



OECD Economics Department Working Papers No. 475

Recent House Price  
Developments: The Role of  
Fundamentals

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<https://dx.doi.org/10.1787/864035447847>

**Unclassified**

**ECO/WKP(2006)3**

Organisation de Coopération et de Développement Economiques  
Organisation for Economic Co-operation and Development

**23-Jan-2006**

**English - Or. English**

**ECONOMICS DEPARTMENT**

**ECO/WKP(2006)3**  
**Unclassified**

**RECENT HOUSE PRICE DEVELOPMENTS: THE ROLE OF FUNDAMENTALS**

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**JT00197301**

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## ABSTRACT/RÉSUMÉ

**Recent House Price Developments: The Role of Fundamentals**

In the vast majority of OECD economies, house prices in real terms have been moving up strongly since the mid-1990s. Because of the important role housing wealth has been playing during the current upswing, this paper will look more closely at what is underlying these developments for 18 OECD countries over the period from 1970 to the present, with a view to shedding some light on whether or not prices are in line with fundamentals. The paper begins by putting the most recent housing price run-ups in the context of the experiences of the past 35 years. It then examines current valuations against a range of benchmarks. It concludes with a review of the links between a possible correction of housing prices and real activity. The main highlights from this analysis are as follows: 1) The size and duration of the current real house price increases; the degree to which they have tended to move together across countries; and the extent to which they have disconnected from the business cycle are unprecedented. 2) Overvaluation of real house prices may only apply to a relatively small number of countries. However, the extent to which these prices look to be fairly valued depends largely on longer-term interest rates remaining at or close to their current low levels. 3) If house prices were to adjust downward, the historical record suggests that the drops might be large and that the process could be protracted, given the observed stickiness of nominal house prices and the current low rates of inflation.

*JEL Classification:* R21, R31.

*Keywords:* House prices, housing markets.

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**Le rôle des fondamentaux dans l'évolution récente des prix des logements**

Dans la grande majorité des pays de l'OCDE, les prix réels des logements se sont accrus fortement depuis le milieu des années 90. Étant donné le rôle important joué par le patrimoine immobilier dans la reprise; cette étude examinera de près les facteurs ayant contribué à cette évolution afin de mieux cerner si les prix des logements depuis 1970, pour 18 pays de l'OCDE, sont justifiés par les fondamentaux. Cette étude commence par replacer les hausses les plus récentes des prix de l'immobilier résidentiel dans le contexte des évolutions observées au cours des 35 dernières années. Elle examine ensuite les prix actuels au regard d'un certain nombre d'indicateurs. Elle s'achève enfin par une analyse des liens entre un éventuel réajustement des prix des logements et l'activité réelle. Les principaux aspects de cette analyse sont les suivants: 1) L'ampleur et la durée de l'augmentation des prix réels des logements, l'homogénéité de leur évolution dans différents pays et leur découplage par rapport au cycle économique sont sans précédent. 2) La surévaluation des prix de l'immobilier n'apparaîtrait que dans un nombre relativement restreint de pays. Cela étant, pour considérer que ces prix sont justifiés, il faut, dans une large mesure supposer que les taux d'intérêt à long terme resteront pratiquement aussi bas qu'actuellement. 3) Si les prix des logements venaient à baisser, l'expérience passée conduit à penser que les baisses pourraient être plus importantes en termes réels et qu'elles pourraient être durables, compte tenu de la rigidité observée des prix des logements en termes nominaux et de la faiblesse actuelle de l'inflation.

*Classification JEL :* R21, R31.

*Mots clés :* Prix des logements, marché immobilier.

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## RECENT HOUSE PRICE DEVELOPMENTS: THE ROLE OF FUNDAMENTALS

Nathalie Girouard, Mike Kennedy, Paul van den Noord and Christophe André<sup>1</sup>

### INTRODUCTION AND SUMMARY

1. In the vast majority of OECD economies, house prices in real terms (the ratio of actual house prices to the CPI) have been moving up strongly since the mid-1990s (Figure 1). Real house prices of the 18 OECD countries for which there is information over the period from 1970 to the present are grouped by the extent of the increases and decreases they have experienced since the mid-1990s.<sup>2</sup> Because of the important role housing wealth has been playing during the current upswing (Catte *et al.*, 2004), this paper will look more closely at what is underlying these developments, with a view to shedding some light on whether or not prices are in line with fundamentals.

2. The paper begins by putting the most recent housing price run-ups in the context of the experiences of the past 35 years. It then examines current valuations against a range of benchmarks. It concludes with a review of the links between a possible correction of housing prices and real activity. The highlights from this analysis are as follows:

- A number of elements in the current situation are unprecedented: the size and duration of the current real house price increases; the degree to which they have tended to move together across countries; and the extent to which they have disconnected from the business cycle.
- While concerns have been expressed in several quarters about high housing prices, the evidence examined here suggests that overvaluation may only apply to a relatively small number of countries. However, the extent to which these prices look to be fairly valued depends in good part on longer-term interest rates, which exert a dominant influence on mortgage interest rates, remaining at or close to their current low levels.
- If house prices were to adjust downward, possibly in response to an increase in interest rates or for other reasons,<sup>3</sup> the historical record suggests that the drops (in real terms) might be large and that the process could be protracted, given the observed stickiness of nominal house prices and the current low rate of inflation. This would have implications for activity and monetary policy.

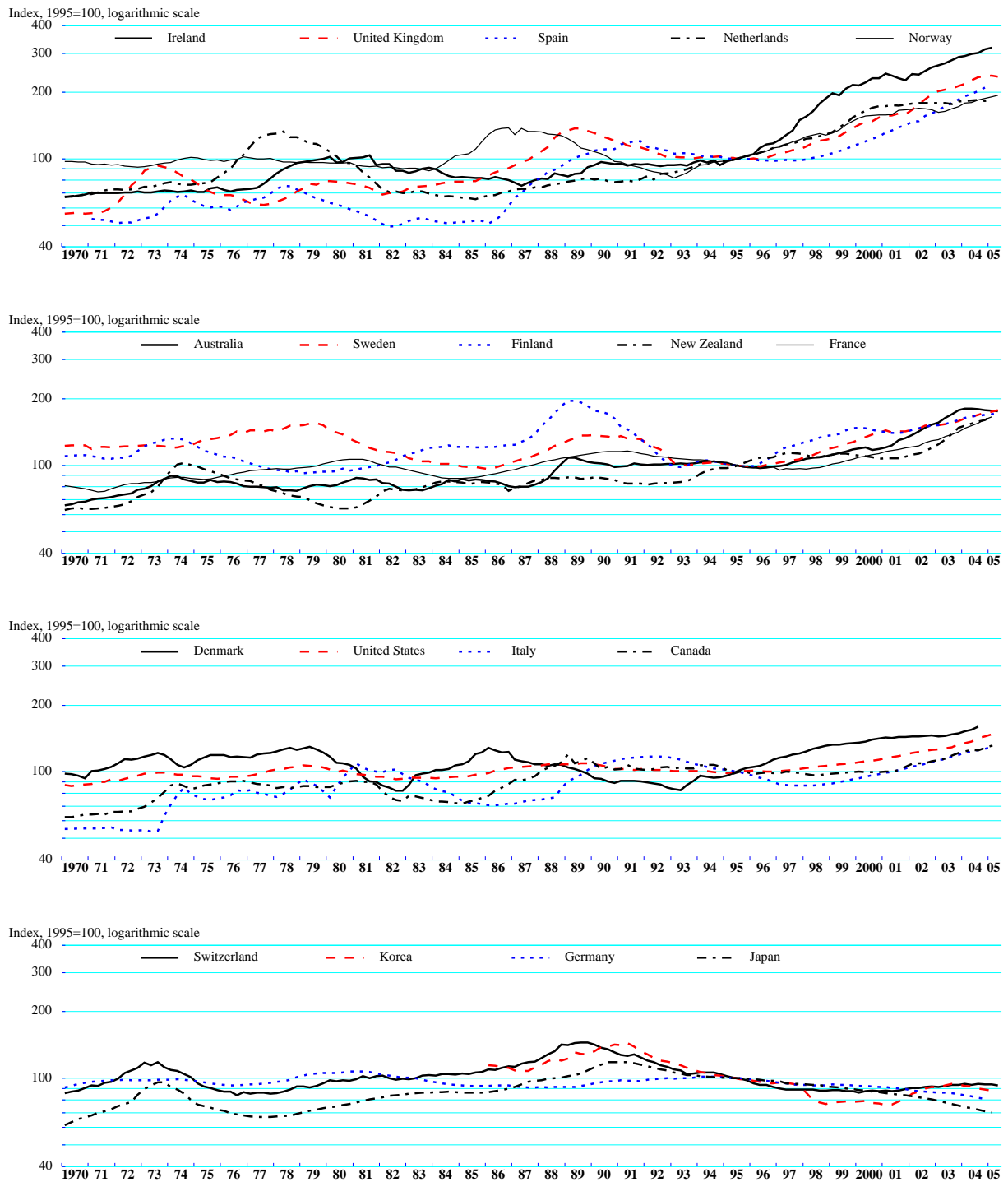
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1. General Economic Analysis Division of the OECD Economics Department. Contact author: Nathalie Girouard ([nathalie.girouard@oecd.org](mailto:nathalie.girouard@oecd.org)). They are grateful to Sebastian Barnes, Benoît Bellone, Pietro Catte, Jean-Philippe Cotis, Boris Cournède, Romain Duval, Jorgen Elmeskov, Michael Feiner, Claude Giorno, Peter Jarrett, Vincent Koen, Paul O'Brien, Robert Price and the Economics Department country desk experts for their comments and the European Central Bank, the Bank for International Settlements and Nomisma for providing valuable data. They would like to thank Anne Eggimann and Sarah Kennedy for secretarial assistance.

2. The frequency, definitions and quality of the data vary greatly across countries. Data for Korea start only in 1986. The sources for the series used are detailed in Table A1 in the Appendix.

3. See Borio and McGuire (2004) who document a tendency for house prices to fall about a year or so after equity prices have peaked and note that once prices fall, the declines tend to take on a life of their own.

**Figure 1. Real house prices have generally been rising**  
 Nominal price deflated by the overall consumer price index



Source: See table A1 in the Appendix for house prices. OECD Main Economic Indicators for consumer price indices.

## THIS HOUSE PRICE BOOM IS DIFFERENT

### *The magnitude and duration of house price cycles*

3. Various statistical and other criteria will be used to put the current period of real house price increases into historical perspective. Based on a procedure to date house price cycles,<sup>4</sup> it appears that, to the extent that there is an “average real-house-price cycle” over the period under consideration, it has lasted about ten years. The main features of the real house price cycles are detailed in Table 1. During the expansion phase of about six years, real house prices have increased on average by around 45%. In the subsequent contraction phase, which lasts around five years, the mean fall in prices has been on the order of 25%. By implication, at least since 1970, real house prices have fluctuated around an upward trend, which is generally attributed to rising demand for housing space linked to increasing *per capita* income, growing populations, supply factors such as land scarcity and restrictiveness of zoning laws, quality improvement and comparatively low productivity growth in construction. See for example Evans and Hartwich (2005) and Helbling (2005).

4. To put the current large run-ups in these prices in perspective, the characteristics of what are considered *major* real house price cycles are calculated in Table 2. To qualify as a major cycle, the appreciation had to feature a cumulative real price increase equalling or exceeding 15%. This criterion identified 37 such episodes, corresponding to about two large upswings on average per 35 years for English-speaking and Nordic countries and to 1½ for the continental European countries.<sup>5</sup> In this context, the current housing price boom differs from the average of past experiences in two important respects.

- First, the size of the real price gains during the current upturn is striking. For Australia, Denmark, France, Ireland, the Netherlands, Norway, Sweden, the United Kingdom and the United States, the cumulative increases recorded in the recent episode have far exceeded those of previous upturns. With the exception of Finland, real house prices in the countries experiencing gains are above their previous peaks.
- Second, its duration has surpassed that of similar past episodes of large real price increases for almost all countries. It is at least twice as long in the Netherlands, Norway, Australia, Sweden and the United States.

### *The link with the overall business cycle*

5. Comparing an aggregate real house price index with the output gap for the OECD as a whole (Figure 2), house-price and business-cycle turning points roughly coincided from 1970 to 2000, although in some upturns prices appear to have lagged OECD-wide slack. The current house price boom, however, is strikingly out of step with the business cycle.

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4. In this paper, the timing of turning points is determined using the Bry and Boschan (1971) cycle-dating procedure, described by Harding (2003). Restrictions were imposed to ensure that the periods of increases and decreases had a minimum length of six quarters so as to avoid spurious cycles. Once the turning points are known, the length of each cycle can be identified.

5. Any choice of what is “a large increase” is necessarily *ad hoc*. A similar procedure to that used here, employed by Helbling (2005), identifies booms and busts episodes when a price change exceeded 15%.

Table 1. Summary statistics on real house price cycles  
1970 Q1 -2005 Q1

	Number	Average duration (quarters)	Average price change (per cent)	Maximum duration (quarters)	Maximum price change (per cent)	Number of turns > 15%
<b>Upturns</b>						
United States	3	17.0	15.3	23	17.0	1
Japan	2	34.5	67.0	54	77.6	2
Germany	3	21.3	12.1	27	15.7	1
France	2	35.5	32.1	44	33.0	2
Italy	2	34.5	81.9	44	98.0	2
United Kingdom	3	18.3	64.2	30	99.6	3
Canada	4	15.5	31.6	27	66.5	2
Australia	6	14.3	31.6	32	84.7	3
Denmark	2	25.0	44.3	37	56.5	2
Finland	3	25.7	61.9	40	111.8	3
Korea <sup>1</sup>	2	12.5	29.0	15	33.5	2
Ireland	2	29.0	40.8	46	53.9	2
Netherlands	1	33.0	98.4	33	98.4	1
New Zealand	4	15.8	37.3	22	62.7	4
Norway	2	14.0	33.7	16	56.3	1
Spain	3	15.0	63.6	23	134.8	3
Sweden	2	19.0	35.8	22	42.5	2
Switzerland	3	28.3	40.2	53	73.5	2
Average	2.7	22.7	45.6	32.7	67.6	2.1
<b>Downturns</b>						
United States	3	14.3	-9.9	21	-13.9	0
Japan	1	15.0	-30.5	15	-30.5	1
Germany	2	16.5	-10.7	25	-15.3	1
France	2	18.5	-18.0	23	-18.1	2
Italy	2	22.0	-30.6	23	-35.3	2
United Kingdom	3	16.3	-25.0	25	-33.7	2
Canada	4	13.0	-13.5	17	-20.9	1
Australia	5	10.0	-10.1	19	-14.7	0
Denmark	2	21.5	-36.2	29	-36.8	2
Finland	3	14.0	-28.4	19	-49.7	2
Korea <sup>1</sup>	2	22.5	-26.7	39	-47.5	1
Ireland	2	16.0	-15.5	23	-27.1	1
Netherlands	1	29.0	-50.4	29	-50.4	1
New Zealand	4	15.0	-15.1	25	-37.8	1
Norway	3	21.3	-19.8	28	-40.6	1
Spain	3	19.3	-21.6	31	-32.2	2
Sweden	3	22.3	-22.7	26	-37.9	2
Switzerland	2	26.5	-34.8	41	-40.7	2
Average	2.6	18.5	-23.3	25.4	-32.4	1.3

Note: The minimum length for a phase (upturn or a downturn) has been set to 6 quarters and phases continuing beyond 2005 Q1 are excluded.

1. The period covered for Korea starts in 1986 Q1.

Source: OECD calculations.

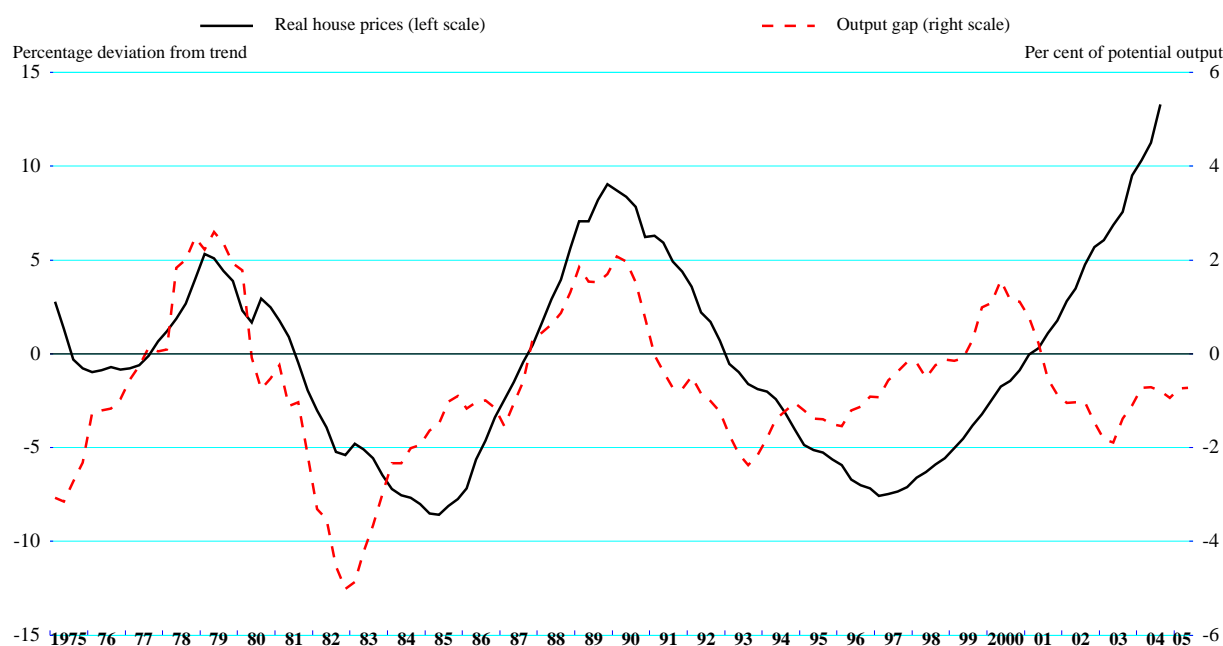


Table 2. Major real house price cycles by country

	Upturns	Duration (quarters)	Downturns	Duration (quarters)
United States	1982Q3-1989Q4: +17.0%	23		
	1995Q1-2005Q2: +52.7%	41		
Japan	1970Q1-1973Q4: +56.5%	15	1973Q4-1977Q3: -30.5%	15
	1977Q3-1991Q1: +77.6%	54	1991Q1-2005Q1: -40.7%	56
Germany	1976Q2-1981Q2: +15.7%	20	1981Q2-1987Q3: -15.3%	25
			1994Q2-2004Q4: -20.5%	42
France	1970Q1-1981Q1: +31.2%	44	1981Q1-1984Q3: -18.1%	14
	1984Q3-1991Q2: +33.0%	27	1991Q2-1997Q1: -18.0%	23
	1997Q1-2005Q1: +74.3%	32		
Italy	1970Q1-1981Q1: +98.0%	44	1981Q1-1986Q2: -35.3%	21
	1986Q2-1992Q3: +65.8%	25	1992Q3-1998Q2: -26.0%	23
	1998Q2-2005Q1: +49.6%	27		
United Kingdom	1970Q1-1973Q3: +64.9%	14	1973Q3-1977Q3: -33.7%	16
	1977Q3-1980Q1: +28.0%	11		
	1982Q1-1989Q3: +99.6%	30	1989Q3-1995Q4: -27.8%	25
	1995Q4-2005Q2: +137.4%	38		
Canada	1970Q1-1976Q4: +46.4%	27	1981Q1-1985Q1: -20.9%	16
	1985Q1-1989Q1: +66.5%	16		
	1998Q3-2005Q2: +39.2%	27		
Australia	1970Q1-1974Q1: +36.3%	16		
	1987:1-1989Q1: +35.9%	8		
	1996Q1-2004Q1: +84.7%	32		
Denmark	1970Q1-1979Q2: +32.1%	37	1979Q2-1982Q4: -36.8%	14
	1982Q4-1986Q1: +56.5%	13	1986Q1-1993Q2: -35.6%	29
	1993Q2-2004Q3: +93.4%	45		
Finland	1970Q1-1974Q2: +23.6%	10	1974Q2-1979Q1: -30.3%	19
	1979Q1-1989Q1: +111.8%	40	1989Q1-1993Q2: -49.7%	17
	1993Q2-2000Q1: +50.3%	27		
	2001Q3-2005Q2: +23.6%	15		
Ireland	1970Q1-1981Q3: +53.9%	46	1981Q3-1987Q2: -27.1%	23
	1987Q2-1990Q2: +27.7%	12		
	1992Q3-2005Q1: +242.7%	50		
Korea <sup>1</sup>	1987Q3-1991Q2: +33.5%	15	1991Q2-2001Q1: -47.5%	39
	2001Q1-2003Q3: +24.5%	10		
Netherlands	1970Q1-1978Q2: +98.4%	33	1978Q2-1985Q3: -50.4%	29
	1985Q3-2005Q1: +183.1%	78		
New Zealand	1970Q1-1974Q3: +62.7%	18	1974Q3-1980Q4: -37.8	25
	1980Q4-1984Q2: +32.5%	14		
	1986Q4-1989Q1: +15.1%	9		
	1992Q1-1997Q3: +38.9%	22		
	2000Q4-2005Q1: +56.0%	17		
Norway	1983Q4-1986Q4: +56.3%	12	1986Q4-1993Q1: -40.6%	25
	1993Q1-2005Q2: +136.3%	49		
Spain	1970Q1-1974Q3: +27.5%	14		
	1976Q2-1978Q2: +28.6%	8	1978Q2-1986Q1: -32.2%	31
	1986Q1-1991Q4: +134.8%	23	1991Q4-1996Q4: -18.3%	20
	1996Q4-2004Q4: +114.2%	32		
Sweden	1974Q1-1979Q3: +29.2%	22	1979Q3-1986Q1: -37.9%	26
	1986Q1-1990Q1: +42.5%	16	1990Q1-1996Q2: -28.2%	25
	1996Q2-2005Q2: +80.1%	36		
Switzerland	1970Q1-1973Q3: +37.7%	14	1973Q3-1976Q3: -29.0%	12
	1976Q3-1989Q4: +73.5%	53	1989Q4-2000Q1: -40.7%	41

1. The period covered for Korea starts in 1986 Q1.

Source: OECD calculations.

**Figure 2. OECD Real house prices and the business cycle**

Note: Real house prices have been detrended using a linear trend. The OECD aggregate has been computed using GDP weights in 2000 in purchasing power parities. Source: OECD Economic Outlook 78 database and OECD calculations.

6. The current upswing is also more generalised across OECD countries than in the past.<sup>6</sup> In particular, a historically high number of countries have been experiencing fairly large increases in house prices since the mid-1990s (Figure 3). A large price increase is defined as twice the mean annual change (which amounts to 5%) over a five-year period, for a total of a 25% increase.<sup>7</sup> A combination of generalised low interest rates across OECD economies, coupled with the development of new and innovative financial products, have no doubt played an important role.

7. Of the 37 large upturn phases between 1970 and the mid-1990s, 24 ended in downturns in which anywhere from one third to well over 100% of the previous gains in real terms were wiped out. This in turn had negative implications for activity, particularly consumption.

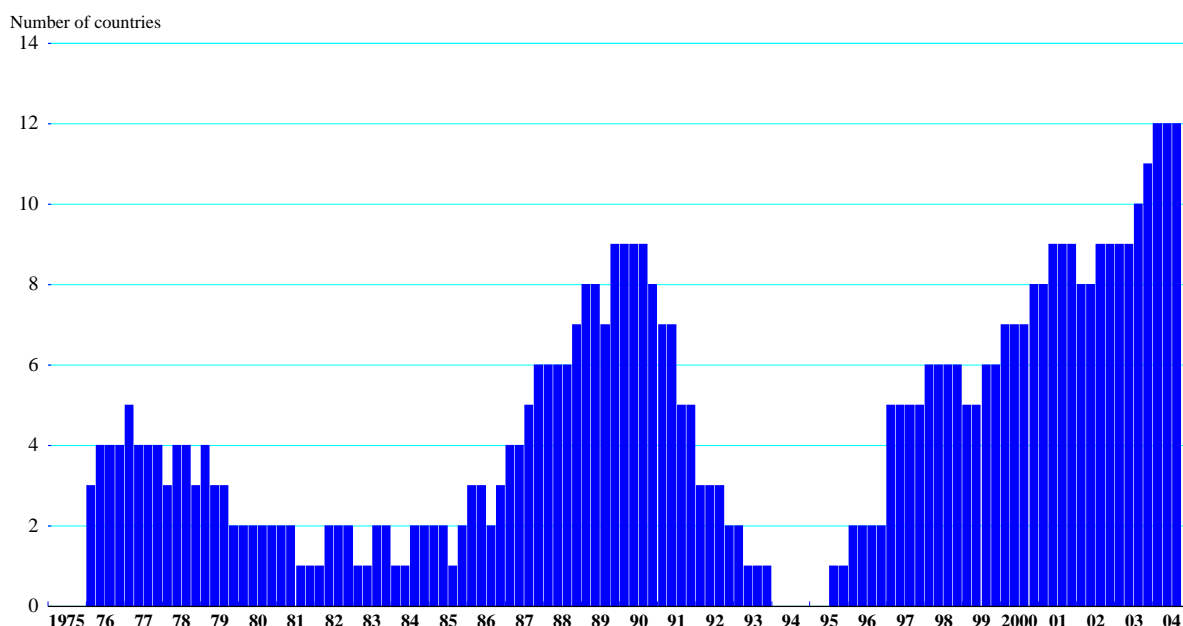
## HOUSE PRICES AND THEIR UNDERLYING DETERMINANTS

8. Unique and dramatic house price increases are not necessarily evidence of overvaluation. To address this issue, it is necessary to relate these prices to their putative underlying determinants. To this end, evidence from econometric models, affordability indicators and asset-pricing approaches, respectively, is examined below, supplemented by a qualitative discussion of other factors affecting house prices.

6. Otrok and Terrones (2005) argue that global factors, including low real interest rates and global business cycles, are important determinants of house price cycles.

7. Other criteria, for instance price changes of at least one standard deviation from the mean, show a similar pattern. See for example, Ahearne *et al.* (2005).

**Figure 3. Cross-country coincidence of real house price increases**  
 Number of countries (out of 17) with over 25% increase in real prices over the previous five years



Source: See table A1 in the Appendix.

### *Evidence from econometric models*

9. Econometric models can be used to compute the “fundamental” price, as determined by demand (derived on the basis of factors such as real disposable income, real interest rates and demographic developments) and supply (derived from factors influencing the available housing stock). Typically, the specification of these models is a long-run (co-integration) relationship between the house price and these determinants, which is then embedded in an error-correction mechanism. The interpretation of the co-integrating relationship provides an estimate of “equilibrium” or long-term house prices, against which current prices can be evaluated.

10. The literature reviewed for this study was confined to recent research detailed in Table 3. It suggests that prices are broadly in line with what were identified as their main determinants in Denmark, Finland, France, the United States and Norway. The findings are mixed for the Netherlands. However, they uniformly point to overvaluation in the United Kingdom, Ireland and Spain.

11. The results from any econometric study, however, can be subject to a number of valid criticisms. For example, it cannot be excluded that the estimated relationship is unstable, possibly because the price elasticities of supply and demand vary over time, due for instance to changes in regulatory conditions, demographic developments and taxes that cannot be adequately taken into account. For example, Gallin (2003) and Gurkaynak (2005) stressed several drawbacks from using an econometric approach for such purposes. Ongoing structural changes in some economies also may not be captured correctly by such methods. Given the margin of uncertainty, this evidence needs to be complemented by other approaches.

Table 3. Review of recent empirical studies on house price determination

Country and authors	Methodology	Elasticity of real house prices relative to housing stock supply	Elasticity of real house prices relative to real disposable income	Elasticity of real house prices relative to real interest rate	Other variables	Estimated overvaluation	Comments
<b>United States</b> Meen (2002)	ECM, 1981Q3-1998Q2	-7.9	2.7	-1.3	Real wealth = 0.7		High growth in real house prices is not attributable to weak supply response. If the housing stock variable is removed, the income elasticity is biased downward.
Schnure (2005)	Panel estimation for regional house prices, short-run specification, 1978-2004		0.2 to 0.3, short-run impact	-0.6 to -1.7, short-run impact	Unemployment = -0.9 to -1.2, labor force = 0.4 to 1.8, short-run impact	No evidence of overvaluation	Increased sensitivity to interest rates since 1990 due to liberalisation of mortgage lending access and higher securitisation. No. obs.:531 to 946.
McCarthy and Peach (2004)	Demand and supply equations, Johansen ML estimation, 1981Q1-2003Q3	-3.2	3.2			No overvaluation since the mid-1990s.	OFHEO and constant quality new home price index give the same conclusions.
<b>Japan</b> Nagahata <i>et al.</i> (2004)	Panel cointegration analysis for 47 prefectures, 1976-2001		0.2 to 0.5	-0.6 to -4.5	Price expectations = 0.8 to 0.9	Land prices in Tokyo have bottomed out around 2002 but not in other areas.	Non-performing loan ratios have a significant explanatory power in the short-run.

Table 3. Review of recent empirical studies on house price determination (continued)

Country	Model	Elasticity of real house prices relative to housing stock supply	Elasticity of real house prices relative to real disposable income	Elasticity of real house prices relative to real interest rate	Other Elasticities	Estimated overvaluation	Notes
<b>Euro area</b>							
Annett (2005)	ECM for eight countries		0.7, variable in log differences	-0.01 to -0.02, variables in log differences	Real credit = 0.2 or real money = 0.1, variables in log differences		Real credit and money are important determinants of long-run trends.
Annett (2005)	Panel regressions for sub-groups of countries based on common institutional characteristics, short-to medium run equations		0.1 to 1.4, short-run impact	-0.01 to -0.03, short-run impact	Real credit = 0.1 to 0.2, real money = 0.4 to 0.6 short-run impact.		Institutional factors help to explain the relationship between credit and house prices.
<b>France</b>							
Bessone <i>et al.</i> (2005)	Demand and supply equations, Johansen ML estimation, 1986-2004	-3.6	8.3			No evidence of overvaluation in 2004.	House prices for Paris only.
<b>United Kingdom</b>							
Meen (2002)	ECM, 1969Q3-1996Q1	-1.9	2.5	-3.5	Real wealth = 0.4		High growth in real house prices is in part attributable to weak supply response. If the housing stock variable is removed, the income elasticity is biased downward.

Table 3. Review of recent empirical studies on house price determination (continued)

Country	Model	Elasticity of real house prices relative to housing stock supply	Elasticity of real house prices relative to real disposable income	Elasticity of real house prices relative to real interest rate	Other Elasticities	Estimated overvaluation	Notes
<b>United Kingdom (continued)</b>							
Hunt and Badia (2005)	ECM, 1972Q4-2004Q4		1.9 in 1999Q4 and 1.5 in 2004Q4	-6.0 in 99Q4		34% in 1999Q4 and 60% in 2004Q2	Improvements in monetary and fiscal policy frameworks have raised sustainable prices beyond what these linear estimation technique can capture, suggesting there is little overvaluation.
<b>Australia</b>							
Abelson <i>et al.</i> (2005)	ECM, 1975Q1-2003Q1	-3.6	1.7	-5.4	CPI = 0.8, unemployment = -0.2, stock index = -0.1		The CPI captures the after-tax investment advantages (expected capital gains and tax benefits)
<b>Denmark</b>							
Wagner (2005)	ECM, 1984Q4-2005Q1	-2.9	2.9	-7.7	Demography = 2.9	9/10 of the increase since 1993 is explained by fundamentals.	Scarcity of land in the Copenhagen area, temporary effect from the introduction of interest only mortgage loans could also account for the rise in house prices.
<b>Finland</b>							
Oikarinen (2005)	ECM, 1975Q1-2005Q2		0.8 to 1.3	-2.2 to -7.5	Construction costs = 1.1 to 2.3	No overvaluation in recent years.	Helsinki Metropolitan Area only. Uses a trend variable to capture financial liberalisation.

Table 3. Review of recent empirical studies on house price determination (continued)

Country	Model	Elasticity of real house prices relative to housing stock supply	Elasticity of real house prices relative to real disposable income	Elasticity of real house prices relative to real interest rate	Other Elasticities	Estimated overvaluation	Notes
<b>Ireland</b>							
OECD Economic Survey (2006)	ECM, 1977Q1-2004Q4 for new and existing houses	-2.0 for new houses, -0.007 for existing houses (time trend relative to pop. 25-44)	1.8 for new and existing houses	-1.9 for new and existing houses		20% since end 2004 for new houses and 10% for existing houses.	The sharp increase in the price of existing house relative to new houses since the mid-1990s may reflect in part relative supply constraints
McQuinn (2004)	3 equations system: inverted demand, supply and housing stock 1980Q1-2002Q4	-0.5	0.1 to 0.2	-0.005	Net migration = 0.02, mortgages approved = 1.0	Little deviation from the fundamental price in recent years.	Short-run income elasticities are high in both equations.  Land costs are an important factor in the recent rise in new house prices.
<b>Netherlands</b>							
OECD Economic Survey (2004)	ECM, 1970-2002	-0.5	1.9	-7.1		.	High growth in real house prices is mainly attributable to weak supply response.
Verbruggen <i>et al.</i> (2005)	ECM, 1980-2003	-1.4	1.3	-5.9		10% in 2003	
Hofman (2005)	ECM, 1974Q1 2003Q3		1.5	-9.42		No deviation from fundamentals in 2004	Van Rooij (1999) also failed to find any long-run effects of housing supply.
<b>Norway</b>							
Jacobsen (2005)	ECM, 1990Q1-2004Q1	-1.7	1.7	-3.2	Unemployment = 0.5	No overvaluation in recent years.	If housing stock is excluded, income elasticity drops to 1.2.

Table 3. Review of recent empirical studies on house price determination (continued)

Country	Model	Elasticity of real house prices relative to housing stock supply	Elasticity of real house prices relative to real disposable income	Elasticity of real house prices relative to real interest rate	Other Elasticities	Estimated overvaluation	Notes
<b>Spain</b> OECD Economic Survey (2004b) Ayuso <i>et al.</i> (2003) and Banca de Espana (2004)	ECM, 1989-2003 1978-2002	-6.9 to -8.1	3.3 to 4.1 2.8	-4.5 (in nominal terms) if the elasticity of income is 1 otherwise insignificant	Population total = 12 to 16.9 Stock market return = -0.3	8% to 17% in mid-2002, 14% to 19% in 2003 and 24% to 31% in 2004.	High growth in real house prices is not attributable to weak supply response.
<b>Group of countries</b> Sutton (2002)	VAR model for the US, Australia, Canada, UK, the Netherlands and Ireland, 1970s-2002Q1			Short rates = -0.5 to 1.5, weaker for long-rates, with lowest estimates for the US and the UK and largest for the Netherlands.	GNP = 1 to 4 after 3 years, largest in Ireland. Share prices = 1 to 5 after 3 years, largest in the UK	Overvaluation in all countries except Canada over 1995Q1 to 2002Q2, largest in Ireland.	
Tsatsaronis and Zhu (2004)	VAR model for 17 countries, grouped on their mortgage finance structures, 1970-2003		Account for less than 10% of total variation in house prices after 5 years	Account for than 11% of total variation in house prices after 5 years	Inflation account for 50% of total variation in house prices after 5 years, while bank credit and term spread account each for around 10%		Mortgage market structures matter for the importance of inflation sensitivity to interest rates and the strength of the bank credit channel.
Terrones and Otrok (2004)	Dynamic panel regressions for 18 countries, 1970-2003		1.1	-1.0	Population growth = 0.3, housing affordability = -0.1, lagged dependent variable = 0.5	Between 1997 to 2003, overvaluation by 10% to 20% in Australia, Ireland, Spain and the United Kingdom, by 10% or less in Sweden and the United States	The growth rate of real house prices is very persistent, shows long-run reversion to fundamentals and dependence on economic fundamentals. No. observations = 524.



*Affordability of housing*

12. One summary measure commonly used to assess housing market conditions is the price-to-income ratio, a gauge of whether or not housing is within reach of the average buyer. If this ratio rises above its long-term average, it could be an indication that prices were overvalued. In that case, prospective buyers would find purchasing a home difficult, which in turn should reduce demand and lead to downward pressure on house prices. Figure 4 shows the ratio of nominal house price to *per capita* disposable income (as well as the ratio of prices to rents, to be discussed next). For almost all the countries shown, the price-to-income ratios in 2005 are substantially above their long-term averages. In the countries with the largest house price increases (Ireland, the Netherlands, Spain and the United Kingdom) as well as in Australia and New Zealand, these ratios exceed their long-term averages by 40% or more. In Canada, Denmark, France and the United States, the run-up has been more moderate but these values still represent historical peaks. The main exception is the sub-group of countries recording declining or more recently stable house prices (Japan, Germany, Korea and Switzerland) and Finland, where price-to-income ratios are below average values.

13. The ratio of prices to household disposable income by itself, however, is not a sufficient metric to evaluate housing affordability. Indeed, house prices do not appear to be linked to income by a stable long-run relationship (Table A2), possibly because the cost of carrying a mortgage has varied over time. In fact, aggregate disposable income is likely not the appropriate denominator. It is an average measure that covers the whole population, whereas house prices are determined in a market where specific groups of sellers and buyers have different and likely higher incomes than the population mean.

14. In Table 4, an indicator of households' mortgage interest payments is constructed based on actual mortgage debt and a typical published mortgage interest rate. These rough-and-ready measures suggest that while mortgage debt burdens have been rising, the ability to service that debt has either been relatively stable or has improved slightly in Denmark, France, Germany, Ireland, Italy, Spain, Sweden and the United Kingdom since the early 1990s. Similarly benign trends have been reported in the literature for several countries.<sup>8</sup> The main exceptions are Australia,<sup>9</sup> the Netherlands<sup>10</sup> and New Zealand where the proportion

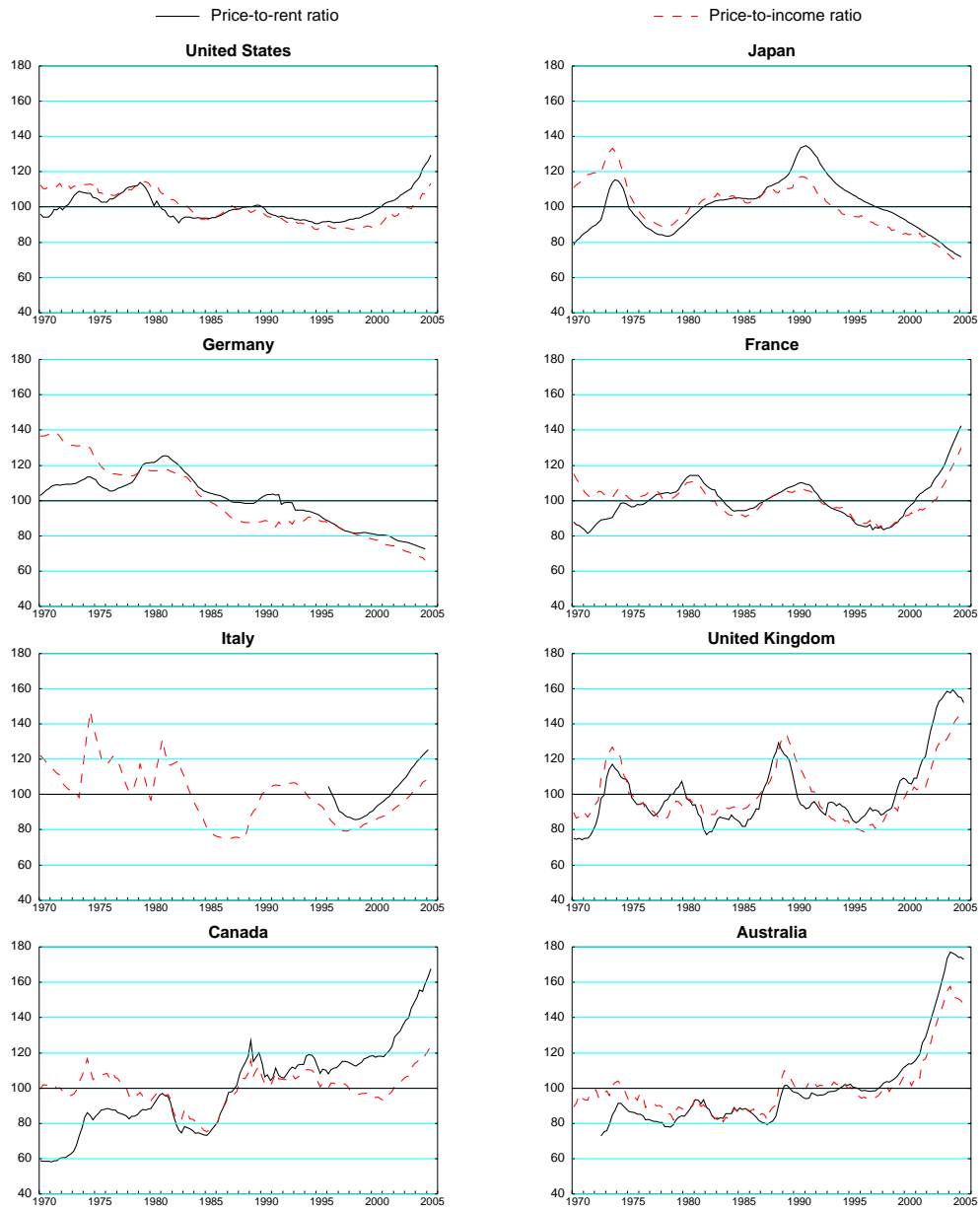
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8. Debelles (2004) for instance notes that there is no clear upward trend in the interest service ratio for eight countries. Central bank studies for France and the Nordic countries indicate falling household interest burdens in recent years (Bank of Finland, 2004, Danmarks Nationalbank, 2005, Norges Bank, 2005, Riksbank, 2004 and Wilhelm, 2005). Similarly, Canada Mortgage and Housing Corporation (2005) reports a falling interest burden, and OECD (2005a) a stable interest burden for the United Kingdom.

9. The Reserve Bank of Australia also reports a rising mortgage-servicing ratio. The large increases in household debt are mostly due to a halving of the mortgage rate and the inflation rate from the 1980s to the 1990s. Other factors that have allowed households and investors to maintain higher levels of debt for longer periods than previously are innovative products following financial deregulation and increased competition among providers of credit (Macfarlane, 2003). See also Australian Bureau of Statistics (2004) and Federal Reserve Bank of Australia (2004).

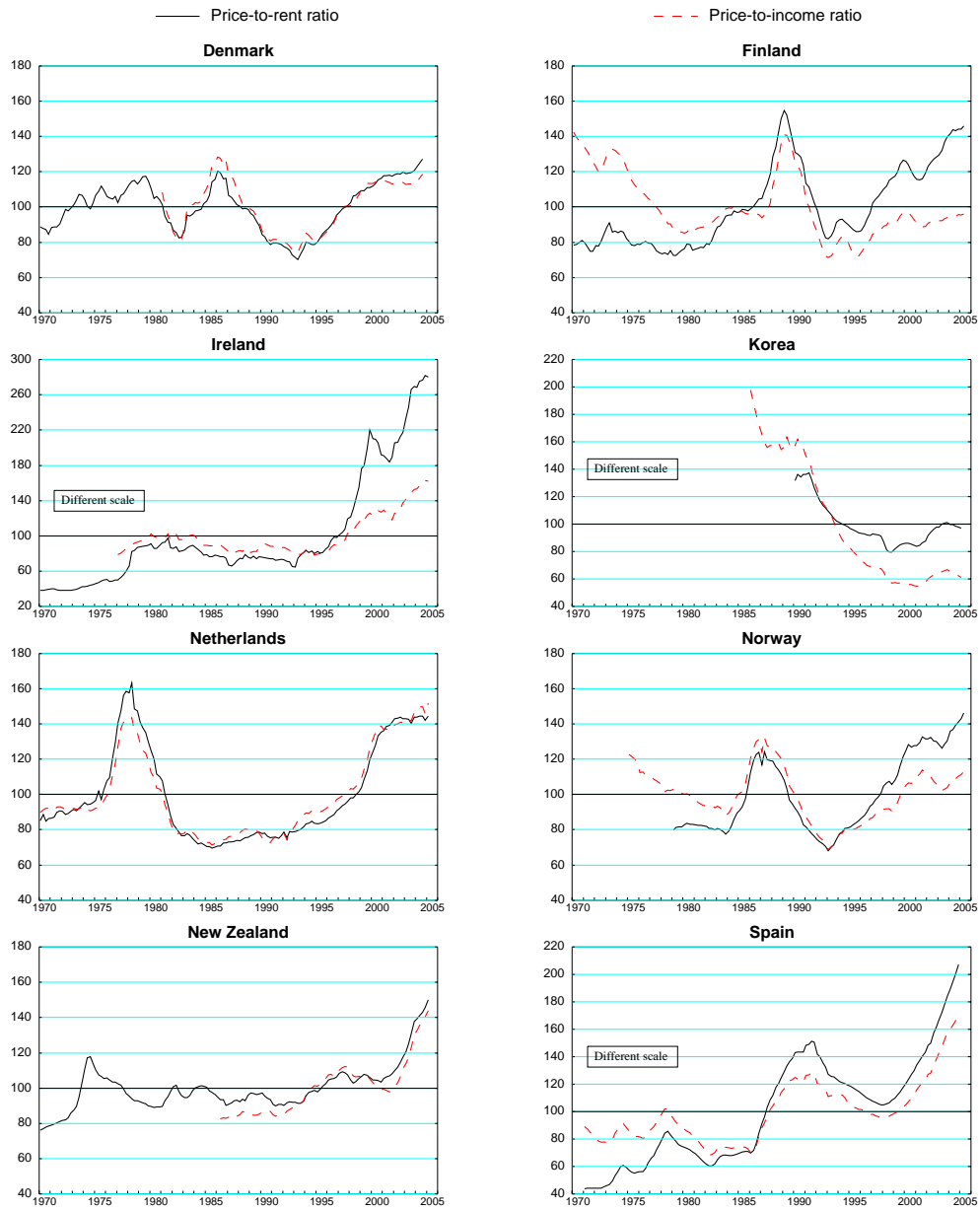
10. Dutch households have strong incentives to maintain mortgages at high levels given the extremely favourable tax treatment of debt-financed owner-occupied housing. Ter Rele and van Steen (2001) have estimated that the subsidy to housing costs for owner-occupiers rises steeply with income for mortgage financing. Mortgage financing combined with a capital insurance policy is subsidised even more. With such a combination, principal repayments are paid into the insurance policy rather than deducted from the outstanding mortgage. This enables the borrower to maximise mortgage interest deductions by not paying off the debt while at the same time accumulating capital in the insurance policy to pay off the debt when the mortgage term expires. See OECD (2004) for more details.

**Figure 4. Price-to-income and price-to-rent ratios**  
 Sample average = 100



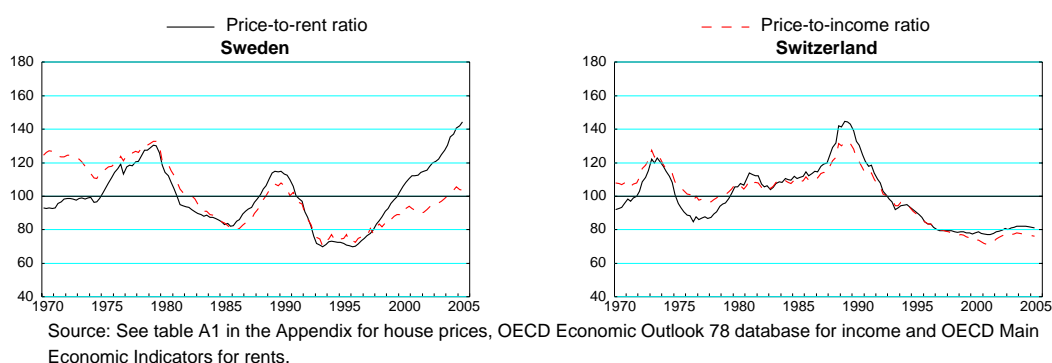
Source: See table A1 in the Appendix for house prices, OECD Economic Outlook 78 database for income and OECD Main Economic Indicators for rents.

**Figure 4. Price-to-income and price-to-rent ratios (cont.)**  
 Sample average = 100



Source: See table A1 in the Appendix for house prices, OECD Economic Outlook 78 database for income and OECD Main Economic Indicators for rents.

**Figure 4. Price-to-income and price-to-rent ratios (cont.)**  
Sample average = 100



of household income required to pay the interest on mortgages has been trending upward, reflecting the increased size of mortgages.

15. Perhaps not surprisingly, taking into account the debt-servicing ratio leads to a different assessment of current house prices than do developments in the affordability ratio itself. The general increase in indebtedness, due in part to deregulation in the mortgage markets (see below), has been mostly offset by the decline in borrowing rates and on average, households do not seem to devote a greater share of their income to debt service than in the recent past.

#### *Asset-pricing approach*

16. Another summary measure used to get an indication of over or undervaluation is the price-to-rent ratio (the nominal house price index divided by the rent component of the consumer price index). This measure, which is akin to a price-to-dividend ratio in the stock market, could be interpreted as the cost of owning versus renting a house. When house prices are too high relative to rents, potential buyers find it more advantageous to rent, which should in turn exert downward pressure on house prices. During the recent upswing, this ratio has generally outstripped the affordability measure, hitting historical peaks in several countries (see Figure 4 above).<sup>11</sup> In Ireland and Spain, two countries experiencing very sharp increases in real house prices, the 2005 level of this ratio is more than 100% above its long-term average. In the other countries reporting high real house price increases and in those experiencing more moderate gains, the ratio is 25% to 50% above its long-term average. Where real house prices have been stable or falling, the price-to-rent ratio lies below its long-run average.

11. Similar results are obtained by Ayuso and Restoy (2003) for Spain, Barham (2004) for Ireland, Weeken (2004) for the United Kingdom and Gallin (2004), Himmelberg *et al.* (2005) and Quigley and Raphael (2004) for the United States.

Table 4. Households mortgage debt and interest burden

	Mortgage debt			Interest payments			Variable interest rates
	% of household disposable income						% of all loans
	1992	2000	2003	1992	2000	2003	2002
United States	58.7	65.0	77.8	4.9	5.2	4.5	33 <sup>1</sup>
Japan	41.6	54.8	58.4	2.5	1.3	1.4	..
Germany	59.3	84.4	83.0	3.9	4.0	3.0	72 <sup>2</sup>
France	28.5	35.0	39.5	1.7	1.4	1.1	20
Italy	8.4	15.1	19.8	0.7	0.8	0.7	56
Canada	61.9	68.0	77.1	5.9	5.7	4.9	25 <sup>1</sup>
United Kingdom	79.4	83.1	104.6	4.4 <sup>3</sup>	3.7	3.0	72
Australia	52.8	83.2	119.5	4.8	6.4	7.9	73 <sup>1</sup>
Denmark	118.6	171.2	188.4	10.6	9.9	8.3	15 <sup>2</sup>
Finland	56.7	65.3	71.0	7.1	2.9	1.9	97
Ireland	31.6	60.2	92.3	2.3	3.0	2.5	70 <sup>2</sup>
Netherlands	77.6	156.9	207.7	5.0	8.4	8.2	15
New Zealand	67.0	104.8	129.0	6.9	9.3	9.4	..
Spain	22.8	47.8	67.4	1.6	2.2	1.7	75
Sweden	98.0	94.4	97.5	5.0 <sup>4</sup>	4.2	3.3	38 <sup>2</sup>

Note: Interest payments are approximated using mortgage debt, mortgage interest rates and typical loan-to-value ratio.

1. 2004-05.

2. 2003.

3. 1993.

4. 1996.

Source: European Central Bank, European Mortgage Federation, Eurostat, US Federal Reserve, Canadian Imperial Bank of Commerce (CIBC), Clayton Research / Ipsos Reid, Mortgage Choice (Australia), Reserve Bank of New Zealand and Bank of Japan.

17. Like the affordability ratio, this indicator cannot be taken at face value.<sup>12</sup> It has to be assessed against the evolution of the user cost of home ownership, which takes account of the financial returns associated with owner-occupied housing, as well as differences in risk, tax benefits, property taxes, depreciation and maintenance costs, and any anticipated capital gains from owning the house (Box 1). Equilibrium in the housing market occurs when the expected annual cost of owning a house equals that of renting, while overvaluation is characterised by an actual price-to-rent ratio greater than that calculated with the user cost, suggesting that it is cheaper to rent.

12. Statistical evidence reported in Table A2 of the Appendix also shows that house price-to-rent ratios, like the affordability measures, are not stationary.

### Box 1. The user cost of housing

The user cost of housing is calculated following a method proposed by Poterba (1992). In particular:

$$\text{User cost of housing} = P(i^a + \tau + f - \pi) \quad (1)$$

The first component within the bracket, the after-tax nominal mortgage interest rate  $i^a$ , is the cost of foregone interest that the homeowner could have earned on an alternative investment. It is adjusted to include the offsetting benefit given by the tax deduction or credit of mortgage interest in countries where this applies (Austria, Denmark, Finland, Germany, Ireland, Italy, the Netherlands, Norway, Spain, Sweden, United Kingdom, United States). This calculation takes into account deduction ceilings or credits and the tax base against which the deduction is applied.<sup>1</sup>  $\tau$  is the property tax rate on owner-occupied houses,  $f$  is the recurring holding costs consisting of depreciation, maintenance and the risk premium on residential property, and  $\pi$ , the expected capital gains (or loss).  $P$  is the house price index.

In equilibrium, the expected cost of owning a house should equal the cost of renting and this implies that the user cost can be expressed as:

$$R = P(i^a + \tau + f - \pi) \quad (2)$$

and by rearranging Equation 2,

$$\frac{P}{R} = \frac{1}{i^a + \tau + f - \pi} \quad (3)$$

Equation 3 provides a relationship between the actual price-to-rent ratio and such features of the user cost as interest rates, depreciation, taxes, etc.

Nominal mortgage interest rates are taken from national sources. Property tax rates are taken from European Central Bank (2003), International Bureau of Fiscal Documentation (1999) and Nagahata *et al.* (2005). The parameter value for  $f$  is constant at 4% and the estimation of  $\pi$  as a moving average of consumer price inflation following the method outlined by Poterba (1992).

1. See van den Noord (2005) for further details on the methodology and Cournède (2005) for an application to the euro area.

18. Figure 5 compares the actual price-to-rent ratio with that based on the user cost of housing over the past ten years. For all countries, the two measures have been set equal to 100 in the most recent year when the actual price-to-rent ratio crossed its 35-year average, which by construction means that the long-run average coincides with fundamentals.<sup>13</sup> The difference between the two series may be considered as an

13. This crude measure of equilibrium partly adjusts for the series' non-stationarity. Another approach would have been to benchmark the series to a point when actual rents were equal to the user cost; however, the user cost series go back only to 1995. This procedure does not work well for Germany because of the significant trend decline in the price-to-rent ratio starting in the early 1980s. For Germany, the two series were therefore arbitrarily set equal to each other in 2000. Choosing an earlier date would imply a larger degree of undervaluation.

approximate indicator of overvaluation, albeit with qualifications. In particular, this measure, based on a long-run concept (the desired price-to-rent ratio), ignores expected shorter-run movements in the variables that make up the user cost, which could potentially narrow the gap between the two series.<sup>14</sup> It also assumes that there is a high degree of arbitrage between the rental and ownership markets. One way to interpret the extent of putative overvaluation is to calculate the difference between the user cost implied by the observed price-to-rent ratio and the one that would align it to its estimated level, based on the fundamentals listed in Box 1 (Figure 5 and Table 5 and Table A3 for the detailed methodology). This difference is expressed in terms of percentage points. In interpreting this information, it is important to note that the results are sensitive to the existing level of interest rates, the choice of a base year, the choice of the house price series used and the assumed level of expected house price inflation. Finally, in some cases the series for house prices do not take account of quality improvements while the series for rents does.

- In the countries with high real house price gains (the United Kingdom, Ireland, the Netherlands and Spain) and in Australia (where very high real prices have more recently been edging down) and in Norway, actual price-to-rent ratios remain noticeably above their “fundamental” levels in 2004, suggesting overvaluation.
- In France, Canada, Denmark and Sweden, actual and “fundamental” ratios have moved in tandem until 2003, but have tended to move apart slightly since. On this score, overvaluation is not very significant in New Zealand.
- In Finland and Italy, the desired price-to-rent ratio has exceeded its actual level in recent years. In the United States, the “fundamental” price-to-rent ratio was above its actual level until 2000, the benchmark year. Since then, the series have moved together and the gap between them has been negligible. On this measure, there does not appear to be much of a case for overvaluation, at least at the national level.
- At the other end of the spectrum, undervaluation (indicated by a “fundamental” price-to-rent ratio above the actual value) has increased in Japan (since 1997), Germany (since 2000) and, to a lesser extent, in Switzerland. In Germany and Japan, this reflects previous building excesses.

### *Other factors affecting house prices*

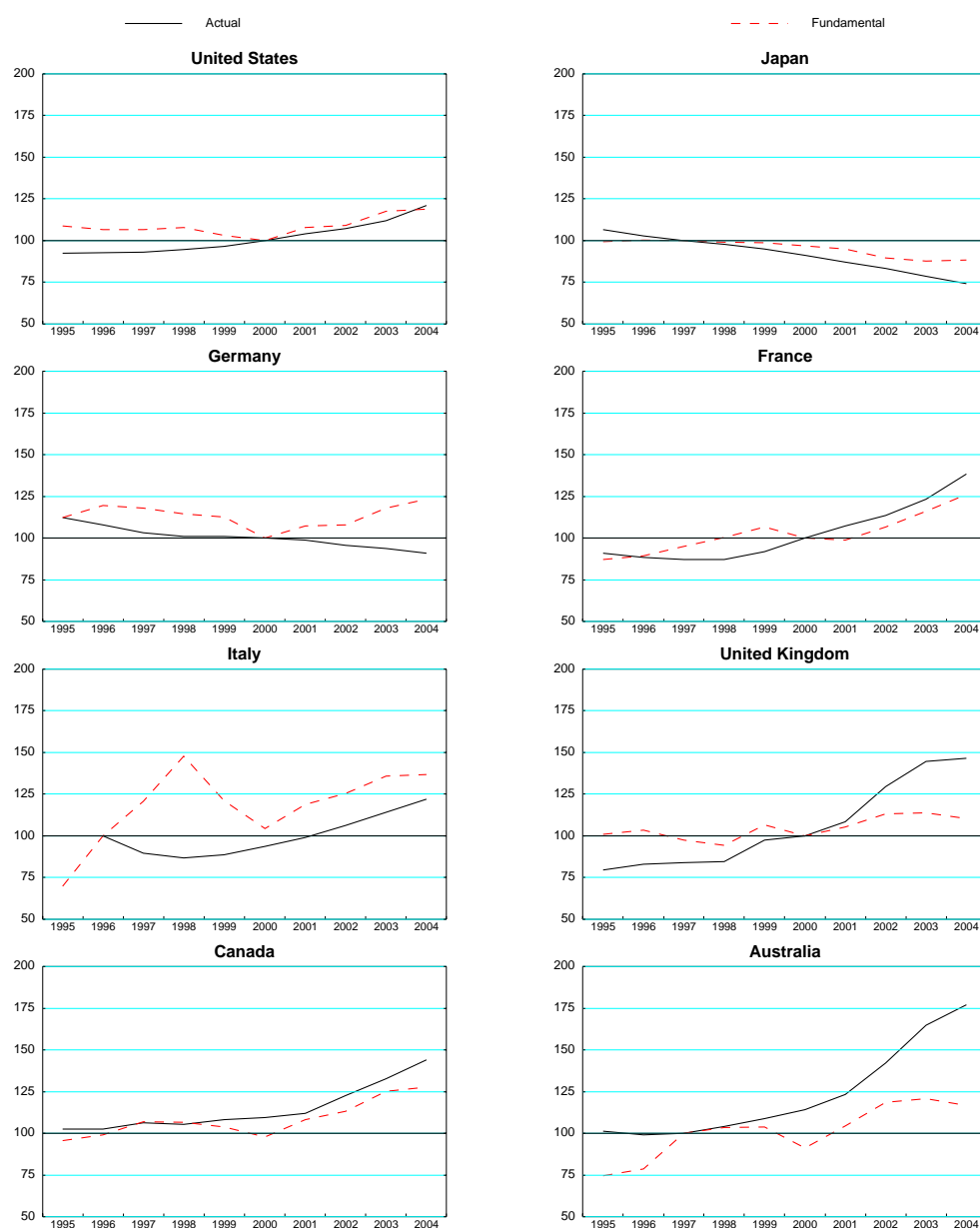
19. House prices can also be affected by other features that are particular to this market. Of note are restrictions on the availability of land for residential housing development that can constrain the responsiveness of supply. These would include tough zoning rules, cumbersome building regulations, slow administrative procedures, all of which would restrict the amount of developable land. However, while the price of housing may be affected, measures like the price-to-rent ratio would not necessarily be, since such factors would presumably raise both prices and rents.

20. In the United Kingdom, complex and inefficient local zoning regulations and a slow authorisation process are among the reasons for the rigidity of housing supply, underlying both the trend rise of house prices and their high variability (OECD, 2004a and 2005a and Barker, 2004). In Ireland and the

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14. Short-run dynamics in housing markets can have powerful effects on house prices. Ortalo-Magné and Rady (2005) for example, using a life-cycle model, show that changes in income of credit-constrained homeowners can lead to sharp price movements, especially when homeowners are moving up the property ladder. So can inter-generational transfers of housing wealth.

**Figure 5. Price-to-rent ratios: actual and fundamental**  
 Long-term average = 100<sup>1</sup>

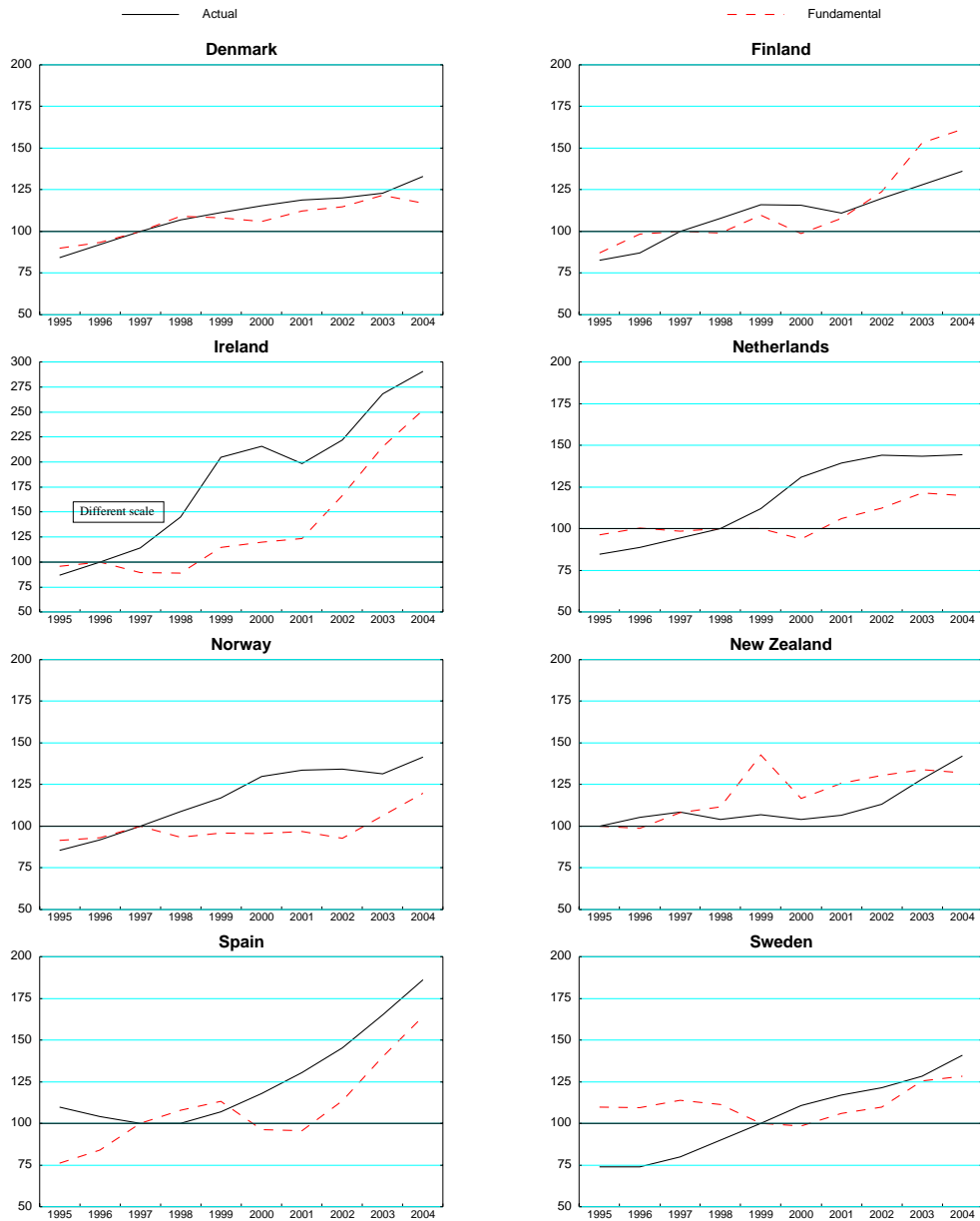


1. For each country, actual and fundamental price-to-rent ratios have been set equal to 100 in the most recent year in which the actual price-to-rent ratio was close to its 35-year average. This procedure does not work well for Germany because of the significant trend decline in the price-to-rent ratio starting in the early 1980s. Consequently, the two series have been arbitrarily set equal to each other in 2000. Choosing an earlier date does not change the results, qualitatively, although the implied degree of undervaluation would be larger.

Source: See table A3 in the Appendix.



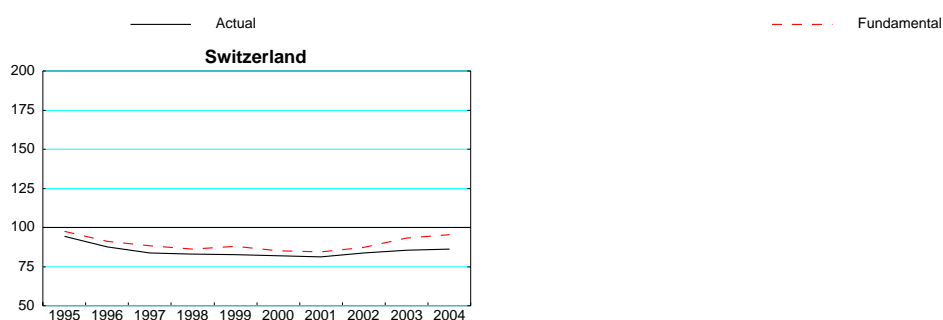
**Figure 5. Price-to-rent ratios: actual and fundamental (cont.)**  
 Long-term average = 100<sup>1</sup>



1. For each country, actual and fundamental price-to-rent ratios have been set equal to 100 in the most recent year in which the actual price-to-rent ratio was close to its 35-year average.

Source: See table A3 in the Appendix.

**Figure 5. Price-to-rent ratios: actual and fundamental (cont.)**  
 Long-term average = 100<sup>1</sup>



1. For each country, actual and fundamental price-to-rent ratios have been set equal to 100 in the most recent year in which the actual price-to-rent ratio was close to its 35-year average.  
 Source: See table A3 in the Appendix.

Netherlands similar factors affect house price dynamics (OECD, 2004 and 2006). In Korea, government limitations on urban land supply (Restricted Development Zone) have been important causes of the rapid rise in housing prices (Gallent and Kim, 2000, Hannah *et al.*, 1993 and OECD, 2005). Heavy land-use regulations in some US metropolitan areas have been associated with considerably lower levels of new housing construction which have restricted housing supply and thus increased house prices in the regulated municipalities as well as in neighbouring towns (Box 2).

Table 5. Sensitivity of fundamental price-to-rent ratios to a change in the housing user cost

	Estimated over-valuation in 2004	Change in user cost	Mortgage rate in 2004
	Per cent	Percentage point	Per cent
United States	1.8	-0.2	5.8
Japan	-20.5	1.2	2.4
Germany	-25.8	3.3	5.7
France	9.3	-0.8	5.0
Italy	-10.9	0.7	4.6
United Kingdom	32.8	-2.8	6.1
Canada	13.0	-1.0	6.2
Australia	51.8	-2.6	7.1
Denmark	13.1	-3.1	5.2
Finland	-15.6	0.9	3.4
Ireland	15.4	-0.4	3.5
Netherlands	20.4	-1.9	5.1
New Zealand	7.6	-0.7	8.0
Norway	18.2	-1.3	4.7
Spain	14.0	-0.6	3.6
Sweden	8.0	-0.7	5.3
Switzerland	-9.7	1.1	3.2

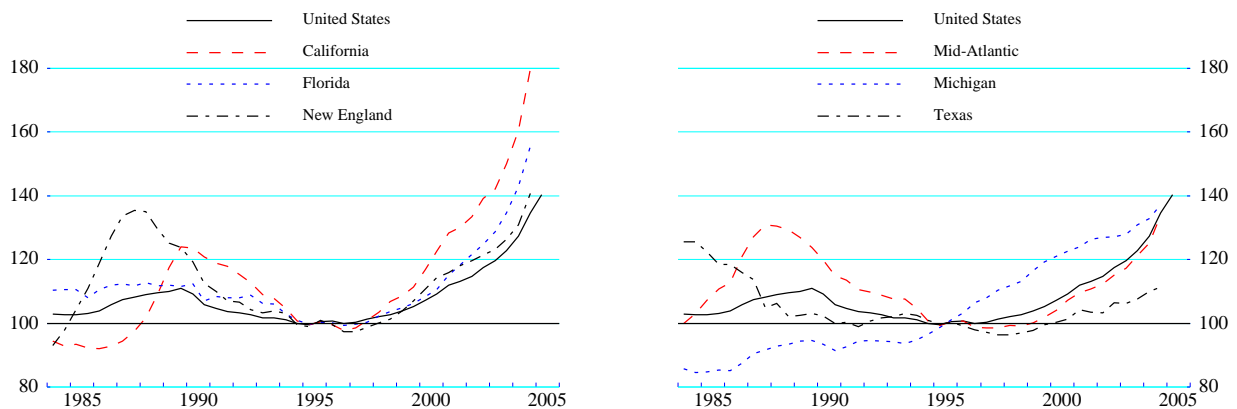
Source: European Central Bank, Statistics Canada and national central banks.

**Box 2. Regional housing markets in the United States**

Several studies on the US regional housing markets have found that the low supply elasticity of housing units is an important factor behind the recent larger price increases in some urban markets.<sup>1</sup> In particular, house prices are much higher than construction costs throughout parts of the Northeast and the West coast. The studies suggest that recent regional patterns of house price expansion do not just reflect faster growing income and population, but also other factors including building regulations on the size and characteristics of houses. They also report that US homebuilders have faced increasing difficulty in obtaining regulatory approval for the construction of new homes in some states, notably California, Massachusetts, New Hampshire, New Jersey and in Washington, D.C. An additional factor has been the increased ability of established residents to block new projects.

The effects of these developments have pushed up prices, in several cases by more than rents and this is an indicator of house price overheating in local US housing markets. These show that while some markets behave as the national market, other markets – such as California and Texas – have returns that are much higher or lower respectively than the national average. The local markets where price-to-rent ratios have reached historical peaks are also the ones where the supply constraint on new construction appears to be most binding, making prices there more volatile. They include the San Francisco, Boston and Los Angeles areas.

**Regional differences in price to rent ratio**  
Index, 1995 = 100

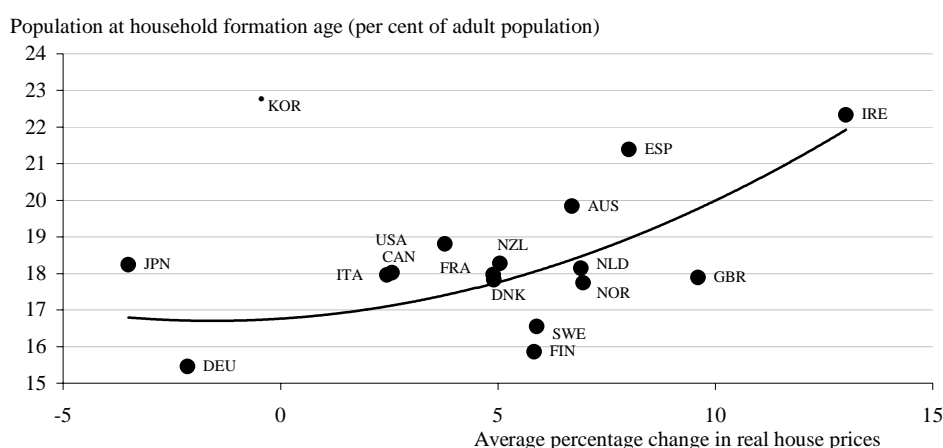


Source: Office of Federal Housing Oversight for house prices and Bureau of Labor statistics for rents.

1. Gleaser and Gyourko (2003), Glaeser *et al.* (2005), Krainer and Wei (2004), Gyourko, Mayer and Sinai (2004), Capozza *et al.* (2002), McCarthy and Peach (2004) and Mayer and Somerville (2000).

21. Demographic developments, over and above their influence through real disposable incomes can also raise housing demand, thereby increasing price levels.<sup>15</sup> In particular, high rates of net migration, declines in the average size of households and increases in population shares of cohorts of individuals in their thirties will boost housing demand by increasing the share of the population of household formation age. In several countries (including Ireland, Spain, Australia, the United Kingdom, the Netherlands and Norway) the high shares of such households in the total population since the mid-1990s have been associated with large increases in real house prices (Figure 6). By contrast, in Germany and Japan, house price declines are associated with a low share of such households in the overall population. As above, these factors should affect both prices and rents, provided that there were no distortions in the rental markets.

**Figure 6. Population and house prices  
1995-2004**



Note: Korea is an outlier and therefore has not been included into the estimation of the trendline.

Source: See table A1 in the Appendix for house prices, United Nations for population.

22. Other factors, however, may just raise the price of housing. Buy-to-let markets, which have grown substantially over the past several years in the countries for which data are available (United States, United Kingdom, Australia and Ireland), are one example. Lower interest rates have increased the return on rental property for investors, enhancing the attractiveness of, and demand for, housing as an investment. Fiscal incentives in some countries have also played a role by providing favourable conditions for those choosing to invest in housing. These markets are, however, dominated by small, first-time investors and their effect on the housing market is not well understood. See for example Scanlon and Whitehead (2005) for a description of the profile and intentions of buy-to-let investors in the United Kingdom.

- In Ireland, the buy-to-let market, while still representing a small share of private rental dwellings in the overall housing stock, at about 8%, has been growing. New buy-to-let mortgages constituted 20% of all mortgage transactions in 2004 and 30% of the second-hand dwellings sold during the first half of 2004 (Koeva and Moreno, 2004).

15. Several studies have looked at the impact of demographic trends on the demand for housing. See Cerny *et al.* (2005) for the United Kingdom; FitzGerald (2005) for Ireland; Kohler and Rossiter (2005) for Australia; and Krainer (2005) and Martin (2005) for the United States.

- In the United States, the proportion of sales attributable to such investors has been rising quickly starting in the late 1990s, reaching around 15% of all home purchases in 2004, much higher than the normal 5%. Such buyers are estimated to be about equally concentrated in fast-growing as well as less-active markets (Morgan Stanley, 2005).
- In the United Kingdom, buy-to-let mortgages have grown substantially since they were introduced in the late 1990s, from about 3% of total mortgage lending in 1999 to around 7% in 2004. The levelling-off in this ratio since mid-2004 has coincided with slowing house price appreciation.
- In Australia, the proportion of such investors doubled from around 15% of total mortgage lending in 1992 to about 30% at the end of 2003 and is high in some regional markets (42% in New South Wales and 35% in Victoria), fuelling concerns about such high levels of property investment and exposure to a significant downturn in the market.

23. A particularly important factor has been financial deregulation in mortgage markets, which has significantly reduced borrowing constraints on households. This process started in the 1980s and saw rapid growth of mortgage credit, starting in the second half of that decade, in several countries. Australia, Canada, New Zealand, the Nordic countries, the United Kingdom and the United States all experienced a sharp rise of mortgage lending and large run-ups in house prices in the late 1980s (Girouard and Blöndal, 2001 and Ortalo-Magné and Rady, 1999). More recent changes in mortgage markets including lending innovations, the adoption of new technologies and the growing use of payment reduction features in mortgages have offered households greater choices and lowered borrowing costs (Table 6). In several countries, variable rate loans have become more accessible in recent years.<sup>16</sup> Some of these instruments offer options allowing households to convert their debt to a fixed rate, thus providing them with a degree of protection against rising rates. In Denmark, the Netherlands and the United States, interest-only mortgage loans have become increasingly available. In Australia, increased competition among credit providers has contributed to the doubling of the number of products provided by lenders. Most other mortgage innovations have taken the form of lengthening terms.

## HOUSING CYCLES AND ECONOMIC ACTIVITY

24. While other housing-market specific factors have had an influence, interest rate developments are likely to play a key role. If these rates were to rise sharply over the coming period – a possibility that is currently treated as a risk in the OECD's projections – house prices would come under downward pressure.<sup>17</sup> In that event, the shape and duration of any subsequent downward adjustments is likely to be conditioned by the current low level of inflation. Based on the historical record, declines in real house prices, when they have followed large run-ups, have taken place more slowly (quickly) if increases in the overall price level are small (large). This is illustrated by the negative cross-country correlation observed between the level of inflation and the duration of the house-price-contraction phases, suggesting that it can be quite protracted at very low inflation rates (Figure 7, upper panel). There is also a tendency for real

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16. For example, in the United States, the share of adjustable rate mortgages rose from about 15% in 2000-03 to around 33% in 2004-05 according to the Federal Housing Finance Board Monthly Interest Rate Survey.

17. Getting a handle on how much downward pressure would be exerted on house prices from an interest rate increase in isolation is difficult. Based on asset-price models, for example, the effect would be large but such calculations only suggest what would happen to the desired price. In practice, the actual adjustment path would depend also on other factors – demographics, regulation, the share of variable rate mortgages, the ability of households to change their mortgages, tax deductibility and the overall economic situation.

Table 6. **Recent mortgage product innovations in selected countries**

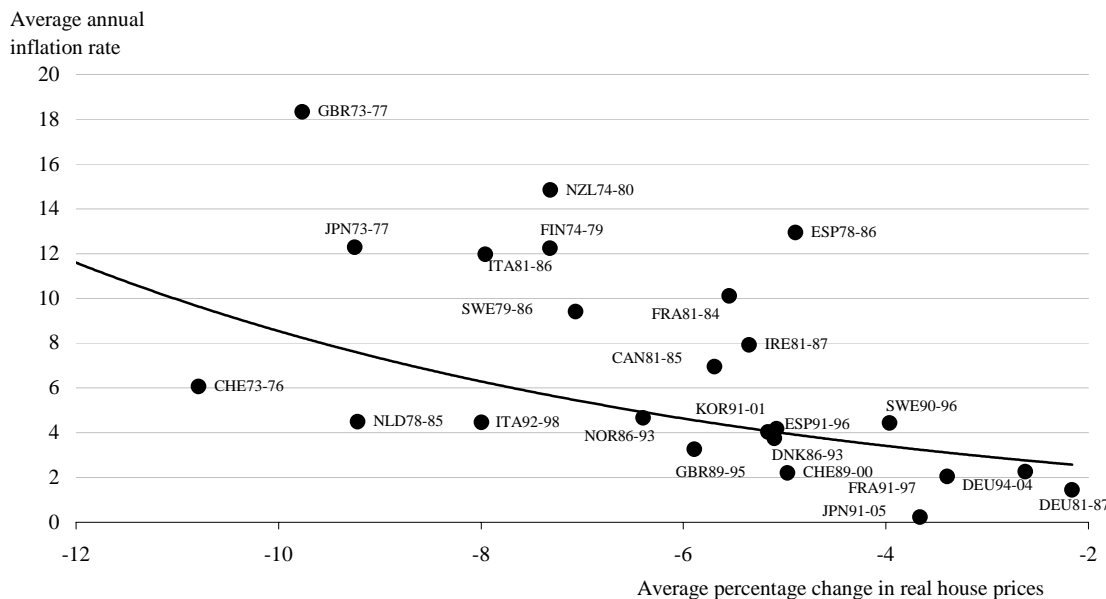
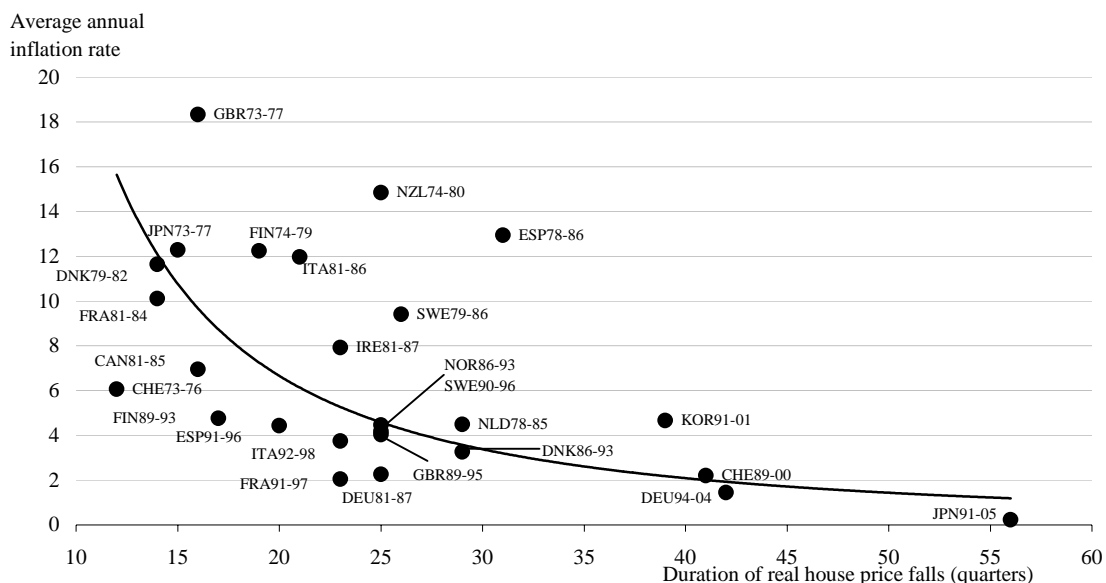
United States	Interest-only loans; Flexible mortgages with variable repayments.
Germany	New Pfandbriefe Law abolishing penalties for early mortgage pay-offs
France	Variable payment mortgages; Lengthening mortgage terms.
United Kingdom	Flexible mortgages; Offset mortgages (savings and mortgage held in same/linked accounts, with savings offset against mortgage balance); Base rate trackers.
Canada	Shorter-term mortgages, initial fixed-rate period shortened from five years to one year; Skip-a-payment, early mortgage renewal and flexible payment schedules.
Australia	Flexible mortgages with variable repayments; Split-purpose loans (splits loan into two sub-accounts, giving tax advantages); Deposit bonds (insurance company guarantees payment of deposit at settlement); Non-conforming loans; Redraw facilities and offset accounts; New providers including mortgage originators and brokers.
Denmark	"Interest-adjusted" loans: interest rate set at regular intervals by sale of bonds; Capped-rate loans; BorigXloans: interest adjusted every six months with reference to ten-day average of CIBOR; Interest-only loans.
Finland	Lengthening mortgage terms; Introduction of state guarantee for mortgages.
Ireland	Lengthening mortgage terms.
Netherlands	Savings or equity mortgages: part of payment covers interest, part goes into fixed interest savings account or equity account (confers tax advantages); Interest-only mortgages.

Source: Scanlon and Whitehead (2004) and Canada Mortgage and Housing Corporation (2005).

prices to fall less at low inflation (Figure 7, lower panel). This feature of the adjustment process stems from the fact that nominal house prices have tended to exhibit downward stickiness. Indeed, housing markets are not as liquid as other asset markets, due to high search and transactions costs as well as the heterogeneous nature of the product. In addition, when overall conditions weaken, owners of existing homes tend to withdraw from the market rather than suffer a capital loss, while builders will not develop new properties.

25. The main channels through which housing cycles affect activity are wealth effects, residential construction and the financial sector. The feed-through from house prices to private consumption occurs either via saving responses to households' perceived wealth or via collateral effects on household borrowing (Catte *et al.*, 2004). In a number of countries (Australia, Canada, the Netherlands, the United Kingdom and the United States) changes in housing wealth have a significant effect on consumption,

**Figure 7. Inflation and real house price adjustment**

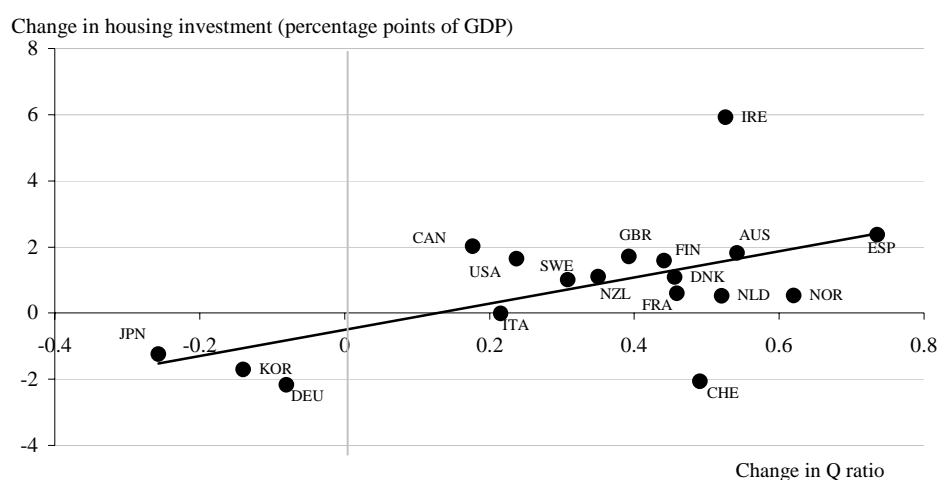


Source: See table A1 in the Appendix for house prices. OECD Economic Outlook 78 database for inflation.

exceeding the effect of changes in financial wealth, in part because financial markets provide easy access to mortgage financing and to financial products that facilitate house equity withdrawal. By contrast, in France, Germany, Italy, Japan and Spain, the housing wealth effect appears to be smaller or insignificant. The strength of the aggregate wealth effect also depends on several other factors including homeownership rates, transaction costs, and housing taxes and subsidies.

26. House prices also have important effects on private residential investment. Changes in the profitability of housing investment affect the construction sector as well as employment and demand in property-related sectors. Figure 8 relates housing investment to its profitability and shows a small but significant positive relationship over the 1995 to 2004 period for most countries. These results suggest that additional factors are important in determining construction activity. Specifically, supply constraints in the form of planning restrictions, the availability of land or the competitive conditions in the construction sector may have played a role in restraining the growth of housing investment.

**Figure 8. Housing investment and the Q ratio**  
1995-2004



Note: The Q ratio is defined as nominal house prices divided by the housing investment deflator.

Source: See table A1 in the Appendix for house prices, OECD Economic Outlook 78 database for housing investment.

27. Sharp downward corrections in asset markets, including in housing markets, can impact the banking sector, which in turn may adversely affect public finances and macroeconomic stability at large (Eschenbach and Schuknecht, 2000 and Girouard and Price 2004). If financial intermediaries misjudge risks, the potential for credit and asset booms to derail and turn into busts is increased. In this context, the pro-cyclicality of bank provisioning is a concern. Banks may be reluctant to make adequate provision for their loan losses when housing markets are buoyant, and supervisors may be reluctant to suggest it without solid evidence (Dobson and Hufbauer, 2001). Hence, when a large shock occurs, banks may find themselves with inadequate cushions to absorb the loss, which could affect credit availability.

28. The range of views on how the monetary authorities should respond to asset price developments, including house prices, is broad. Some advocate central banks responding to house (or other asset) prices only to the extent that they contain information about future output growth and inflation, and, if



desired, using alternative policy instruments (taxes and regulations) to stabilise housing cycles (Bernanke, 2002).<sup>18</sup> Others advocate that central banks should “lean against the wind” by having a tighter stance than would otherwise be warranted by overall demand conditions in the face of abnormally rapid increases in real house prices, particularly as there might be risks to financial stability (European Central Bank 2005 and Issing 2003).

29. The reaction of central bankers to house price inflation also depends on the treatment of housing costs in the inflation measure being targeted. Rents actually paid by tenants are included in the inflation measures of all countries. However, current practices vary both in the inclusion of owner-occupier's imputed rents and in the method used to calculate imputed rents. In Australia, Canada, New Zealand and Sweden, the imputed rents are calculated using some measure of house prices. In Japan and the United States, imputed rents are based on actual rents. In the Euro area and the United Kingdom, the implicit rents paid by homeowners are excluded. More generally, in the event of a downturn, the extent to which policy has to respond depends importantly on the size of the shock and the ability of the economy to absorb it.<sup>19</sup>

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18. Under this view, the costs of intervention in the face of rapidly increasing real house prices is judged to outweigh the benefits, in good part because the lags in the transmission mechanism are long and variable. In this regard, a pre-emptive hike in interest rates (over and above what is judged necessary for overall price stability purposes), may well be counterproductive (*i.e.* the effects would kick in when the housing market has already peaked). Moreover, a tighter policy to prick a housing bubble (if one could safely be identified) is also considered potentially damaging for other sectors.

19. In the United States, for example, one estimate is that a reversion to the long-run price-to-rent ratio would represent a shock that is about half the size of the US stock market decline in 2000-02, and would likely be easily absorbed (Yellen, 2005). Economies that tend to be resilient to shocks are those that have flexible labour and product markets and well-functioning financial systems. These typically have potential growth rates that are higher than the average of OECD economies.

*Appendix*

Table A1. Definition and source for house prices

	House price definition	Seasonal adjustment	Source
United States	Nationwide single family house price index	No	OFHEO, 1975Q1-2005Q2
Japan	Nationwide urban land price index	No	Japan Real Estate Institute, 1990S1-2005S1
Germany	Index for total Germany, total resales	--	Bundesbank, 1994-2004
France	Indice de prix des logements anciens, France	No	INSEE, 1996Q1-2005Q1
Italy	Media 13 area urbane numeri indice dei prezzi medi di abitazioni, usate	No	Nomisma, 1991S1-2005S1
United Kingdom	Mix-adjusted house price index	No	ODPM, 1968Q2-2005Q2
Canada	Multiple listing series, average price in Canadian dollars	Yes	Ministry of Finance, 1980Q1-2005Q2
Australia	Index of a weighted average of 8 capital cities	No	Australia Bureau of Statistics, 1986Q2-2005Q2
Denmark	Index of one-family house sold	No	Statistics Denmark, 1971Q1-2004Q3
Spain	Precio medio del m <sup>2</sup> de la vivienda, mas de un año de antigüedad	No	Banco de Espana, 1987Q1-2004Q4
Finland	Housing prices in metropolitan area, debt free, price per m <sup>2</sup>	No	Bank of Finalnd, 2000Q1-2005Q2
Ireland	Second hand houses	Yes	Irish Department of Environment 1980Q1-2005Q1
Korea	Nationwide house price index	No	Kookmin Bank, January 86-May 2005
Netherlands	Existing dwellings	No	Nederlandsche Bank, January 76-May 2005
Norway	Nationwide index for dwellings	Yes	Statistics Norway, Table 03860, 1992Q1-2005Q2
New Zealand	Quotable value index for dwellings (new and existing)	No	Reserve Bank, 1979Q4-2005Q1
Sweden	One and two dwelling buildings	No	Statistics Sweden, 1986Q1-2005Q2
Switzerland	Single-family home	No	Swiss National Bank, 1970Q1-2005Q2

*Note:* Quarterly and/or annual data provided by the Bank for International Settlements (based on national sources) have been used in the countries for which the sample period (1970Q1 – 2005Q2) was incomplete.

*Source:* OECD compilation.

Table A2. Stationarity test for price-to-income and price-to-rent ratios

*Augmented Dickey-Fuller unit root test*

	Price-to-income ratio		Price-to-rent ratio	
	1970Q1 - 2004Q4	1970Q1 - 2000Q4	1970Q1 - 2004Q4	1970Q1 - 2000Q4
United States	-1.15	-0.98	-0.92	-2.37
Japan	-1.34	-2.03	-2.05	-2.58
Germany	-1.04	-1.31	-0.23	-0.61
France	-1.71	-1.85	-1.33	-2.89**
Italy	-2.37	-2.13	..	..
United Kingdom	-2.43	-3.51***	-1.53	-3.15**
Canada	-1.36	-1.58	0.14	-1.58
Australia	1.47	-1.76	-0.49	-1.82
Denmark	-1.91	-1.94	-1.68	-2.08
Finland	-3.20 **	-2.97**	-1.53	-2.13
Ireland	-0.03	-2.82*	0.73	-1.14
Netherlands	-1.97	-2.29	-2.09	-2.74*
New Zealand	-2.25	-1.81	-1.12	-3.61***
Norway	-0.39	-2.18	-1.41	-1.89
Spain	-0.18	-1.55	-0.13	-1.36
Sweden	-2.08	-1.93	-2.17	-2.91**
Switzerland	-1.60	-1.46	-2.64 *	-2.70*
Korea	-0.97	-0.65	-3.32**	-1.91

*Note:* \*, \*\* and \*\*\* indicate the stationarity at the 10%, 5% and 1% level respectively. The lag structures for the ADF equations are chosen using the Schwarz Information Criterion. The critical values are from MacKinnon (1996). For Denmark, Ireland, Italy, Korea and Norway, the sample is shorter due to data availability.

*Source:* OECD calculation.

**Table A3. Calculation of fundamental price-to-rent ratios**

<b>Definitions and sources</b>	
ECB mortgage rate	Annualised agreed rate (AAR) / Narrowly defined effective rate (NDER), Credit and other institutions (MFI except MMFs and central banks) reporting sector - Loans for house purchasing, Over 5 years maturity, Total amount, Outstanding amount business coverage, Euro, Households & individual enterprises (S.14 & S.15) sector.
Property tax rate rates	International Bureau of Fiscal Documentation (1999), Nagahata et al. (2004), Fraser institute and OECD estimates.
Recurrent holding costs	Constant at 4% for all countries.
House price indices	See Appendix table A1.
Average house prices	European Mortgage Federation (2004), ERA immobilier (2005), national sources and OECD estimates.
After-tax mortgage rate formula	See Van den Noord (2005).

Table A3. Calculation of fundamental price-to-rent ratios (continued)

	United States														
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
<b>House price index (2000=100)</b>	71.8	72.7	74.3	75.6	77.0	79.1	81.9	84.8	89.1	93.6	100.0	107.9	134.1	158.8	186.6
<b>Average house price (P)</b>	100,209	101,444	103,721	105,519	107,510	110,426	114,330	118,338	124,411	130,621	139,621	150,687	187,247	221,773	260,552
<b>Mortgage rate (i)</b>	10.1%	9.2%	8.4%	7.3%	8.4%	8.0%	7.8%	7.6%	6.9%	7.4%	8.1%	7.0%	6.5%	5.8%	5.8%
<b>After income tax mortgage rate (i<sup>a</sup>)</b>	6.1%	5.5%	5.0%	4.4%	5.0%	4.8%	4.7%	4.6%	4.2%	4.5%	4.8%	4.2%	3.9%	3.5%	3.5%
<b>Property tax rate (τ)</b>	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
<b>Expected house price inflation rate (π)</b> (Last 5 years moving average of CPI)	4.0%	4.4%	4.3%	4.1%	3.6%	3.1%	2.9%	2.7%	2.4%	2.4%	2.5%	2.5%	2.3%	2.4%	2.5%
<b>Fundamental price-to-rent ratio</b>	11.6	13.1	13.8	14.7	12.7	12.3	12.0	12.0	12.2	11.6	11.3	12.2	12.3	13.3	13.4
<b>Index</b>	102.9	116.2	122.6	130.1	112.7	108.8	106.6	106.4	107.8	103.1	100.0	107.7	109.1	117.5	118.8
<b>Actual price-to-rent ratio</b>	99.3	96.1	95.1	93.9	92.8	92.3	92.6	93.0	94.6	96.6	100.0	104.0	107.2	112.0	121.0

After-tax mortgage rate:  $i^a = i - 0.4 \text{ Min}(i, 1000000 \cdot i/P)$

Table A3. Calculation of fundamental price-to-rent ratios (continued)

	Japan														
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
<b>Mortgage rate (i)</b>	7.6%	7.5%	6.1%	5.1%	4.2%	3.3%	2.6%	2.6%	2.6%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%
Bank of Japan - Floating interest rates - Mortgages															
<b>After income tax mortgage rate (i<sup>a</sup>)</b>	7.6%	7.5%	6.1%	5.1%	4.2%	3.3%	2.6%	2.6%	2.6%	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%
<b>Property tax rate (τ)</b>	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%
<b>Expected house price inflation rate (π)</b> (Last 5 years moving average of CPI)	1.2%	1.8%	2.2%	2.3%	2.0%	1.4%	0.7%	0.7%	0.6%	0.4%	0.2%	0.1%	-0.4%	-0.6%	-0.6%
<b>Fundamental price-to-rent ratio</b> $1/(i^a + \tau + \pi)$	8.3	8.8	10.4	11.7	12.7	13.0	13.1	13.1	13.0	12.9	12.7	12.5	11.8	11.5	11.6
Index (1997=100)	63.0	66.7	79.2	89.4	96.4	99.4	100.1	100.0	98.8	98.6	96.8	94.9	89.5	87.7	88.3
<b>Actual price-to-rent ratio</b> (1997=100)	131.3	132.8	123.8	115.5	110.2	106.4	102.9	100.0	97.8	94.8	91.0	87.1	83.2	78.7	74.1

After-tax mortgage rate:  $i^a = i$

Table A3. Calculation of fundamental price-to-rent ratios (continued)

	Germany														
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Bundesbank, total															
House price index (2000=100)	82.6	86.7	92.8	97.9	102.0	103.0	102.0	100.0	99.0	100.0	100.0	100.0	98.0	97.0	95.0
Germany, total															
resales															
Average house price (P)	98,808	103,690	111,016	117,114	122,000	123,229	122,035	119,645	118,443	119,638	119,640	119,642	117,252	116,054	113,661
Euros															
Mortgage rate (i)	11.0%	11.0%	10.6%	8.8%	8.8%	8.7%	7.7%	7.1%	6.6%	6.4%	7.6%	6.9%	6.8%	5.9%	5.7%
ECB <sup>1</sup>															
After income tax mortgage rate (i <sup>a</sup> )	10.3%	10.4%	10.0%	8.3%	8.4%	8.3%	7.2%	6.7%	6.3%	6.0%	7.2%	6.6%	6.4%	5.6%	5.4%
Property tax rate (τ)	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Expected house price inflation rate (π)	1.4%	2.1%	3.1%	3.7%	3.7%	3.5%	3.1%	2.5%	1.8%	1.3%	1.3%	1.4%	1.3%	1.3%	1.5%
(Last 5 years moving average of CPI)															
Fundamental price-to-rent ratio $1/(i^a + \tau + \pi)$															
Index (2000=100)	7.2	7.5	8.4	10.5	10.4	10.3	10.9	10.8	10.5	10.3	9.1	9.8	9.9	10.8	11.3
Actual price-to-rent ratio (2000=100)	78.7	82.6	91.9	114.5	113.4	112.5	119.7	118.0	114.6	112.5	100.0	107.4	107.9	117.9	123.4
127.4	126.2	122.4	117.1	115.8	112.4	107.9	103.3	101.1	101.1	101.1	100.0	99.4	95.7	93.7	91.0
Calculation of after-tax mortgage rate															
i <sup>c</sup>	9.6%	9.7%	9.4%	7.6%	7.7%	7.6%	6.6%	6.0%	5.5%	5.2%	6.5%	5.8%	5.6%	4.7%	4.5%
10-year government bond rate (r)	8.7%	8.5%	7.9%	6.5%	6.9%	6.9%	6.2%	5.7%	4.6%	4.5%	5.3%	4.8%	4.8%	4.1%	4.0%

After-tax mortgage rate:  $i^a = i^c + (i - i^c) e^{-\tau r}$ , where  $i^c = i - 0.53 \text{ Min}(0.05, 2556/P)$





Table A3. Calculation of fundamental price-to-rent ratios (continued)

	Italy														
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Nomisma - Media 13 aree urbane, Numeri indice dei prezzi medi di abitazioni, Usate Euros	79.5	89.2	94.7	94.9	92.2	92.9	89.8	85.7	87.5	92.4	100.0	108.2	118.6	130.8	143.7
<b>Average house price (P)</b>	67,079	75,213	79,869	80,046	77,763	78,360	75,777	72,279	73,788	77,901	84,341	91,257	100,000	110,278	121,230
<b>Mortgage rate (i)</b>	10.2%	10.0%	10.0%	11.3%	11.1%	12.8%	9.1%	7.2%	5.5%	6.1%	6.5%	5.3%	5.0%	4.6%	4.6%
<b>After income tax mortgage rate (i<sup>a</sup>)</b>	9.2%	9.1%	9.1%	10.4%	10.2%	11.9%	8.2%	6.2%	4.6%	5.2%	5.7%	4.5%	4.3%	4.0%	4.1%
<b>Property tax rate (τ)</b>	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
<b>Expected house price inflation rate (π)</b> (Last 5 years moving average of CPI)	5.7%	5.8%	5.9%	5.8%	5.3%	5.1%	4.6%	4.0%	3.5%	3.0%	2.4%	2.2%	2.3%	2.4%	2.5%
<b>Fundamental price-to-rent ratio</b> $1/(i^a + \tau + f - \pi)$	13.3	13.6	13.7	11.5	11.3	9.2	13.2	16.0	19.6	16.0	13.8	15.8	16.6	18.0	18.1
Index (1996=100)	100.6	103.0	103.8	87.1	85.0	69.7	100.0	120.7	147.8	121.1	104.3	119.0	125.2	135.9	136.5
<b>Actual price-to-rent ratio</b> (1996=100)							100.0	89.4	86.8	88.7	93.7	99.1	106.2	113.9	121.8

After-tax mortgage rate:  $i^a = i - \text{Min} (0.19 i, 687/P)$

Table A3. Calculation of fundamental price-to-rent ratios (continued)

	United Kingdom														
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
<b>House price index (2000=100)</b>	64.9	64.0	61.5	60.4	62.0	62.4	64.7	70.4	78.4	87.0	100.0	108.1	125.5	145.3	162.5
<b>Average house price (P)</b>	72,641	71,606	68,759	67,576	69,366	69,830	72,381	78,733	87,751	97,294	111,829	120,939	140,408	162,499	181,762
<b>Mortgage rate (i)</b>	11.9%	10.2%	9.1%	7.5%	8.2%	8.2%	7.2%	7.8%	8.6%	6.9%	7.6%	6.8%	5.7%	5.5%	6.1%
<b>After income tax mortgage rate (i<sup>a</sup>)</b>	10.7%	9.2%	8.2%	6.7%	7.4%	7.4%	6.5%	7.0%	7.8%	6.2%	6.8%	6.1%	5.1%	4.9%	5.5%
<b>Property tax rate (τ)</b>	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
<b>Expected house price inflation rate (π)</b> (Last 5 years moving average of CPI)	6.0%	6.4%	6.4%	5.7%	4.6%	3.4%	2.7%	2.6%	3.0%	2.8%	2.7%	2.6%	2.3%	2.2%	2.5%
<b>Fundamental price-to-rent ratio</b> $1/(i^a + \tau + \pi)$	8.5	10.3	11.3	12.4	10.3	9.1	9.3	8.8	8.5	9.6	9.0	9.5	10.2	10.3	9.9
<b>Index (2000=100)</b>	94.5	114.1	125.8	137.8	113.9	100.8	103.4	97.5	94.2	106.4	100.0	105.2	113.1	113.9	110.1
<b>Actual price-to-rent ratio</b> (2000=100)	90.8	87.2	84.2	88.2	86.3	79.4	82.9	83.9	84.4	97.3	100.0	108.2	129.3	144.6	146.3

After-tax mortgage rate:  $i^a = i - \text{Min}(0.10, 30000/P)$

Table A3. Calculation of fundamental price-to-rent ratios (continued)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
<b>Canada</b>															
CANSIM, Table 176-0043: Financial market statistics, last Wednesday unless otherwise stated;															
<b>Mortgage rate (i)</b>	13.4%	11.1%	9.5%	8.8%	9.5%	9.2%	7.9%	7.1%	6.9%	7.6%	8.4%	7.4%	7.0%	6.4%	6.2%
Canada; Chartered bank - conventional mortgage: 5 year (Percent) [B14051]															
<b>After income tax mortgage rate (i<sup>a</sup>)</b>	13.4%	11.1%	9.5%	8.8%	9.5%	9.2%	7.9%	7.1%	6.9%	7.6%	8.4%	7.4%	7.0%	6.4%	6.2%
<b>Property tax rate (<math>\tau</math>)</b>	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
<b>Expected house price inflation rate (<math>\pi</math>)</b> (Last 5 years moving average of CPI)	6.5%	5.9%	6.0%	6.0%	5.6%	5.2%	4.7%	3.9%	3.4%	2.9%	2.6%	2.6%	2.9%	3.2%	3.3%
<b>Fundamental price-to-rent ratio <math>1/(i^a + \tau + \pi)</math></b> Index (1991=100)	8.1	9.3	11.1	12.1	10.6	10.5	11.4	11.5	11.0	9.8	8.9	9.7	10.4	11.5	11.9
<b>Actual price-to-rent ratio</b> (1991=100)	86.6	100.0	119.5	129.4	113.4	112.9	122.7	123.6	118.1	105.2	95.5	104.3	111.9	123.1	127.5
	100.4	100.0	101.3	104.7	109.7	102.5	102.5	106.5	105.3	108.4	109.6	112.0	122.7	132.8	144.1
After-tax mortgage rate: $i^a = i$															

Table A3. Calculation of fundamental price-to-rent ratios (continued)

	Australia														
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Reserve Bank of															
<b>Mortgage rate (i)</b>	16.4%	13.4%	10.6%	9.4%	9.1%	10.5%	9.7%	7.2%	6.7%	6.6%	7.7%	6.8%	6.4%	6.6%	7.1%
Australia -Housing															
loans Variable	16.4%	13.4%	10.6%	9.4%	9.1%	10.5%	9.7%	7.2%	6.7%	6.6%	7.7%	6.8%	6.4%	6.6%	7.1%
Banks Standard															
<b>After income tax mortgage rate (i<sup>a</sup>)</b>	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
<b>Property tax rate (τ)</b>	7.9%	6.8%	5.3%	4.2%	3.0%	2.5%	2.4%	2.2%	2.0%	2.0%	1.9%	2.3%	2.8%	3.2%	3.4%
<b>Expected house price inflation rate (π)</b>															
(Last 5 years moving average of CPI)															
<b>Fundamental price-to-rent ratio 1/(i<sup>a</sup>+τ+f-π)</b>	8.0	9.4	10.7	10.8	10.0	8.3	8.8	11.2	11.6	11.6	10.2	11.7	13.3	13.5	13.1
Index (1997=100)	71.8	83.7	95.7	96.5	88.8	74.4	78.7	100.0	103.4	103.7	91.2	104.3	118.6	120.7	116.6
<b>Actual price-to-rent ratio</b>	96.8	96.1	96.8	98.8	101.6	101.2	99.0	100.0	104.2	108.8	114.3	123.3	142.1	164.7	176.9

After-tax mortgage rate: i<sup>a</sup> = i

Table A3. Calculation of fundamental price-to-rent ratios (continued)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
<b>Denmark</b>															
Statistik Denmark, main indicators (monthly), residential property prices - index nsa, cash price of one-family houses sold.															
<b>House price index (2000=100)</b>	54.8	55.6	54.7	54.2	60.7	65.4	72.4	80.7	88.0	93.9	100.0	105.8	109.7	115.3	128.1
<b>Average house price (P)</b>	74,070	75,031	73,833	73,169	82,047	88,293	97,797	109,008	118,835	126,848	135,077	142,926	148,200	155,758	173,047
<b>Mortgage rate (i)</b>	12.6%	10.8%	9.7%	8.2%	8.0%	8.2%	7.6%	6.7%	5.8%	6.1%	6.6%	6.0%	5.8%	5.3%	5.2%
Bank of Denmark															
<b>After income tax mortgage rate (i<sup>a</sup>)</b>	8.5%	7.4%	6.7%	5.8%	5.7%	5.8%	5.4%	4.9%	4.3%	4.5%	4.8%	4.5%	4.3%	4.0%	4.0%
<b>Property tax rate (τ)</b>	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
<b>Expected house price inflation rate (π)</b> (Last 5 years moving average of CPI)	3.9%	3.7%	3.3%	2.6%	2.1%	2.0%	1.9%	1.9%	2.1%	2.2%	2.3%	2.4%	2.4%	2.5%	2.2%
<b>Fundamental price-to-rent ratio</b> $1/(i^a + \tau + f - \pi)$	10.4	11.4	11.8	12.2	11.6	11.3	11.7	12.6	13.7	13.6	13.3	14.1	14.4	15.2	14.8
Index (1997=100)	83.1	90.9	94.3	97.2	92.5	89.9	93.3	100.0	109.2	108.0	105.9	112.1	114.8	121.0	117.4
<b>Actual price-to-rent ratio</b> (1997=100)	82.4	80.0	76.2	73.4	80.0	84.3	92.1	100.0	106.9	111.2	115.3	118.8	120.0	122.9	132.8

After-tax mortgage rate:  $i^a = i - 0.385 \text{ Min}(i - 0.02, 2150000/P)$

Table A3. Calculation of fundamental price-to-rent ratios (continued)

	Finland														
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Bank of Finland - Housing prices in metropolitan area, debt-free price per m <sup>2</sup>	96	82	68	62	66	64	67	79	87	95	100	99	107	113	122
Average house price (P)	77,838	67,024	55,579	50,745	53,741	51,785	54,633	64,185	70,749	77,079	81,491	80,835	86,855	92,403	99,149
Mortgage rate (i)	13.8%	13.9%	14.1%	11.1%	9.2%	9.2%	7.3%	6.5%	6.3%	5.4%	6.6%	6.3%	5.4%	4.0%	3.4%
After income tax mortgage rate (i <sup>a</sup> )	12.5%	12.4%	12.3%	9.1%	7.3%	7.2%	5.4%	5.0%	4.9%	4.1%	5.4%	5.1%	4.2%	2.9%	2.4%
Property tax rate ( $\tau$ )	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Expected house price inflation rate ( $\pi$ ) (Last 5 years moving average of CPI)	5.0%	5.3%	5.0%	4.4%	3.3%	2.3%	1.5%	1.2%	1.0%	1.0%	1.5%	1.9%	2.0%	1.8%	1.7%
Fundamental price-to-rent ratio Index	8.5	8.8	8.7	11.3	12.3	10.9	12.3	12.5	12.4	13.8	12.4	13.5	15.5	19.2	20.2
Actual price-to-rent ratio	67.9	70.1	69.3	90.1	98.0	87.1	98.3	100.0	99.0	109.8	98.7	107.9	123.7	152.9	161.2
	122.0	103.2	85.5	81.7	87.4	82.7	87.0	100.0	107.8	116.0	115.8	110.9	119.7	128.0	136.1

After-tax mortgage rate: i<sup>a</sup> = i - 0.3 Min (i, 3364/P)

1. See Definitions and sources.

Table A3. Calculation of fundamental price-to-rent ratios (continued)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
<b>Ireland</b>															
<b>House price index (2000=100)</b>	33	34	34	35	37	39	45	54	71	86	100	108	120	139	155
Irish Department of the Environment															
<b>Average house price (P)</b>	62,453	63,896	65,409	66,731	69,900	74,281	85,424	102,520	134,268	163,699	190,388	206,012	228,000	264,124	294,724
Euros															
<b>Mortgage rate (i)</b>	12.1%	11.6%	12.2%	9.8%	7.4%	7.9%	7.0%	7.4%	7.4%	5.2%	5.4%	5.8%	4.8%	4.0%	3.5%
ECB <sup>1</sup>															
<b>After income tax mortgage rate (i<sup>a</sup>)</b>	10.0%	9.5%	10.2%	7.9%	5.9%	6.2%	5.6%	6.2%	6.4%	4.4%	4.8%	5.2%	4.3%	3.5%	3.1%
<b>Property tax rate (τ)</b>	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
<b>Expected house price inflation rate (π)</b>	3.3%	3.2%	3.2%	3.0%	2.7%	2.5%	2.2%	1.9%	2.1%	2.0%	2.6%	3.2%	3.8%	4.0%	4.2%
(Last 5 years moving average of CPI)															
<b>Fundamental price-to-rent ratio <math>1/(i^a + \tau + f - \pi)</math></b>	9.4	9.7	9.1	11.3	13.9	13.0	13.6	12.1	12.1	15.5	16.2	16.7	22.6	29.1	34.2
Index (1996=100)	69.2	71.3	67.0	83.5	102.5	95.6	100.0	89.3	88.9	114.6	119.5	123.2	166.4	214.6	251.9
<b>Actual price-to-rent ratio</b>	79.2	77.5	73.8	78.9	86.5	86.9	100.0	114.1	145.0	204.5	215.8	199.2	222.1	268.0	290.8
(1996=100)															
<b>Calculation of after-tax mortgage rate</b>															
i <sup>c</sup>	9.7%	9.2%	9.9%	7.5%	5.6%	6.0%	5.4%	5.9%	6.2%	4.3%	4.6%	5.1%	4.2%	3.4%	3.0%
i <sup>d</sup>	10.2%	9.7%	10.3%	8.0%	6.0%	6.4%	5.7%	6.2%	6.5%	4.4%	4.8%	5.2%	4.3%	3.5%	3.1%
10-year government bond rate (r)	10.3%	9.4%	9.3%	7.6%	8.0%	8.2%	7.2%	6.3%	4.7%	4.8%	5.5%	5.0%	5.0%	4.1%	4.1%

After-tax mortgage rate:  $i^a = i^c + (i^d - i^c) e^{-5r}$ ,  $i^c = i - 0.24 \text{ Min}(i, 6.349\%)$ ,  $i^d = i - 0.8 \times 0.24 \text{ Min}(i, 6.349\%)$

1. See Definitions and sources.



Table A3. Calculation of fundamental price-to-rent ratios (continued)

	Netherlands														
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Nederlandsche bank, unpublished. Residential property prices.	39.1	40.1	43.5	47.1	51.8	54.5	59.7	65.8	72.1	83.3	100.0	109.7	116.6	119.5	124.2
<b>Average house price (P)</b>	74,812	76,746	83,172	90,022	99,062	104,343	114,170	125,915	137,950	159,273	191,304	209,887	223,000	228,692	237,684
<b>Mortgage rate (i)</b>	10.2%	10.4%	9.9%	8.2%	8.2%	8.1%	7.0%	6.7%	6.2%	5.9%	7.0%	6.4%	6.3%	5.5%	5.1%
<b>After income tax mortgage rate (i<sup>a</sup>)</b>	4.8%	4.9%	4.7%	4.0%	4.0%	4.0%	3.5%	3.4%	3.2%	3.1%	3.6%	3.3%	3.3%	2.9%	2.8%
<b>Property tax rate (τ)</b>	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
<b>Expected house price inflation rate (π)</b> (Last 5 years moving average of CPI)	0.7%	1.3%	2.1%	2.5%	2.8%	2.7%	2.5%	2.3%	2.2%	2.1%	2.1%	2.6%	2.8%	2.8%	2.6%
<b>Fundamental price-to-rent ratio</b> $1/(i^a + \tau + f - \pi)$	11.9	12.7	14.5	17.2	18.3	18.0	18.7	18.4	18.7	18.7	17.5	19.8	21.0	22.7	22.4
Index (1998=100)	63.9	68.2	77.8	92.0	97.8	96.4	100.4	98.5	100.0	100.1	93.9	106.1	112.5	121.5	120.1
<b>Actual price-to-rent ratio</b> (1998=100)	77.4	76.2	78.4	80.5	84.4	84.6	88.9	94.5	100.0	112.0	130.9	139.5	144.1	143.3	144.5

After-tax mortgage rate: <sup>a</sup> $i = i - 0.6 (i - 0.0125)$

1. See Definitions and sources.

Table A3. Calculation of fundamental price-to-rent ratios (continued)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
<b>Norway</b>															
Norges Bank -															
<b>Mortgage rate (i)</b>	13.2%	12.8%	12.5%	11.5%	8.7%	7.8%	7.0%	6.3%	7.0%	7.0%	7.2%	7.5%	7.7%	6.3%	4.7%
Mortgage companies rates (households)															
<b>After income tax mortgage rate (i<sup>a</sup>)</b>	9.5%	9.2%	9.0%	8.3%	6.2%	5.6%	5.0%	4.5%	5.0%	5.0%	5.2%	5.4%	5.5%	4.5%	3.4%
<b>Property tax rate (τ)</b>	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
<b>Expected house price inflation rate (π)</b> (Last 5 years moving average of CPI)	6.3%	5.5%	4.2%	3.3%	2.7%	2.4%	1.9%	2.0%	2.0%	2.2%	2.3%	2.7%	2.4%	2.4%	2.1%
<b>Fundamental price-to-rent ratio</b> $1/(i^a + \tau + f - \pi)$	12.6	11.9	10.5	10.4	12.1	12.6	12.9	13.8	12.9	13.2	13.2	13.4	12.8	14.7	16.6
Index (1997=100)	91.1	85.9	76.0	75.2	87.8	91.3	92.9	100.0	93.3	95.8	95.7	96.9	92.5	106.2	119.8
<b>Actual price-to-rent ratio</b> (1997=100)	90.2	80.7	74.2	72.9	81.4	85.3	91.7	100.0	108.6	116.9	129.9	133.5	134.2	131.4	141.5

After-tax mortgage rate: i<sup>a</sup> = i - 0.28 i

Table A3. Calculation of fundamental price-to-rent ratios (continued)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
<b>New Zealand</b>															
<b>Mortgage rate (i)</b>															
Reserve bank of New Zealand - Variable first mortgage housing rates	15.1%	12.6%	9.8%	8.7%	8.4%	10.8%	10.9%	9.8%	9.4%	6.6%	8.4%	7.6%	7.6%	7.4%	8.0%
<b>After income tax mortgage rate (i<sup>a</sup>)</b>	15.1%	12.6%	9.8%	8.7%	8.4%	10.8%	10.9%	9.8%	9.4%	6.6%	8.4%	7.6%	7.6%	7.4%	8.0%
<b>Property tax rate (τ)</b>	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
<b>Expected house price inflation rate (π)</b> (Last 5 years moving average of CPI)	9.4%	7.3%	4.4%	3.3%	2.6%	2.1%	2.0%	2.1%	2.1%	1.7%	1.5%	1.5%	1.8%	1.9%	2.4%
<b>Fundamental price-to-rent ratio</b> $1/(i^a + \tau + f - \pi)$	10.4	10.7	10.6	10.7	10.2	7.9	7.8	8.5	8.8	11.2	9.2	9.9	10.3	10.5	10.4
Index (1995=100)	131.9	136.2	134.6	135.8	129.1	100.0	98.8	108.1	111.7	142.7	116.6	125.7	130.4	133.9	131.9
<b>Actual price-to-rent ratio</b> (1995=100)	95.0	90.5	91.3	91.7	97.4	100.0	105.2	108.3	104.0	106.8	104.0	106.6	113.3	128.3	141.9

After-tax mortgage rate:  $i^a = i$

Table A3. Calculation of fundamental price-to-rent ratios (continued)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
<b>Spain</b>															
Banco de España -															
<b>House price index (2000=100)</b>	62.0	70.6	70.2	70.0	71.0	72.5	73.9	75.3	79.1	87.4	100.0	115.6	134.1	158.8	186.6
Precio medio del m <sup>2</sup> de la vivienda libre, más de un año de antigüedad															
<b>Average house price (P)</b>	44,387	50,558	50,220	50,082	50,846	51,879	52,915	53,889	56,633	62,564	71,591	82,733	96,000	113,701	133,583
Euros															
<b>Mortgage rate (i)</b>	17.0%	16.7%	15.7%	14.6%	11.1%	11.8%	10.2%	7.6%	6.3%	5.3%	6.3%	6.4%	5.4%	4.3%	3.6%
ECB <sup>1</sup>															
<b>After income tax mortgage rate (i<sup>a</sup>)</b>	13.3%	13.1%	12.3%	11.5%	8.7%	9.3%	8.0%	6.0%	5.0%	4.2%	5.0%	5.1%	4.3%	3.4%	2.8%
<b>Property tax rate (τ)</b>	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%
<b>Expected house price inflation rate (π)</b> (Last 5 years moving average of CPI)	6.5%	5.9%	6.0%	6.0%	5.6%	5.2%	4.7%	3.9%	3.4%	2.9%	2.6%	2.6%	2.9%	3.2%	3.3%
<b>Fundamental price-to-rent ratio</b> $1/(i^a + \tau + f \cdot \pi)$	8.7	8.5	9.2	9.9	12.9	11.5	12.6	14.9	16.0	16.7	14.3	14.2	16.8	20.7	24.3
Index (1997=100)	58.8	57.1	62.1	66.4	86.8	77.1	84.4	100.0	107.7	112.6	96.0	95.4	113.0	139.0	163.3
<b>Actual price-to-rent ratio</b> (1997=100)	134.9	141.0	129.3	118.1	113.6	109.8	104.2	100.0	100.2	106.9	117.9	130.7	145.3	165.0	186.2
<b>Calculation of after-tax mortgage rate</b>															
i <sub>c</sub>	12.3%	12.0%	11.3%	10.5%	8.0%	8.5%	7.3%	5.5%	4.5%	3.8%	4.6%	4.6%	3.9%	3.1%	2.6%
i <sub>d</sub>	13.6%	13.4%	12.5%	11.7%	8.9%	9.5%	8.2%	6.1%	5.0%	4.3%	5.1%	5.1%	4.3%	3.4%	2.8%
10-year government bond rate (r)	14.6%	12.8%	11.7%	10.2%	10.0%	11.3%	8.7%	6.4%	4.8%	4.7%	5.5%	5.1%	5.0%	4.1%	4.1%

After-tax mortgage rate:  $i^a = i^c + (i^d - i^c) e^{-2\tau}$ , where  $i^c = i - 0.28i$  and  $i^d = i - 0.20i$

1. See Definitions and sources.

Table A3. Calculation of fundamental price-to-rent ratios (continued)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
<b>Sweden</b>															
Swedish Central															
<b>Mortgage rate (i)</b>	13.4%	10.9%	10.2%	8.7%	9.7%	10.4%	8.2%	7.3%	6.3%	7.2%	7.0%	6.6%	6.5%	5.6%	5.3%
Bank - new loans >5 years, households															
<b>After income tax mortgage rate (i<sup>a</sup>)</b>	10.6%	8.6%	8.1%	6.9%	7.7%	8.3%	6.5%	5.8%	5.0%	5.7%	5.5%	5.2%	5.2%	4.4%	4.2%
<b>Property tax rate (τ)</b>	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%
<b>Expected house price inflation rate (π)</b> (Last 5 years moving average of CPI)	6.2%	7.3%	6.9%	6.7%	5.8%	4.2%	2.4%	2.1%	1.1%	0.8%	0.5%	0.8%	1.1%	1.6%	1.6%
<b>Fundamental price-to-rent ratio</b> $1/(i^a + \tau + f + \pi)$	10.4	15.0	15.4	18.1	14.0	10.7	10.7	11.2	10.9	9.8	9.6	10.4	10.7	12.3	12.6
Index (1999=100)	106.0	153.7	157.7	184.7	143.0	109.7	109.6	114.0	111.4	100.0	98.5	106.0	109.6	125.4	128.4
<b>Actual price-to-rent ratio</b> (1999=100)	116.8	104.1	87.2	73.4	75.5	74.0	73.8	80.1	90.1	100.0	110.7	116.9	121.4	128.3	140.8

After-tax mortgage rate:  $i^a = i - 0.21 i$

Table A3. Calculation of fundamental price-to-rent ratios (continued)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
<b>Switzerland</b>															
<b>Mortgage rate (i)</b>															
Swiss National Bank	6.3%	6.8%	6.9%	6.6%	5.6%	5.5%	5.1%	4.6%	4.1%	3.9%	4.2%	4.4%	4.0%	3.4%	3.2%
- First mortgages															
<b>After income tax mortgage rate (i<sup>a</sup>)</b>	5.5%	6.0%	6.1%	5.9%	5.0%	4.9%	4.5%	4.1%	3.7%	3.5%	3.7%	3.9%	3.6%	3.0%	2.8%
<b>Property tax rate (τ)</b>	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
<b>Expected house price inflation rate (π)</b> (Last 5 years moving average of CPI)	2.5%	3.6%	4.1%	4.4%	3.9%	3.2%	2.2%	1.5%	0.8%	0.8%	0.7%	0.8%	0.8%	0.9%	0.9%
<b>Fundamental price-to-rent ratio</b> $1/(i^a + \tau + f - \pi)$	10.0	10.5	11.1	11.8	12.4	11.5	10.7	10.4	10.1	10.3	10.0	9.9	10.2	11.0	11.2
Index (1993=100)	84.9	89.7	94.1	100.0	105.5	97.6	91.2	88.6	86.2	87.9	85.3	84.4	87.2	93.5	95.7
<b>Actual price-to-rent ratio</b> (1993=100)	138.7	124.0	110.9	100.0	99.3	94.4	87.7	83.8	83.2	82.6	82.2	81.5	83.8	85.5	86.4

After-tax mortgage rate: i<sup>a</sup> = i - 0.115 i

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