB Occasional Paper No. 8 on identifying early warning indicators for real estate-related crises. Specifically, the paper considers the following discrete choice (logit) model:

$$\Pr(y_{it} = 1|\alpha_i, X_{K,it}) = F(\alpha_i + X'_{K,it}\beta_K)$$

where y_{it} represents our response variable (taking the value 1 for observations 5 to 12 quarters before real estate-related banking crises and 0 otherwise), the matrix $X_{K,it} = (x_{1,it}, \dots, x_{k,it})$ collects the potential explanatory variables (including a constant term) and the vector $\beta_K = (\beta_1, \dots, \beta_k)$ their corresponding regression coefficients. $F(\cdot)$ represents a logistic function of the form $F(z) = (1 + e^{-z})^{-1}$, which maps the indicators to the predicted crisis probability.[59] The best model, i.e. the one associated with the largest AUROC, features real total credit growth, the nominal bank credit-to-GDP ratio, the (residential) real estate price-to-rent[60] ratio, the three-month money market rate and inflation as explanatory variables. This model presents an AUROC of 0.95, a very low probability of missing crises (Type I error=2%) and a 20% chance of false alarms (Type II error).

To better understand how to interpret interaction terms and marginal effects in non-linear regression models, consider the following non-linear model, characterised by a dichotomous dependent variable y and two independent variables (x_1 and x_2) as well as their interaction. While x_1 is continuous, x_2 is a dummy variable.

$$E(y|x_1, x_2) = F(\alpha_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 (x_1 \cdot x_2)) = F(z)$$

where, in the case of the logit model, $F(z)$ represents the logistic cumulative distribution. Marginal effects represent the marginal contribution of each independent variable to the conditional expected value of y. While in a linear model marginal effects are straightforward and given by the regression coefficients β_i, in a non-linear framework the marginal effects of the two explanatory variables are given by the total derivative of $E(y|x_1, x_2)$ with respect to the relevant x:

59 The logit models are estimated as population averaged regressions, so that $\alpha_i = \alpha$. Since this model assumes independence over *i* and *t*, robust standard errors are used to take into account possible mis-specifications.

60 Expressed in deviations from its mean.

$$\frac{\partial E(y|x_1,x_2)}{\partial x_1} = \frac{\partial F(z)}{\partial x_1} \cdot \frac{dz}{dx_1} = \frac{\partial F(z)}{\partial x_1} \cdot (\beta_1 + \beta_3 x_2)$$

$$\frac{\partial E(y|x_1,x_2)}{\partial x_2} = \frac{\partial F(z)}{\partial x_2} \cdot \frac{dz}{dx_2} = \frac{\partial F(z)}{\partial x_2} \cdot (\beta_2 + \beta_3 x_1)$$

This entails important implications. First, the marginal effect of x_j is not constant, but it can vary with the specific values of x_j, even in the absence of interaction terms (cf. Figure 1). Second, even in the absence of interaction terms ($\beta_3 = 0$), the addition of a dummy variable shifts the curve: the marginal effect of x_1 is influenced by x_2, through $\frac{\partial F(z)}{\partial x_1}$. Figure 1 represents such a case, assuming $\beta_2 > 0$. In this case for a given value of x_1, the marginal effect of x_1 is higher when $x_2 = 1$; when $x_2 = 1$ and $\beta_2 > 0$, $F(z)$ shifts to the left. Finally, the interaction term affects the steepness of the curve. Figure 2 shows a case in which the marginal effect of x_1 is different for different values of x_1 and for different values of x_2.

Chart 56
Logit model with a continuous explanatory variable and augmented with dummy

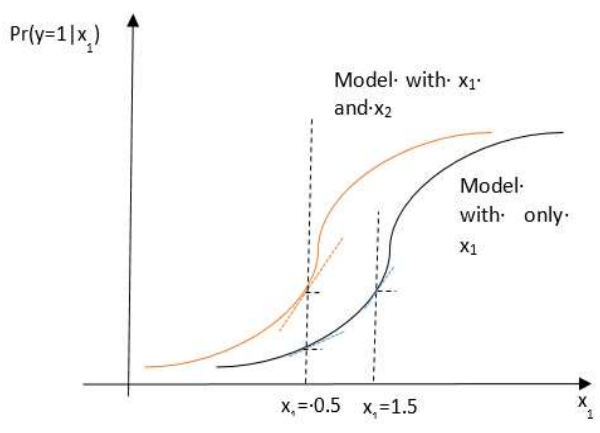


Chart 57
Logit model with a continuous explanatory variable, dummy variable and their interaction

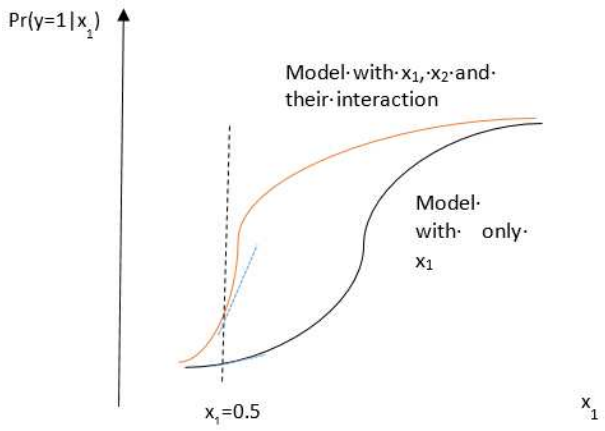


Table 16 presents the results of the estimation of the reference logit model augmented, in turn, with one structural variable related to the real estate sector as well as its interaction with real total credit growth.[61]

Table 16
Results of logit models with structural indicators

	Best OP logit	Best OP + DSR	Best OP + bank leverage	Best OP logit (reduced)	Best OP + DSR (reduced)	Best OP + bank leverage (reduced)
Real total credit growth	0.166***	0.239***	0.070*	0.146*	0.668***	0.061
Bank credit to GDP	0.049***	0.050***	0.053***	0.044***	0.060**	0.054***
RRE price to rent	0.037**	0.053**	0.057	0.056*	0.086*	0.057*
Money market rate	0.426***	0.566***	0.950*	0.664	1.233*	1.041*
Inflation	-0.302**	-0.379**	-0.704*	-0.307	-0.592	-0.709**
DSR Q4		2.891*			15.876**	
DSR Q4*Real total credit growth		-0.177*			-0.668**	
Bank leverage Q4			-0.996			-1.182
Bank leverage Q4*Real total credit growth			0.194**			0.207**
Constant	-10.224***	-12.790***	-11.968***	-10.726***	-29.372**	-12.296***
Number of observations	1573	1473	617	607	607	607
TPR	0.981	0.896	0.839	0.875	0.833	0.839
FPR	0.203	0.143	0.070	0.163	0.158	0.078
Relative usefulness (θ=0.5)	0.778	0.753	0.770	0.712	0.675	0.761
AUROC	0.947	0.953	0.955	0.912	0.896	0.953

*Significance code: * p<0.05; ** p<0.01; *** p<0.001*

Since the number of observations available for the structural indicators is smaller than that of the explanatory variables present in the baseline model, the estimation is run on two samples. The first three columns of Table 16 report the results of the estimation performed on the whole sample for which observations are available. The last three columns report the results of the estimation performed on a reduced sample, where the same observations are used for every logit model, thereby eliminating potential differences in results given by the different samples considered.

Table 16 presents, in addition to the estimated regression coefficients, a battery of evaluation criteria for assessing the ability of the model to identify pre-crisis vulnerable periods. It is interesting to notice that, over the entire sample, adding structural real estate-related variables only slightly improves the predictive ability of the model. Indeed, both models including the debt service ratio and bank leverage exhibit a slight increase in AUROC compared with the baseline model: in both cases a lower true positive rate (TPR) can be observed, accompanied by a lower false positive rate (FPR).

Focusing more specifically on the contribution of structural characteristics to explaining the probability of entering into a vulnerable pre-crisis period, more insights can be drawn by examining average

61 The specific feature of the Swedish real estate crisis (see Section 2.3.1) should not affect the results. As pointed out in ESRB Occasional Paper No. 8, the best-performing logit model identified in the paper is robust to changes in the composition of the sample: the out-of-sample exercise along the cross-country dimension (i.e. excluding from the sample the three countries that experienced two crisis periods – Denmark, Sweden and the UK) confirms the out-of-sample performance of the best logit model and the validity of the results also for countries not included in the estimation sample.

marginal effects.[62] Table 17 shows the (average) marginal effect of the structural and the cyclical variable of interest (i.e. real total credit growth), as well as the (average) marginal effect of the cyclical credit variable for different levels (i.e. 0 or 1) of the structural real estate variable considered.

Table 17
Average marginal effects from logit models with structural indicators (p-values shown between brackets)

	Best OP logit	Best OP + DSR	Best OP + bank leverage	Best OP logit (reduced)	Best OP + DSR (reduced)	Best OP + bank leverage (reduced)
Average marginal effect						
Real total credit growth	0.0075	0.0050	0.0056	0.0072	0.0016	0.0055
	(0.000)	(0.003)	(0.000)	(0.097)	(0.270)	(0.000)
DSR Q4		0.0395			0.0617	
		(0.108)			(0.004)	
Bank leverage Q4			0.0567			0.0550
			(0.0009)			(0.011)
Average marginal effect of real total credit growth at:						
DSR Q4=0		0.0062			0.0046	
		(0.001)			(0.011)	
DSR Q4=1		0.0033			0.000	
		(0.101)			(0.988)	
Bank leverage Q4=0			0.0024			0.0020
			(0.061)			(0.134)
Bank leverage Q4=1			0.0131			0.0127
			(0.000)			(0.000)

High bank leverage is associated with a higher probability of a real estate-related banking crisis occurring. The bank leverage ratio has a statistically significant marginal effect on the probability of upcoming real estate-related distress periods, in line with the graphical analysis. This is true for both samples on the basis of which the model is estimated. In both cases, countries exhibiting bank leverage falling in the fourth quartile of the cross-country distribution have approximately a 5.5% higher chance of experiencing a real estate-related banking crisis. Furthermore, a high bank leverage ratio increases the marginal effect of real total credit growth.

Evidence on the marginal effect of high levels of the debt service ratio is mixed. In fact, comparing columns 2 and 5 of Table 17, no clear-cut conclusions can be drawn, as also reported in Chart 57.

The predictive power of models including the structural indicator dummies is at least as good as that of the logit model. Table 18 presents the results of the logit analysis performed using the set of dummies representing the structural features of countries' real estate markets. The evaluation statistics reported at the bottom of the table reveal that the predictive ability of models including structural indicator dummies is at least as good as that of the reference logit model: in all cases, the AUROC is at least as high as 0.947. Furthermore, the models' performance in terms of true and false positive rates is very similar.

The analysis of the marginal effects confirms the insights of the earlier graphical analysis. Table 19 presents the estimated marginal effects of real total credit growth and the structural indicators, as well as the different marginal effect of real total credit growth for different levels of the

62 Even though the predictive ability of the model does not significantly improve when adding structural variables (probably because the reference logit model is the best in terms of AUROC), the latter can still have a significant direct and/or indirect effect on the probability of entering into a vulnerable pre-crisis period.

structural indicators considered. The results reveal that the LTV ratio, the contribution of housing taxes to the marginal cost of owner-occupied housing and the share of new lending granted at a variable rate have a statistically significant marginal effect on the probability of forthcoming real estate-related banking crises.

More specifically, high LTV levels are associated with a 6.4% higher vulnerability to real estate-related distress events (statistically significant at the 10% level). Furthermore, compared with countries with average LTV ratios below the 66th percentile of the cross-country distribution, in high LTV countries the marginal effect of real total credit growth on real estate-related financial stability risks is 0.75% higher.

A smaller contribution of housing taxes to the marginal cost of housing increases the vulnerabilities related to real estate-related distress events.[63] This implies that the tax treatment of housing matters for financial stability: in particular, low taxation of RRE properties leads to a 4.4% increase in the probability of experiencing a real estate-related crisis in the near future. In addition, an advantageous tax treatment of housing reinforces the marginal contribution of real total credit growth. In countries with lower housing taxation, stronger credit growth developments increase the probability of financial instability by almost 1%.

A large share of variable rate mortgage loans in new lending seems to have a negative marginal effect on the probability of upcoming distress related to the real estate sector. This result looks somewhat counter-intuitive, since floating mortgage loan rates are sometimes thought to amplify the link between property prices and interest rates and therefore exacerbate the pro-cyclicality of the real estate market. However, the effect of the share of variable rate loans crucially depends on the evolution of market interest rates. If, during a bust phase, monetary policy tries to offset the economic slowdown by lowering interest rates, variable rate loans might actually dampen the pro-cyclicality of the real estate market (see also Section 3.1).

Table 18
Results of logit models with dummy variables for structural characteristics

	Best OP logit	Best OP + LTV	Best OP + DTI	Best OP + Taxmarg	Best OP + ConVAT	Best OP + Varmort	Best OP + Matur
Real total credit growth	0.166***	0.140**	0.211***	0.169***	0.205***	0.216***	0.204***
Bank credit to GDP	0.049***	0.058***	0.054***	0.059***	0.054***	0.059***	0.054***
RRE price to rent	0.037**	0.044***	0.045***	0.040***	0.053***	0.054***	0.044***
Money market rate	0.426***	0.519***	0.497***	0.496***	0.530***	0.528***	0.490***
Inflation	-0.302**	-0.414***	-0.407***	-0.355**	-0.431***	-0.398***	-0.400***
LTV		0.879					
LTV*Real total credit growth		0.051					
Debt to income			0.665				
Debt to income*Real total credit growth			-0.087				
Tax on housing				1.189			
Tax on housing*Real total credit growth				0.044			
Construction VAT					-0.716		

63 This indicator takes a value of 1 when a country exhibits a contribution of housing taxes to the overall housing cost below the 33rd percentile of the cross-country distribution.

Table 18

Results of logit models with dummy variables for structural characteristics

	Best OP logit	Best OP + LTV	Best OP + DTI	Best OP + Taxmarg	Best OP + ConVAT	Best OP + Varmort	Best OP + Matur
Construction VAT*Real total credit growth					-0.078		
Variable rate mortgage loans						-0.602	
Variable rate mortgage loans*Real total credit growth						-0.112*	
Maturity							0.321
Maturity*Real total credit growth							-0.087
Residential investment							
Residential investment*Real total credit growth							
Constant	-10.224***	-11.619***	-11.294***	-11.999***	-11.151***	-11.853***	-11.135***
Number of observations	1573	1573	1573	1573	1573	1573	1573
TPR	0.981	0.962	0.981	0.952	0.962	0.962	0.962
FPR	0.203	0.196	0.201	0.204	0.156	0.170	0.182
Relative usefulness (θ=0.5)	0.778	0.765	0.780	0.748	0.806	0.792	0.779
AUROC	0.947	0.947	0.947	0.948	0.949	0.953	0.948

*Significance code: * p<0.05; ** p<0.01; *** p<0.001*

Table 19

Average marginal effects (p-values shown between brackets)

	Best OP logit	Best OP + LTV	Best OP + DTI	Best OP + Taxmarg	Best OP + ConVAT	Best OP + Varmort	Best OP + Matur
Average marginal effect							
Real total credit growth	0.0075 (0.000)	0.0061 (0.001)	0.0064 (0.001)	0.0070 (0.000)	0.0077 (0.000)	0.0074 (0.000)	0.0066 (0.000)
LTV		0.0640 (0.069)					
Debt to income			-0.0100 (0.825)				
Tax on housing				0.0808 (0.014)			
Construction VAT					-0.0522 (0.127)		
Variable rate mortgage loans						-0.0548 (0.059)	
Maturity							-0.0226 (0.586)
Residential investment							
Average marginal effect of real total credit growth at:							
LTV = 0		0.0045 (0.026)					
LTV = 1		0.0120 (0.000)					
DTI = 0			0.0086 (0.007)				
DTI = 1			0.0049 (0.043)				
Taxmarg = 0				0.0054 (0.004)			
Taxmarg = 1				0.148 (0.000)			
ConVAT = 0					0.0097 (0.000)		
ConVAT = 1					0.0029 (0.136)		
Varmort = 0						0.0097 (0.000)	

Table 19
Average marginal effects (p-values shown between brackets)

	Best OP logit	Best OP + LTV	Best OP + DTI	Best OP + Taxmarg	Best OP + ConVAT	Best OP + Varmort	Best OP + Matur
Varmort = 1						0.0021	
						(0.135)	
Matur = 0							0.0088
							(0.002)
Matur= 1							0.0041
							(0.102)

3.3 Conclusions and possible way forward

The analysis presents preliminary evidence that structural features of real estate markets are relevant for financial stability. Initial results highlight the role of features such as high LTV ratios, a favourable tax treatment of housing, and high levels of bank leverage as positively affecting the vulnerability of countries to real estate-related distress events. High shares of new lending granted at a variable rate, instead, decrease the probability of upcoming distress events.

However, the role of structural market features in shaping the real estate cycle is not easy to assess, for three reasons: first, because they can have either a direct or indirect effect on other structural and cyclical variables; while direct effects are easier to measure, indirect ones are more difficult to disentangle; second, because the relevant phase of the cycle where their amplifying/mitigating role appears is not yet clear; and third, because their effect can be direct or indirect, mitigating or amplifying, in different phases of the cycle.

While structural market features may indirectly influence cyclical developments in the build-up phase, they are likely to directly influence the depth of the crisis. Imbalances and structural developments prevailing during the upturn phase are more likely to influence the resilience to a negative shock, rather than influencing the likelihood of that shock occurring. Future research is needed to analyse more closely the depth of real estate-related banking crises, as well as the role of cyclical and structural characteristics in shaping them.

Conducting a rigorous analysis on structural real estate and mortgage market features crucially relies on the availability of comparable data. Currently, time series related to lending standards (e.g. mortgage loan maturities, the share of fixed/variable rate mortgage loans in the outstanding stock, debt-to-income ratios) are largely not available. Closing existing data gaps is therefore essential for the monitoring and the analysis of structural developments.

Section 4
Lessons for tackling risks stemming from the residential real estate sector[64]

4.1 Introduction

The macroprudential toolkit related to real estate markets can be divided into three categories (or "stretches"): income stretch, collateral stretch and banking system stretch.[65] The "income stretch" category comprises LTI, DSTI and DTI limits as well as amortisation requirements. Such instruments are often complemented with sensitivity tests (e.g. interest rate assumptions to calculate debt service costs). The instruments considered in the "collateral stretch" category are LTV limits and amortisation requirements. Amortisation requirements are included in two stretches as they affect the repayment burden (and are thus related to income) and also bring down the LTV ratio over time (and thus affect the collateral stretch). Instruments addressing "banking system stretch" comprise sector-specific capital-based requirements such as increasing risk weights or underlying parameters for real estate-related exposures.[66]

The instruments complement each other as they differ in their effectiveness in curbing the financial cycle and in the way they can act as system buffers in a downturn situation (see Section 4.2). Additionally, a combination of income stretch instruments and collateral stretch instruments may also be a way to mitigate leakage (see Section 4.3).

In the EU, a range of real estate instruments have been implemented in the past 2-3 years (Table 20).[67] As real estate market cycles and credit cycles differ at the country level, it is too much of a generalisation to say that most countries implemented these instruments in response to the crisis. Indeed, some of these countries did not experience a crisis in 2007-08.

Some of the regulations have been designed or calibrated specially to cope with risk stemming from foreign currency lending (e.g. in HU, PL, RO) or interest rate risk (e.g. in UK, NO). Also, other measures not dealt with in this report have been implemented in a number of countries, such as bans on unhedged foreign currency (FX) lending (e.g. AT, HU, PL) or funding requirements (e.g. HU).

64 Prepared by a team coordinated by Katrine Graabæk Mogensen (Danmarks Nationalbank) and comprising Christian Castro (Banco de España), Jelena Cirjakovic (Banka Slovenije), Dragan Crnogorac (European Banking Authority), Krzysztof Gajewski (Narodowy Bank Polski), Christian Glebe (Deutsche Bundesbank), Sten Hansen (Finansinspektionen), Steffen Lind (Finanstilsynet), Rhiannon Sowerbutts (Bank of England), Katharina Steiner (Oesterreichische Nationalbank) and Luminita Tatarici (Banca Naţională a României).

65 An in-depth description of most of these instruments, including their transmission channels as well as legal and institutional considerations stemming from CRD IV/CRR, can be found in ESRB (2014).

66 In the EU, the legal basis for such requirements is formed by Articles 124-164 and Article 458 of the CRR and Pillar 2 requirements. For a detailed description of the legal basis, see ESRB (2014). Instruments related to income and collateral stretch are based on national legislation.

67 The country-specific findings of this report rely, inter alia, on the responses to a survey on the concepts and definitions of macroprudential real estate instruments carried out within the ESRB membership. No distinction is made between whether instruments are introduced as hard measures or as "soft law" (i.e. best practice recommendations) and the table is not necessarily exhaustive on the measures taken, especially before the recent financial crisis. For example, in Norway the authorities set a voluntary DSTI requirement in a mortgage lenders' code of conduct in 2006 before using the macroprudential instruments more actively (Salim and Wu, 2015). Another example is the minimum standards on foreign currency lending implemented by the Austrian authorities in 2013 which affected mortgage loans to a large extent (Financial Market Authority, 2013).

Such instruments are not specific to the real estate sector, but they may have an important bearing on the build-up and materialisation of real estate-related systemic risks.

Table 20

Use of macroprudential instruments related to the real estate market and year of introduction

			Income stretch		Collateral stretch		Banking system stretch
Country	Cluster	No. of instruments	LTI, DTI and DSTI limits	Affordability requirement	Amortisation requirements	LTV limit	Sectoral capital requirements
AT	2	0					
BE	1	1					2013
BG	5	0					
CZ	5	1				2015	
CY	3	2	2013			2003	
DK	2	3		2012	2000[1]	2015	
DE	2	0					
EE	4	3	2015		2015	2015	
ES	4	0					
FI	3	2		2010		2016	
FR	1	0					
HU	5	2	2015*			2010	
HR	-	1					2014
IE	4	4	2015	2012		2015	2007
IT	1	0					
LT	5	3	2011		2011	2011	
LU	3	1					2012
LV	5	1				2007	
MT	4	1				2014	
NL	2	3	2013		2013	2012	
NO	-	2		2011		2010	
PL	3	3	2014[4]		2014	2014	
PT	2	0					
RO	5	2	2004			2004*	
SE	2	2[2]			20152	2010	2007
SI	5	0					
SK	5	3	2015		2015	2014	
UK	3	2	2014	2014			
Total number of countries using instruments:		**20**	10	5	6[3]	16	5

*Notes: Grey rows indicate that the country experienced a real estate crisis in the 1990s or during the global financial crisis starting in 2008 according to the real estate crisis database (Table 11 in section 2.3.1). Clusters refer to the **pre-crisis** country clusters as identified in Section 1.4. No clustering results are available for HR and NO.*

[1] The rule came into force before 2000, but the exact year is unknown.

[2] Proposal has been put on hold.

[3] Excluding Sweden (see note 2).

[4] Latest modification. Initially, limits were introduced in 2011.

** Asterisk denotes regulations that specifically account for FX risk in their design, either at the time of introduction or later on.*

Source: Survey on the design of instruments (excluding sectoral capital requirements) conducted among ESRB membership (2015).

There are differences in the type of macroprudential action taken between the country clusters identified in Section 1 (Table 21). Measures relating to income stretch are most commonly used by countries from cluster 5. These countries do not use any sectoral capital requirements. The most active use of LTV restrictions can be observed among countries from clusters 3 and 5. Countries from clusters 1 and 3 have not implemented amortisation requirements. However, there is no clear link

between each cluster's structural characteristics and the macroprudential actions taken by countries in each cluster. Actions taken will, for example, also depend on the stage of the financial cycle in each country.

Table 21
Percentage of countries in each cluster using a given instrument (July 2015)

Instrument	Income stretch		Collateral stretch	Banking system stretch
Cluster	LTI, DTI and DSTI limits	Amortisation requirements	LTV limit	Sectoral capital requirements
1 (shorter loan maturities, mid-range LTVs, low indebtedness)	20%	0%	0%	20%
2 (longer maturities, moderate LTVs, high indebtedness)	17%	50%	50%	17%
3 (mid-range maturities, higher LTVs, higher indebtedness)	40%	20%	80%	20%
4 (longer maturities, lower LTVs, high indebtedness)	33%	0%	67%	33%
5 (short maturities, quite high LTVs, low household indebtedness)	63%	38%	75%	0%

4.2 Selection of instruments

The operation, or the strength, of transmission channels between the real economy and banks' exposures to real estate can be influenced by the use of macroprudential instruments.[68] Other real estate market-related policies (e.g. tax or structural policies) also impact the transmission channels and can amplify or dampen the effects of the instruments.

A combination of instruments seems to be the most suitable and comprehensive response to vulnerabilities stemming from excessive credit growth and leverage related to residential real estate as the instruments address different risks and channels. Chart 58 illustrates the set of selected instruments around the three stretches that may involve vulnerabilities for the financial system. There is no particular sequencing applicable to the use of the stretches, and the instruments can be used on a stand-alone basis or in combination. Capital-based instruments in the bottom of the triangle may be the most effective in directly enhancing resilience, whereas restrictions related to income and collateral stretches are comparatively more effective in curbing the financial cycle (ECB, 2015b). Income stretch instruments are likely to be the most constraining in the build-up phase, whereas the collateral buffer also contributes to system resilience in a downturn. Capital-based instruments can be applied to both the stock and flow of new loans, whereas measures from the other two stretches can typically be applied only for new loans. A combination of instruments may also be a way to deal with some leakage problems, as leakage from one stretch can be captured by another stretch.

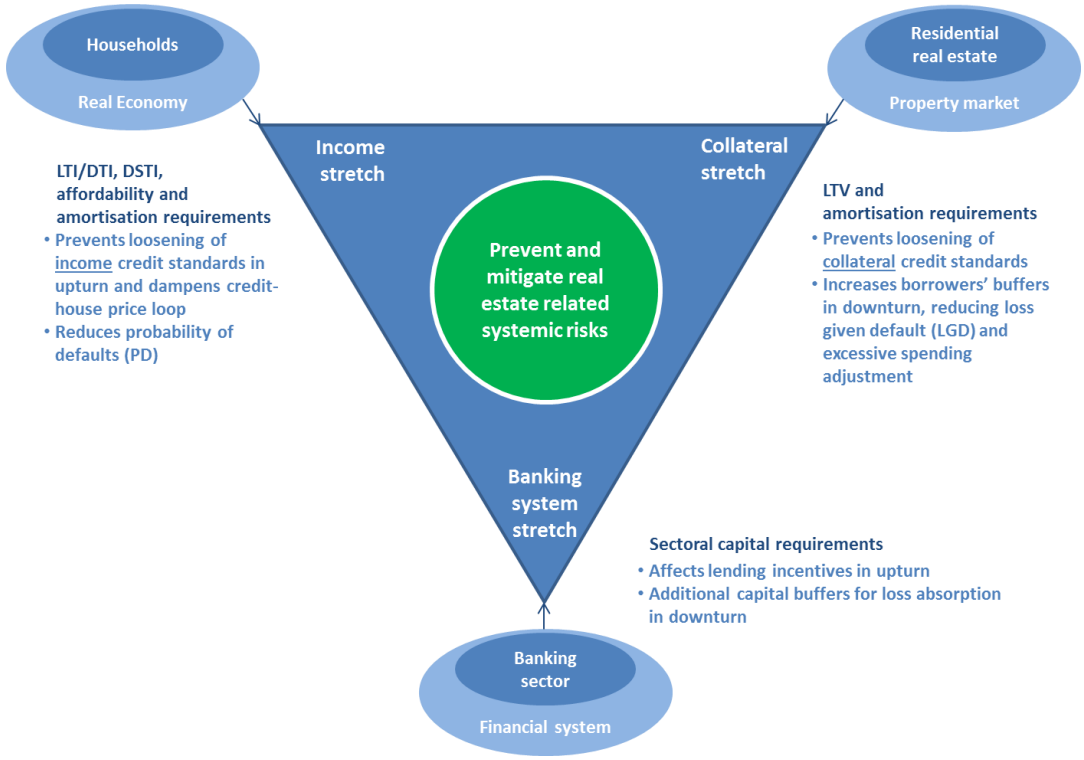
In practice, a combination of instruments, even if not applied simultaneously, is the rule rather than the exception, in particular for collateral and income stretch instruments. Only in four Member States is the use of an LTV limit not combined with a requirement related to borrowers'

68 For a detailed description of the transmission channels, see ESRB (2014).

income stretch (Table 20). Amortisation requirements, being more dependent on the specificities of mortgage lending, are less common and were perceived as a structural intervention.

Effective communication is likely to be a key element when applying several instruments at the same time. This allows the regulator to refer to reasons for the chosen combinations, e.g. different sources of risk or a potential for leakage.

Chart 58
Instruments by stretches related to real estate lending



Source: Expert Group on Real Estate

4.2.1 Income stretch instruments

"Income stretch" instruments can dampen the build-up of systemic risks resulting from excessive credit growth and leverage. Credit growth could be dampened by restricting the loan amount relative to the income of the borrower. LTI, DTI and DSTI ratios are by definition targeted in the sense that they only affect those borrowers or credit standards of institutions that will result in the most stretched conditions, hence shaping the tail of the distribution, in contrast to general restrictions on credit growth. An amortisation requirement will increase the DSTI and thus reduce the affordability of home ownership for borrowers with a limited repayment capacity.

The instruments may also increase the resilience of the financial system to the extent that lower debt service ratios reduce ex ante the PDs of households.[69]

The immediate net effect of income requirements could put downward pressure on house prices. The introduction of an income requirement may reduce the demand for real estate by reducing the ability to borrow of households that depend on credit, and can therefore put downward pressure on house prices. A house price decline increases the LGDs of the existing stock of lending and thus reduces banks' resilience. Therefore, such instruments should preferably be introduced and/or tightened during the build-up phase when real estate prices are increasing.

4.2.2 Collateral stretch instruments

"Collateral stretch" instruments limit the impact of materialising risks by enhancing borrowers' own buffers in case of stress or default. By building up buffers up front (LTV) or over time (amortisation requirements), they work as a cushion before losses reach banks' balance sheets or before consumption is scaled back. These instruments work ex post by mitigating the effects of the materialisation of risks in real estate exposures. They can thus help to address risks rooted in property markets, particularly in relation to property prices and changes in valuation, which may crystallise in different LGDs. Working in the other direction, lower LTVs can result in reduced capital holdings (under both the IRB and standardised approaches) because lower LTV loans have lower RWs and thus lower capital requirements.

An LTV cap may also dampen credit growth by preventing a loosening of credit standards in the build-up phase. An LTV cap will restrict the obtainable loan amount of some borrowers and/or the amount banks may offer for a given level of the borrower's own funds, and thus tends to dampen excessive credit growth and leverage, helping to prevent a loosening of lending standards. However, the dampening effect on the credit cycle may be limited as existing homeowners are less likely to find the cap binding, as house prices are typically increasing in the build-up phase.

A restriction on borrowers' ability to obtain credit will reduce demand for real estate and tends to put downward pressure on real estate prices. The ultimate impact on real estate prices, however, is not clear-cut. Construction and new supply of housing may fall as demand is reduced, potentially dampening the downward pressure from reduced demand. Note also that the subdued demand may relate to dwelling size, and that the price per square metre (the basis of real estate price statistics) can remain unchanged. In addition, while the long-run effect on banks' resilience of an LTV cap, amortisation requirement or maturity requirement is expected to be positive, it can be negative in the short run as a house price reduction will increase the LTVs on existing loans and thus increase LGD. Therefore, such instruments should preferably be introduced and/or tightened during the build-up phase when real estate prices are increasing.

69 For instance, it has been demonstrated in Lithuania that higher debt service ratios can be associated with a higher share of households with overdue mortgage payments (see Bank of Lithuania, 2015).

4.2.3 Banking system stretch instruments

"Banking system stretch" instruments aim to limit the impact of materialising risks by enhancing the loss-absorbing capacity of banks. A common instrument here is a macroprudential sectoral capital-based requirement. Sectoral capital-based tools can be used to target risks in the real estate sector directly.[70] As such, these instruments can help to enhance resilience in the banking sector, in particular in countries where large direct losses related to real estate lending are considered to be a risk. If risks are expected to materialise in a way that results in losses more broadly via the effect on the real economy, that could indicate the need to use general capital requirements such as the countercyclical capital buffer or the systemic risk buffer.

Increased capital requirements on real estate exposures might also have a dampening effect on credit growth by shaping banks' risk-taking incentives. Instruments that require banks to hold more capital in relation to real estate exposures will incentivise them to reduce the supply of credit to home buyers or increase interest rates on real estate loans to cover the costs of the additional capital requirement, which can also lead to a reduction in credit for real estate purposes. However, this effect is thought to be of secondary importance.[71] Higher capital requirements incentivise banks to increase capital and/or reduce lending to the least profitable and perhaps also least resilient real estate buyers – both reactions will lead to greater bank resilience. However, there could also be a crowding-out of other types of lending which offer less promising returns than real estate lending (ESRB, 2014).

4.2.4 Country experiences

The implementation of new macroprudential measures following the crisis and efforts to operationalise the macroprudential framework have been accompanied by more work on the efficiency of instruments. Crowe (2011) finds evidence in favour of the beneficial impact of macroprudential measures (e.g. LTV limits) in addressing housing booms,[72] but the evidence on RWs is not clear-cut. Kuttner and Shim (2013) find that instruments such as RWs and limits on credit growth have little or no detectable effect on the housing market. Other measures, including those in the income and collateral stretch categories (DSTI and LTV), do appear to slow housing credit growth down, with clearer-cut evidence on the effect of the DSTI in econometric studies. Cerutti et al. (2015) argue that addressing a real estate boom requires a mix of policies (macroprudential, monetary, fiscal), but they place macroprudential policy in the first line of defence, given its capacity to take into account the specific features of real estate markets.

The experience with income and collateral stretch instruments shows they had a somewhat dampening impact on credit growth and borrowers' resilience. Initially, Romania used explicit limits (in 2004): a DSTI limit of 30% for consumer loans and 35% for mortgage loans, and an LTV limit of 75% for mortgage loans. Later, Banca Naţională a României moved from explicit DSTI caps to recommendations to credit institutions on how to establish their own maximum values according to

70 Broader capital-based tools such as the countercyclical capital buffer and the systemic risk buffer can also help to contain risks from this sector (particularly when excessive credit growth is explained by a sharp accumulation of real estate exposures). These instruments are outside the scope of this report.

71 See e.g. ESRB (2014) and ECB (2015b).

72 Nevertheless, the results should be interpreted with caution because only a few countries in the analysis have time variation in maximum LTVs (limiting the time dimension) and the estimated elasticities from panel studies capture mostly the divergence in levels across countries in the samples (i.e. the cross-sectional dimension).

their specific credit risk and accounting for stress, such as shocks on interest rates, FX risk and income risk. Neagu et al. (2015) investigate the efficiency of these measures in curbing credit growth and maintaining the quality of the loan portfolio and find that: (i) the impact of regulation on credit growth ranges between 3 and 11 percentage points in the first quarter after implementation, but gradually fades away and nears zero after five quarters after implementation, and (ii) the episodes of easing regulation are associated with an increase in the NPL ratio (for both consumer and housing loans) and with higher sensitivity to macroeconomic developments (such as developments in the unemployment rate).

There is also evidence of the effectiveness of the differentiated and time-varying use of an instrument. For instance, South Korea's experience with macroprudential instruments started in 2002, with the implementation of an explicit LTV limit (60% for speculative areas), differentiated further by loan maturity and value. An explicit DSTI cap was first introduced in 2005 and set at 40% for housing loans granted by banks in speculative zones if the borrower was single or the borrower's spouse had debt. LTV and DSTI instruments were calibrated differently by taking into account several characteristics: (i) LTV limits were related to loan maturity, housing prices and the location of the property, and (ii) DSTI caps were set in accordance with borrower characteristics, housing prices and the location of the property. LTV caps were adjusted several times between 2002 and 2014 and took a value between 40% and 70%, while DTI caps were set between 40% and 75%. Empirical studies[73] show that macroprudential tools contributed to the stabilisation of housing markets and kept the credit expansion under control. Nevertheless, Kim (2013) raises the point that the effectiveness of macroprudential instruments was also supported by real estate lending specificities (e.g. the large share of short-term bullet mortgage loans) and that the measures were prone to leakages.

The experience with banking system stretch instruments (in particular higher RWs) shows a less clear picture as regards their effectiveness in curbing credit growth. This supports the view that they would be comparatively more efficient for making the banking sector more resilient. Bulgaria[74] increased the RWs in 2005 conditioned on the LTV level, with a 50% RW set for mortgages with an LTV ratio below 70% (down from 80% previously) and a 100% RW otherwise. In April 2006 the RW for mortgage loans used in the calculation of the capital adequacy ratio was effectively raised, by lowering the LTV ratio from 70% to 50%. Evidence suggests this was ineffective in stopping the boom in asset prices and limiting the associated post-bust damage to the financial sector (Dell'Ariccia et al., 2011). In March 2006, Estonia increased RWs for housing loans from 50% to 100% to slow down the growth of housing loans. As a response, the banks (the majority of them were foreign-owned) decided to increase capital by attracting subordinated liabilities from parent banks instead and continued their lending (Eesti Pank, 2006, Sutt et al., 2011). This is in line with the general conclusions of Dell'Ariccia et al. (2011).

4.3 The importance of the effective design of macroprudential instruments[75]

The design and explicit definition of a policy measure are crucial for an instrument's effectiveness. Important elements are clear and explicit definitions as regards collateral valuation, the

73 Akinci, O. and Olmstead-Rumseyy, J. (2015), Kim, C. (2014) and Kim, C. (2013).

74 Bulgaria was not among countries that contributed to the survey on the concepts and definitions of macroprudential real estate tools carried out for the purpose of this report.

75 Some parts of this section refer to the survey on concepts and definitions of macroprudential real estate tools carried out for the purpose of this report, which does not cover all EU Member States.

level of aggregation, the degree to which the instrument is binding and possible exemptions. Most notably, leakages and unintended side-effects, such as the reinforcement of a downturn, can be addressed.

When dealing with systemic risk from real estate markets, policy-makers have to decide not only on which instrument to use and when, but also how to design it. Careful design is essential to achieve the goal of reducing systemic risk, while at the same time minimising distortions to the economy. Both the choice of the instruments (see Section 4.2) and their design are affected, among other things, by the structural characteristics of national real estate markets (see Section 1).

Instrument design is a crucial component for the effectiveness of a measure.[76] One of the main aspects of instrument selection and design should be avoiding/limiting leakage and unintended side-effects. By defining the instrument metrics in a comprehensive way, incentives to circumvent the rules can be mitigated.[77] In this respect, a combination of instruments (a "package") and careful design of each element complement each other and could address some of the leakages.

Different approaches to instrument design are being used. The design of instruments varies on aspects such as exemptions granted, whether or not to cover all the loans taken out by a borrower, the type of income to be included, the degree to which the measure will be binding, and whether the instrument may be adjusted over the cycle.

Member States differ with respect to the degree of detail of their measures. In some cases, less detailed rules are preferred for reasons of data availability or monitoring (e.g. without a credit register it might be difficult to monitor borrowers' total indebtedness). In other cases, authorities may opt for very precise definitions. This limits the scope for discretion and "creativity" in interpreting the rules, but may be overly burdensome. The effectiveness of a measure should be the guiding principle. The central question is to find the optimal degree of complexity. Examples of very detailed regulation can be found in some Asian countries, e.g. LTV limits in Hong Kong or South Korea.[78] Instrument design, however, is no panacea and it may be too much to ask to avoid all possible kinds of leakage.

A proportionate cap is an innovation that exempts part of the loan portfolio from a limit. The use of such "speed limits" can increase the flexibility of policy-makers and regulated entities. These caps give banks some flexibility in their lending, acknowledging that there might be cases where it might be justified to grant loans not respecting the cap, thereby also reducing incentives to circumvent them.[79] Such design can be helpful at an early stage of the financial cycle when the cap is not yet binding, lessening also potential political costs from constraining some borrowers' credit. It also increases the number of policy variables as the share that can exceed the cap can be varied by the policy-maker. The discretion to determine who is allowed to exceed the limit is left to the bank. Proportionate caps have been recently introduced in several Member States (e.g. CZ, EE, IE, NO, SK, UK).[80] New Zealand has made use of them since October 2013. The country recently presented a proposal with

76 Crowe et al. (2011) also find that a careful design of macroprudential measures is the key to avoid circumvention and regulatory arbitrage, thus improving their effectiveness.

77 The definition can for example take into account the regulatory perimeter. For example, in Romania, the instruments have been adjusted in order to better contain the systemic risks and to limit the circumvention since the first introduction of DSTI and LTV caps at the end of 2003 (see Banca Naţională a României, 2014, chapter 7.1).

78 See, for example, Hong Kong Monetary Authority (2011) and Igan and Kang (2011).

79 In New Zealand, one reason for a "speed-limit" LTV was to avoid leakages because the speed limit raises the uncertainty around the payoffs to unregulated lenders entering the market (see Reserve Bank of New Zealand, 2014).

80 It has also been introduced in Norway (see https://www.regjeringen.no/en/aktuelt/regulation-on-requirements-for-residential-mortgage-loans/id2417372/).

added flexibility, as not only the cap is differentiated but also the share of the portfolio that can exceed the limit across sectors/regions (Reserve Bank of New Zealand, 2015).

Other types of exemptions and differentiations are also used when designing instruments, especially collateral stretch ones. Exemptions can be motivated by: (i) the need to target the rules at a specific market segment and/or to target according to how different groups may be impacted by the regulation (e.g. an LTV cap is likely to be less constraining for existing house owners than for first-time buyers in the build-up phase[81]), (ii) recognition that under some circumstances exceeding limits is acceptable within predefined boundaries (e.g. exemptions from LTV limits for insured loans), and (iii) the need to preserve competition and mobility in the market (exemption for switcher mortgages or mortgages with arrears[82]).

Granting exemptions can be a key element in instrument design to avoid reinforcing downturn effects. For example, refinancing risk can force borrowers to sell their house or become trapped with their existing lender if they are subject to negative income or house price shocks when the initial period of rate fixation is shorter than the loan maturity. This could lead to further downward pressure on house prices or cuts in consumption. Consideration should therefore be given to design features that can limit such side-effects. A number of countries have already used exemptions to this effect in the design of their instruments by allowing for the refinancing or transferability of existing lending.

When housing supply is inelastic, excluding construction lending or lending for new houses from the application of instruments could be considered. Such an exemption was applied by New Zealand[83] but not by the Member States surveyed for this report. On the other hand, policy-makers should take into account that when lenders and borrowers expect rising prices, an exemption for construction lending may induce speculation, which could then amplify a subsequent downturn.

Income and collateral stretch instruments are by their very nature targeted. Such instruments only affect those borrowers or credit standards of institutions that will result in the most stretched conditions, hence shaping the tail of the distribution.

While there is a strong case to use standardised definitions for instruments outside the CRR/CRD IV at the national level, this is less obvious at the European level. [84,85] Standardised definitions – not necessarily levels – within a country are warranted to safeguard a level playing field[86] and to minimise the regulatory burden and are also justified because the market has the same structural characteristics. But standardised definitions across countries might prevent tailoring the use of instruments to the characteristics of the national market. For example, there may be country-specific reasons (e.g. tax or legal reasons) why an income-related instrument is better defined relative to gross

81 Other economic policies can serve the purpose of protecting some groups from being adversely affected, e.g. structural/social policies such as social housing or state subsidies.

82 Alternative Repayments Arrangement or other options agreed with a borrower, the purpose of which is to resolve a borrower's pre-arrears or arrears situation (Central Bank of Ireland, 2014).

83 Reserve Bank of New Zealand, "Framework for Restrictions on High-LVR Residential Mortgage Lending", 2014.

84 In many cases, instruments are caps on metrics that could also serve as indicators, for example the LTV ratio. Therefore, instrument concepts can be close to indicator concepts. Since this section covers instruments, however, arguments are made from the instrument perspective.

85 Real estate instruments from CRR/CRD IV such as increased risk weights are already standardised to a wide degree. Therefore, the discussion is focused on tools outside the CRR/CRD IV such as LTV caps.

86 All institutes have to report the same data and satisfy the same regulation.

or net income. On the other hand, different definitions can be an obstacle to reciprocity. Furthermore, a cross-country comparison of the use of instruments hinges on comparable concepts.

Another design aspect is whether to set a fixed level for the instrument or to vary it over the cycle. Macroprudential instruments are often used in response to new developments, but they could also be implemented at fixed levels that are not intended to be varied over time. Such an approach would create a more predictable environment for the targeted institutions, minimise the risk of inaction bias, and lessen the risk of pro-cyclicality resulting from implementation lags. On the other hand, using static levels carries the risk that they do not keep pace with new market developments, could create a "comfort zone" for policy-makers and could be more difficult to communicate, if introduced in a stable environment. Table 22 elaborates further on the pros and cons of such an approach.

Table 22
Pros and cons of introducing static levels of instruments over the financial cycle

Pros	Cons
• Creates stable, predictable policy, reducing the costs to banks of operationalising new credit standards • Minimises the risk of policy-maker inaction bias and lessens the risk of pro-cyclical amplification (e.g. risks of implementation lags for countercyclical measures) • Promotes awareness when assessing risks, with the potential drawback of reducing the incentive for institutions to make their own, more prudent, assessments • Establishes a norm that can incentivise more conservative choices by borrowers about indebtedness	• The impact on constraining imprudent credit growth or house price bubbles may decline over time[87] • Difficult to estimate the appropriate level to minimise systemic risks through the cycle[88] • Potentially more prone to leakages over time[89] • Risks creating a "comfort zone" for policy-makers, as risks could accumulate close to the tail of the distribution[90] • Difficult to communicate and explain, especially in a stable environment ("disaster myopia")

Changing the limits of collateral- or income-related instruments over the cycle is seen as a valid option by almost half of the Member States that apply such instruments. In the case of interest

87 Neagu et al. (2015) find that for Romania the incremental impact of the prudential measures on bank lending is significantly reduced after one year, and it is close to zero after two years.

88 Sánchez (2015) addresses the issue of over-regulation: "Excessive regulation may hinder the development of the financial system, damaging long-term economic potential, something especially harmful for countries suffering from low financial penetration."

89 In the case of New Zealand, Rogers (2014) finds that the temporary nature of the measures and the way of constructing them (as a speed limit) might reduce the leakages associated with this type of measure. On the other hand, imposing a fixed level may allow lenders more room to adjust to the "new normal".

90 Caps could also be interpreted as a signal of levels deemed tolerable by the prudential regulator.

rate sensitivity and amortisation requirements, authorities are less inclined to adapt them to cyclical movements.

Policy measures should be introduced in a sufficiently timely manner to act preventively, being mindful of the lags in transmission mechanisms. This reflects the prudential nature of macroprudential policy and the fact that income and collateral stretch tools can typically only be applied to new loans. Whether this favours one approach over the other depends on country-specific characteristics, the nature of the risk and these lags. In any case, as risks evolve and experience is gained, the need to adjust instruments or introduce further measures may arise. The use of real estate-related measures is most likely going to be a dynamic process where experience with the tools feeds back into the selection and design process.

4.3.1 Income stretch instruments

Key aspects of the design of income-based instruments are income definitions and how interest rate risk is accounted for. There are differences across countries regarding whether gross or net post-tax income is used. In most countries, stable sources of net income are taken into account. However, the practical experience is that in some circumstances authorities allow less stable sources of income to be included in the definition (Table 23). Three Member States explicitly allow rental income from letting property to be included.[91]

Table 23
Income-related instruments: selected design features

Design feature	Answers
Type	• DSTI (CY, EE, HU, LT, NL, PL, RO, SK) • LTI (IE, UK) • DTI (none)
Income	• Income type: net, monthly (EE, HU, LT, PL, RO, SK), gross, yearly (IE, NL, UK*) • Mandatory deductions: none (EE, HU, IE, UK), other financial obligations (LT, PL), cost of living (NL, PL, SK) • Income verification: mostly on the basis of documents issued by an employer or tax authority • Unstable sources of income can be included (usually up to banks' discretion) • Rental income from letting property can be included (EE, HU, LT)

Note: The number of countries in brackets may not always add up to the total number of countries using a given instrument as shown in Table 1 because: (i) for a number of questions, countries could choose more than one answer, and (ii) some countries did not provide answers to all questions or did not reply to the survey
** The FPC has flexibility in the choice of the income concept, currently gross income is used.*
Source: Survey on the design of instruments (excluding sectoral capital requirements) conducted among ESRB membership (2015).

91 As Article 125(2)(b) of the CRR stipulates that exposures are only fully and completely secured by mortgages on residential property if "the risk of the borrower shall not materially depend upon the performance of the underlying property or project", one has to be careful in considering rental income from the respective mortgage.

In principle, the numerator instruments that relate borrower obligations to income should take into account the overall indebtedness of the borrower. Some countries (IE, UK) have chosen to implement an LTI where the numerator is a single mortgage loan. This choice was partly motivated by the lack of a fully operational credit register that would allow monitoring of borrowers' overall indebtedness. In Ireland, once the credit register has been fully established, the authorities will consider implementing a DTI cap - an instrument that, according to the survey for this report, no country has yet implemented.

The design of income stretch instruments needs to take into account possible leakages. If rules are binding, borrowers and lenders may try to overcome them, for example by lengthening loan durations to decrease monthly debt servicing burdens or by switching to financing from a non-bank financial institution. Table 24 lists possible options to deal with common pitfalls of income stretch instruments.

Table 24
Leakages matrix: income stretch

Instrument	Leakage/pitfall	Possible options
LTI, DTI, DSTI, affordability requirements	Longer duration	• Amortisation assumptions or requirements (maturity cap) • DTI/LTI instead of DSTI
	Increase in non-bank lending	• Regulation referring to a product or borrower, not institution • Extending the regulation to non-bank financial institutions
	Sensitivity to interest rate changes	• LTI/DTI instead of DSTI • Interest rate stress tests
	Sensitivity to interest rate changes	• LTI/DTI instead of DSTI • Interest rate stress tests
	Teaser rates	• No deferred or rising payments • Regulation over the whole period of the loan
	Lax stress assumptions	• Institutions should conduct their own stress tests and should consider regulatory assumptions as a minimum standard
Amortisation requirements	High monthly repayment burden	• Combined use with DSTI

Low levels of interest rates increase the amount of credit that can be granted to a customer for a given income, but if rates rise some borrowers may no longer be able to service their debt.

Such risk is commonly addressed by using additional interest rate stress (sensitivity) tests when determining borrowers' creditworthiness. Sensitivity tests can be used as a part of affordability tests or DSTI limits.

Amortisation requirements are often used in combination with DSTI caps. Since institutions may attempt to overcome DSTI limits by extending the maturity of loans, the majority of Member States that have DSTI limits in force have also implemented amortisation requirements. The maximum maturity period varies between 30 years (e.g. EE, SK) and 40 years (e.g. LT) (see Table 25). In some countries, the maximum amortisation period for the loan is higher than the maximum period that can be taken into account for calculating creditworthiness.

Addressing the risk of evading DSTI caps through longer-dated loans is not the only motivation for introducing amortisation requirements. Such requirements can be a response to rising durations for which mortgages are granted, or to rapid household credit growth. In the Member States surveyed, the average maturity of post-crisis mortgage loans is nearly 24 years in countries that do not have maturity caps in force and 22.5 in those that have implemented such restrictions. Amortisation requirements need not be expressed in terms of maturity; they can also be specified in terms of amortisation rates. For example, the Swedish FSA has proposed annual amortisations of 2% for loans with an LTV ratio above 70%, and amortisations of 1% for loans with an LTV ratio between 50% and 70%.[92] A similar proposal has been put forward by the Norwegian government (Finansdepartementet, 2015).

Table 25
Amortisation requirements: selected design features

Design feature	Answers
Type	Maturity cap (EE, LT, PL, SK), amortisation requirement (DK, NL, SE, SK)
Loans covered	Total loan (DK, EE, LT, PL, SK), part of the loan (DK, NL), individual amortisation scheme (DK)
Maturity caps	30 years (EE, SK, for LT from 1 November 2015 onwards), 35 years (PL), 40 years (LT)

Note: The number of countries in brackets may not always add up to the total number of countries using a given instrument as shown in Table 20 because: (i) for a number of questions, countries could choose more than one answer, and (ii) some countries did not provide answers to all questions or did not reply to the survey.
Source: Survey on the design of instruments (excluding sectoral capital requirements) conducted among ESRB membership (2015).

92 On 23 April 2015 the Swedish FSA (Finansinspektionen) put the implementation on hold owing to an unclear legal mandate. On 20 May 2015 the government announced its ambition to provide the necessary legal support for Finansinspektionen.

Table 26
Sensitivity tests: selected design features

Design feature	Answers
Type of stress test	Interest rate (DK, FI, IE, LT, NO, PL, SK, UK) FX (PL) LGD/PD (LU)
Assumptions for interest rate increase	2 percentage points (IE, SK), 3 percentage points (UK), 4 percentage points (PL), 5 percentage points (LT, from 1 November 2015 onwards)
Exemptions	Stress tests are applied only when interest rate refixing period is shorter than maturity (SK) Mortgage loan has a fixed rate for its full maturity; 5% of mortgages in terms of value are allowed to be issued with a DSTI of up to 60% (LT*)
Timing	Structural intervention (LT, LU, NO, PL, SK), temporarily applied (NO)

** Exemption is valid from 1 November 2015.*
Note: The number of countries in brackets may not always add up to the total number of countries using a given instrument as shown in Table 20 because: (i) for a number of questions, countries could choose more than one answer, and (ii) some countries did not provide answers to all questions or did not reply to the survey
Source: Survey on the design of instruments (excluding sectoral capital requirements) conducted among ESRB membership (2015).

4.3.2 Collateral stretch instruments

Key aspects of the design of collateral-based instruments include valuation approaches and the coverage of the instrument.

Table 27
LTV ratio: selected design features

Design feature	Answers
Numerator	All actually disbursed new loans (sometimes credit lines as well) secured by a mortgage, irrespective of purpose (purchasing, renovating) or type of property (OOH, BTL – exception: SE, only OOH*)
Denominator (valuation)	Market value of the property (DK, EE**, FI, HU, IE**, LT, NL, NO, PL, RO, SE), transaction value of the property (EE**, IE**, NO, SK), mortgage lending value (NO, SK)
Aggregation	Collateral level (DK, EE, HU, LT, SE, SK), loan level (FI, NL, PL, RO), borrower level (IE, NO)
Timing	LTV at origination (EE, FI, HU, IE, LT, NL, NO, RO, SK), LTV updated for repayment, etc. (PL); applies usually from the date the contract is signed or the date when it becomes effective

** The regulation of the housing market in SE effectively means that a BTL market is not economically viable.*
*** The lower of the market value and the transaction price.*
Note: The number of countries in brackets may not always add up to the total number of countries using a given instrument as shown in Table 20 because: (i) for a number of questions, countries could choose more than one answer, and (ii) some countries did not provide answers to all questions or did not reply to the survey. OOH stands for owner-occupied housing and BTL for buy to let.

Ideally, the valuation of collateral should allow for little discretion and exclude cyclical elements. Housing valuations tend to be pro-cyclical. Using less cyclical measures (e.g. a prudent valuation or mortgage lending value) could ensure that the instrument acts as a natural stabiliser. The crucial point is that institutions should have little discretion in determining the value. Otherwise, collateral valuations might be overvalued, particularly in times of excessive optimism. The majority of Member States surveyed used market values for LTV (Table 27). The mortgage lending value (MLV), where, among other things, long-term sustainable aspects of the property value are taken into account, is used by two countries.[93] [94]

In some non-European countries (Korea, New Zealand), LTV limits are designed and calibrated to take into account regional differences in housing markets. The aim is to address problems arising in selected areas of the country (regional hot-spots, e.g. big cities) that are often a result of speculative activity. Such design can take the form of stricter LTV limits for purchasing a property in selected areas (Korea) or lower exemptions ("speed limits", e.g. New Zealand[95]). The result of supplementing an LTV limit with, for example, an LTI limit may in effect be that lending in larger cities is more constrained than in other parts of the country as house prices are typically relatively higher in larger cities.

The design of instruments that are based on the value of real estate needs to take into account closely related regulation (for example, with respect to covered bonds) to minimise the compliance burden. First, macroprudential instruments based on the value of collateral should ideally have the same valuation method to achieve comparability. Second, if there are rules and methods for the valuation of properties in the pool of covered bonds for determining capital requirements or in property tax legislation, there may be advantages in these also being used in macroprudential instruments.

Increasing the value of collateral is one of the possible leakages that should be addressed in the design of collateral stretch instruments. Other possible leakages include topping up the loan (by taking out an unsecured loan at another institution to comply with the LTV requirement) or splitting up the loan (borrowing from multiple lenders). Table 28 lists possible ways to deal with such leakages and pitfalls.

Table 28
Leakages matrix: collateral stretch

Instrument	Leakage/pitfall	Possible options
LTV	Topping up	• DSTI/DTI rule • Verifying the source of the borrower's deposit • Broadening the definition of the numerator
	Splitting up	• Maintaining a credit register or mortgage register
	Increasing the value of the property	• Using the lower of the market value of the property and the value assessed by the appraiser

93 For example, in Germany, the MLV is used for the valuation of collateral underlying a covered bond-type asset pool ("Pfandbriefe"). The MLV is based on a prudential assessment of the long-term value of the collateral without taking speculative elements into account.

94 The EBA is developing regulatory technical standards for rigorous criteria for the assessment of the mortgage lending value (see Article 124(4)(a) of the CRR).

95 http://www.rbnz.govt.nz/regulation_and_supervision/banks/consultations/Response-to-submissions-21-august.pdf

4.3.3 Banking system stretch instruments

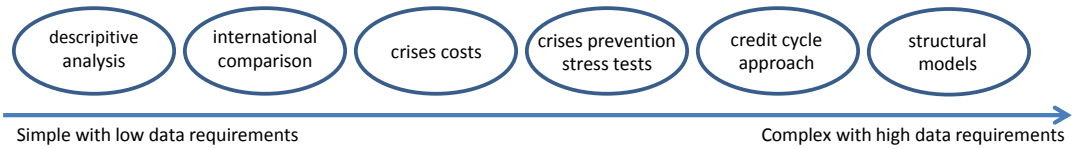
Five Member States use specific RRE instruments related to banking system stretch (Table 20).[96] Three countries made changes to the capital requirements for real estate loans, but using different implementation measures. As an example, Belgium introduced in 2013 higher RWs for mortgages for IRB banks as a response to rising house prices and rapid mortgage lending growth. In April 2014, the Belgian authorities notified the ESRB of their intention to maintain higher RWs in accordance with Article 458 of the CRR.[97]

4.4 Calibration of real estate instruments

4.4.1 Calibration principles

A wide array of methods, involving varying degrees of complexity and data intensity, can be used to help to calibrate macroprudential instruments. Expert judgement is critical when setting an instrument, but this judgement may be usefully informed by such methods (Chart 59).

Chart 59
Calibration methods according to complexity



Source: Expert Group on Real Estate

Member States take many different approaches to the calibration of instruments. The selection of macroprudential real estate instruments and their calibration is first and foremost a national responsibility.[98] Given the very specific national characteristics of real estate markets outlined in Section 1 of the report, the use of different approaches seems warranted.

96 The design of sector-specific capital requirements is governed by the CRR and was hence not included in the survey for the purpose of this report.

97 See also Section 4.4 for the Swedish experience with the calibration of RWs.

98 For countries participating in the SSM, the SSM Regulation (Council Regulation (EU) No 1024/2013 of 15 October 2013) provides that the ECB should be consulted on intended macroprudential policy measures within CRR/CRD IV. Also, if deemed necessary, the ECB can apply higher requirements for capital buffers and apply more stringent measures aimed at addressing the risks (referred to as "topping-up power") under Article 5.2. The obligation to notify the ECB or topping-up power does not apply to instruments implemented at national discretion, such as LTV, LTI and DSTI measures (ESRB, 2014).

A combination of calibration methods seems to be a promising approach to gauge the potential impact of the policy measure from different perspectives. If different calibration methods point to somewhat different settings, judgement will be needed.[99] Even if different methods lead to similar indications regarding the level of the chosen instrument, it may be necessary to take a more conservative stance on the instrument's level to better reflect the systemic risks; this was, for example, the approach followed in Sweden in its deployment of risk weights.[100]

The specific risks to be addressed with the use of an instrument are highly relevant for its calibration. For example, the calibration of an LTI or DSTI cap should differ depending on whether the instrument primarily targets the borrowers' and/or the lenders' resilience. Empirical evidence shows that in some countries, consumers will cut expenditure considerably rather than default on their mortgages. As a result, if the aim of the policy measure is to limit potential negative effects of household indebtedness on the economy more broadly, rather than exclusively to limit future defaults in the event of a downturn, a different calibration may need to be chosen. The calibration of LTV caps could also reflect the heterogeneity of default risk across classes of borrowers, such as first-time buyers and second and subsequent buyers (see also Section 4.3 on granting exemptions).[101] Another objective could be to dampen pro-cyclical dynamics in credit and housing markets or to strengthen the resilience of the banking sector via capital requirements. A sequencing of objectives might be necessary.[102]

The timing of implementation during the cycle affects calibration. If macroprudential instruments are set to insure against a build-up in real estate risk, then this may involve a different calibration compared with setting a policy later in the financial cycle. In the latter case, the short-term costs of the same calibration may be higher – as it would be immediately binding – which might lead to a somewhat looser calibration being chosen.[103]

A cost-benefit analysis is important, but work on that topic in the field of macroprudential policy is still in its relative infancy. The use of an instrument is likely to bring about costs (e.g. higher borrowing costs or smaller mortgage loans for some borrowers). In the long run, the benefits should outweigh the costs. However, assessing the net benefit of macroprudential policy still remains uncharted territory. In particular, most macroprudential policies have been implemented only recently so that it is too early to evaluate their full impact, and often the costs tend to be more easily identified (particularly by industry) than the benefits, which may only accrue over time. There is though some preliminary evidence that real estate measures (e.g. LTV limits) – also combined with tax measures – have helped to reduce the build-up of leverage in the housing sector (Morgan, Regis and Salike, 2015; Salim and Wu, 2015). Regular monitoring of key mortgage and housing market indicators should be standard procedure in the ex post monitoring of policies' effectiveness, which might trigger a subsequent adjustment in the measures (IMF GMPI database, 2013). One way to approach an ex ante

99 For example, the Swiss authorities highlight the need for more discretion in the decision on the instrument in case of a heterogeneous picture of the situation on the domestic mortgage and real estate market (see IMF GMPI Survey, 2013).

100 The Swedish FSA used historical information, stress tests, international comparisons and qualitative assessment for the calibration of RWs. Different methods lead to similar indications for the level of the chosen instrument, namely setting higher RWs.

101 Kelly, O'Malley and O'Toole (2015) find for a cross-section of Irish mortgages in 2003 that first-time buyers have lower default rates than second and subsequent buyers. While the default risk increases linearly with the LTV at origination up to an LTV of 85%, it increases sharply above this threshold. The default rate of first-time buyers is 45% lower at an LTV of 80-85%. The relationship between default rates and LTI is more linear.

102 For example, Irish macroprudential policy decided to first target the resilience of banks and households to financial shocks and then to dampen pro-cyclical dynamics between property lending and housing prices (Central Bank of Ireland, 2014).

103 For example when there is no house price/credit boom, one could set a DTI limit of 5 because the banks are not (yet) lending at very high income stretches, so it is not binding. But if the limit is only being implemented once house prices are booming, one may have to set a DTI limit of 6 as credit is already being granted at higher income stretches, hence the calculated cost of the policy would be greater.

analysis of policies' net benefit is to work towards estimations of the transmission channels of the instruments and to use examples of best practice in other countries or interpret the benefit as avoiding the "cost of non-action". The latter can be approximated by the costs of a real estate crisis in other countries. It should also be considered who bears the cost of (non-)action.

Leakages will affect the calibration and also the design. If an instrument is prone to leakages or only applies to a subset of institutions (e.g. only banks headquartered within a specific country), the work of Bianchi and Bengui (2014) suggests that macroprudential actions can still be effective but the calibration may need to be tighter to have a similar effect. However, the more binding the instrument, the more likely agents are to find ways to avoid it. Calibration and design issues therefore interact.

Structural features of real estate markets or the economy and the interaction with other policy areas should be considered. For instance, the tax deductibility of mortgage interest and/or longer repayment periods for mortgages is likely to have an effect on the proportion of lending affected by a given limit.[104] The simultaneous existence and interaction of various policy measures (also) targeting real estate markets and/or indebtedness – whether they be macro- or microprudential measures, or monetary policy or tax and structural policies – should also be considered in the calibration of macroprudential instruments. In addition, the interaction with different credit standards matters (Dietsch and Welter-Nicol, 2014).

4.4.2 Calibration methods

Some specific calibration methods are outlined below, starting with simpler hands-on approaches and going on to look at more academic methods. Box 4 illustrates the use of some of these methods for a number of Member States.

a) Descriptive analysis. A necessary first step is understanding the real estate market and its financing structure, as an important basis for expert judgement (e.g. see the case study on Romania in Box 4).

Pros: simple; suitable for any real estate instrument and for developing a common understanding of risks in the national market; regular monitoring is important for potentially adjusting the policy measure.

Cons: does not allow a simultaneous impact of developments in policy and real estate markets, e.g. on lending volumes, to be disentangled.

b) International benchmarking. Other countries' experience can serve as a benchmark for domestic action, after taking cross-country differences in structural and dynamic characteristics into account. A selection of best practices could be based on similarities of these characteristics. International experience and academic studies can be helpful in identifying critical thresholds for instrument

104 Tax deductibility may incentivise a borrower to take the maximum mortgage possible and then save elsewhere. Repayment and amortisation does not happen over time and therefore borrowers will have an incentive to have the highest LTV they can (and not change it). This leads to more concentrated LTV limits.

calibration.[105] Annex 3 provides an EU-wide overview of macroprudential measures already implemented, which features widespread use of LTV and LTI/DSTI tools.[106]

Pros: simple; suitable for any real estate instrument and for developing a common understanding of best practices; easy communication of role-model countries; might serve as a substitute for a lack of information/data at national level; might complement econometric approaches to calibration.

Cons: does not take into account country-specific macrofinancial circumstances;[107] peer-group comparisons should be updated regularly as other countries might move forward with their own policies; difficult to implement when a dynamic approach is desirable; most case studies are relatively recent ones, which makes it difficult to judge the effectiveness of instruments.

c) Crisis costs. As one element, costs of bank recapitalisations following housing market crises can be related to the risk-weighted assets of banks. This can give a first indication of capital needs in case of a crisis and of the capital required to increase the resilience of the banking system. In addition, public guarantees (on mortgage portfolios) may point to potential systemic risks and costs if these guarantees are drawn. Information from indicators signalling the build-up and materialisation of systemic risks in the real estate sector (e.g. real estate prices) may also be useful when calibrating activation and deactivation rules associated with different instruments.

Pros: particularly suitable for sectoral capital requirements (balance sheet instruments); easy to communicate; same approach might be followed for the calibrations of aggregate capital requirements; useful to get a feeling of the potential minimum thresholds for instruments.

Cons: need to be narrowed down to address specific risks and losses stemming from the real estate sector exclusively; disentangling other sources of risk and the multiple effects occurring during a banking crisis may not be easy in practice; backward-looking - prior experience is not necessarily representative of how losses may occur in a future downturn.

d) Crisis prevention – stress-test approach. Stress tests can also guide calibrations by providing estimates of losses under different scenarios and parameter values.[108]

Pros: more complex but well-developed methodology and experience with stress testing (tools in place in many countries); allows simulations of scenarios which may be difficult to capture in a formal theoretical model; suitable for any real estate instrument as stress tests can be undertaken at the bank and household level (microeconomic stress tests); suitable for adjustment.

105 For example, the Central Bank of Ireland (2014) points out that the Basel Committee on Banking Supervision defines a high LTV as greater than 80%. In addition, Article 125 of the CRR requires that banks hold higher capital against certain residential loan exposures with an LTV higher than 80%. Such indications can serve as a first benchmark.

106 See also Crowe et al. (2011) for a review of countries' experiences with a number of measures to address real estate risks.

107 For instance, in countries where savings in assets other than houses are associated with preferential treatment, e.g. pension savings, households may be less inclined to also put their savings into their houses from a life-cycle perspective. Whether the resulting higher LTVs (following lower down payments or less amortisation) are associated with higher systemic risk relative to countries with lower LTVs is likely to depend on a multitude of factors.

108 For example, the Central Bank of Ireland (2014) applied its loan loss forecasting models to simulate loan losses, had LTV ratios been lower. Although such an analysis does not account for feedback loops (e.g. between tighter lending standards, mortgage credit growth and house prices), it provides a first (though underestimated) indication of the potential impact of an LTV cap. Another example is provided by the Norwegian central bank (Andersen, 2013), which used historical default and loss data, stress tests and other data to estimate what the average risk weight should be.

Cons: stress tests may not take into account all the relevant issues; may be subject to some arbitrary assumptions for the scenarios; not easy to disentangle feedback effects; data requirements are high.

e) Credit cycle approach. Excessive credit growth in boom times can lead to a build-up of risks and consequently result in excessive credit cuts during the bust. Linking LTVs/LTIs and DSTIs/DTIs to movements in the credit cycle allows for a better understanding of the impact of these ratios on excessive credit growth. In addition, impulse response functions can be used to analyse the impact of caps on LTVs/LTIs or DSTIs/DTIs on credit series to learn more about alternative thresholds (e.g. Albacete et al., 2014). As with the early warning approach, cross-country or country-specific studies can be used.

Pros: reasonably simple to do basic analysis; suitable for LTV/LTI or DSTI/DTI limits and sectoral capital requirements; mixture of rule-based and discretionary approach possible; targets credit expansion more directly; aims to tackle the source of credit-driven banking crises; estimation can be constantly updated.

Cons: difficult to define thresholds for excessive developments; needs agreement on credit cycle definitions (e.g. which credit aggregates should be targeted) and measurement (e.g. statistical filters or alternative techniques used to calculate equilibrium or long-run credit levels); lack of data in countries without enough observations on full credit cycles.

f) Structural models. For example, credit risk portfolio models (e.g. on residential housing loans) applied at an aggregate level might be used to calculate the potential effects of LTV/LTI and DSTI/DTI caps on credit losses (e.g. Harrison, 2009; Andersen, 2013; Montes, 2013). These types of models can be used to calibrate both PDs and LGDs, and are therefore informative for the calibration of risk weights. The estimates of the losses can then be integrated into stress-test analyses which would allow for consideration of alternative scenarios. In addition, one could measure the contribution of loan portfolio segments to total portfolio losses and thus gauge the riskiness of different sub-portfolios (e.g. portfolios according to LTV or DSTI characteristics). The results can give an indication of optimal levels for LTV/DSTI caps. Dietsch and Welter-Nicol (2014), for example, find that portfolio credit risk in the French credit market is close to the 100% LTV and 35% DSTI thresholds, which is near to the levels of the internal guidelines often used by banks. The combination of both instruments can be effective in keeping the total portfolio credit risk in check.

g) DSGE models. For example, Quint and Rabanal (2013), though their work is still in a relatively early stage of development, may also help to guide calibrations for LTV/LTI and DSTI/DTI limits.

Pros: complex; suitable for any real estate instrument; data requirements are high; well founded in economic theory; allows an integrated view; permits a better articulated representation of key transmission channels.

Cons: some assumptions may be unrealistic or difficult to calibrate; the use of general equilibrium models in financial stability is still in an early stage; take time to calibrate; more suitable for steady-state level rather than adjustments.

Box 4

Country examples of calibration methods

The calibration of LTV and DSTI limits in Romania

In the case of Romania, the calibration method was a hybrid approach that combined both qualitative and quantitative analyses. The qualitative assessment looked at potential upside and downside risks associated with such measures (e.g. the costs of circumvention via granting of loans by unregulated institutions, extension of maturities, promotional loans, etc.). The quantitative analysis relied on a set of key metrics: (i) risk indicators (NPL ratios by type of loan, income, currency, LTV bucket and maturity), (ii) the share of exposures by sub-portfolio (outstanding stocks and flows) and associated growth rates, and (iii) real estate market developments. The analysis of NPLs by several categories (LTV buckets, categories of income, vintages, etc.) was very informative. The most recent regulation in Romania has proposed different levels of LTV caps by type of borrower (hedged vs. unhedged) and by currency. This distinction was made based on the evidence of different repayment behaviours, and because mortgage loans in foreign currency exhibited higher NPL ratios.

The authorities later moved from explicit DSTI caps to requiring credit institutions to establish their own maximum values according to their specific credit risk and after accounting for a stress scenario, such as shocks on interest rates, exchange rate risk and income risk (see Neagu et al., 2015).

The calibration of LTI and interest rate stress in affordability requirements in the UK

In the UK, the Financial Policy Committee (FPC) examined evidence from the period before the financial crisis and noticed that UK households with gross DSTIs in excess of around 40% were more likely to experience payment difficulties. In previous stress episodes, such as the early 1990s, payment difficulties had arisen at much lower DSTIs. As an approximate guide, at a mortgage rate of 7%, DSTIs in the range of 35-40% are roughly equivalent to LTI ratios of around 4.25-4.75 for a 25-year mortgage. An LTI limit was preferred to a DSTI limit as the latter would also require a mortgage term limit.

The FPC also considered measures to tackle risks related to variable rate mortgage loans. In response to a recent mortgage market review, many lenders said they had already been using a stressed interest rate assumption of around 7% in their affordability tests for mortgages. This implied a “stress” of 2½ to 3 percentage points relative to current mortgage rates, compared with an increase implied by current market expectations of around 2¼ percentage points. The prescribed stress of 300 basis points was calibrated to avoid any relaxation in this level and to ensure that a prudent level was applied by all institutions.

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Annex 1
Case study – the evolution of foreign currency mortgages in Poland

After the breakdown of the communist system in the 1990s, Poland managed to create from scratch a market economy and a simple and effective banking sector relying on large universal banks. At the same time, the long-run housing policy was oriented towards owner-occupied housing (OOH) and housing loans. However, the development of mortgage loans was hindered by high inflation (19.9% in 1996 and 7.3% in 1999) and the lack of know-how.

In the 1990s OOH was financed with double indexed mortgage loans and (mostly in USD) loans denominated in foreign currencies (FX). This was the introduction of FX lending to the financial market. As the economic transformation had started with a strongly undervalued Polish zloty (PLN), the currency appreciated continuously in later periods. Consequently, consumers had a low perception of the FX risk and FX lending became popular. After 2000, the mortgage market developed only with decreasing inflation and increasing economic growth and income. Migration to large cities started. Against the background of high inflation and a high mortgage interest rate for PLN loans, Polish banks started, with the help of their foreign owners, to issue FX-denominated mortgages. They were mostly denominated in CHF – the cheapest available currency at that time.

Consumers expected house prices to rise after the EU accession and the demand for new housing rose amidst a very small developer market, and as a result house prices started to rise in 2003. Loan disbursements and house prices accelerated further in 2005. During the period 2005-07 house prices and the amount of outstanding mortgages doubled. Banks wanted to sustain the mortgage demand by easing credit granting conditions, especially for the income buffer.

The fast increase of mortgages in connection with rising house prices prompted the Financial Supervision Authority (FSA) to react. Since July 2006, Recommendation S has forced banks issuing FX-denominated loans to calculate the mortgage affordability of their clients in the following way: they assume a PLN loan (with higher interest rates) and have to increase the mortgage value by 20% in the calculation. In 2007 the RW for the part of the FX-denominated loan with an LTV lower than 50% was increased from 35% to 75%. At the same time, the RW for this part of PLN loans was lowered to 35%. In both cases the RW for the part of the loan that corresponds to 50-100% of the LTV remained the same and stayed at 100%. In June 2012 the RW for them was increased to 100%, irrespective of the LTV level. The version of Recommendation S that came into force in June 2014 forbids granting FX-denominated loans to consumers who cannot hedge against the FX risk, thus who do not have a permanent income in the currency of the mortgage.

The regulations introduced in 2006-07 were not well accepted, neither by banks, nor by consumers, nor by a large fraction of politicians. After criticism, the location, structure and tasks of the FSA were changed in 2008. This strongly affected the effectiveness of its work. After 2008, the banking sector started to curb FX lending at its own initiative. As it was forbidden to grant FX-denominated loans to customers with an income in a different currency, banks finally started to grant only PLN loans.

Even though there were significant house price increases in the largest cities in Poland, the scale of the problems caused was too small to cause any harm to the housing sector and the

financial sector. A significant part of the FX-denominated loans was financed by foreign banks owning the domestic banks with short-term FX swaps. Those banks sustained the financing of their subsidiaries. Thus the main effect of FX shocks was the growing demand for PLN-denominated deposits and the growth of their interest possibly balancing the FX shock. In the following years the FSA made banks open long-run credit lines between domestic banks that issued FX loans and their parent banks, in order to decrease the liquidity risk. The disequilibrium in the housing market was absorbed over the following years. The last remaining effect of the boom were large portfolios of CHF-denominated loans, which amount to around CHF 40 billion or 10% of GDP and 11% of banking sector assets.

A current analysis of the banking sector performed by Narodowy Bank Polski (NBP) and the FSA shows that the regulations improved the quality of this loan portfolio significantly. The quality of FX-denominated loans was better than that of PLN loans. Later on, FX shocks did not alter their quality significantly. One important determinant of this outcome is the fact that Recommendation S forbids banks to grant FX-denominated loans to those households that could not afford PLN loans, a practice they applied earlier.

Other factors making the FX-denominated loan portfolio so resilient to shocks were their interest rate type, the current economic situation of EU countries and the actions of their central banks amidst the economic crisis in Europe. The most common mortgage form was a mortgage with a fixed mark-up and an interest rate indexed to the LIBOR. The FX shock was cushioned by the drastic reduction of the LIBOR, when central banks loosened their monetary policy to deal with the economic problems. As a consequence the CHF/PLN exchange rate and the interest rate level moved in opposite directions, and the increase of the debt service was wiped out by the fall in interest rates. For most clients the costs of the FX-denominated mortgages were lower than those for PLN loans, which had an impact on the quality of those loan portfolios.

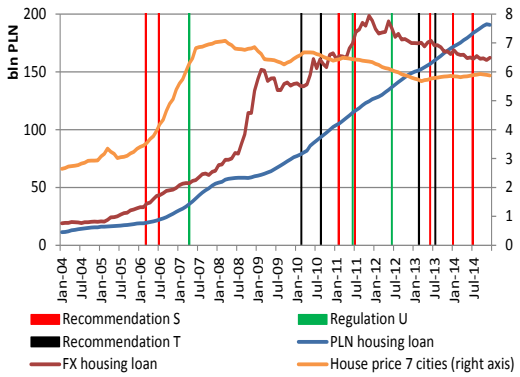
Another test came in January 2015 when the Swiss National Bank (SNB) removed the 1.20 floor on the Swiss franc against the euro, which resulted in an unprecedented appreciation of the CHF against the PLN. This happened during an election period. So far, the FX-denominated loan portfolio has performed well. However, the FSA has taken steps to make the absorption of this shock easier. They recommended various possibilities to the banks: to take the negative LIBOR interest rate into account for the indexing of the mortgage rate; to allow a cost-free change of the FX-denominated loan for a PLN loan at the current NBP rate; to lower the spread during FX transactions that are used to pay back the loan; to no longer ask for additional insurance when the LTV exceeds 100%; to allow for a break in the service of the debt; and to allow the mortgage period to be extended.

The Polish banking sector is highly capitalised and passed a stress-test scenario assuming that the CHF equals PLN 4.5 or even 5. The FSA offers an alternative solution to the problem. It allows the denomination of the loan to be changed from CHF to PLN, and the distribution of the costs equally between the bank and its client. This process may last until the loan is repaid. It can be assumed that most lenders will not use this option as they expect an appreciation of the PLN in the long run.

Chart 60

Housing loan receivables (PLN billions), regulations and house prices in the seven biggest cities

(PLN/ 1 sq. m.)

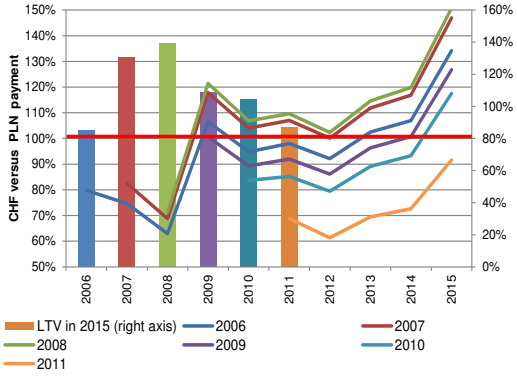


Sources: NBP and FSA.
Notes: The brown and blue lines represent the outstanding housing mortgage in FX and PLN, respectively. The orange line shows the house prices in the seven major cities. The vertical lines indicate the introduction or modification of Recommendations S and T, Regulation U and other regulations.

Chart 61

Monthly repayment of CHF housing loans (in PLN) versus PLN housing loans (housing purchased in the specified year) and LTV level in January 2015

(percentage)



Sources: NBP and FSA.
Notes: The lines represent the ratio of a FX mortgage repayment and the repayment of a comparable mortgage taken out in PLN at a given time. The bars indicate the LTV of each cohort at the end of January 2015.

Annex 2
Documentation on clustering of countries based on their structural features

The clustering was done for a **pre-crisis period** (taking 2007-08 data) and a **post-crisis period** (2012-13).

Country coverage

EU countries excluding Croatia (as there were almost no data available).

2.1 Imputation

In clustering, missing data are problematic (as clustering is based on distance measures). Therefore we applied imputation. The imputation was done with the software program R.

The applied imputation algorithm follows the following steps:

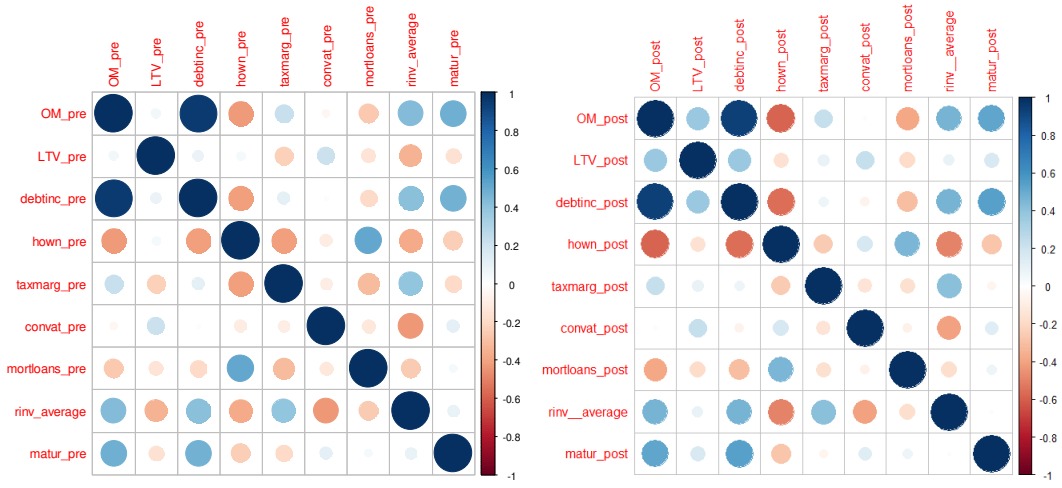
1) extract variables with full observations;

2) compute matrix correlations for all variables and find variables with complete observations which are best correlated with missing values (Chart 62)

3) generate linear regression models: check whether R^2 is OK and whether the individual model has a good fit in terms of the missing observations.

2.1.1 Correlation

Chart 62
Correlation matrix pre- and post-crisis



2.1.2 Regression models: imputed variables

The following regression models were applied:

$$dependent\ variable\ y = f(independent\ variables\ x_i\ with\ full\ observations) + \varepsilon$$

Table 29
Variables in the regression model used to impute data (suffix "_pre" means pre-crisis period and "_post" means post-crisis period)

Dependent variable	Independent variable	R2
taxmarg_pre	taxmarg_post, OM_pre, rinv_average	0.88
mortloans_pre	mortloans_post, LTV_pre, matur_pre	0.62
convat_pre	convat_post, LTV_pre, rinv_average	0.84
debtinc_pre	OM_pre	0.90
LTV_pre	LTV_post,convat_post,rinv_average	0.44
taxmarg_post	taxmarg_pre, OM_post, hown_post, rinv_average	0.90
mortloans_post	mortloans_pre, OM_post, hown_post, rinv_average	0.65
debtinc_post	OM_post	0.82
matur_post	matur_pre, OM_post, debtinc_post	0.58
LTV_post	LTV_pre, OM_post, debtinc_post, rinv_average	0.41

This table captures only non-cyclical variables. The variable rinv_average to measure the strength of housing supply was used over the whole sample period as the share of residential investment in GDP changes only gradually.

2.2 Standardisation

After imputation we did a classical standardisation (X minus the mean for X, divided by the standard deviation of X).

2.3 Clustering

Applied method:

Hierarchical approach – Ward's linkage

Performed in Stata version 13.1

Annex 3
Overview of the use of real estate-related instruments in the EU/EEA

The following tables present an overview of real estate-related measures taken by EU/EEA countries. It is challenging to determine exactly when a measure is taken with a macroprudential purpose. Therefore, the tables follow the ESRB's broad interpretation of "measures of macroprudential interest" rather than "macroprudential measures".

Table 30
LTV in the EU and Norway

Country	Level (baseline)	Remarks	Cyclicality and exemptions	Implementation date
Cyprus	70-80%	80% for financing the primary permanent residence of the borrower, and 70% for all other property financing cases.	N/A	4 December 2013
Denmark	95%	Home buyers are generally required to make a down payment of at least 5% when purchasing a home.	N/A	N/A (in process)
Estonia	85%	LTV limit is 90% if guaranteed by KredEx. Up to 15% of the amount of new housing loans issued in a quarter are allowed to breach the limit. Exemptions for mortgages in arrears.	Structural and cyclical	1 March 2015
Finland	90-95%	LTV of 90% (95% for first-time house buyers) by law. Cap can be tightened by 10 percentage points by Finnish FSA.	Cyclical, cap can be tightened	1 July 2016
Hungary	45-80%	Limits are differentiated according to currency of loan (HUF - 80%, EUR - 60%, other currencies - 45%). Exemptions for switcher mortgages, mortgages in arrears and loans under a certain threshold.	Structural and cyclical	1 January 2015
Ireland	70-90%	Proportionate LTV limits of: 80% for non-first-time buyers (FTBs); 90% for FTBs of properties up to EUR 220,000; a sliding LTV limit based on property value for FTBs over EUR 220,000. To be exceeded by no more than 15% of the value of new lending for primary homes. Buy-to-let (BTL) loans with LTV greater than 70% should be no more than 10% of the value of new BTL loans. Exemptions for switcher mortgages, mortgages in arrears and negative equity.		9 February 2015
Latvia	90%	90% for residential mortgage lending; 95% for loans supported by a state guarantee under the Law on Assistance in Resolution of Dwelling Issues. The LTV requirement is set in the Law on Consumer Rights' Protection, but Latvijas Banka can issue a recommendation on the appropriate LTV level.	N/A	July 2014
Lithuania	85%	Exemptions for switcher mortgages and low loan amounts.	Structural	1 September 2011
Malta	70%	Continuation of practice since 2008 for exposures secured by mortgages on residential property and attracting a risk weight of 35% not to exceed 70% of the market value of that property.		N/A (EBA notified)
Netherlands	103% (->100%)	LTV limit for new mortgage loans decreases stepwise by 1 percentage point per annum from 106% in 2012 to 100% in 2018. Exemptions for switcher mortgages, negative equity and loans for energy-saving renovations.	Structural	1 January 2012
Norway	85%	Supervisory guidelines for prudent residential mortgage lending practices specify that the LTV should not be more than 85%.	Structural and cyclical	1 December 2011
Poland	90% (->80%)	For residential real estate: 2014 - 95%, 2015 - 90%, 2016 - 85% (90%)*, 2017 - 80% (90%)* *If the part above the cap is insured or collateralised with funds on a bank account, or government or NBP securities.	Structural	1 January 2014
Romania	60-95%	85% for local currency-denominated loans, 80% for FX loans granted to hedged borrowers, 75% for EUR-denominated loans granted to unhedged borrowers, 60% for other FX loans granted to unhedged borrowers, and 95% for loans in the Prima Casă programme. Exemptions for first-time	Structural	31 October 2011

Table 30
LTV in the EU and Norway

Country	Level (baseline)	Remarks	Cyclicality and exemptions	Implementation date
		buyers with loans secured partially or totally by the state.		
Slovakia	90-100%	Recommendation: LTV of new loans should not be more than 100%. Volume of new loans with LTV of 90-100% should not exceed given share of total new loans. The proportionate LTV limit is gradually tightened over time (from 25% until 30 June 2015 to 10% from 1 January 2017 onwards). Exemptions for non-topped-up loans and building societies.	Structural	1 November 2014
Sweden	85%	Exemptions for switcher mortgages.	Structural and cyclical	1 October 2010

Source: ESRB (2015).

Table 31
LTI and DSTI in the EU and Norway

Country	Type	Level (baseline)	Differentiation	Cyclicality and exemptions	Implementation date
Cyprus	DSTI	35-60%	Limited to the lower of: (a) 35% (60%) of the borrower's total monthly income or (b) the difference between the total monthly income and the total monthly expenditure for low(high)-income borrowers.		4 December 2013
Estonia	DSTI	50%	Of borrower's net income. Up to 15% of the amount of new housing loans issued in a quarter is allowed to breach the limit. Exemptions for mortgages in arrears.	Structural and cyclical	1 March 2015
Hungary	DSTI	10-60%	The cap is differentiated according to the currency of the loan (HUF, EUR, other currencies) and the net income of the borrower (<=/ > HUF 400,000). De minimis exception for very small loans. Exemptions for switcher mortgages and mortgages in arrears.	Structural and cyclical	1 January 2015
Ireland	LTI	3.5	New housing loans with LTI greater than 3.5 should not be more than 20% of the aggregate value of new housing loans. Exemptions for switcher mortgages and mortgages in arrears.	Structural and cyclical	9 February 2015
Lithuania	DSTI	40%	Of borrower's net income. Certain exemptions are introduced effective 1 November 2015 (see Section 4, Table 26).	Structural	1 September 2011
Netherlands	DSTI	10-38%	Limited to the lower of: (a) 35% (60%) of the borrower's total monthly income or (b) the difference between the total monthly income and the total monthly expenditure for low(high)-income borrowers.	Structural	2013
United Kingdom	LTI	4.5	Of borrower's net income. Up to 15% of the amount of new housing loans issued in a quarter is allowed to breach the limit. Exemptions for mortgages in arrears.	Cyclical	1 October 2014

Source: ESRB (2015).

Table 32

Loan maturity and amortisation in the EU and Norway

Country	Type	Level (baseline)	Differentiation	Cyclicality	Implementation date
Estonia	Mat.	30 years	Up to 15% of the amount of new housing loans issued in a quarter are allowed to breach the limit.	Structural and cyclical	1 March 2015
Lithuania	Mat.	40 years	For new loans.	Structural	1 September 2011
Netherlands	Amor.	30 years	New mortgage loans are only tax-deductible when they are amortised within 30 years.	Structural	1 January 2013
Slovakia	Amor.		Loans with (partial) deferred payment of interest or principal should not be granted. Specified exceptions are allowed.	Structural	1 March 2015
	Mat.	30 years	For new housing loans. No more than 10% of new loans can exceed this limit.		
Poland	Mat.	35 years		Structural	Beginning of 2014
Sweden	Amor.	N/A	Need for new mortgage loans to repay at least 2% of loan per year until LTV is 70% and thereafter at least 1% of the loan until the LTV is 50%.	N/A	N/A (on hold)

Source: ESRB (2015).

Table 33

RWs and LGDs in the EU and Norway

Country	Type	Differentiation	Implementation date
Belgium	RW	5 percentage point add-on to the risk weights applied by banks that use the IRB approach to mortgage loans to Belgian residents covered by residential real estate in Belgium.	8 December 2013[1]
Croatia	RW	Stricter definition of residential property for preferential risk weighting (e.g. owner cannot have more than 2 residential properties, exclusion of holiday homes, need for occupation by owner or tenant).	1 January 2014
Luxembourg	RW	Institutions using the standardised approach for credit risk need to apply a risk weight of 75% to the part of the mortgage loan exceeding 80% of the value of the real estate object.	1 July 2013
Norway	LGD RW	Increase minimum EAD weighted average LGDs for retail exposures secured by residential real estate in Norway from 10% to 20%. Tighter requirements for residential mortgage lending models.	1 January 2014 1 January 2015 (in process)
Sweden	RW (Pillar 2)	A risk weight floor of 25% (previously 15%) for Swedish mortgage loans by IRB banks.	8 September 2015

Note: [1]Continuation of a measure (but now under CRD IV/CRR) that was already applicable.
Source: ESRB (2015).

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The cut-off date for the data included in this report was 26 June 2015.

ISBN 978-92-899-1966-1 (online)
DOI 10.2866/545064 (online)
EU catalogue No QB-04-15-943-EN-N (online)