

## Twin peaks in equity and housing prices?<sup>1</sup>

*The strength of housing markets around the world has helped to cushion the recent slowdown in global economic activity. How long should we expect this to continue? A sample of industrialised countries covering three decades allows us to explore this question through an analysis of major peaks in equity and housing prices, the associated booms and busts and the underlying credit conditions.*

*JEL classification: E300, E320.*

Some three years after the global bust in equity markets, and despite a weak economic backdrop, housing prices have continued to rise in many countries. This remarkable buoyancy seems rather unusual by past experience and raises questions about the sustainability of current trends. Could housing prices falter any time soon? And if they do, could large declines be in store? Answers to these questions are particularly important at the current juncture, as the strength of housing markets has been a significant factor helping to cushion the slowdown in global economic activity that started in the autumn of 2000 and to underpin the subsequent recovery (BIS (2003)).

To cast light on these issues, we examine the evolution of housing prices in a sample of 13 industrial countries since the early 1970s in search of statistical regularities that might help us chart the future. We ask three questions. First, how often have major equity price peaks been followed by housing price peaks? Second, when they have, what has been the lag and what factors have affected it? Finally, what has determined the size of the subsequent fall in housing prices?

Methodologically, our analysis complements existing work in at least two ways. It focuses squarely on the relationship between housing and equity markets, the two asset classes that make up the bulk of private sector wealth. In addition, it pays particular attention to “extreme events”, in the form of major peaks and troughs in the prices of these two assets, the associated booms and busts, and their link to unusually large fluctuations in credit. By contrast, much of the existing work analyses the average or typical relationship between

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<sup>1</sup> We would like to thank Guy Debelle and Eli Remolona for useful comments and discussion. The views expressed in this article are those of the authors and do not necessarily reflect those of the BIS.

housing prices and their determinants (eg Tsatsaronis and Zhu, in this *Quarterly Review*).<sup>2</sup>

We reach three main conclusions. First, over the period 1970–99, equity price peaks tended to be followed by housing price peaks, with an average lag of about two years. Econometric analysis indicates that equity price peaks heralded subsequent housing price peaks even after allowing for such traditional determinants of housing prices as interest rates, output growth and unemployment. Housing price peaks tended to occur in the wake of comparatively strong economic conditions, especially if these had been accompanied by unusually rapid and sustained credit and equity price growth (“financial imbalances”). Thus, on this evidence alone, the continued rise in housing prices since the equity price peak in 2001 does appear somewhat unusual. Second, movements in interest rates appear to have important implications for housing price dynamics. There is some evidence that reductions in interest rates following a peak in equity prices lengthen the lag while increases shorten it. The clearest link is with short-term nominal rates, regardless of country-specific characteristics of the housing market. This underscores the role of monetary policy. Finally, the subsequent decline in housing prices appears to have had a certain life of its own and to have been partly shaped by the characteristics of the previous expansion. Specifically, the size of the declines studied was closely and positively related to the size of the previous increases, as is typical of boom and bust cycles. And they were larger when preceded by a build-up of financial imbalances. These relationships are apparent over and above those with the evolution of economic activity during the decline in housing prices and with interest rates, which also seem to have exerted some influence.

In the next section we outline the relationship between housing and equity prices since the 1970s. In the following three sections we explore each of the key issues in turn, namely the predictive content of equity prices for subsequent housing price peaks, the determinants of the lag, and the factors that help explain the size of the subsequent decline. In the conclusion we infer some potential implications for the current cycle and outlook, paying attention to the statistical limitations of the exercise and to changes in the economic environment relative to previous episodes.

## Cycles in equity and housing prices

Since the early 1970s, a number of major cycles in both housing and equity prices (adjusted for inflation) have taken place in industrial countries, coinciding roughly with business fluctuations (Graph 1).<sup>3</sup> Visual inspection

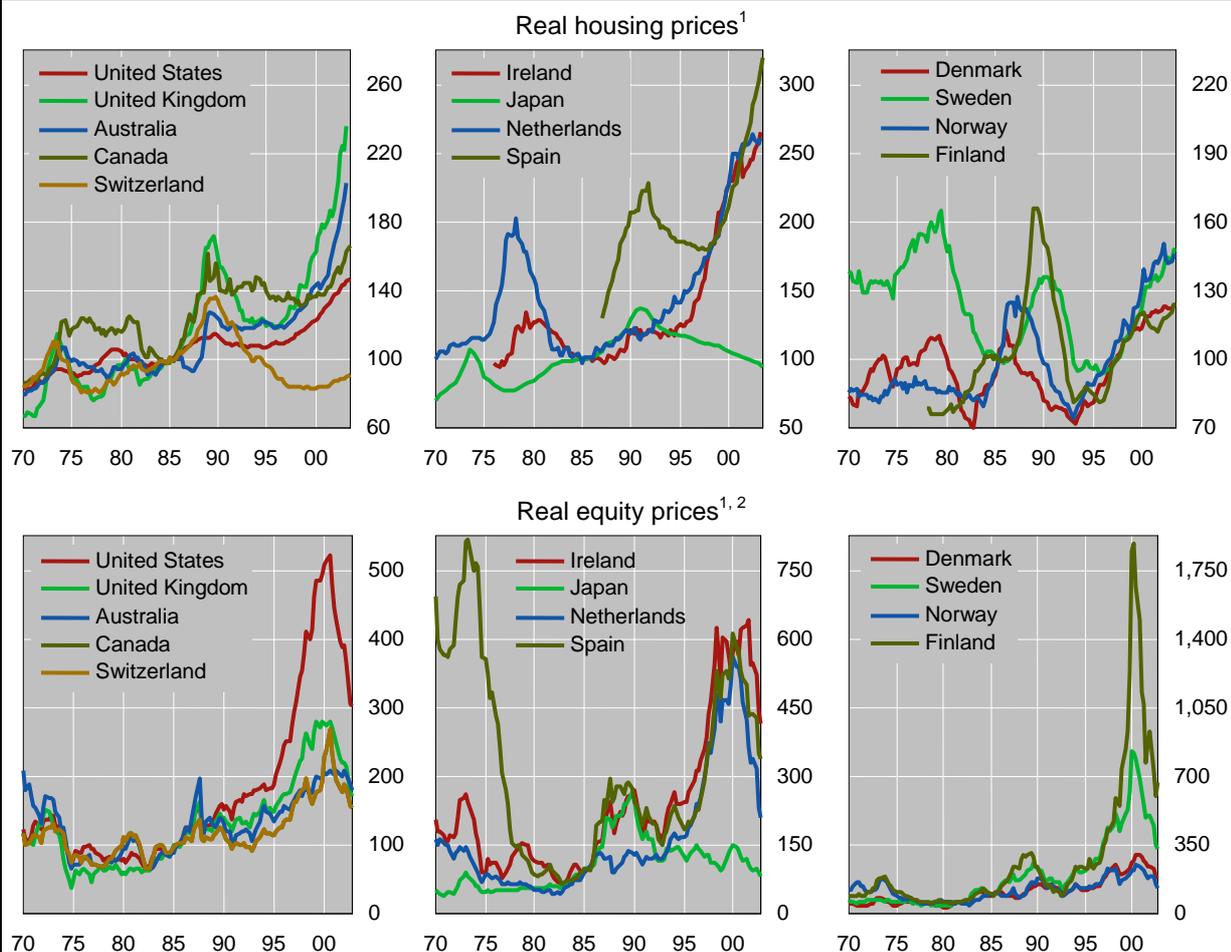
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<sup>2</sup> Exceptions include BIS (1993), Borio et al (1994) and, more recently, BIS (2003), IMF (2003) and Detken and Smets (2003).

<sup>3</sup> Throughout the rest of this paper, references to housing and equity prices imply inflation-adjusted prices. The sample of countries used in Graph 1 and in subsequent statistical analysis comprises Australia, Canada, Denmark, Finland, Ireland, Japan, the Netherlands, Norway, Spain, Sweden, Switzerland, the United Kingdom and the United States. The housing

## Equity and housing prices around the world

1985 = 100



<sup>1</sup> Nominal prices deflated by the personal consumption deflator. <sup>2</sup> National benchmark indices.

Sources: Japan Real Estate Institute; national data.

Graph 1

indicates that these cycles have tended to cluster around four periods: the early to mid-1970s, the late 1970s to early 1980s, the late 1980s to early 1990s and, more recently, the late 1990s to early 2000s. The cycle in the late 1970s–early 1980s is smaller than the rest; the most recent one is not yet completed.

A closer look at the data reveals that there is a clear tendency for peaks in equity prices to precede peaks in housing prices (Table 1). To identify housing price peaks more formally, we consider a 13 quarter rolling window, intended to capture sizeable peaks broadly consistent with those that take place at business cycle frequencies.<sup>4</sup> Table 1 shows that most equity price peaks were

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price series for Spain starts in 1987 Q1, that for Finland in 1978 Q2, and that for Ireland in 1976 Q1. For Japan, the semiannual land price series compiled by the Japan Real Estate Institute is used in place of housing prices. This is converted to quarterly data by taking the simple average of two adjacent periods.

<sup>4</sup> The corresponding rolling window for equity prices is 21 quarters. To ensure that only significant peaks are identified, the rise in the price since the trough following the previous peak must exceed a certain threshold. This threshold is set at the 10th percentile of all price

Peaks in housing and equity prices tend to occur in pairs

Housing and equity price peaks: stylised facts								
Pairs of equity price and housing price peaks								
Period <sup>1</sup>	Country	Housing price peak		Period <sup>1</sup>	Country	Housing price peak		
		Date	Lag			Date	Lag	
1970–74	Denmark	1973 Q3	2	1985–91	Finland <sup>2</sup>	1985 Q1	45	
	United Kingdom	1973 Q3	5		Denmark	1986 Q1	9	
	Japan	1973 Q3	2		Norway <sup>2</sup>	1987 Q2	30	
	United States	1973 Q4	4		Canada	1989 Q1	6	
	Canada	1974 Q2	5		Australia	1989 Q2	7	
	Norway	1974 Q4	5		Finland	1989 Q2	0	
	Average lag length		3.8		United Kingdom	1989 Q3	8	
1979–82	Denmark	1979 Q2	11		Switzerland	1989 Q4	9	
	Ireland	1979 Q2	2		United States	1989 Q4	9	
	United Kingdom	1980 Q3	5		Sweden	1990 Q1	2	
	Canada	1981 Q1	1		Netherlands	1990 Q2	3	
	Australia	1981 Q2	2		Ireland	1990 Q3	2	
	Switzerland	1982 Q1	12		Japan	1991 Q1	5	
	Average lag length		5.5		Spain	1991 Q4	17	
					Average lag length		10.9	

Note: The lag is the number of quarters between consecutive equity and housing price peaks. Independent equity price peaks, ie those followed by a second peak in equity prices prior to a peak in housing prices, occurred in the Netherlands (1986 Q3), Denmark (1990 Q1), Norway (1990 Q2), Australia (1994 Q1), Denmark (1994 Q1) and Spain (1994 Q1). An independent housing price peak, ie a peak where the previous peak in housing prices happened after the previous peak in equity prices, occurred in the United States (1979 Q2). Other peaks in housing prices are associated with equity price peaks which occurred prior to the start of the sample period. These include Switzerland (1973 Q3), Australia (1974 Q1), the Netherlands (1978 Q2) and Sweden (1979 Q3).

<sup>1</sup> Equity price peaks for the most recent cycle (1996–2002) are as follows: Japan (1996 Q2), Ireland (1998 Q2), the United Kingdom (1999 Q2), Japan (2000 Q1), the Netherlands (2000 Q1), Spain (2000 Q1), Sweden (2000 Q1), Finland (2000 Q2), Canada (2000 Q3), Norway (2000 Q3), Switzerland (2000 Q3), the United States (2000 Q3), Denmark (2000 Q4) and Australia (2002 Q1). <sup>2</sup> Equity prices in Norway spiked in 1987 Q3, one period following the peak in housing prices. However, this was not identified as a peak based on our algorithm settings. Housing price data for Finland start in 1978 Q1. Thus, it is possible that a peak in housing prices occurred in Finland after the peak in equity prices in 1973, but before the start of the housing price data, and that the reported 45 quarter lag is too long. In any case, this observation is not included in the regression analysis because of missing interest rate data for the early 1970s.

Table 1

followed by housing price peaks. Indeed, we identify only five housing price peaks that were not preceded by equity price peaks.<sup>5</sup> The average lag has been some two years and has typically ranged between two and nine quarters. By comparison with the 1970s, the period surrounding the 1987 downturn in equity prices saw a relatively large number of equity-housing price peak pairs. Moreover, the average lag during this period was longer than that associated with the more inflationary 1970s–early 1980s, at seven quarters (once three

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rises between peak and trough using the entire sample of countries and years. Admittedly, identifying precisely “true” housing price peaks is not that easy. Housing price series are not very homogeneous across countries in terms of coverage and methodological approaches. Moreover, for any given index, systematic changes in the composition of the stock of housing sold in the market at different points in the asset price cycle could bias the series. Even so, the broad picture is unlikely to be significantly affected.

<sup>5</sup> Because our equity data start in 1970, we are unable to identify clear peaks in equity prices for two housing price peaks which occur between 1970 and 1974. We err on the side of caution in classifying these housing price peaks as independent events.

outliers are removed) compared with close to four and 5.5 quarters respectively in the two preceding cases.

The lag between peaks in the current cycle is long by historical standards

Even compared with the 1987 period, however, the recent as yet unfinished cycle stands out. Three years after the global peak in equity prices and their subsequent collapse, real housing prices have continued to rise in many countries. By the second quarter of 2003, for instance, housing prices had appreciated by no less than 60% in the United Kingdom since the peak in equity prices in the second quarter of 1999. Similarly, they had increased by close to 50% in Spain, by around 20% in Australia, Canada and Sweden, and by 15% in the United States since the respective peaks in equity prices. The main exceptions to this sustained increase are countries where prices have not yet recovered from previous booms and busts, such as Japan and Switzerland. In these cases, prices have actually continued to fall or have risen only slightly recently. Moreover, although the rate of growth in housing prices has slowed in recent quarters in many countries, peaks generally still appear far away. Excluding Japan, housing prices continued to rise through the third quarter of 2003 in every country for which data are available. The year-over-year change in housing prices in the United States was approximately 4% per year in the third quarter, while that in Canada and Spain stood between 10 and 15% per year.

Why such an unusually long lag? A number of possible factors spring to mind. One possibility might be that, on balance, the slowdown in economic activity and the rise in unemployment have not been as large as on previous occasions, at least in comparison with the recessions of the 1970s and early 1980s. A related factor is that, contrary to the typical past experience, monetary policy was eased substantially following the most recent stock market bust and weakening in economic activity (Graph 2). This is because, in contrast to past cycles, the slowdown was not fundamentally triggered by a tightening of monetary policy to fend off rising inflation. Rather, it was ushered in by a largely spontaneous reversal in an investment and stock market boom which had been accompanied by rapid credit expansion. As a result, quiescent inflation has given central banks much more room for manoeuvre. While in the late 1980s the stock market crash elicited a qualitatively similar response, policy was subsequently tightened more quickly, as economic activity proved more resilient and inflationary pressures emerged in a number of countries.<sup>6</sup>

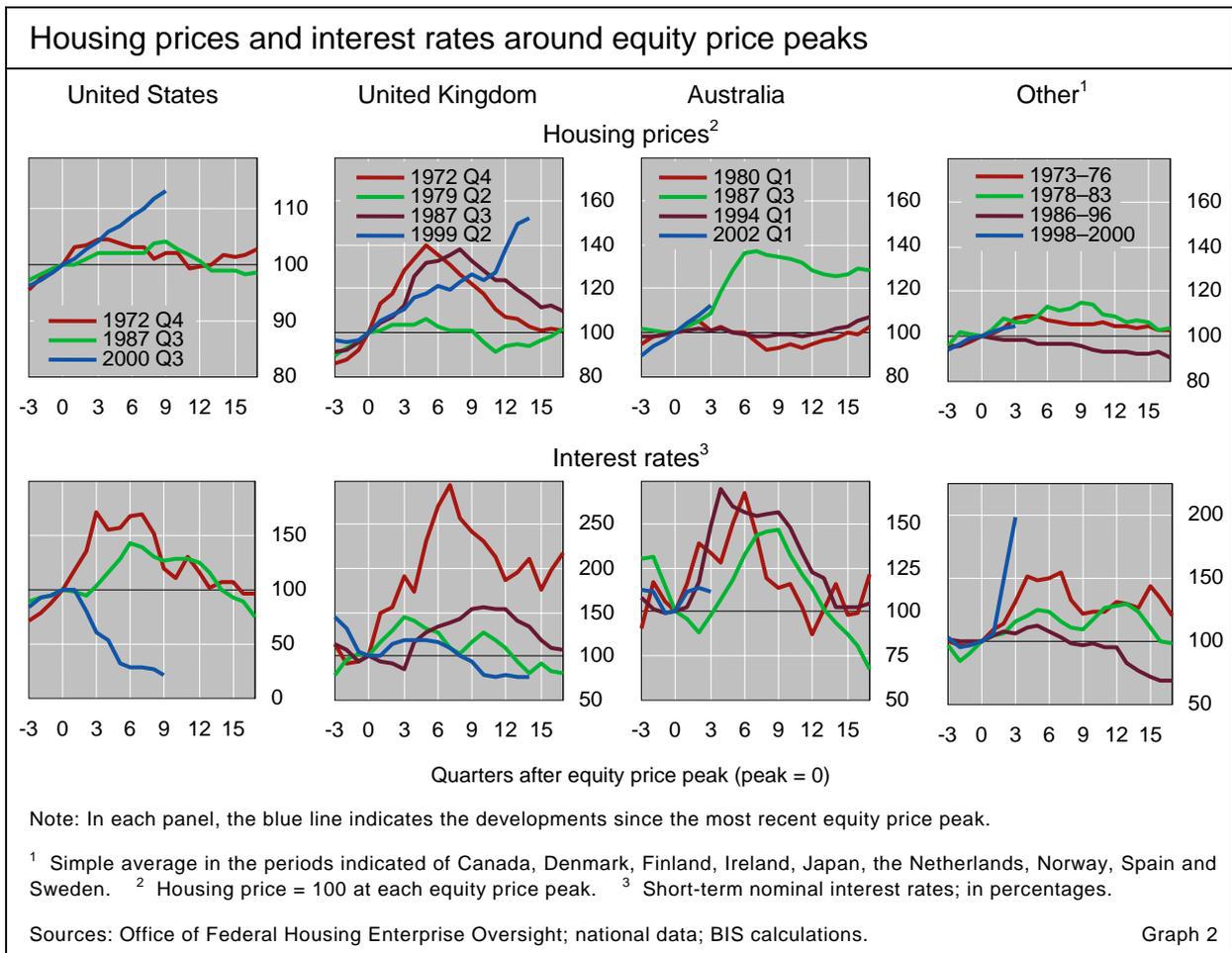
Not all equity price peaks are followed by housing price peaks

In fact, one might legitimately ask whether housing prices need fall at all. Indeed, the record shows that not all the equity price peaks picked by the algorithm have been followed by housing price peaks. And it is possible to envisage that, in a number of countries, prices may simply slow down as a strengthening of the economic recovery carries them along.

A closer look at the historical record will help to cast light on these issues. Specifically, we need to examine the past relationships between equity and housing prices, in addition to the economic circumstances against which they

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<sup>6</sup> This episode is examined in more detail in Borio and Lowe (2003).



occurred. Our statistical analysis covers a set of 13 industrial countries and is carried out on quarterly data from 1970 Q1 to 1999 Q4. We purposefully leave out the most recent episode, which, as noted, has not yet fully unfolded. As before, all asset prices are in inflation-adjusted or “real” terms, and are deflated by the consumer price index.

### Do equity price peaks predict housing price peaks?

We next consider sequentially whether equity prices help to predict peaks in housing prices (a) on their own, (b) after allowing for macroeconomic variables that have traditionally been found to explain housing price movements (“control variables”) and (c) after taking into account financial imbalances built up during the boom.<sup>7</sup> The traditional variables include output growth and changes in unemployment, inflation and interest rates. We considered both nominal and inflation-adjusted interest rates, as well as short-term (three-month) and long-term rates, but report only the results for those interest rates with the highest explanatory power.<sup>8</sup> The financial imbalance proxy captures episodes of

<sup>7</sup> See the accompanying piece by Tsatsaronis and Zhu for references.

<sup>8</sup> Throughout the analysis presented here, short-term nominal interest rates tended to be more statistically significant. The combination of real short-term interest rates and separate inflation

“excessive” *simultaneous* expansion in credit and real equity prices. Specifically, a financial imbalance is said to exist if the deviations from trend (“gaps”) in both the ratio of credit to GDP and in real equity prices exceed certain critical thresholds. The value of the thresholds has been calibrated to maximise the predictive content of the proxy variable for subsequent banking crises over a horizon of three to five years ahead.<sup>9</sup> This variable is included because, in previous work, it has also been found to help predict subsequent output weakness and disinflation (Borio and Lowe (2003)). By the same token, it may also help to predict housing price peaks.

The predictive power of the various variables is established through a series of probit regressions. These allow us to assess the increase in the probability of seeing a housing price peak given that an equity price peak has occurred, and given the prior behaviour in the control variables and the financial imbalance proxy. We look at predictive performance over different horizons. Four basic results deserve highlighting (Tables 2 and 3).

First, equity price peaks have considerable predictive content for subsequent housing price peaks (Table 2). The (unconditional) probability of a

Predicting housing price peaks based on equity price peaks <sup>1</sup>							
Horizon of dependent variable	Combination of predictive variables					Probability of peak	
	Equity peak <sup>2</sup>	Interest rates	GDP growth	Unemployment			
					Unconditional	Conditional <sup>3</sup>	
Four quarters	0.18***				0.09	0.27	
	0.16***	0.02***				0.25	
	0.12**	0.02***	0.01**	-0.10***		0.21	
Eight quarters	0.33***				0.18	0.50	
	0.30***	0.03***				0.48	
	0.25***	0.02**	0.03***	-0.15***		0.43	
Twelve quarters	0.38***				0.27	0.65	
	0.36***	0.03***				0.63	
	0.33***	0.01	0.04***	-0.18***		0.60	

<sup>1</sup> Based on quarterly data (1971 to end-1999) for 13 developed countries. Control regressors include single lags of GDP growth, changes in short-term nominal interest rates and changes in unemployment. The coefficients on these controls can be interpreted as the change in the probability of a peak in housing prices given a marginal change in the regressor from its sample mean. One, two and three asterisks denote significance at the 10%, 5% and 1% level respectively. All regressions were run with four lags of these control variables, with qualitatively and quantitatively similar results. <sup>2</sup> The coefficient on the binary regressor capturing peaks in equity prices can be interpreted as the change in the probability of a housing price peak given a discrete change in the regressor. <sup>3</sup> The conditional probability given a peak in equity prices is the sum of the unconditional probability and the coefficient on the equity peak regressor. Table 2

rate regressors yielded qualitatively similar, but less robust, results. For brevity, we present only those results obtained using nominal rates.

<sup>9</sup> The thresholds correspond to a 4 and 60 percentage point deviation from trend for the private credit/GDP ratio and inflation-adjusted equity prices respectively. With these settings, the dummy variable is switched on for Japan in the early 1970s, and for more than half the other countries in the sample at some point in the early to mid-1980s. For further explanation of the construction of the proxy for financial imbalances and its predictive performance, see Borio and Lowe (2003). For a similar analysis on annual data, see Borio and Lowe (2002a,b).

Predicting housing price peaks based on financial imbalances <sup>1</sup>					
	Change in the unconditional probability of a peak in housing prices				
Unconditional probability	Equity price peak <sup>2</sup>	Financial imbalance <sup>2,3</sup>	Interest rates <sup>4</sup>	GDP growth <sup>4</sup>	Unemployment <sup>4</sup>
0.09	0.17***	0.21***			
0.09	0.11**	0.19***	0.02***	0.01**	-0.10***

<sup>1</sup> Results from probit regressions, with the dependent variable defined as a zero/one dummy corresponding to the occurrence/non-occurrence of a peak in housing prices within the next four quarters. One, two and three asterisks denote statistical significance at the 10%, 5% and 1% level respectively. The results are robust to changes in the horizon over which the peak in housing prices is predicted, eg eight and 12 quarters ahead. <sup>2</sup> The change in the probability of a peak in housing prices conditional on either a peak in equity prices or a financial imbalance having occurred. <sup>3</sup> The financial imbalance dummy is set to one if the credit gap is larger than 4 percentage points and the equity gap is larger than 60 percentage points eight quarters prior to the equity price peak. With no control variables, the coefficients on this variable under alternative lag specifications are 0.08\*\*, 0.20\*\*\* and 0.15\*\*\* for four, six and 10 quarters prior to the equity price peak respectively. With controls, the corresponding coefficients are 0.05, 0.15\*\*\* and 0.14\*\*\* respectively. <sup>4</sup> Control regressors include single lags of GDP growth, the change in short-term nominal interest rates and the change in the unemployment rate. The coefficients on these controls can be interpreted as changes in the probability of a housing price peak given a marginal change in the corresponding regressor from its sample mean. All regressions were run with four lags of these control variables, with qualitatively and quantitatively similar results.

Table 3

country experiencing a housing price peak in any one, two or three consecutive years (four adjacent quarters) is 9%, 18% and 27% respectively. These probabilities almost double in the periods following an equity price peak.<sup>10</sup> Moreover, the predictive content of equity price peaks is remarkably robust to the inclusion of other variables. The inclusion of output growth and changes in unemployment and in interest rates hardly affects the marginal increment in the probability of observing a housing price peak associated with an equity price peak or its statistical significance. Nor are these probabilities materially influenced by the build-up of financial imbalances during the preceding boom.<sup>11</sup>

Housing peaks are more likely after peaks in equity prices ...

Second, housing price peaks have tended to follow periods of comparatively strong economic activity (Table 2). For example, the coefficients on the lag of GDP growth, while not always individually significant when multiple lags are included, indicate that the overall effect is positive and statistically significant. Similarly, the effect of unemployment is negative, implying that a fall in unemployment in the periods preceding a peak in equity

... following periods of strong economic growth ...

<sup>10</sup> We also iterated through independent variables, holding the dependent variable constant at four quarters. This is equivalent to estimating the probability of a housing price peak within the *following* year (fixed time) given an equity price peak within the *previous* two quarters, four quarters, six quarters, etc. The results are consistent with those discussed above. For robustness, the regressions were also run in the reverse direction, where peaks in housing prices are used to predict peaks in equity prices. This exercise generally yields negative coefficients on the housing price dummy variable, indicating that the incidence of a housing price peak lowers the probability of experiencing an equity price peak.

<sup>11</sup> The close relationship between equity and housing price peaks is broadly consistent with theory. For instance, both equity and real estate are long-lived assets and, effectively, claims on real goods or services. As such, they should be expected to have a number of economic determinants in common. At the same time, share prices exhibit less inertia, not least as the market on which they are traded is much more liquid. In addition, initial declines in equity prices from a major peak can in turn induce portfolio shifts into real estate, driving a wedge between their movements. See below for a further discussion of factors affecting the observed lag given the physiological faster adjustment in equity prices.

prices leads to a higher probability of experiencing a peak in housing prices in the quarters ahead.

... and periods of monetary tightening

Third, increases in interest rates were a factor bringing the rise in housing prices to a halt. Somewhat surprisingly perhaps, it is nominal short-term rates that matter most amongst the control variables. While lags of nominal long-term interest rates also enter significantly in many instances, they do so with smaller and less significant coefficients. Moreover, real interest rates, whether short-term or not, are less statistically significant than their corresponding nominal rates, although they tend to perform better when lags of inflation rates are included in the regression. Changes in nominal rates may matter most because they are more closely related to changes in financing constraints in the short run, such as increases in the proportion of income absorbed by interest payments, and hence to both the ability to borrow and willingness to lend (see the special feature by Debelle in this *Quarterly Review*).<sup>12</sup> The greater relevance of short-term over long-term rates may reflect in part similar factors.<sup>13</sup> But, more generally, it may result from the broader influence exerted by monetary policy on economic agents' incentive and ability to spend, not least by affecting expectations about future income streams and attitudes towards risk.

The build-up of financial imbalances also plays a role

Finally, the occasional build-up of financial imbalances during the preceding boom has clear additional information content (Table 3). The predictive ability of the financial imbalance proxy is highest with a lag of eight quarters with respect to the equity price peak. The corresponding increase in the probability of observing a subsequent housing price peak is larger than that associated with the equity price peak itself.<sup>14</sup> This is true regardless of whether other control variables are included. In fact, although not listed in the table, the probability of experiencing a housing price peak within the next two years, given the *joint event* of an equity price peak and a financial imbalance eight quarters prior to this peak, increases by some 50 percentage points (pushing the conditional probability to close to 70%), considerably larger than if the two events took place in isolation. This evidence suggests that the build-up of excessive debt limits the shock absorption capacity of the system once equity prices reverse their course, thereby paving the way for a subsequent softening in housing prices too.

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<sup>12</sup> For corroborating evidence on the role of nominal, as opposed to real, interest rates in this context in the United States, see Brayton and Reifschneider (2003).

<sup>13</sup> If this was the only effect, however, one would expect to see greater variation across countries, given major differences in the proportion of mortgage financing at variable and fixed rates (Borio (1997)).

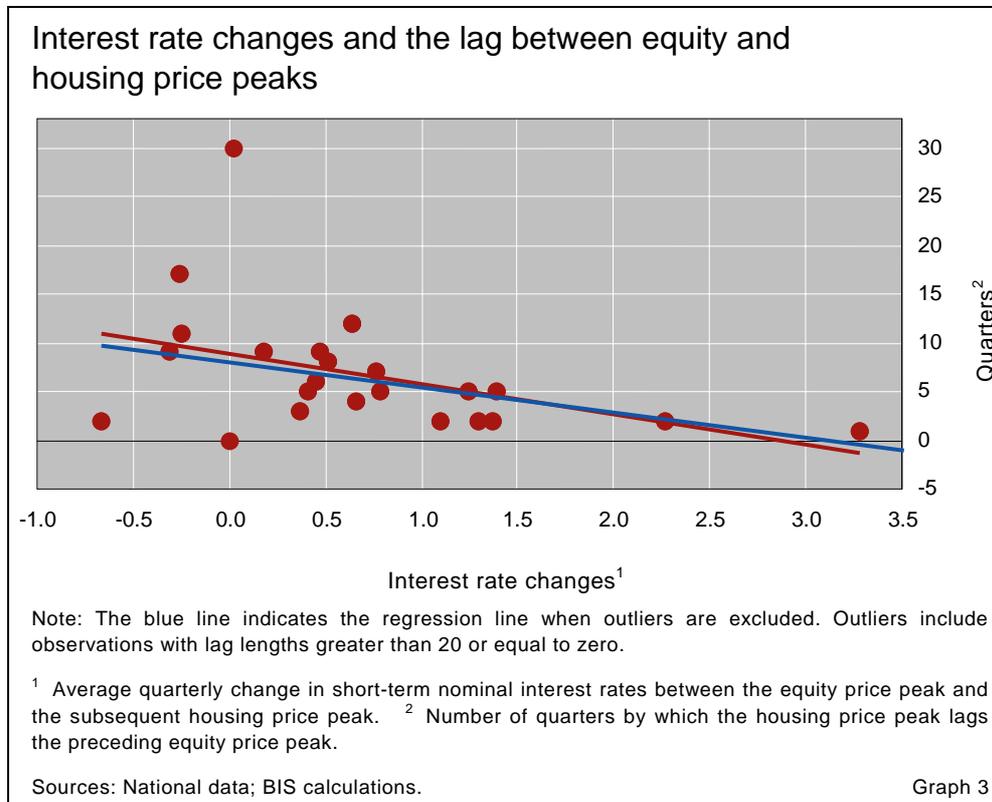
<sup>14</sup> Table 3 illustrates the case of observing a housing price peak over the subsequent four quarters. Similar results also hold when the horizon is extended further. For example, a financial imbalance eight quarters prior to an equity price peak raises the probability of a housing price peak within the two years following the equity price peak by 31 percentage points.

## What explains the lag length?

Thus far the evidence indicates that equity price peaks, especially if preceded by large credit and equity price booms, by increases in short-term nominal rates and by strong economic activity, tended to herald peaks in housing prices over the period considered. To what extent do these factors also help to explain the length of the lag between the equity and housing price peaks?

To address this question, we consider a subsample of the overall data, namely all housing price peaks that are preceded by equity price peaks (ie the observations in Table 1).<sup>15</sup> We then regress the lag length between these peaks on our variables of interest, namely the average change in interest rates, output growth, unemployment, and our proxy for financial imbalances.<sup>16</sup>

Longer lags  
between equity and  
housing price  
peaks ...



<sup>15</sup> Interest rate data for Denmark, Finland and Norway are missing for the early years of our sample, leading to the loss of three observations from the list in Table 1.

<sup>16</sup> The average change in interest rates is calculated as the cumulative change from the peak in equity prices to the peak in housing prices divided by the lag length. This normalisation helps to control for the considerable heterogeneity in the length of the period over which interest rates move following an equity price peak. On the other hand, this introduces the dependent variable into the right-hand side of the estimating equation, possibly leading to endogeneity problems. An alternative is to calculate the change in these regressors over a fixed period after the peak in equity prices, and then iterate through various period lengths in separate regressions. This exercise yields coefficients on the interest rate variable which are of the expected sign but are imprecisely estimated (generally insignificant).

The results suggest that the variable that contains the most information about the lag length is the short-term nominal interest rate.<sup>17</sup> Increases in these rates shorten the lag, while reductions lengthen it in a statistically and economically significant way (Graph 3).<sup>18</sup> Across our sample of countries, the average quarterly change in interest rates between peaks in equity and housing prices was around 70 basis points, and was associated with a lag length of seven quarters. Taken at face value, the results indicate that, had the average quarterly change in interest rates been 25 basis points less, the lag length would have increased by about one quarter. Looking at the result from the opposite perspective, it is as if increases in interest rates helped to bring housing price booms to a halt. On this basis alone, actual declines in interest rates following an equity price peak could potentially be associated with considerably longer lags.

... are associated  
with monetary  
easing

The statistical association between average changes in interest rates and the lag between equity and housing price peaks is robust to a number of alternative econometric specifications. In particular, the inclusion of the change in GDP growth, itself not statistically significant, slightly reduces the size of the coefficient on the interest rate variable but does not alter the basic result. Other explanatory variables, namely various lags of the financial imbalance proxy and changes in unemployment, do not seem to have a statistically significant effect on the lag length. Likewise, the exclusion of outlier observations reduces the size of the coefficient on interest rate changes by about one third, implying that a fall in short-term rates has a smaller effect on lag length, but increases the accuracy of the estimated coefficient (higher level of statistical significance).

### What explains the size of the decline?

So far, we have touched on the determinants of peaks in housing prices and their lag with respect to equity price peaks. But do the above variables tell us anything about the size of the bust too? After all, it is the size of the fall that is of greater significance for economic activity. As housing values are the largest component of household wealth, significant declines in those values can have strong wealth effects, leading to reductions in consumption, investment and overall economic activity. Indeed, it would appear that busts in housing prices have had a larger negative impact on these macroeconomic variables than have busts in equity prices (IMF (2003)).

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<sup>17</sup> The average change in interest rates between peaks ranges from a maximum of 3.27 percentage points per quarter during the Canadian equity-house price cycle in 1981 Q1 to a minimum of -0.66 percentage points per quarter for the Irish cycle in 1990 Q3.

<sup>18</sup> This statement implicitly assumes that interest rate changes have a *symmetric effect* on the lag length. That is, many of the 23 equity-housing price pairs included in the regression occur in the 1970s and 1980s, when inflation was relatively high. As a result, only four of these 23 observations are actually associated with a *fall* in interest rates following the equity price peak. Thus, a more accurate statement would be that the experience from the 1970s and 1980s implies that *smaller than average increases* in interest rates following a peak in equity prices are associated with longer lags between peaks.

The fact that, over the sample period, booms are not much smaller than busts adds urgency to this question. On average, housing prices fell by 20% from each peak, within a range of 3 to some 50%, while the rise from the previous trough averaged close to 40%. This actually means that if, say, housing prices started at a value of 100, the boom would, on average, take them to close to 140 and the subsequent decline back to around 110.

The severity of previous busts in housing prices ...

In order to examine whether the size of the fall in housing prices can be explained by the characteristics of the economic slowdown and, more ambitiously, by those of the preceding boom, we proceed as follows. We relate the peak-to-trough decline in housing prices to two sets of variables, corresponding to the characteristics of the previous boom and the subsequent decline. As regards the boom, we include the trough-to-peak increases in equity prices and in housing prices; a variable capturing whether a financial imbalance was present or not; and the change in nominal interest rates in the four quarters prior to the housing price peak. As regards the bust, we include the peak-to-trough decline in equity prices as well as the change in output growth, unemployment and nominal short-term interest rates during the fall in housing prices. Three conclusions stand out (Table 4).

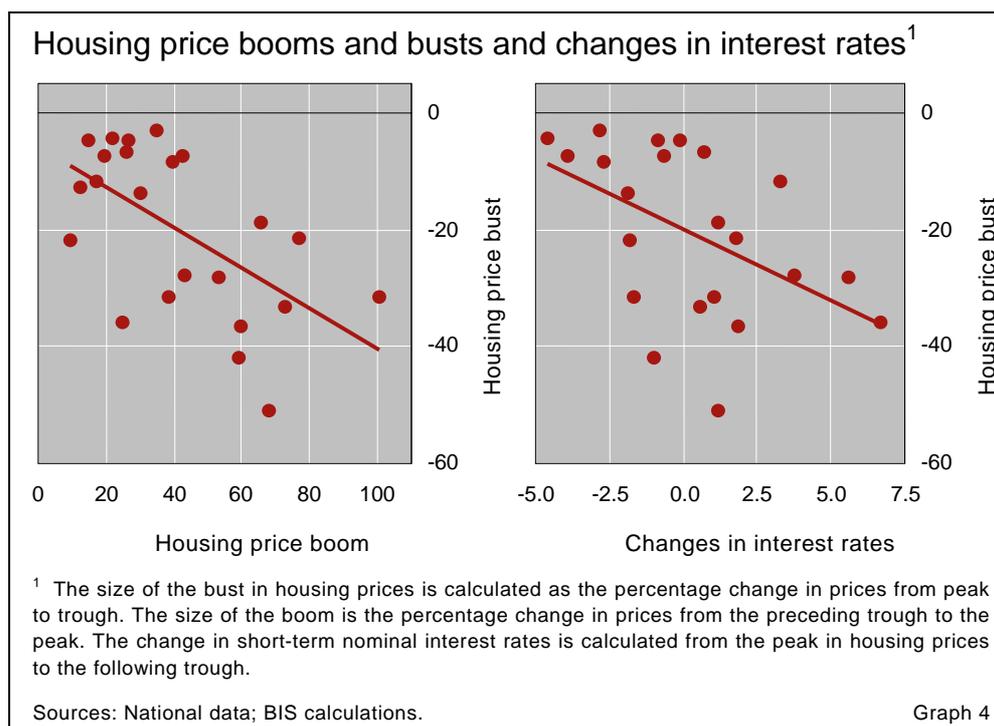
First, the own dynamics component of housing prices is evident. Other things equal, the larger the boom in housing prices, the larger the bust (Graph 4). The coefficient on the trough-to-peak rise in housing prices indicates that a one standard deviation rise in the size of the boom in housing prices adds approximately 8 percentage points to the subsequent fall. Using the sample averages, and assuming a housing price index of 100 at the preceding trough, if housing prices rose by two thirds they would be up by only some 20–30% at the end of the bust. The size of the boom remains statistically significant even after the inclusion of other explanatory variables, with very little change in its impact. This own dynamics could reflect, for instance, the self-reinforcing interaction between rising and falling prices, extrapolative expectations of further price changes in the same direction and the demand for

... is related to the size of the boom in housing prices ...

Predicting the size of the housing price bust <sup>1</sup>								
Dependent variable: percentage peak-to-trough fall in housing prices								
Housing price boom	Equity price <sup>2</sup>		Financial imbalance <sup>3</sup>	Interest rate change <sup>4</sup>		Output growth <sup>4</sup>		R-squared
	Boom	Bust		To peak	After peak	To peak	After peak	
-0.34***								0.35
-0.31***	-0.02							0.38
-0.34***		0.16						0.39
-0.27***			-22.22***					0.54
-0.21**			-24.02***	-0.15	-2.12***			0.71
-0.21***			-27.18***	-0.51	-2.21***	-0.04	3.17***	0.80

<sup>1</sup> Results from OLS regressions of the peak-to-trough percentage change in housing prices on various regressors. <sup>2</sup> The equity price changes are calculated as the percentage variation in equity prices from the previous trough to the peak in equity prices, and from the peak in equity prices to the following trough. <sup>3</sup> The financial imbalance dummy is set to one if the credit and equity gaps (deviations from ex ante recursive trends) exceed 4 and 60 percentage points in the sixth quarter prior to the equity price peak. <sup>4</sup> The change in interest rates and GDP growth is calculated over four periods prior to and following the peak in housing prices. Neither the change in nor the level of the unemployment rate (before and after the peak in housing prices) entered significantly.

Table 4



investment in housing, in combination with only lagged reactions in the supply of new housing.<sup>19</sup>

This result is supported by the relatively poor information content of several of our other variables of interest. Somewhat surprisingly perhaps, on its own, the size of the boom and bust in equity prices seems to have, at best, only marginal predictive power. The other variables capturing the degree of economic weakness do not fare much better. While output growth after the equity price peak does seem to temper the severity of the housing price bust, the change in unemployment (not shown) is not significant.

Second, confirming the importance of the characteristics of the preceding boom, financial imbalances during that phase do appear to help explain the subsequent bust in housing prices. Taken literally, our results imply that a financial imbalance six quarters prior to the peak in housing prices translates into a bust in housing prices some 20 percentage points more severe than would otherwise be the case.<sup>20</sup> Thus, it seems that what matters is not so much the size of the equity boom per se but, rather, whether unusually sustained and rapid increases in the ratio of private credit to GDP and equity prices occur simultaneously, pointing to the build-up of vulnerabilities in the system.

Finally, nominal interest rates do seem to have an effect (Graph 4). In particular, reductions in nominal rates following the housing price peak appear to help cushion the fall; the impact of changes prior to the peak, while working in the expected direction, is harder to discern statistically.

<sup>19</sup> On this, see Case and Shiller (1989), Capozza et al (2002) and Zhu (2003).

<sup>20</sup> Financial imbalances that occur four or eight periods prior to the peak in housing prices have similar although smaller predictive content for the bust in housing prices.

... and the build-up of financial imbalances

## Conclusion

The statistical regularities that emerge over the period from the early 1970s to the mid-1990s point to the following picture. On balance, housing price peaks tended to follow equity price peaks with a lag of at least one year and in the wake of relatively buoyant economic activity. This was especially the case if the peaks had been preceded by the build-up of financial imbalances, in the form of unusually rapid and sustained private credit expansion alongside equity price booms. Increases in interest rates seem to have played a role in bringing about the peak in housing prices. The subsequent bust in housing prices had a certain life of its own, driven to a considerable extent by the size of the previous boom and, occasionally, exacerbated by the build-up of financial imbalances during the boom phase. Declines in nominal interest rates, however, could help to cushion the fall to some extent.

What does this imply for the current juncture? In drawing inferences, due regard should be given to the limitations of the exercise. For one, the data set is rather small, as we are just looking at major episodes and the data on housing prices do not go back beyond the 1970s.<sup>21</sup> In addition, there have been some significant changes in the broad economic environment relative to the period for which the statistical regularities were uncovered. Lower and more stable inflation is the clearest such example. These should be taken into account when forming an overall judgment.

Even so, at least two broad inferences would seem warranted. First, looking back, the unusual strength of housing prices during the recent economic slowdown and subsequent recovery may well have been driven to some extent by own dynamics, as increases in prices feed onto themselves, and have been supported by the decline in nominal short-term interest rates associated with the sizeable monetary easing following the slowdown. In sharp contrast to most previous episodes, quiescent inflation has provided central banks with ample room for manoeuvre, which they have exploited. Second, it is hazardous to speculate on how long housing prices could continue to rise and, if they peaked, what the size of any subsequent fall might be. In particular, in the absence of clear inflationary pressures, policy rates could stay low for considerably longer than in the past, removing what appears to have been a significant trigger for declines in the past. At the same time, one cannot rule out entirely the possibility that, even in the absence of sharp increases in rates, own dynamics might, at some point, act as a drag on prices. And, if experience can be taken as a guide, other things equal, the countries most vulnerable to considerable declines would seem to be those where prices had risen the most and where other signs of the build-up of financial imbalances may have been present during the boom phase.

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<sup>21</sup> Moreover, the data points may not quite be independent across countries, to the extent that they may be driven by common factors across countries. If so, the number of independent episodes in the cross-sectional analysis is smaller than assumed by the statistical techniques. This would increase the uncertainty of the corresponding estimates.

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