Focus

I. Assessing the dynamics of house prices in the euro area

This focus section presents a housing market imbalance 'toolkit' to identify unsustainable housing market developments early on. It combines a house price cycle analysis and a range of valuation methods. The house price cycle analysis identifies over- or under-valuation of house prices by comparing actual prices with an estimated filtered trend, and then detecting local peaks and troughs. Unsustainable developments (boom/bust episodes) are separated from milder cyclical ups (bull phase) and downs (bear phase) by looking at their amplitude and duration (and severity as a combination of both dimensions). As a result, Member States can be grouped according to any unsustainable developments identified in the last upswing as those with: (i) long and ample booms, (ii) sudden and sharp booming periods, (iii) long and mild developments above the trend, with lower average house price growth rates and, (iv) no identified booming episodes. The outcome of the cyclical analysis is supplemented with valuation methods to obtain confirmation signals coming from affordability and price-to-rental ratios as well as equilibrium house price estimates based on economic fundamentals, such as total population, real disposable income and long-term interest rates. None of the methods used is exempt from caveats and technical challenges but the combination of all the relevant dimensions allows a comprehensive approach.

I.1. Introduction

Developments in housing markets can have widespread macroeconomic effects on economic activity, the functioning of the labour market, macro-financial stability and general welfare (including redistribution of resources within and across generations, or exposure of citizens to credit and market risk). Moreover, inappropriate institutional, regulatory and fiscal settings in housing can foster macro-financial risks and vulnerabilities in the banking sector and inefficient allocation of resources, crowding out tradable sectors.

Against this background, a key challenge for policy makers in the euro area is to identify unsustainable developments in house prices (boom-bust episodes) early on. Assessing those imbalances and their associated risks is, however, technically challenging and multiple dimensions need to be taken on board, reflecting heterogeneous institutional frameworks in mortgage and housing markets across Member States as well as dissimilar macroeconomic conditions.

The objective of this focus section is to present an attempt at building a comprehensive approach to gauging the dynamics and sustainability of house price developments in the euro area. The analysis provides an overall assessment of the degree of imbalances at Member State level.

Identifying unsustainable developments in house prices is not a straightforward task. A range of methods can be used, from simple descriptive statistics to more complex econometric modelling approaches. No method is exempt from limitations and should therefore be used in isolation.

In order to cover all the relevant dimensions and compensate for the limitations of individual methodologies, the analysis presented in this section is based on an encompassing approach, a housing imbalance toolkit which combines:

- **A house price cycle analysis**, which identifies booms and busts as episodes of protracted/sharp movements in house prices away from their trend. It also relates house price dynamics to developments in macroeconomic conditions.

- **Confirmation signals from valuation methods**. The identification of unsustainable housing developments can benefit from confirming signals based on: *(i)* indicators of affordability and rental ratios and *(ii)* econometric estimations of house prices, considering housing as a consumption good and relating prices to housing demand (income, demographic pressures, credit developments, etc.) and/or supply (existing stock of housing, building permits, unsold houses, land availability or construction costs, etc.) factors.

Sections 2 and 3 describe these two approaches in some detail. Section 4 presents an overall assessment of housing imbalances derived from

the use of this toolkit and concludes by sketching out the way forward.

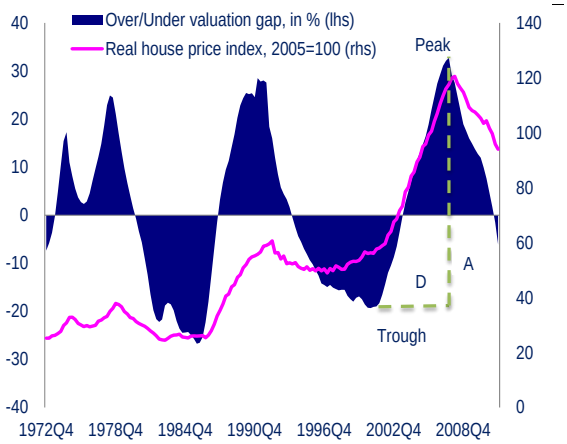
I.2. The housing imbalance toolkit: a house price cycle analysis

General principles

Following Agnello and Schuknecht (2009), ([1]) the analysis of house price cycles rests on Hodrick-Prescott (HP) detrending techniques. This makes it possible to extract the cyclical component of house prices, namely the house price gap (i.e. the actual price minus the trend). Indicators of the severity of house price cycles are computed on the basis of the magnitude and duration of the different phases of the housing cycle. More specifically, severity in the dynamics of house prices over the cycle is estimated via a multi-step approach (see Graph I.1 for an example):

- Relative (or deflated) housing prices are detrended and troughs and peaks are identified for the resulting house price gap.
- The duration (D) and cumulated change or amplitude (A) are computed over the different trough-peak and peak-trough phases.
- The severity (S) of the bull/bear phases is then estimated by the area of a triangle with base given by the duration and height given by the amplitude (S = (A× D) / 2).
- The main data source is the Experimental House Price Index built by Eurostat and supplemented with ECB, OECD and BIS data. ([2]) The Eurostat index has a short time coverage (it goes back to only 2005) but is the only harmonised and thus consistently comparable indicator for euro area Member States. Overall, the data sample covers euro area countries from 1972Q2 to 2012Q2 although the panel is very incomplete and just a handful of Member States present the total 162 data points.

Graph I.1: **Relative house price gap, Spain (1972Q4-2012Q2) (1)**



(1) The overvaluation or relative price gap is calculated as the difference between actual prices and their filtered trend.
Source: Eurostat and DG ECFIN calculations.

First step: estimating deviations from the trend

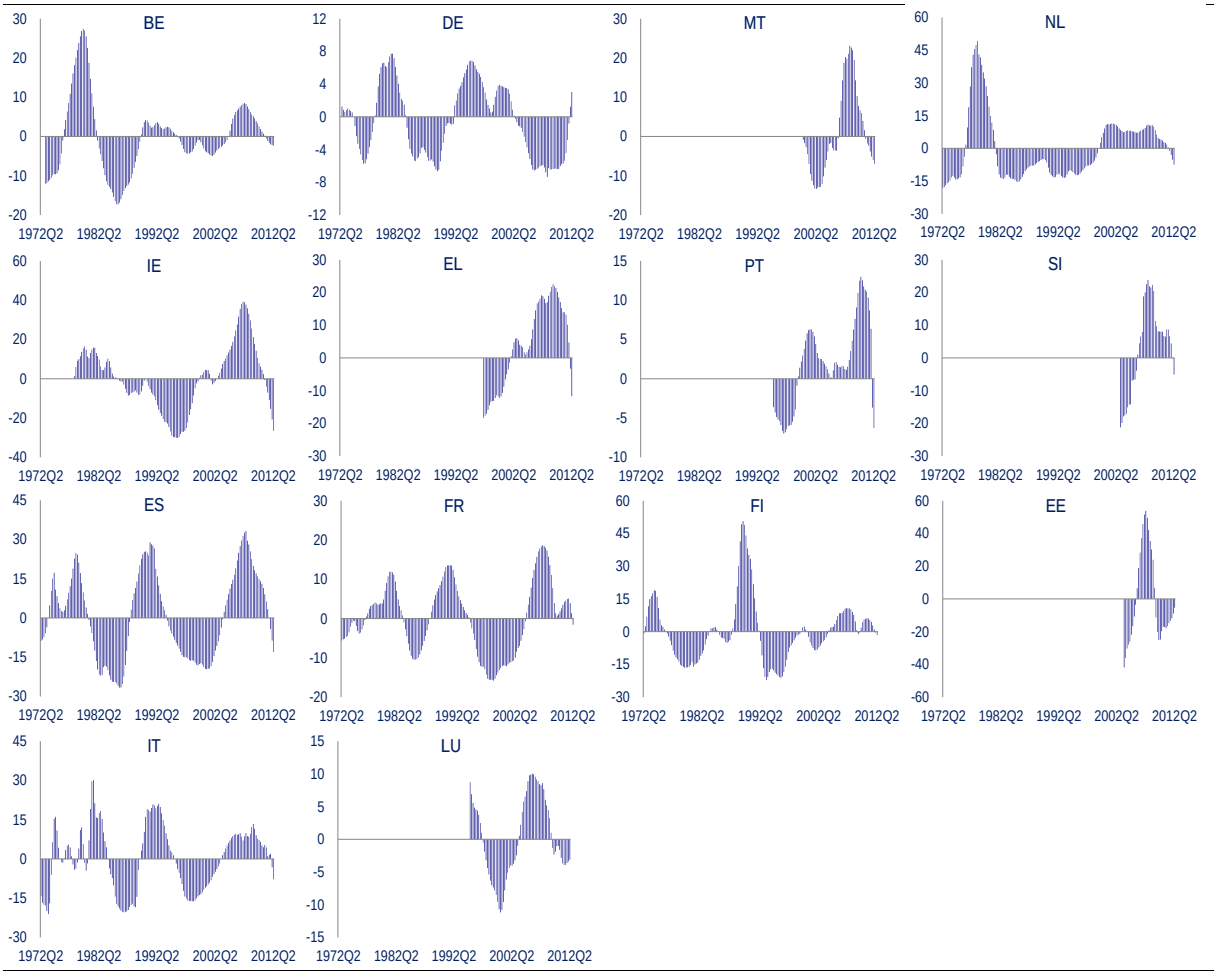
House prices are decomposed into trend and cycle terms using the HP filter. The HP filter, although easy to interpret and in widespread use, has several well-known drawbacks. It poses problems at the end of the sample and the choice of the smoothing parameter (λ) substantially influences the outcomes. Moreover, the HP filter and its variants generally tend to overestimate the number of boom/bust episodes as they also detect short-lived developments.

In order to minimise the end-point problem, ARIMA models are first fitted to the logs of the real house price series. The series are then extended with the forecasts given by the univariate models. Finally, the HP filter is applied in order to detrend real house prices and obtain the house price gap, calculated as the difference between actual prices and the trend. ([3])

Results are presented in Graph I.2. It can be noted that the peak of the last cycle took place around 2008 for most countries. The analysis also suggests that only Germany is currently presenting a positive gap with respect to its trend, as relative house prices are growing again, after a protracted period of decline in the years preceding the crisis. In contrast, the adjustment taking place in most other countries since 2008 has driven their house price gaps into negative territory.

([1]) Agnello, L., and L. Schuknecht (2009), 'Booms and busts in housing markets: Determinants and implications', *ECB Working Paper*, No 1071.
([2]) Eurostat (2010), 'Experimental house price indices for the euro area and the European Union', Research Paper, December 2010.
([3]) The smoothing parameter is set to 100 000 as in Goodhart, C. and B. Hofmann (2008), 'House prices, money, credit and the macroeconomy', *ECB Working Paper Series*, No 888, and Agnello and Shuknecht (2009).

Graph I.2: **Relative house price gap, selected euro area countries (in %, 1972Q2-2012Q2) (1)**



(1) The overvaluation of relative price gap is calculated as the difference between actual prices and their filtered trend.
Source: DG ECFIN.

The results presented in the graph should not, however, be interpreted as evidence of price misalignments in the euro area. Countries experiencing housing adjustment episodes are now below their trend. The trend should not be interpreted as a floor, however. During a downswing, house prices naturally evolve below the trend without necessarily indicating significant misalignment. In contrast, prices in Germany present a positive gap. Prices are now experiencing an upward cyclical phase after reaching a trough in 2008. Continuous monitoring will be needed to determine whether and when this cyclical upward movement becomes unsustainable.

Second step: identifying and analysing the house price cycle

A classical NBER analysis is applied to detrended house price data, first detecting peaks and troughs with the Bry and Boschan (1971) algorithm ([4]) and then discarding small fluctuations that cannot be considered as genuine cyclical developments. ([5]) Following this approach makes it possible to obtain information on the amplitude, duration and severity of the house price cycle for euro area countries. The phases of the cycle are presented in Table I.1.

([4]) Bry, G. and C. Broschan (1971), 'Cyclical analysis of time series: Selected procedures and computer programs', UMI publisher.

([5]) Restrictions imposed to eliminate minor fluctuations include using a rolling window of 12 quarters of the price series, eliminating episodes with two consecutive peaks or troughs and imposing a change in the sign of the relative price gap (going from over- to under-valuation or vice versa) in order to confirm a change in the phase of the cycle.

In addition, unsustainable boom-bust developments are separated from more moderate changes in house prices by applying restriction criteria to the severity indicator. These consist in either removing the first three quartiles of the distribution or allowing only fluctuations above a certain threshold (two standard deviations). Both methods produce relatively similar results, with the corresponding characteristics of the boom and bust episodes shown in the last two rows of Table I.1. ([6])

A first look at the data reveals some important features of the latest housing cycle in the euro area.

First, average duration, amplitude and also severity are fairly symmetrical across the house price gap cycle. Indeed, bear periods tend to match bull periods. Bear episodes lasted on average 22 quarters, with a cumulated drop in relative prices from peak to trough of 31 pp (relative to trend) ([7]) while bull episodes lasted on average 26 quarters, with cumulated price gains of 32 pp. Moreover, the latest upswing was longer and more exuberant than previous episodes, lasting on average 33 quarters, with an amplitude of 39 pp. Given the symmetry between bull and bear periods, the severity of bull periods may be used as a benchmark for assessing the required adjustment in the current bear period. When assessing the potential for further house price corrections, what matters is not the distance with respect to the trend (traditionally known as over- or under-valuation) but rather net severity, measured as the severity accumulated over the build-up phase minus its counterpart accumulated over the correction.

Second, when gauged against the full sample, nine euro area Member States (IE, EL, ES, FR, IT, NL, PT, SI and EE) presented boom features over the last decade, according to at least one of the three cyclical indicators (amplitude, duration or severity). ([8]) The case for Ireland and Spain is clear-cut as they surpass the thresholds for the three cyclical indicators, presenting a long and ample upswing in house prices relative to trend that can be regarded as a boom. Both countries have experienced strong price corrections in recent years that can be classed as busts according to the metrics used here. Estonia and, to a lesser extent, Slovenia witnessed a short and sudden upswing, which was more than offset in cumulative terms in a short period of time since the peak. Lastly, France, Italy, the Netherlands and Portugal witnessed long albeit more moderate deviations of prices from the trend. ([9]) Indeed, developments in their relative house prices are signalled as unsustainable due to the long duration of the upswing rather than to cumulated price change. Interestingly, these countries are among those which have not experienced sizeable corrections so far, suggesting that the amplitude criterion (i.e. cumulated price changes) might be a better proxy than the duration criterion for detecting price rises that are likely to turn into damaging busts.

It is important to interpret these findings on house price cycles in the broader context of macroeconomic developments. Member States which followed strong bull house price dynamics over the past cycle, such as Ireland, Spain and to some extent Estonia and Slovenia, have all recently undergone a strong correction of their residential investment rates, while their economic activity was contracting. In these countries, the housing boom of the previous decade was associated with various degrees of external imbalances which have since been to some extent reversed. Moreover, a strong accumulation of household debt came hand-in-hand with housing imbalances. Rapid credit growth fuelled housing market activity, leaving households with a substantial debt overhang in several Member States. In the downturn, protracted deleveraging processes will most likely accompany house price adjustments. In 2012Q1 household deleveraging was already under way in countries such as Estonia, Ireland and Spain.

By contrast, in Member States with a protracted but more moderate house price upswing, such as France, the Netherlands and Italy, the increase and subsequent correction in residential investment were more moderate. Household indebtedness has not receded after the onset of the global economic and financial crisis and current account dynamics have also been little affected by the crisis.

([6]) Bull or bear periods during which at least one of the three cyclical indicators (amplitude, duration, severity) exceeds the average level found during boom or bust episodes are shaded in grey in the table.

([7]) As correction is ongoing in most Member States, bear figures might be slightly biased upwards.

([8]) Booms are defined as discussed previously, i.e. bull periods for which the severity indicator exceeds either the 3rd quartile of the distribution or 2 standard deviations, with both thresholds yielding similar results.

([9]) Even more so for the Netherlands, where the 1989Q3 peak could be considered as local, with the latest bull phase starting already in 1985Q2.

Table I.1: **Identification of boom/bust episodes out of bull/bear cyclical developments In relative house price gaps, euro area (1)**

	Bull phases				Bear phases			
Country	[Trough-Peak]	Amplitude (% of trend)	Duration (quarters)	Severity	[Peak-Trough]	Amplitude (% of trend)	Duration (quarters)	Severity
BE	Q1 1973-Q3 1979	39.5	26	128.2	Q3 1979-Q3 1985	44.7	24	134.0
	Q3 1985-Q2 1990	21.5	19	51.0	Q2 1990-Q4 2001	9.1	46	52.3
	Q4 2001-Q2 2007	13.4	22	36.9	Q2 2007-Q2 2012	10.8	20	27.1
DE	Q2 1976-Q2 1981	13.5	20	33.8	Q2 1981-Q1 1989	14.4	31	55.8
	Q1 1989-Q4 1994	13.5	23	38.8	Q4 1994-Q1 2008	14.2	53	94.1
	Q1 2008-Q2 2012	10.4	17	22.1				
IE	Q1 1978-Q4 1979	17.8	7	15.6	Q4 1979-Q4 1995	46.6	64	372.8
	Q4 1995-Q1 2007	69.4	45	390.4	Q1 2007-Q2 2012	65.8	21	172.7
EL	Q1 1997-Q1 2009	40.9	48	245.4	Q1 2009-Q2 2012	34.2	13	55.6
ES	Q2 1972-Q2 1978	33.6	24	100.8	Q2 1978-Q4 1985	51.5	30	193.1
	Q4 1985-Q1 1991	55.6	21	146.0	Q1 1991-Q4 2000	48.5	39	236.4
	Q4 2000-Q3 2007	52.8	27	178.2	Q3 2007-Q2 2012	46.2	19	109.7
FR	Q2 1972-Q4 1980	17.5	34	74.4	Q4 1980-Q1 1985	22.4	17	47.6
	Q1 1985-Q1 1991	24	24	72.0	Q1 1991-Q3 1998	29.4	30	110.3
	Q3 1998-Q1 2007	34.4	34	146.2	Q1 2007-Q2 2012	20.2	21	53.0
IT	Q1 1980-Q2 1981	34.6	5	21.6	Q1 1975-Q1 1980	15.3	20	38.3
	Q3 1986-Q3 1992	41.5	24	124.5	Q2 1981-Q3 1986	50.6	21	132.8
	Q3 1998-Q4 2008	29.6	41	151.7	Q3 1992-Q3 1998	37.3	24	111.9
					Q4 2008-Q2 2012	21.1	14	36.9
LU	Q2 2000-Q4 2005	21.2	22	58.3	Q1 1995-Q2 2000	19.9	21	52.2
					Q4 2005-Q3 2011	13.9	23	40.0
MT	Q2 2002-Q1 2008	36.5	23	104.9	Q1 2000-Q2 2002	14.2	9	16.0
					Q1 2008-Q2 2012	30.1	17	64.0
NL	Q2 1972-Q2 1978	67.4	24	202.2	Q2 1978-Q2 1985	64.6	28	226.1
	Q2 1985-Q3 1989	20.3	17	43.1	Q3 1989-Q2 1993	18.4	15	34.5
	Q2 1993-Q4 2007	25	58	181.3	Q4 2007-Q2 2012	18.6	18	41.9
PT	Q4 1996-Q1 2010	19.9	53	131.8	Q1 1995-Q4 1996	10.6	7	9.3
					Q1 2010-Q2 2012	19.2	9	21.6
SI	Q1 2003-Q4 2007	45	19	106.9	Q4 2007-Q2 2012	28.9	18	65.0
FI	Q2 1979-Q3 1984	18.6	21	48.8	Q1 1974-Q2 1979	35.5	21	93.2
	Q3 1986-Q2 1989	55.8	11	76.7	Q3 1984-Q3 1986	7.2	8	7.2
	Q2 1993-Q4 1999	24.4	26	79.3	Q2 1989-Q2 1993	72.8	16	145.6
	Q4 2001-Q1 2007	19.5	21	51.2	Q4 1999-Q4 2001	11	8	11.0
	Q1 2009-Q3 2010	7.3	6	5.5	Q1 2007-Q1 2009	11.9	8	11.9
EE	Q3 2003-Q2 2007	95.7	15	179.4	Q2 2007-Q3 2009	78.9	9	88.8
	Q3 2009-Q2 2012	30.4	11	41.8				
Mean		31.7	25	102.8		30.5	22	87.1
Threshold (3rd quartile)		41.1	26	146.0		45.8	24	111.5
Threshold (2 std. dev.)		38.4	26	161.7		39.8	26	158.9

(1) No analysis could be conducted for Cyprus, Austria and Slovakia due to the short data sample, starting in 2005Q1.
Source: DG ECFIN.

I.3. The housing imbalance toolkit: confirmation signals from valuation methods

In order to identify unsustainable developments in housing markets, house price cycle analysis can be supplemented with affordability (price-to-income) and dividend (price-to-rental) ratios. These ratios can be compared to their long-term averages, with the gap between the latter and the actual value providing information on over- or under-valuation.

Conclusions based on these indicators have to be considered with caution due to their simplifying assumptions. Comparisons with the long-term average are only valid for stationary series. However, traditional unit root tests point to non-stationary properties of affordability and dividend ratios in many countries; see for example Caporale and Gil-Alana (2010). ([10]) Moreover, as pointed out in André (2010), ([11]) affordability ratios can be affected by changes in the distribution of income across age groups or changes in the average size of households, while rentals can be highly regulated, distorting the interpretation of price-to-rental ratios.

([10]) Caporale, G.M. and L.A. Gil-Alana (2010), 'US disposable personal income and housing price index: A fractional integration analysis', *Discussion Papers of DIW Berlin 1070*, DIW Berlin, German Institute for Economic Research.

([11]) André, C. (2010), 'A bird's eye view of OECD housing. markets,' *OECD Economics Department Working Papers*, No 746, OECD Publishing.

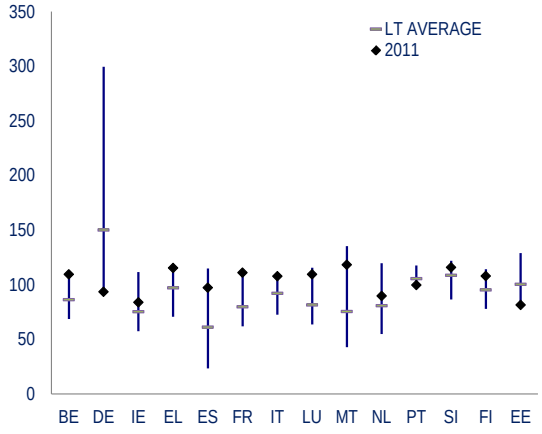
I.3.1. Affordability ratios

Housing upswings need to be checked against affordability pressures for the average buyer. Indeed, an increase in households' real disposable income can potentially accommodate rising house prices. On the other hand, prolonged and rapid increases in the price-to-disposable income ratio or even deviations from its long-term average could be interpreted as a sign of overvaluation.

Construction of the series for the euro area

Affordability ratios for the euro area are constructed, according to the OECD definition, ([12]) as the ratio of the nominal house price index to gross disposable income per capita. ([13]) This ratio is rebased to 100 in 2005, and therefore it cannot be compared across countries, but to each Member State's long-term average.

Graph I.3: **Ratio of price to disposable income, euro area countries (2005=100) (1)**



(1) Data for DE up to 1990 refer to West Germany. Sample max. and min. values are depicted by the blue bars.
Source: AMECO, OECD, Eurostat, ECB, BIS.

As shown in Graph I.3, Germany stands out with a current price-to-income ratio well below its long-term average and at a historical low. Estonia and Portugal also currently appear at very low levels. Ireland, the Netherlands and Slovenia are currently close to their long-term average, following their recent adjustments. These countries could be regarded as subject to only limited downward pressures in house prices, according to the indicator.

On the other hand, Belgium, Spain, France, Luxembourg and Malta currently present large deviations from their long-term benchmark, suggesting higher adjustment potential. Finland, Italy and Greece are also among those with a price-to-income ratio above the historical average, although in these countries the gap is smaller in relative terms and therefore the scope for correction seems lower (classed as medium pressures).

Additional analysis using effort ratios

Findings based on the price-to-income ratio have to be considered with caution due to their simplifying assumptions. There appears to be no cointegration relationship between house prices and disposable income in the long run, possibly due to time-varying mortgage costs (see Girouard *et al.* 2006). It is therefore useful to look at other affordability indicators, such as the interest burden, in combination with the total debt figures.

As shown in Table I.2, indebtedness has reached record-high levels over the last cycle, leaving households with a large debt overhang. However, in most Member States this did not translate into a lower ability to service debt due to the prevailing low-interest environment.

Table I.2: **Household debt and interest burden against disposable income (in %)**

	Household debt to disposable income (%)					Interest burden to disposable income (%)			
	1995	2000	2007	2011		1995	2000	2007	2011
BE	54.3	62.6	79.8	85.2	BE	2.4	2.5	3.0	1.5
DE	89.7	108.0	92.1	88.4	DE	5.4	5.2	4.0	2.9
IE (1)	n.a.	112.1	201.7	202.5	IE (1)	n.a.	4.9	8.1	3.1
EL	n.a.	50.2	71.1	84.6	EL	n.a.	0.2	2.3	2.7
ES	n.a.	69.1	127.7	123.6	ES	n.a.	2.3	5.3	3.0
FR	51.5	54.2	74.7	82.9	FR	3.1	2.2	3.6	2.0
IT	24.3	34.0	58.3	65.4	IT	2.1	1.0	2.2	0.8
CY (2)	95.9	115.7	154.9	173.0	CY (2)	5.9	7.3	4.4	5.1
LU	n.a.	n.a.	126.7	132.2	LU	n.a.	n.a.	5.9	2.5
NL	n.a.	163.7	249.8	266.0	NL	n.a.	9.2	11.7	6.5
AT (2)	106.0	73.7	86.7	90.5	AT (2)	6.9	2.4	2.8	1.6
PT	63.1	84.5	127.8	125.6	PT	2.2	2.6	8.0	2.9
SI (2)	35.4	0.0	42.0	47.2	SI (2)	4.9	1.7	2.2	1.4
SK (2)	0.0	9.5	47.9	56.1	SK (2)	1.3	0.7	2.1	1.1
FI	8.5	61.2	98.1	103.5	FI	1.0	2.6	4.7	1.6

(1) 2002 first data available. (2) 2010 latest annual data available.
Source: Eurostat.

([12]) Girouard, N., M. Kennedy, P. Van den Noord and C. André (2006), 'Recent house price developments: The role of fundamentals,' *OECD Economics Department Working Papers*, No 475, OECD Publishing.
([13]) The house price index is calculated as in the previous section. For Bulgaria and Malta, GDP is used instead of gross disposable income per capita.

In absolute levels, the Netherlands stands out as presenting the highest interest burden. This feature represents undoubtedly a manifestation of its particular institutional features in mortgage markets (and related tax arrangements), ([14]) but nevertheless points towards additional risks in the event of increases in interest rates. The interest burden has recently increased in Greece: although still low in relative terms, it could continue to rise as the disposable income prospects are poor. In contrast, Belgium, France and Italy have benefited from a low interest rate environment. This reduced interest burden alleviates somewhat their affordability analysis.

I.3.2. Price-to-rental ratios

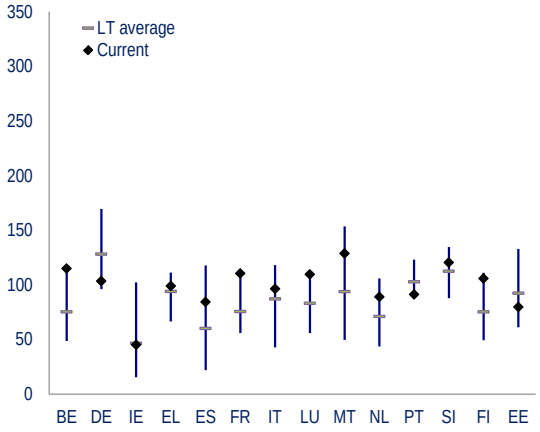
Housing prices can also be assessed against the cost of renting. Following the asset price modelling literature, house price changes are expected to be driven by changes in expected capital gains or in future housing services (rental yields). In equilibrium, agents should be indifferent between buying/selling and renting. Thus, movements in the price-to-rental ratio could be interpreted as a sign of overheating (higher ratio) or cooling (lower ratio) markets. When prices gain ground relative to rentals, there will be downward pressures on the former through lower demand, and vice versa.

Construction of the series for the euro area

Price-to-rental ratios are constructed, using the OECD definition, as the nominal house price index divided by the rental component of the consumer price index. ([15])

In broad terms, the price-to-rental ratio shows a significant increase in the cost of owning versus the cost of renting in the last 10 years for most Member States, pointing to the existence of imbalances in the housing sector (Graph I.4). More specifically, Belgium, Spain, France, Luxembourg, Malta and Finland represent examples of high potential for correction, given that their current index is well above its long-term average. The opposite appears to be the case in Germany, Ireland, Portugal and Estonia, which are subject to low pressures according to the price-to-rental ratio. Greece, Italy, the Netherlands and Slovenia could be regarded as in-between cases as their current level stands above but close to the benchmark.

Graph I.4: **Price-to-rental index, euro area countries (2005=100) (1)**



(1) Sample max. and min. values are depicted by the blue bars.
Source: Eurostat, OECD, ECB, BIS.

This simple descriptive analysis suffers, however, from an important drawback. As in the case of the affordability ratios, taking the long-term average as a benchmark equilibrium value assumes stationarity, which contradicts the empirical evidence in many cases. ([16])

Additional analysis using imputed rents

In order to overcome these caveats, theoretical ways of estimating equilibrium prices can be introduced. The user cost of owning a house, known as the imputed rent, is a function of a number of components that include mortgage payments, forgone interest that the owner would have earned by investing in something other than the house (opportunity cost) and various other costs such as taxes and maintenance costs. These costs are offset by a number of benefits that accrue through owning a house, such as possible tax deductibility and expected capital gains.

Graph I.5 presents the gap between actual house prices and the estimated equilibrium values using the method of imputed rents. A high value for the gap reflects potential overvaluations in the

([14]) The combination of a relatively large share of variable interest rate mortgages and high interest rate deductibility yields a substantial gap between gross and net (after-tax) servicing costs for Dutch households.

([15]) The house price index is derived from Eurostat's Experimental House Price Index combined with other sources. The rental component of consumer price index is derived from the OECD Main Economic Indicators database, except for Malta, where Eurostat data are used.

([16]) See Krainer, J. and C. Wei (2004), 'House prices and fundamental value', FRBSF Economic Letter 2004-27.

Box I.1: **Deriving equilibrium house prices**

A Theoretical approach (following Bolt *et al.* 2011)

The imputed rent H_t, i.e. the user cost of owning a house, is a function of a number of parameters (Himmelberg *et al.* 2005) ([1]), for example:

$$H_t = m_t P_t + \varphi_t P_t - (\delta E_t P_{t+1} - P_t),$$

where P_t is the price of the house, m_t is the mortgage rate and hence $m_t P_t$ is the mortgage the owner has to pay, φ_t is a factor that captures costs that the owner incurs (such as maintenance costs) and $\delta E_t P_{t+1}$-P_t is the expected capital gain, with $(1-\delta)$ the physical depreciation of the house. Note that this is a simplified version of the factors affecting imputed rents as described in the main text. Re-arranging this in terms of the house price, we have:

$$P_t = \frac{H_t + \delta E_t P_{t+1}}{R_t}$$

where $R_t=1+m_t+\varphi$. Assuming rational expectations we can iterate forward and replace the forward-looking price with its infinite sum, i.e.

$$P_t = E_t \left(\sum_{i=0}^{\infty} \frac{\delta^i H_{t+1}}{\prod_{j=0}^{i} R_{t+j}} \right).$$

In equilibrium, and following the no-arbitrage condition, agents should be indifferent between buying and renting. This implies that in equilibrium the cost of owning and using a house is the same as the cost of renting one and imputed rents equal actual rents. We can replace one for the other in the equation above to obtain an explicit form for equilibrium prices:

$$\overline{P}_t = E_t \left(\sum_{i=0}^{\infty} \frac{\delta^i Q_{t+1}}{\prod_{j=0}^{i} R_{t+j}} \right).$$

Linearising the equations (following Hott and Monnin 2008) ([2])

We need to linearise the price equation in order to transform it into a linear function of stationary variables. We define $X_t=P_t/H_t$ as the price to imputed rent ratio. We can then rewrite the price equation as:

$$X_t = \frac{\delta X_{t+1}(H_{t+1}/H_t) + 1}{R_t}.$$

After linearising through first-order Taylor expansion, iterating forward and taking conditional expectations, we substitute imputed rents with actual rents through the arbitrage condition, arriving at an equilibrium equation that can be estimated:

$$\overline{x}_t = \sum_{i=1}^{\infty} \rho^i E_t \left(\Delta q_{t+i} - \frac{1}{\rho} m_{t+i} \right) - m_t + c,$$

$$\overline{x}_t = \overline{p}_t - q_t$$

Estimation

Consider the following VAR specification $z_t=Azt\text{-}1+u_{t-1}$,where z_t is the vector of observables and A a set of estimated coefficients. Variable u_t is a set of iid errors. Estimating this VAR allows us to forecast the future values of z_t.

For the equilibrium model discussed so far the relevant vector is:

$$\overline{z}_t = [x_t \;\; \Delta q_t \;\; m_t \ldots x_{t-k} \;\; \Delta q_{t+k} \;\; m_{t-k}].$$

We can therefore re-write the equilibrium price to imputed rent ratio as

$$\overline{x}_t = \sum_{i=1}^{\infty} \rho^i g_1 E_t(\overline{z}_{t+i}) + g_2 \overline{z}_{t+c},$$

where $g_1=[0\ 1\ -1/\rho\ 0 \ldots 0]'$ and $g_2=[0\ 0\ -1\ 0 \ldots 0]'$. Once we have the fitted values for the equilibrium price to imputed rent ratio, we can back out the equilibrium prices.

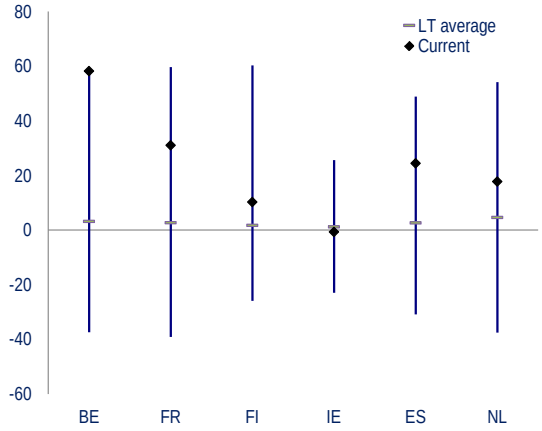
(estimation routine provided by Marco van der Leij, University of Amsterdam, gratefully acknowledged)

([1]) Himmelberg, C., C. Mayer and T. Sinai (2005), Assessing high house prices: Bubbles, fundamentals and misperceptions, Journal of Economic Perspectives, 19(4), pp. 64-92.

([2]) Hott C. and P. Monnin (2008), Fundamental real estate prices: An empirical estimation with international data, The Journal of Real Estate Finance and Economics, Springer 36(4), pp. 427–450

housing market. In qualitative terms, figures are roughly in line with the information reflected in Graph I.4, although current overvaluation seems more contained when compared to equilibrium levels instead of long-term averages. Moreover, looking at the almost negligible long-term average of the estimated gap, these series could be thought of as stationary, presenting mean-reverting properties.

Graph I.5: **House price valuation gap based on imputed rents, selected euro area economies (%) (1)**



(1) Current date is 2011 Q4 and the starting point differs across countries: BE 1976Q4, IE 1987Q1, ES 1981Q1, FR 1973Q3, NL 1974Q2, FI 1980Q3, DK 1981Q1, SE 1980Q2, UK 1973Q3. Sample max. and min. values are depicted by the blue bars.
Source: DG ECFIN.

Belgium, Spain and France show the highest overvaluation figures and thus the biggest potential for correction according to this methodology. In the same manner, the adjustment witnessed so far in Ireland closed the gap, while more is to be expected in Spain and the Netherlands. Finland is above but close to the long-term average.

Two important caveats apply to this interpretation of upcoming price adjustments. On the one hand, it implies that all the correction will take place through actual prices, with equilibrium prices held constant. Obviously, this is not necessarily the case as large shifts in equilibrium prices also occur, especially during periods of economic stress, and therefore the necessary adjustment may turn out to be larger than the overvaluation gap. ([17]) On the other hand, a protracted period of undervalued prices generally follows booming episodes. Therefore, prices could go beyond closure of the gap. The absence of long time series makes it difficult to estimate equilibrium prices for most of the euro area Member States.

I.3.3. House prices and market fundamentals

The aim of this section is to provide estimates of the deviations of house prices from equilibrium values justified by fundamentals. The empirical literature is based on various methods of estimation of the effects of supply and demand factors on housing and mortgage markets. These include simple time series methods, single-country multivariate approaches (structural vector auto-regressive models (VAR) or vector error correction models (VECM)), ([18]) multi-country panel approaches, or a combination of the latter two (panel VECM or VAR). ([19])

VAR- and VECM-based models can take into account the dynamic interplay between house prices, disposable income, demographic developments, housing investment, and credit conditions. In addition, VECM models can distinguish between short-term and long-term variations of real house prices in response to changes in other variables. In this setting, house prices can be assessed by comparing the actual prices to estimated fundamental values.

Miles and Pillonca (2008) ([20]) decompose house price changes into their main driving factors. They identify as the main demand shifters real disposable income, real interest rates and demographics, while changes in the housing stock are generally taken as a proxy for the impact of the supply side. According to the authors, changes in income per capita and real interest rates explain around 40 % of house price changes on average.

Population growth and particularly immigration flows provided an important spur to house prices in Ireland, Spain and the United States in pre-crisis years. In some countries, the increase in

([17]) The fact that the estimated equilibrium price is not constant needs to be taken into account. Spain is a natural example where, despite strong adjustment in the housing market, the gap has been almost unchanged due to falling estimated equilibrium prices.

([18]) See Girouard *et al.* (2006) for a literature survey, updated by Borowiecki (2008), 'A macro view of the Swiss real estate market: an empirical study of the housing economy', Diploma thesis at the Swiss Banking Institute at the University of Zürich.

([19]) See Goodhart, C. and B. Hofmann (2007), 'House prices and the macroeconomy: Implications for banking and price stability', *Oxford University Press*, Oxford.

([20]) Miles, D. and V. Pilonca (2008), 'Financial innovation and European housing and markets', *Oxford Review of Economic Policy*, Vol. 24. No 1, 2008, pp. 145-175.

Graph I.6: **Pooled estimate of long-run equilibrium house prices (1)**

(1) Equilibrium house prices are derived from equations relating house pries to their fundamental (see text).
Source: DG ECFIN.

house prices came hand-in-hand with rapid developments in residential investment, leading to an increase in the housing stock. This provided at least some counterweight to the demand increase, especially in Ireland, Spain, Greece and Portugal. Finally, the authors identify a residual factor related to the prospects of future capital gains. The general feeling that house prices would rise indefinitely was fuelling demand through a drop in the expected user costs of owning a house, and relaxing to some extent the restrictions to accessing the mortgage market faced by households due to the collateral role of houses.

Along these lines, André (2010) provides a detailed classification of mortgage market developments that also contributed to real house price increases during the years preceding the crisis: the extension of loan terms, an increase in the share of flexible-interest vs fixed loans, increased loan-to-value ratios, developments of housing equity withdrawal and development of subprime loans with their securitisation schemes, among others. Finally, country-specific factors, such as demand by non-residents for seasonal occupation, were especially relevant for Mediterranean countries such as Spain and France.

It appears from these studies that the separation of house price shifters into fundamental and non-fundamental variables is a complex task. Indeed, structural changes in the mortgage and house markets (e.g. increased average LTV, longer mortgage maturity, tax incentives) may lead to changes in housing demand, and therefore push the equilibrium house price upwards. However, if these structural changes turn out to be unsustainable, the equilibrium house prices may also need to revert to past levels.

In order to estimate the equilibrium values for house prices justified by fundamentals, a VECM system has been designed building on a previous

study by ZEW. ([21]) The authors construct for a panel of 14 advanced economies four VECM models, each using a system of four fundamental variables, the real house price being in all cases one of them. The other variables are chosen from among: total population, urban population share, real housing investment, real disposable income per capita, real short-term interest rate and real long-term interest rate. ([22]) The authors show that these variables tend to follow integrated processes and that there is a cointegrating relationship among them.

Following the same approach, a four-variable system of the real house price, the total population, the real disposable income per capita and the long-term interest rate is estimated for the period 1972-2011 on pooled data with country fixed effects. ([23]) The house prices and the estimates of the long-run equilibrium are presented in Graph I.6.

A house price adjustment is under way in countries that were identified previously as following strong bull/bear dynamics. Fundamental trend house prices are retreating as disposable income and interest rates adjust in Greece, Ireland and Portugal, and similar developments are to be expected in Spain and Slovenia. In countries where current prices are above or at the currently declining trend (Greece, Spain, Slovenia) house price pressures seem rather high. House prices are well below their long-term trend in Ireland and, to a lesser extent, in Portugal: medium to high future price pressures are expected as fundamentals continue to adjust.

According to the overvaluation estimates, adjustment seems to be at an earlier stage in the Netherlands, Belgium, Malta and Italy. The adjustment of prices in France was short-lived and the estimated overvaluation gap has increased recently. All these countries could experience moderate downward pressures in the near future.

Estonia had a strong adjustment below trend in the early stages of the crisis and house prices started to increase recently. Future upward developments warrant close surveillance. Lower price pressures are currently estimated for Finland, Luxembourg and Slovakia.

These results should, however, be interpreted with caution as they are subject to considerable estimation caveats. First, identifying the effects of fundamentals on equilibrium prices is challenging. Moreover, it is important to bear in mind that in an overheating environment some fundamental determinants could be overshooting their long-term sustainable values. Possible developments in fundamentals that affect the long-term trend also need to be taken into account (e.g. currently Spain or Slovenia). Identification problems in the pooled fixed-effect estimation are severe for Member States with limited available data series, or where housing markets have been subject to significant structural changes during recent years.

I.4. Overall assessment

The identification of unsustainable developments in house prices is surrounded by a high degree of uncertainty, affecting researchers' and policy makers' capacity to foresee the timing and extent of house price cycles. No methodology is exempt from caveats and technical challenges. The combination of the relevant dimensions presented in this paper nevertheless permits a comprehensive approach helping, on the one hand, to identify booms followed by busts and, on the other hand, to assess the dynamics of undergoing adjustment processes.

The identification of unsustainable developments requires confirming signals from the different methods. At this stage one of the main challenges remains pooling the information and the results coming from the various tools. The crossing of the cyclical identification of a boom with a confirming signal from any (or several) of the other overvaluation methods might be a way forward, as suggested in Dreger and Kholodilin (2011). ([24]) The dynamics of the ongoing correction phase in most housing markets in the euro area can also be proxied through the proposed toolkit. First, as stated above, severity indicators in the boom give a first-hand quantification of the extent of the required adjustment, in terms of both duration and amplitude. Second, VECM models might help forecast developments in house prices conditional on the evolution of their determinants.

([21]) ZEW (2011), 'Housing markets and intra-euro area macroeconomic imbalances: Identifying policy instruments', Unpublished study for the European Commission.

([22]) The modelling approach builds on Gattini and Hiebert (2010), 'Forecasting and assessing euro area house prices through the lens of key fundamentals', *European Central Bank Working Papers Series*, No 1249, October.

([23]) Germany and Austria are excluded due to specific housing market dynamics; Cyprus is excluded for reasons of data availability.

([24]) Dreger and Kholodilin (2011).

All in all, comparative cross-country analysis covering the main relevant dimensions gives an insight into housing market imbalances and provides a first approximation to existing divergences between euro area countries. Table I.3 presents an overview of the housing market pressures as signalled by the different methods.

Table I.3: **Overall downward pressures (1)**

		Price-to-income		Price-to-rental		Econometric model	
		Pressures	Qualifier (a)	Pressures	Qualifier (b)	Pressures	Qualifier (c)
Group I	IE	Low	+	Low	=	Medium	+
	ES	High	=	High	=	High	=
Group II	SI	Low	=	Medium	na	High	-
	EE	Low (2)	+	Low	na	Low	=
Group III	EL	Medium	+	Medium	na	High	=
	FR	High	-	High	=	Medium	=
	IT	Medium	-	Medium	na	Medium	=
	NL	Low	+	Medium	=	Medium	=
Group IV	PT	Low	+	Low	na	Medium	+
	LU	High	=	High	na	Low	=
	MT	High	=	High	na	Medium	+
	FI	Medium	=	High	-	Low	=
	BE	High	-	High	=	Medium	=
	DE	Low (2)	=	Low	na	na	na

(1) The qualifiers indicate higher (+), unchanged (=), or lower (-) downward pressures than those given by the basic pressures indicator. (a) Effort ratio; (b) Imputed rents; (c) Fundamentals dynamics.
(2) Estonian and German house prices have recently been on an upward path.
Source: DG ECFIN.

Countries are grouped according to the unsustainable developments in the last upswing identified in the housing cycle analysis of Section 1.1. **Group I** corresponds to Member States having experienced long and ample booms. **Group II**, in turn, refers to sudden and sharp booming periods, while **Group III** includes countries where house prices stayed above their trend for a prolonged period of time, averaging lower house price growth rates. Finally, **Group IV** stands for countries where no booming episodes were identified. ([25])

Three valuation indicators, together with their respective qualifiers, also allow us to classify countries according to low/medium/high downward price pressures. Among Member States in Group I and II, and given confirming signals from valuation methods, the adjustment process in Spain might continue further. On the other hand, current valuation indicators for Ireland and Estonia signal low or moderate pressures, although potential adverse developments in the fundamental determinants of Irish house prices and the recent turnaround of prices in Estonia should be followed carefully. Signals from valuation methods for Slovenia are somewhat equivocal, but the risk of adverse fundamental developments potentially points to medium-to-high price pressures. Within Group III, Greece and France signal medium-to-high price pressures, but current economic conditions in the former would imply higher risks. Finally, among Group IV countries possible downward pressures are signalled in Malta, Luxembourg and Belgium. Downward pressures in Germany seem low and house prices have recently been increasing. Despite the absence of a clear house price boom in these countries before the crisis, these signals deserve further inspection.

These results should be interpreted as warning signals pointing to countries where the housing market requires more in-depth analysis, also looking at institutional specificities and sub-national developments. There is a need to better understand how structural features of the housing and mortgage markets, including tax incentives (see the specific contribution on housing taxation in this volume), affect real estate and credit developments and facilitate or hinder the emergence of imbalances on these markets. This should also be supplemented with an analysis of the disparities in housing valuation between regions/cities given that factors at play might differ between urban and rural or coastal areas. Assessing vulnerabilities stemming from the institutional and regulatory frameworks in the housing and mortgage markets and depicting local housing market specificities can help in designing sensible and specific policy responses in a consistent and comparable way.

([25]) Portugal qualifies as a non-booming country due to its downward sloping trend.