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Interest rates and house prices in the United States and around the world

Gregory D Sutton, Dubravko Mihaljek and Agne Subelyte[1]

Abstract

This paper estimates the response of house prices to changes in short- and long-term interest rates in 47 advanced and emerging market economies. We use data that statistical authorities selected as their best house price series, covering almost half a century of quarterly observations for the United States and over 1,000 annual observations for the rest of the sample. We find a surprisingly important role for short-term interest rates as a driver of house prices, especially outside the United States. Our interpretation is that this reflects the importance of the bank lending channel of monetary policy in house price fluctuations, especially in countries where securitisation of home mortgages is less prevalent. In addition, we document substantial inertia in house prices and find that changes in interest rates and other determinants affect house prices gradually rather than on impact. This suggests that modest cuts in policy rates are not likely to rapidly fuel house price increases. Finally, we find that US interest rates seem to affect house prices outside the United States.

Keywords: interest rates, house prices, monetary policy, bank lending channel, random walk, house price bubble, United States, advanced economies, emerging market economies

JEL classification: E39, E43, E58, G12, R31, R32.

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1. Introduction

This paper estimates the response of house prices in 47 advanced and emerging market economies (EMEs) to changes in short- and long-term interest rates. Our study has four novel aspects. First, we analyse in some detail the impact of short-term interest rates on house prices. Second, we look at the responsiveness of house prices around the world to US interest rates. Third, we use a unique data set on house prices compiled by the BIS in cooperation with national statistical and monetary authorities. And fourth, our empirical framework tries to capture the important role of inertia in house prices.

Our focus on short-term interest rates is motivated by their link to monetary policy. As a house is a long-lived asset, the interest rate appropriate for relating the service flow from a house to its price is arguably a long-term rate. However, house prices also depend importantly on ease of access to credit, which is in turn significantly affected by the monetary policy stance. Bernanke and Blinder (1992), for instance, showed that changes in the US federal funds rate were associated with changes in lending by US banks, an effect that has become known as the bank lending channel of monetary policy. Short-term interest rates, which are more closely related to the stance of monetary policy, might therefore be just as important a "fundamental" for house prices as longer-term rates. Indeed, we find a surprisingly important role for short-term interest rates as drivers of house prices, especially outside the United States. Our interpretation is that this reflects an important role for the bank lending channel of monetary policy, especially in countries where securitisation of home mortgages is less prevalent.

The motivation for looking at the responsiveness of house prices around the world to not only domestic but also US interest rates is that the latter have become a key measure of the global cost of financing. We do find spillover effects from US interest rates, both short and long ones, on house prices outside the United States.

Our study draws on the BIS residential property price statistics and, in particular, the "preferred" house price series as identified by national statistical offices or central banks. We compiled over 1,000 annual observations on house prices for the non-US countries in our sample from these series and about a half century of quarterly house prices for the United States. We use these data to estimate the dynamic impact of changes in interest rates and other explanatory variables on real house prices around the world.

We find that real house prices display inertia when they adjust to new levels and that changes in short-term interest rates from up to five years in the past can have a significant impact on current changes in house prices. We interpret this as a consequence of the large transaction costs associated with trading residential real estate, which implies that the demand for housing adjusts slowly in response to changes in interest rates and other driving variables. Given this protracted response, modest cuts in policy rates are unlikely to rapidly fuel house price bubbles.

The finding of inertia in house price movements is not new: Case and Shiller (1989) documented it for several US cities as early as the 1980s. For the cities they studied, annual changes in real house prices tended to be followed by price changes in the same direction the following year. We show that this is also the case for real house prices at the country level in both advanced economies and EMEs.

In contrast, studies based on modern asset pricing theory assume that new information about economic fundamentals gets incorporated into house prices more or less instantaneously. Himmelberg et al (2005) provide an example of such an analysis and calculate that a 1 percentage point decline in real interest rates could raise house prices by as much as 19–33% in US cities with persistently high house price growth. Our empirical estimates indicate a much smaller response of real house prices to changes in interest rates. In the case of the United States, we find that a 1 percentage point decline in the US short rate leads to a 5% increase in house prices after three years. We find even smaller interest rate effects in other countries. Although the interest rate impacts we estimate are much smaller than the theoretical impacts reported by Himmelberg et al (2005), our estimates are between two and five times larger than those of Jarociński and Smets (2008) and Crowe et al (2011). We believe that the difference between what asset pricing models predict and what we find can be explained by the large search and transaction costs associated with trading residential real estate, and shifting between owner-occupied and rental housing, that asset pricing theory ignores.

Concerning the relation of our estimates to previously published research, we believe that we document a larger impact of interest rates on house prices in part because we consider the effects of both nominal and real interest rates. Our results show a small but statistically significant impact of the level of a short-term real interest rate on real house price growth, even after allowing for a long distributed lag of changes in the short-term nominal rate.

The paper is organised as follows. Section 2 describes the data and the main stylised facts on house prices and interest rates in our sample. Section 3 presents the empirical model. Sections 4–6 look at the determinants of house prices in the United States, other advanced economies, and EMEs. Section 7 concludes.

2. Data and stylised facts

Data samples

Despite their importance, data on house prices are a relatively new statistical indicator. One reason is that house price data in many countries used to be compiled by real estate associations rather than statistical offices. That practice changed with the Great Financial Crisis. Another is that standardisation of house prices can be challenging even within a single country. Different house price indices cover different types of dwelling (new, existing, apartments, houses etc), forms of ownership (owner-occupied, built for wholesale) and geographical areas (capital city, regions).

The house price data used in this paper come from a newly compiled BIS data set on residential property prices (see Scatigna et al (2014)). The data set consists of several series for each country, differentiated by types of housing, geographical areas and time frequencies. The series are transmitted to the BIS by national statistical offices or central banks. These authorities also identified their preferred house price series, which facilitated the choice of data for cross-country comparisons.

For the majority of countries, we use a data set that contains the most homogeneous and internationally comparable house price series provided to the BIS, the so-called *Selected Dataset*. For 18 advanced economies we use an additional data set with longer historical data, backdated by the BIS in cooperation with national authorities.[2] We also construct longer series at an annual frequency for a sample of seven central and eastern European economies. Appendix 1 lists all the metadata.

[2] These data have already been used in a number of studies; see eg Drehmann et al (2012).

The full data set covers 47 countries, of which 20 are advanced economies and 27 are EMEs.[3] We separately analyse house prices in the United States, other advanced economies and EMEs. Most regressions use data at an annual frequency. For the United States, we use a sample of quarterly house prices from 1970 to 2015.

The data set is unbalanced: the sample begins between 1963 and 1988 for advanced economies, and between 1970 and 2009 for EMEs. For 16 out of 20 advanced economies, the data go back to the late 1960s or early 1970s, giving us 50 annual and around 720 total observations. Although long historical series are unavailable for most EMEs (with the exception of Korea and South Africa), we gathered at least 17 years of data for more than a third of the countries, and at least 12 years for another third. The full EME sample has 340 annual observations.

House prices in the long term

Is housing a good long-term investment? Our data suggest that the answer is a qualified "yes": nominal house prices increased on average by close to 7% per annum and real prices by 2¼% in the sample of 20 advanced economies for which there are 45 years of data on average (Table 1).[4] The corresponding figures for EMEs are 7% and 3% per annum over an average sample length of 15 years. The biggest single-year nominal increases in advanced economies ranged from 16% in Germany to over 50% in Italy (in 1974); the biggest single-year declines from –2% (also in Germany) to –19% (Ireland, in 2009) (Table 1). The EMEs have experienced even wider variations: nominal house prices increased up to 87% in a single year (Latvia, in 2002), and fell by close to 40% in a year (Latvia, the Czech Republic and Estonia, all in 2009).

One striking feature of house price growth is its persistence. With the exception of Germany, Portugal and Switzerland, advanced economies have seen nominal house prices growing by an average of at least 6% per year for 40 years or longer. In the United States, for instance, this resulted in a 13-fold increase in nominal house prices over a period of 47 years; in Norway, in a 77-fold increase over 66 years.

Another way to appreciate the persistence of house prices is to contrast the length of their upswings and downswings. We define an upswing (downswing) as a period of nominal house price increases (decreases) sustained in an individual country for three years or more. Based on this definition, periods of upswing accounted for nearly 80% of the advanced economy sample. The upswings lasted on average 13 years; with the longest one, in Australia, still continuing after half a century (Table 2 and Appendix Table A1). By contrast, downswings accounted for only 8% of the advanced economy sample; they lasted on average five years, and the longest one, in Japan, lasted 13 years. In EMEs, upswings accounted for two thirds of the sample. They lasted on average eight years, and the downswings four years (Table 2 and Appendix Table A2).

[3] The advanced economies are: Austria, Australia, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States. We excluded five advanced economies (Cyprus, Greece, Iceland, Luxembourg and Malta) for which we had fewer than 20 annual observations. The EME sample includes: Bulgaria, Brazil, China, Croatia, the Czech Republic, Estonia, Hong Kong SAR, Hungary, Indonesia, Israel, Korea, Latvia, Lithuania, Morocco, Macedonia, Mexico, Malaysia, Peru, the Philippines, Poland, Romania, Russia, Singapore, Slovakia, Slovenia, South Africa and Thailand.

[4] We use nominal house prices for illustration because of their signalling nature in the formation of expectations about future house prices. Even in equity markets there is evidence that investors suffer from inflation illusion: Modigliani and Cohn (1979) and Campbell and Vuolteenaho (2004) show, for instance, that investors apparently value equities using the nominal interest rate instead of the real interest rate.

Main statistics on house price growth Table 1

Country	In nominal terms, Percent per year			In real terms, Percent per year			Change since start of sample[1]		Years in sample
	Average	Max	Min	Average	Max	Min	Nominal	Real	
Advanced economies	***6.8***	***51***	***–19***	***2.2***	***31***	***–19***	***2,124***	***173***	***47***
Spain	9.8	38	–15	2.5	31	–17	4,657	149	44
United Kingdom	9.3	38	–8	3.9	26	–13	6,036	405	48
New Zealand	8.8	40	–4	2.7	26	–9	7,459	265	53
Italy	8.8	51	–6	1.7	27	–7	3,481	98	45
Ireland	8.7	30	–19	2.6	20	–16	3,589	175	44
Australia	8.1	25	–2	3.0	16	–7	6,556	373	55
Norway	7.1	30	–14	2.5	26	–18	7,726	304	66
Sweden	7.1	19	–11	2.4	13	–15	2,046	165	44
Canada	7.1	27	–5	2.8	15	–14	1,886	219	45
Japan	7.1	37	–6	3.8	30	–14	4,437	661	60
France	6.7	20	–6	2.2	13	–6	2,260	178	50
Finland	6.7	35	–17	1.7	28	–19	1,426	81	45
Denmark	6.4	24	–12	1.8	22	–15	1,328	94	45
United States	6.0	18	–14	1.8	12	–17	1,332	110	47
Belgium	6.0	21	–5	2.3	14	–12	2,203	230	55
Austria	6.0	27	–5	3.8	23	–6	402	173	29
Netherlands	5.9	39	–11	2.4	30	–16	1,454	173	41
Portugal	3.6	19	–7	–0.5	7	–10	144	–14	27
Switzerland	3.5	17	–5	1.1	11	–11	360	55	44
Germany	2.8	16	–2	0.0	13	–5	255	–1	47
Emerging markets	***6.9***	***87***	***–39***	***3.1***	***83***	***–41***	***131***	***38***	***17***
Latvia	16.7	87	–39	12.1	83	–41	504	233	15
Russia	16.5	48	–21	5.4	35	–27	612	76	14
Brazil	12.8	25	–2	5.9	19	–10	424	114	14
Estonia	12.4	51	–36	8.3	45	–36	522	219	18
South Africa	10.8	38	–8	2.0	30	–21	14,730	114	50
Lithuania	9.3	52	–31	6.9	48	–34	239	131	17
Hong Kong SAR	9.2	40	–28	4.4	32	–30	1,562	224	37
Hungary	8.6	46	–6	3.2	33	–10	260	55	17
Bulgaria	8.0	48	–21	8.0	48	–40	225	27	18
Peru	7.6	28	–14	4.6	21	–16	218	99	17
Poland	7.3	53	–14	5.4	50	–16	131	72	14
Slovakia	6.7	40	–11	3.2	29	–13	107	38	13
Philippines	5.9	11	0	2.4	8	–4	49	17	7
Malaysia	5.6	12	1	3.3	10	–1	137	66	16
Israel	5.3	18	–6	1.9	15	–6	185	44	21
Mexico	5.2	8	4	1.1	4	–1	66	12	10
Czech Republic	5.2	31	–37	2.8	28	–38	87	31	16
Indonesia	4.8	12	2	–2.1	5	–7	84	-24	13
Slovenia	4.1	22	–12	1.8	18	–13	52	17	12
Thailand	4.0	8	0	2.7	6	–1	37	21	8
Korea	3.6	17	–9	–0.3	14	–16	177	-13	30
China	3.5	9	–4	0.6	5	–5	41	6	10
Singapore	3.4	25	–14	1.8	22	–15	66	26	18
Croatia	2.8	18	–6	0.1	14	–7	60	-2	18
Romania	–4.6	4	–14	–7.4	4	–19	–25	-38	6

[1] In per cent; for advanced and EME aggregates, median values over the samples.

Sources: BIS residential property price statistics; authors' calculations.

Upswings and downswings in nominal house prices[1]

In years — Table 2

	Advanced economies		EMEs	
	Upswings	Downswings	Upswings	Downswings
Total	748	80	279	48
Average length	13	5	8	4
Maximum length	50	13	22	6
Most frequent length	4	4	4	4
Median length	11	4	7	4
Number of up/downswings	79	8	36	11
Percent of total sample period	58	17	65	11
Years in the sample	943		426	

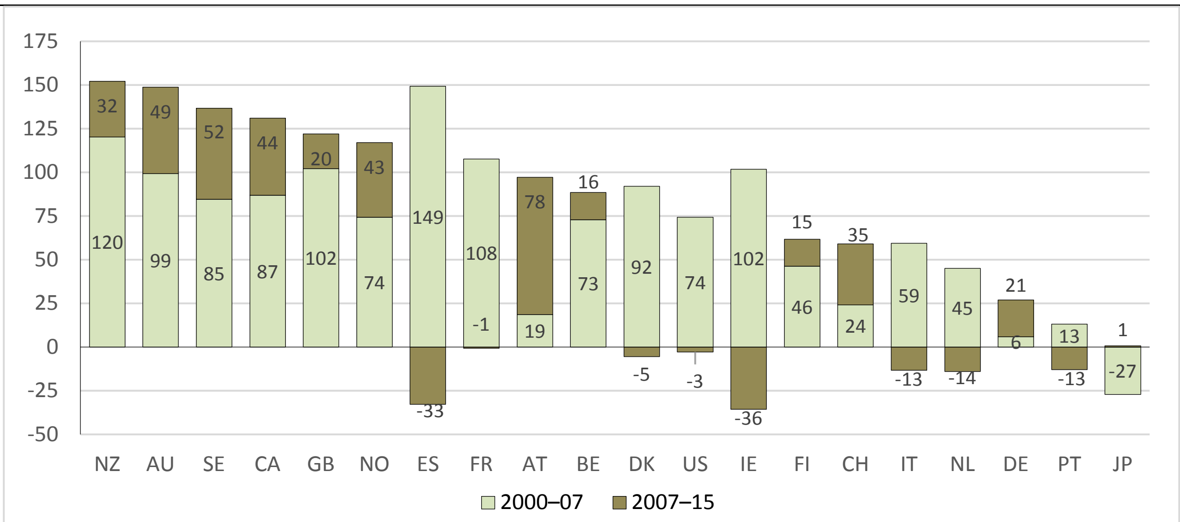
[1] Upswings (downswings) are defined as periods of nominal house price increases (decreases) sustained in an individual country for three years or more.

Sources: BIS residential property price statistics; authors' calculations.

The surge in house prices has been particularly pronounced since the turn of the millennium. Between 2000 and 2015, nominal house prices increased by 100% or more in half the economies in our sample (Graphs 1 and 2). Most experienced a housing boom before 2007 (light bar segments). But many have also seen very rapid house price growth since 2007 (dark bar segments). These included Australia, Austria, Canada, the Netherlands, Norway, Sweden and Switzerland among advanced economies; and Brazil, Hong Kong SAR, Israel, Malaysia and Peru among EMEs.

Cumulative growth in advanced economy nominal house prices: 2000–07 and 2007–15

In per cent — Graph 1



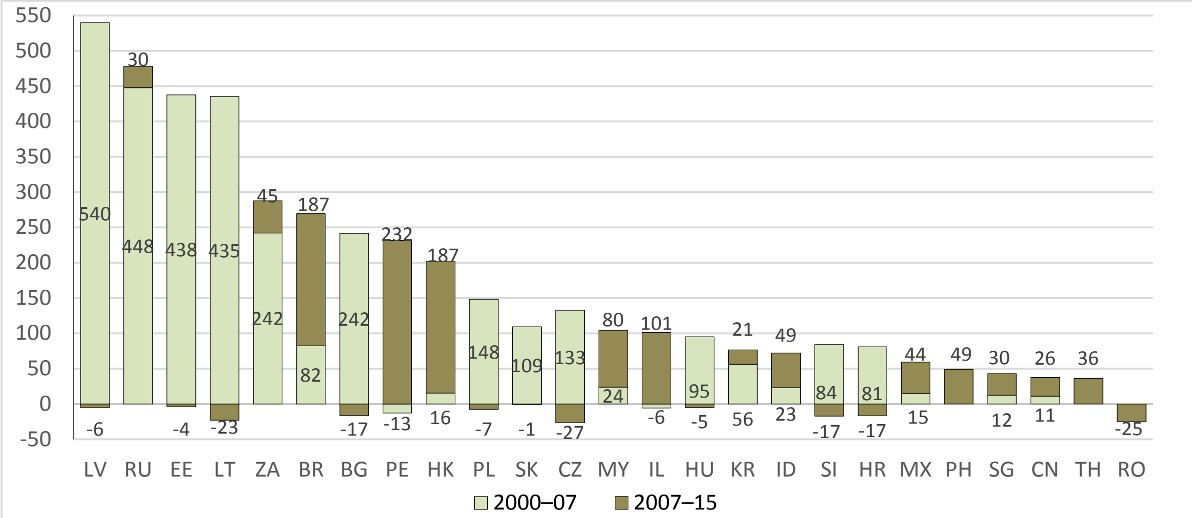
Sources: BIS residential property price statistics; authors' calculations.

What do the data tell us about the relationship between the two main variables of interest – house prices and short-term interest rates? We expect rising interest rates to be associated with slower growth in house prices, and vice versa. However, contemporaneous changes in short-term interest rates and real house prices are in fact positively correlated (Graph 3). And except for the EME sample, this relationship is statistically highly significant.

Data for individual countries also indicate that real house prices often move in the same direction as interest rates. This was the case for instance in many advanced economies during 2005–07 (Appendix Graph A1). But in other countries, eg Mexico, real house prices reacted little, if at all, to interest rate changes over the past decade (Appendix Graph A2). There are also many cases where real house prices simply kept on rising regardless of interest rate changes, eg in Australia, Austria, Canada, Hong Kong SAR, Malaysia, Norway, Peru, Sweden and Switzerland for the past 10 years or so (Appendix Graphs A1 and A2).

Cumulative growth in EME nominal house prices: 2000–07 and 2007–15

In per cent Graph 2



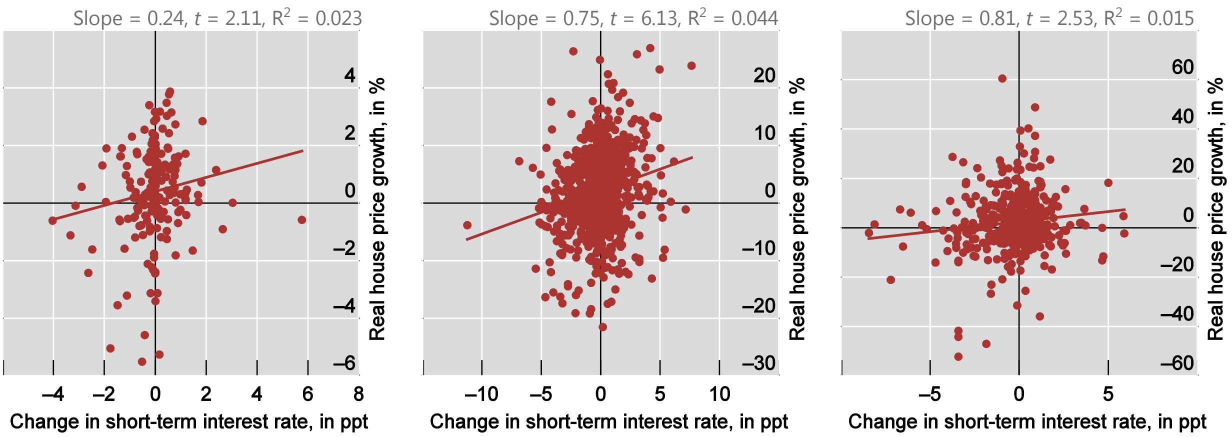
Sources: BIS residential property price statistics; authors' calculations.

However, *past* changes in interest rates on average do affect real house price changes in the expected direction. For instance, changes in interest rates lagged by eight quarters in the United States, and by two years in non-US advanced economies and EMEs, are negatively correlated with current changes in real house prices; this negative relationship is statistically highly significant in all three samples (Graph 4).

The empirical relationship between changes in interest rates and real house prices might therefore not be as straightforward as implied by simple models. Changes in interest rates often seem to affect real house prices with long delays. This suggests that several lags of interest rate changes would have to be included in an empirical model of house price determination. And, in view of their extraordinary persistence, several lags of real house price changes would have to be included, too.

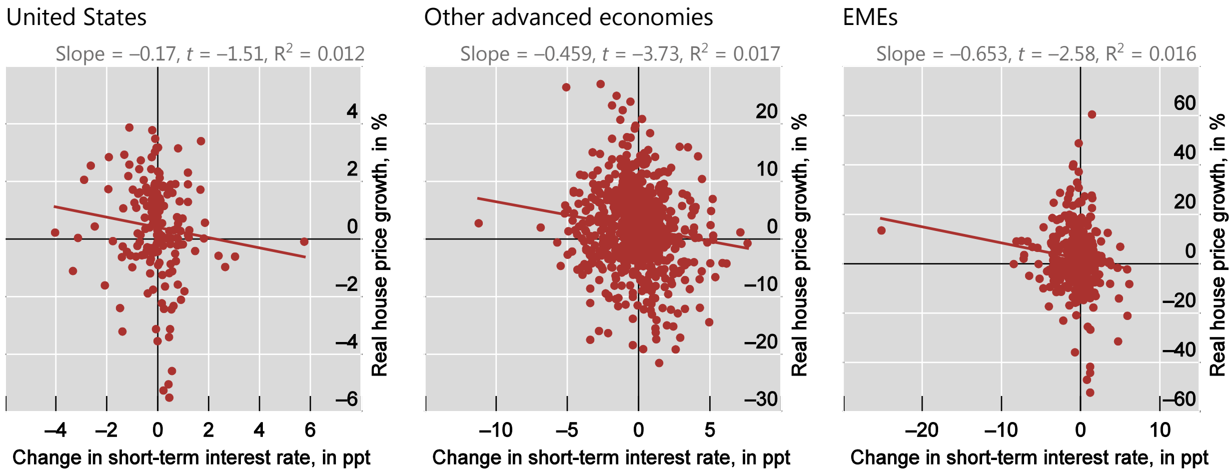
Contemporaneous changes in real house prices and nominal short-term interest rates Graph 3

United States | Other advanced economies | EMEs



Sources: Bloomberg; CEIC; Datastream; IMF, *International Financial Statistics*; national data; authors' calculations.

Changes in real house prices and lagged nominal short-term interest rates[1] Graph 4



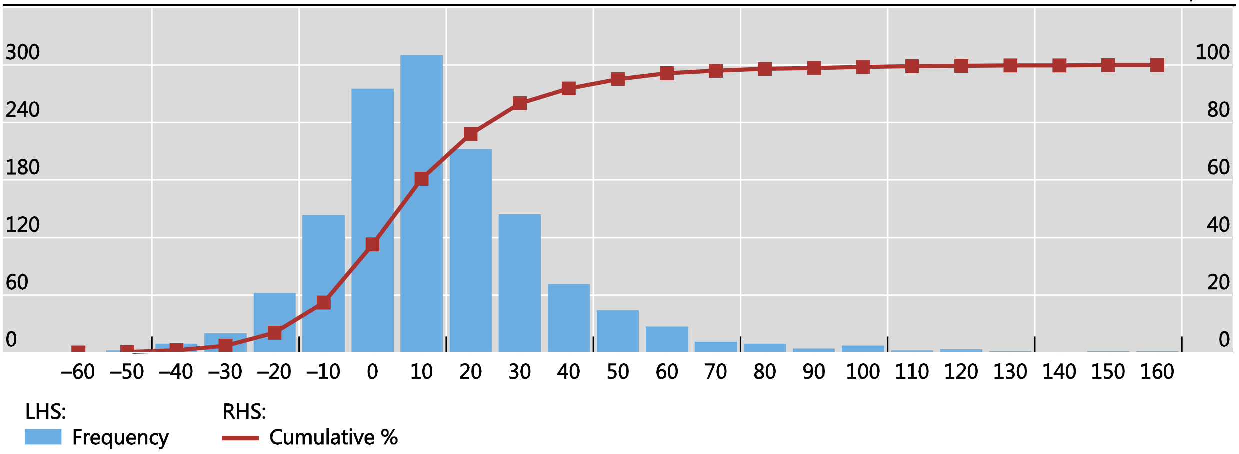
[1] Interest rates were lagged by eight quarters for the United States and two years for other advanced economies and EMEs.

Sources: Bloomberg; CEIC; Datastream; IMF, *International Financial Statistics*; national data; authors' calculations.

One way to illustrate the importance of inertia is to consider the likelihood of a fall in real house prices at a given point in time. Rosengren (2011) suggested, for instance, that an important myth contributing to the crisis was the belief that a diversified portfolio of US residential real estate had little risk of falling in value. As it turned out, US real house prices fell by as much as 31% over the course of 2007–09.

Distribution of three-year changes in real house prices

In per cent Graph 5



Sources: BIS residential property price statistics; national data; authors' calculations.

Graph 5 shows a histogram of three-year changes in real house prices for all countries except the United States: at 37%, the probability for real house prices to fall over a three-year period was quite high. The likelihood of a fall at least as large as that experienced in the United States was much lower: 2.3%. However, the histogram reports unconditional probabilities. Against the backdrop of a growing US house price bubble in 2000–06, and much new supply coming on stream due to elevated construction, the conditional probability of a marked house price decline was larger. How much larger is open to debate, but we can take 2.3% as a lower bound to the probability of the three-year decline experienced in the United States.

3. Empirical model

House price dynamics is usually analysed within the framework of either asset pricing or demand/supply models. The asset pricing model considers living in a house one owns and selling it and moving to rental housing as two alternative "assets" to be priced. The equilibrium occurs when the expected cost of owning a house equals that of renting it. While theoretically appealing, this approach is of limited use in cross-country empirical work: rental data are unavailable for most EMEs and unreliable for many advanced economies, as rental markets are often either over-regulated or very opaque. As a result, the available data on rents usually bear little resemblance to rents prevailing in the market.

Although we are unable to test the asset pricing model directly, we can shed some light on two of its key implications. First, the random walk hypothesis, which states that only new information about economic fundamentals (rents, interest rates) influences house prices, and implies that there is little or no inertia in house prices. And, second, that interest rates are likely to be a key determinant of house prices, given that the latter represent an expected present value of future rents.

The alternative specification is the standard demand/supply model, which looks at housing as a durable credit-financed consumption good. It typically analyses house price dynamics with the help of demand determinants such as household income and wealth, interest rates, labour market and demographic factors, and, on the supply side, the price of land, construction costs (wages of construction workers, material costs etc), and, ideally, supply restrictions such as zoning, building, environmental and other regulations. With the exception of supply side variables, which are difficult to obtain for most economies (especially the price of land and the extent and nature of regulations), our specification includes these basic house price determinants.

In particular, our dependent variable is the change in real (ie CPI-adjusted) (log) house prices, Δh^p, where Δ is the first-difference operator. As explanatory variables we use real GDP growth, Δy (a proxy for real income growth); total employment growth, Δl (a proxy for changes in labour market and demographic factors); and a number of interest rate variables, Δi. Growth of the domestic bank credit to the non-financial private sector was also initially included, but was eventually dropped because of its high correlation with real GDP growth.

We investigate the impact of both *changes* in and *levels* of interest rates; the former are specified in nominal terms, the latter in real, ie CPI-adjusted terms (i^r). Theoretical models of the demand for housing would suggest a role for real interest rates in the demand for housing, but nominal interest rates are also important, as lending criteria (eg debt service or debt-to-income ratios) are typically specified in nominal terms. Nominal interest rates may also be important if a large number of potential home buyers suffer from money illusion. Changes in interest rates are expressed in percentage points, real interest rates in percent, and all other changes as differences in natural logarithms. A detailed description of explanatory variables is provided in Appendix 1.

The baseline equation we estimate is thus:

$$\Delta h^p{}_t = c + \sum_{i=1}^{n_1} \alpha_i \Delta h^p{}_{t-i} + \sum_{i=1}^{n_2} \beta_i \Delta y_{t-i+1} + \sum_{i=1}^{n_3} \gamma_i \Delta l_{t-i+1} + \sum_{i=1}^{n_4} \delta_i \Delta i_{t-i+1} + \eta i_t^r + \varepsilon_t \quad (1)$$

where c is a constant and ε an error term. This equation is estimated with lags of variable lengths, first on quarterly data for the United States and then on annual data for the two panels of advanced and emerging market economies.

Most studies rely on statistical tests to determine a single, "optimal" length of the time lag for individual variables. However, evidence from Graphs 3 and 4 and Appendix Graphs A1–A3 suggests that this approach might significantly underestimate the impact of changes in interest rates on a persistent variable such as changes in house prices. We therefore include many lags of explanatory variables and consider their cumulative effect on changes in house prices.

The use of contemporaneous values in the level of a real interest rate and the change in a nominal interest rate raise the possibility that our results are affected by simultaneous equations bias. The reason is that house prices embody information relevant for the stance of monetary policy, which is itself a key determinant of interest rates. Simple experiments consisting of replacing the current values of some of the interest rates in our regression model with their one-period lagged values suggest, however, that this bias is small, if it exists at all. We believe that this reflects inertia in house prices: it takes time for changes in economic fundamentals to be incorporated into prices of illiquid assets such as houses.

4. United States

How have changes in interest rates affected real house prices in the United States over the past half century? Table 3 reports OLS estimates of equation (1) relating real house price growth to short-term interest rates and the explanatory variables discussed above, from Q2 1970 to Q4 2015. Several results are worth highlighting.

House price changes are highly persistent

Changes in US house prices are highly persistent: four of the eight lags of quarterly real house price growth are statistically significant at traditional confidence levels. All lags except the fourth, sixth and eighth enter the regression with a positive sign. Thus, US house prices tend to move in the same direction for about a year after being hit by a disturbance, and then exhibit a modest reversal.

These results in our view provide clear evidence against the random walk model for real house prices. In particular, this pattern of US house prices is unlikely to be a consequence of forecastable changes in the service yield to housing. Rather, it is more likely that it arises from the large search and transaction costs associated with trading residential real estate. Under this view, forecastable upward moves in house prices persist in equilibrium because the large search and transaction costs associated with house purchases make it difficult to develop profitable trading rules. It is also impossible to take advantage of forecastable declines in house prices, because there is no mechanism to short-sell homes. As we show below, correctly capturing inertia is important when accurately estimating the long-run impact of a disturbance on house prices.

Income and employment growth seem less important

Interestingly, real GDP growth (as a proxy for income) and total employment growth do not seem to affect house price growth strongly in this setup. Only two of the coefficients on GDP growth are statistically significant (for lags of one and five quarters, at the 10% level only), and only one on employment growth (for a lag of five quarters, at the 5% level). However, as with interest rates, cumulative effects of changes in real GDP and employment growth on house price growth are non-negligible and positive: about 0.15 percentage points for a 1 percentage point faster GDP growth sustained over six quarters, and 0.24 points for a 1 percentage point faster employment growth.

Determinants of real house price growth in the United States, 1970 Q2–Q4 2015[1] Table 3

Variables	Coefficient	*t*-statistic	Probability
Real house price growth (t–1)	0.695	8.58	0.0000
Real house price growth (t–2)	0.167	1.71	0.0890
Real house price growth (t–3)	0.225	2.30	0.0226
Real house price growth (t–4)	–0.400	–3.99	0.0001
Real house price growth (t–5)	0.261	2.61	0.0100
Real house price growth (t–6)	–0.052	–0.53	0.5968
Real house price growth (t–7)	0.020	0.21	0.8378
Real house price growth (t–8)	–0.080	–0.99	0.3251
Real GDP growth	–0.001	–0.01	0.9911
Real GDP growth (t–1)	0.156	1.78	0.0766
Real GDP growth (t–2)	–0.009	–0.10	0.9171
Real GDP growth (t–3)	0.049	0.64	0.5202
Real GDP growth (t–4)	0.046	0.51	0.6096
Real GDP growth (t–5)	–0.165	–1.86	0.0654
Real GDP growth (t–6)	0.076	0.89	0.3731
Total employment growth	–0.163	–0.70	0.4878
Total employment growth (t–1)	–0.260	–1.06	0.2931
Total employment growth (t–2)	–0.160	–0.67	0.5052
Total employment growth (t–3)	0.154	0.64	0.5208
Total employment growth (t–4)	0.222	0.94	0.3500
Total employment growth (t–5)	0.559	2.39	0.0181
Total employment growth (t–6)	–0.115	–0.51	0.6110
Change in short-term interest rate	–0.0005	–0.56	0.5773
Change in short-term interest rate (t–1)	–0.0008	–1.02	0.3075
Change in short-term interest rate (t–2)	–0.0004	–0.43	0.6685
Change in short-term interest rate (t–3)	–0.0004	–0.47	0.6418
Change in short-term interest rate (t–4)	–0.0004	–0.51	0.6111
Change in short-term interest rate (t–5)	–0.0024	–2.70	0.0078
Change in short-term interest rate (t–6)	–0.0004	–0.42	0.6764
Change in short-term interest rate (t–7)	–0.0019	–2.16	0.0326
Change in short-term interest rate (t–8)	0.0009	1.14	0.2580
Change in short-term interest rate (t–9)	0.0006	0.75	0.4537
Change in short-term interest rate (t–10)	–0.0015	–1.93	0.0549
Change in short-term interest rate (t–11)	0.0003	0.38	0.7081
Change in short-term interest rate (t–12)	0.0013	1.66	0.0993
Level of short-term interest rate, in real terms[2]	–0.0007	–2.18	0.0306
R^2	0.78		
Number of observations	183		

[1] Quarter-on-quarter growth rates. [2] Nominal interest rate less the annual percentage change in the CPI for the previous quarter.

Sources: Bloomberg; CEIC; Datastream; IMF; national data.

Interest rates matter for house prices

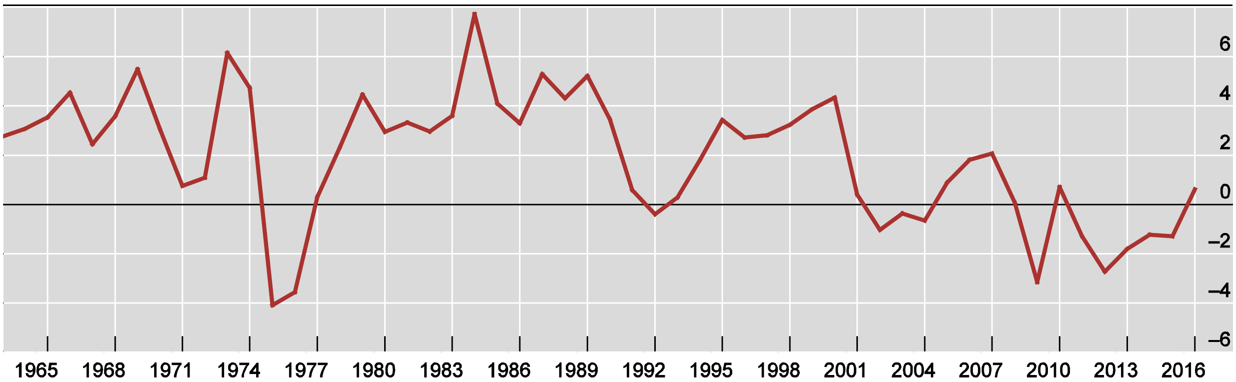
Another key finding is that of a small but protracted impact of changes in **nominal short-term interest rates** on house price growth. Only two of the 13 estimated coefficients on interest rate changes are statistically significant at traditional levels (lags 5 and 7). However, all but four are negative. This impact is difficult to show with the small sample sizes often used in the literature. Indeed, we show in the next section that changes in short-term interest from as long as five years in the past can have a statistically highly significant impact on current changes in house prices.

We also find a small but statistically significant impact from the **real short-term interest rate** on house price growth. The evolution of the US real short-term rate over the sample period is shown in Graph 6. There are both high- and low-frequency movements in this variable. In particular, there was a marked increase in the US real short-term rate from the mid-1970s to the mid-1980s, after which a long-term decline set in. In view of the importance of US financing conditions for global financial markets, this long-term trend has also been reflected in a trend decline in interest rates in other economies (shaded areas in Appendix Graphs A1–A3).

US real short-term interest rate[1]

Per cent

Graph 6



[1] Three-month Libor rate deflated with previous year's CPI; annual averages.

Sources: Datastream; national data.

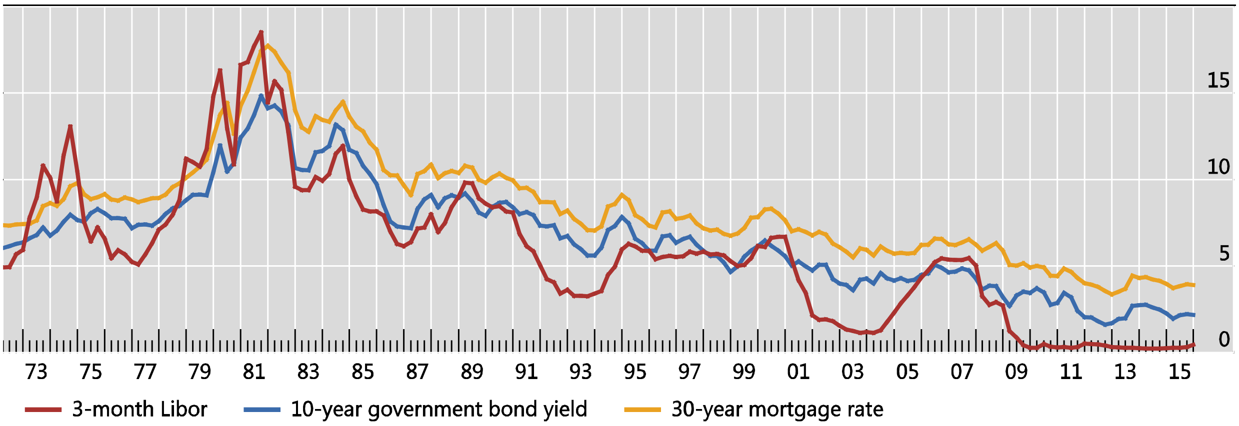
Given that monetary policy affects the level of the short-term nominal interest rate, and that policy rates may be set with a view to affecting house prices, the use of contemporaneous values of the level and change in short-term rates may introduce a simultaneous equation bias in our OLS estimates. When we re-estimate the regression replacing the contemporaneous value of the real short-term rate with its value lagged one quarter, the coefficient rises only slightly, from –0.0007 to –0.0006. We take this as evidence that potential simultaneous equations bias is most likely to be small.

How do US house prices respond to changes in **long-term interest rates**, which would at first glance seem to be more relevant for the path of house prices? Graph 7 plots two US long-term interest rates – the 10-year government bond yield and the 30-year mortgage rate – against the three-month nominal Libor used above. The 10-year bond yield and the 30-year mortgage rate co-move closely, so using one or the other should not matter for regression results. In our regressions we included the 10-year bond yields, as their coverage is much broader across countries.

US nominal interest rates

In per cent

Graph 7



Sources: Bloomberg; Datastream; national data.

Estimates of the effects of long-term interest rates on house prices are provided in Appendix Table A3. They are broadly comparable to those in Table 3: real house prices are again persistent; GDP growth is somewhat more and employment growth somewhat less significant; and most coefficients on long-term interest rates are properly signed but fewer are significant than in the case of short-term rates. As discussed below, this results in very similar cumulative effects on house prices of long-term and short-term interest rates.

Cumulative effects of interest rates are large

Our estimated model permits a straightforward calculation of the response of house prices to a 100 basis-point fall in the nominal short-term rate if two main conditions hold: (i) inflation expectations do not change in response to a 100 basis-point fall in the nominal short-term rate that takes place at time zero, so the real short-term rate also falls by 100 basis points at time zero; and (ii) the cut in rates remains in force for the next three years. Appendix 3 explains how we derive cumulative effects as reported in the graphs below.

Under these assumptions, our estimated model implies that a 100 basis-point fall in the nominal US short-term rate generates a rise in real house prices, relative to the baseline, of about 8 percentage points after three years.

There are reasons to suspect that this dynamic impact overstates the sensitivity of real house prices to short-term interest rates. The full sample includes the 2000–06 period, during which short-term rates were low and house prices surged. Yet the house price bubble of 2000–06 could have been the result of other factors that just happened to coincide with the period of low interest rates, such as the pronounced decline in lending standards associated with the US subprime mortgage boom. To eliminate this special effect, we consider a different time period: if a systematic reaction of house prices to interest rates was the main cause of the bubble, then we should be able to find a significant interest rate effect prior to 2000 as well.

Graph 8 plots the estimated interest rate effect on real US house prices, up to 12 quarters into the future, for a 100 basis-point fall in the nominal US short-term rate. The exercise uses the assumptions stated above, for the same regression model reported in Table 3, but estimated only on data up through 1999 Q4. Consistent with our conjecture, we find a smaller impact of changes in short-term interest rates on US house prices: a 100 basis-point reduction in the short-term rate is now associated with a 5 percentage point rise in real house prices after three years relative to baseline (upper left-hand panel). Note that there is only a tiny response of house prices initially, but the effect steadily increases for the next 12 quarters.

Comparison with earlier studies

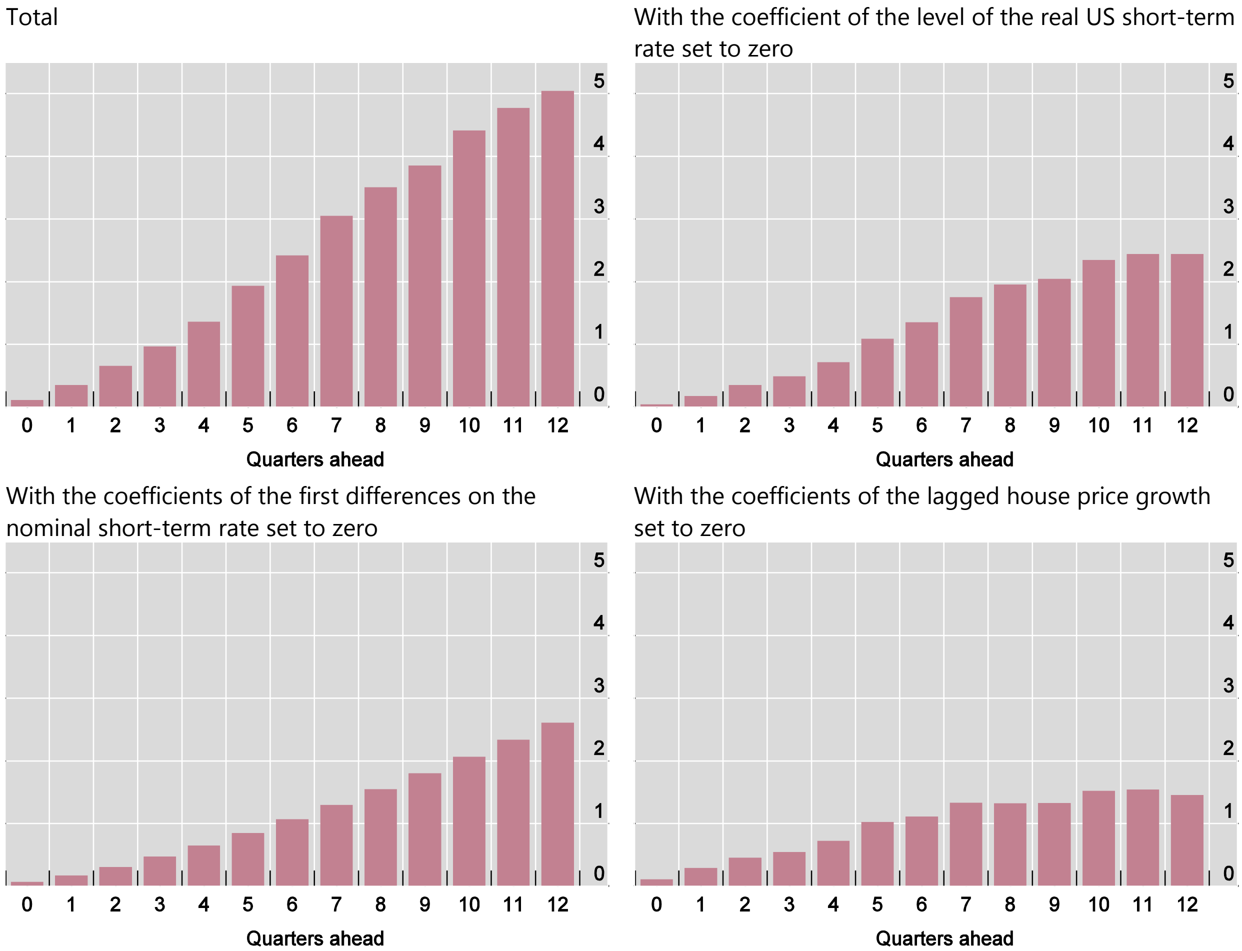
Persistence of house prices

Our finding of substantial inertia in real house prices suggests that Bayesian estimation methods that rely on a random walk prior – for instance Jarociński and Smets (2008) – are likely to underestimate the effects of interest rate disturbances on house prices. The bottom right-hand panel of Graph 8 shows the estimated impact on house prices when we set all of the coefficients on lagged house price growth equal to zero. This is not a pure random walk model because it permits serially correlated changes in the other explanatory variables to generate fluctuations in real house prices that are partly predictable. It is nevertheless an approximate random walk model.

The results of the experiment show that imposing an approximate random walk model for real house prices leads to a substantial underestimation of the impact of changes in interest rates. This suggests that the random walk prior should not be employed in the estimation of price dynamics for illiquid assets like housing, for which it is not reasonable to expect new information about economic fundamentals to be rapidly incorporated into prices. Of course, the random walk prior makes good sense for assets traded in liquid markets with low transaction costs, where estimated forecastability is likely to be spurious.

Estimated interest rate effect on the real US house prices: 1970 Q2–Q4 1999[1]

In per cent | Graph 8



[1] Cumulative impact of a 100 basis-point fall in the nominal US short-term rate. Details of the calculation are provided in the Appendix 3.

Source: Authors' calculations.

Interest rate effects

Even the conservative estimates of dynamic interest rate effects shown in the top left-hand panel of Graph 8 are considerably larger than some previously reported ones. For instance, Sutton (2002), using a small VAR model, estimated that US real house prices increased by about half a percentage point, relative to baseline, four quarters after a surprise 100 basis-point fall in the real short-term rate. This is about a third of the size of the effect shown in the top left-hand panel of Graph 8. Jarociński and Smets (2008), using a Bayesian VAR in levels on data through the first half of 2007, found that US real house prices fell by half a percentage point, relative to baseline, 10 quarters after a surprise 25 basis-point rise in the federal funds rate. Our conservative estimates would predict a bit more than a 1 percentage point fall in real house prices 10 quarters after the equivalent interest rate change, about twice the effect reported by Jarociński and Smets (2008).

Do we find larger interest-rate effects because the studies mentioned above have estimated VAR models, while the present paper estimates a single regression equation that treats contemporaneous values of interest rates as exogenous variables? Our estimates suggest that the answer is no. The bottom left-hand panel of Graph 8 shows the impact of a 100 basis-point fall in the real short-term rate implied by our estimated model, setting all of the coefficients on changes in the nominal short-term rate equal to zero. This exercise predicts a rise in house prices of about half a percentage point after four quarters. This is the same impact Sutton (2002) found for a VAR model of real house price growth, estimated over roughly the same sample period, which includes the level of the US real short-term rate, but not changes in the nominal US short-term rate. This suggests that our larger estimated impact arises because the present study also includes a long distributed lag of changes in the nominal short-term rate. One explanation for its additional importance could be that a large part of the population does not distinguish between nominal and real interest rates, ie it suffers from money illusion.

The effects of reversing the experiment are shown in the top right-hand panel of Graph 8: it suggests that the level of the real short-term rates and the distributed lag of changes in the nominal short-term rate contribute roughly equally to our total estimated impact of a 5 percentage point gain after three years, following a 100 basis-point cut in short-term rates. We suspect that the long distributed lag of changes in the nominal short-term rate are partly driving this result. In particular, we found correctly signed interest rate coefficients for lags up to seven quarters. By comparison, Sutton (2002) used four, and Jarociński and Smets (2008) five quarterly lags of interest rates. This implicitly sets the coefficients of longer interest rate lags to zero. Our results suggest that both studies should have employed more lags.

One additional reason why the estimated dynamic effects of interest rates on house prices shown in Graph 8 are larger than those reported in the previous studies we cite is that our calculations assume that interest rates remain 100 basis points lower than they were at the beginning of period zero for the next three years. In particular, we do not allow interest rates to exhibit any mean reversion over the course of the experiment. In contrast, impulse response functions obtained from VAR models permit interest rate shocks to dissipate steadily over time.

Another finding that differs from some previous studies is that changes in interest rates influence real house prices only gradually over time rather than mostly on impact. For instance, Del Negro and Otrok (2007) estimated impulse responses from monetary policy shocks that display a relatively large initial impact on house prices, which then declines over time. One reason is that monetary policy shocks are identified in part by the requirement that they have the largest effect on house prices. This identification assumption leads to large contemporaneous effects. Iacoviello and Neri (2010), who used a DSGE model, also reported impulse responses showing a large initial effect of a monetary policy shock on US house prices that subsequently dissipated. In contrast, Iacoviello (2005) reported impulse responses that showed real US house prices falling for about eight quarters following an unexpected rise in the nominal federal funds rate. His VAR model was identified by way of a Choleski decomposition of the reduced form error terms.

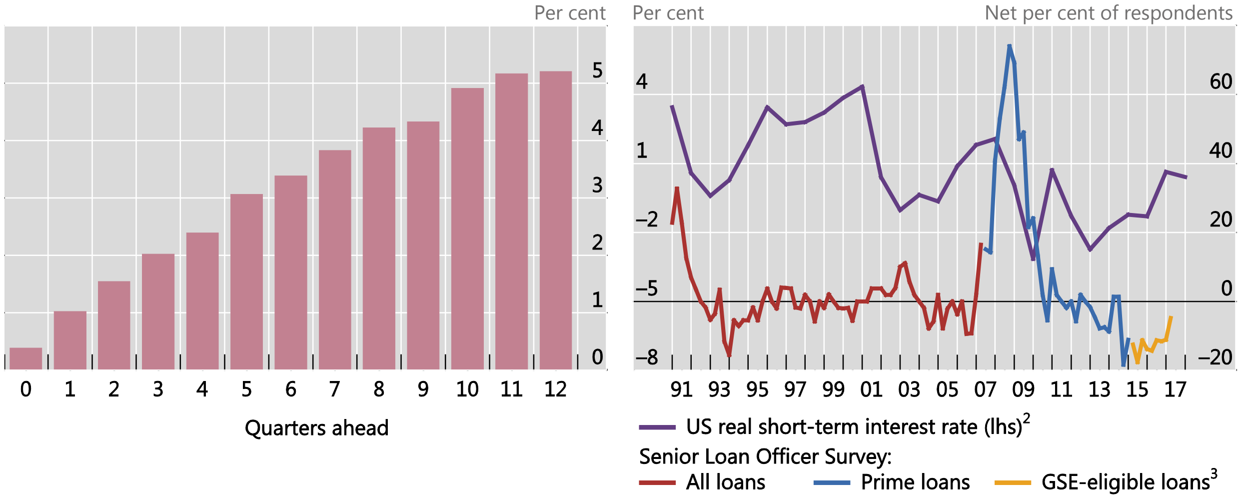
Short-term vs long-term interest rate effects

The left-hand panel of Graph 9 shows the estimated effects on US real house prices of a 100 basis-point fall in nominal and real US *long-term* interest rates. The estimation period is the same as in Graph 8. The impact of a change in long-term rates is stronger initially, but then rises less quickly than that for short-term rates. After 12 quarters, the effects are basically the same.

Why would short-term rates be as important to house prices as long-term rates? As noted above, one possibility is that short-term rates better capture the additional boost to house prices resulting from the bank lending channel of monetary policy. Kishan and Opiela (2000) found that small US banks reduced their real estate lending in response to a tightening of monetary policy. They argued that small banks – especially undercapitalised ones – found it more difficult to replace demand deposits with other funding sources and were hence more likely to reduce lending when financing conditions tightened. While they did not provide separate results for lending for residential and commercial real estate, it seems plausible that the cuts in lending induced by rising funding costs affected housing demand and eventually led to some drop in house prices.

Long-term interest rates, lending standards and real US house prices — Graph 9

Cumulative impact of long-term interest rates on US house prices: 1970 Q2–Q4 1999[1] | Survey respondents reporting tightening standards for housing loans and US real short-term interest rate



[1] Cumulative impact of a 100 basis-point fall in the nominal US long-term rate; see Appendix 3 for details. [2] Three-month Libor rate deflated with previous year's CPI; annual averages. [3] Government sponsored enterprise (GSE).

Sources: Datastream; The Federal Reserve Board, *Senior Loan Officer Survey on Bank Lending Practices*; national data; authors' calculations.

Arguably, the bank lending channel is more important when home mortgages are not securitised. When they are, funding for additional home loans can be obtained by selling, for the purpose of securitisation, loans the bank has already made. This suggests that the relative importance of short- vs long-term rates in determining house prices would be greater in those countries where securitisation of home loans is less prevalent than in the United States. This is exactly what we find in other advanced economies and EMEs (see Sections 5 and 6).

A related issue is whether changes in lending standards play a role in driving house prices, presumably by being part of the bank lending channel. Data on lending standards for US residential real estate are available from 1990 (Graph 9, right-hand panel). The lending standards series is dominated by two large spikes associated with recessions in 1990–91 and 2008–09. This suggests that a large component of the lending standards series is endogenous: weak economic conditions and probably also falling prices of residential real estate lead to a tightening of standards, which are then relaxed as economic conditions return to more normal levels. Also, there does not appear to be a strong correlation between the lending standards series and the US real short-term rate, our proxy for the stance of US monetary policy (purple line in Graph 9, right-hand panel).

5. Other advanced economies

We next study the impact of interest rates on real house prices in advanced economies other than the United States. For a panel of 20 countries, we have a total of 718 annual observations. We use panel least squares estimates with country and time fixed effects. Table 4 reports two sets of estimates: one with changes in domestic short-term interest rates and the level of the US real rate (Panel A), and another with only domestic interest rates, both changes and the level (Panel B). Table A4 in the Appendix provides the corresponding estimates with long-term interest rates.

House prices are persistent, fundamentals important

Panel estimates for non-US advanced economies provide additional evidence that house price moves in one year tend to be followed by moves in the same direction the following year (Table 4). The positive coefficients on lagged real house price growth are both large and statistically highly significant. The coefficient turns negative at lag two, suggesting some reversal in house price growth over the medium term, as we also found in US quarterly data.

GDP growth affects house price growth in non-US advanced economies almost one-for-one: in Panel A, the coefficient on contemporaneous GDP growth is equal to 0.95 and is statistically highly significant. Output growth lagged two years has a weaker but also significant impact on house price growth. In addition, contemporaneous growth in total employment (estimated coefficient of 0.65) strongly affects the growth in house prices. In Panel B, the effects of GDP growth on house prices are even stronger; those of employment are about the same.

Domestic vs US interest rates

Estimates for non-US advanced economies provide further evidence for a small but persistent effect of interest rate changes on house price growth: in Panel A, five of the six coefficients have the expected negative sign; three are statistically significant at the 5% level or higher (lags one, three and five); and the one on current interest rate change is significant at the 10% level. The finding that interest rate changes from up to five years in the past can significantly affect current house prices underlines the importance of considering a long distributed lag for interest rate changes.

The estimated coefficient on the contemporaneous value of the US real short-term interest rate is small (–0.0034) but statistically highly significant, suggesting that shifts in the stance of US monetary policy might also affect house prices in other advanced economies. For instance, the real US short-term rate fell rapidly when monetary policy was eased to offset the effects of recessions in 1989, 2000 and 2007. This could have put upward pressure on house prices outside the United States if overseas banks funded themselves in part in the US interbank market.

The upper left-hand panel of Graph 10 plots the estimated impact on house prices of a global, perfectly correlated fall in short-term interest rates across countries. This includes a 100 basis-point fall in the nominal short-term interest rate in every country in the sample, plus the equivalent fall in the US short-term real interest rate. Of course, as short-term interest rate changes are not normally so highly correlated, our estimates can be taken as an upper bound to the impact of changes in US interest rates on house prices in other advanced economies. The estimates suggest that a 100 basis-point fall in global short-term rates is associated with a rise in advanced economy real house prices by 3½ percentage points, relative to baseline, after three years. The effect continues to grow in years four and five, reaching almost 5 percentage points after five years.

Determinants of real house price growth in non-US advanced economies, 1966–2015			Table 4
Variables	Coefficient	*t*-statistic	Probability
A. With domestic and US short-term interest rates			
Constant	–0.02	–5.41	0.0000
Real house price growth (t–1)	0.58	15.18	0.0000
Real house price growth (t–2)	–0.19	–5.03	0.0000
Real GDP growth	0.95	7.90	0.0000
Real GDP growth (t–1)	–0.12	–0.95	0.3414
Real GDP growth (t–2)	0.38	3.15	0.0017
Total employment growth	0.65	3.77	0.0002
Total employment growth (t–1)	–0.22	–1.22	0.2212
Total employment growth (t–2)	0.13	0.84	0.4017
Change in domestic short-term interest rate	–0.0019	–1.79	0.0737
Change in domestic short-term interest rate (t–1)	–0.0053	–4.52	0.0000
Change in domestic short-term interest rate (t–2)	–0.0005	–0.41	0.6814
Change in domestic short-term interest rate (t–3)	–0.0026	–2.55	0.0111
Change in domestic short-term interest rate (t–4)	0.0015	1.62	0.1056
Change in domestic short-term interest rate (t–5)	–0.0023	–2.53	0.0115
Level of US short-term interest rate, in real terms[1]	–0.0034	–4.40	0.0000
R^2	0.59		
B. With only domestic interest rates			
Constant	–0.02	–4.50	0.0000
Real house price growth (t–1)	0.58	14.83	0.0000
Real house price growth (t–2)	–0.17	–4.61	0.0000
Real GDP growth	1.16	8.45	0.0000
Real GDP growth (t–1)	0.20	1.28	0.2011
Real GDP growth (t–2)	0.19	1.32	0.1881
Total employment growth	0.62	3.56	0.0004
Total employment growth (t–1)	–0.51	–2.78	0.0057
Total employment growth (t–2)	0.04	0.23	0.8218
Change in domestic short-term interest rate	0.0017	1.17	0.2426
Change in domestic short-term interest rate (t–1)	–0.0033	–2.35	0.0192
Change in domestic short-term interest rate (t–2)	0.0005	0.33	0.7387
Change in domestic short-term interest rate (t–3)	–0.0025	–1.96	0.0501
Change in domestic short-term interest rate (t–4)	0.0011	0.89	0.3738
Change in domestic short-term interest rate (t–5)	–0.0021	–1.91	0.0568
Level of domestic short-term interest rate, in real terms[1]	–0.0023	–2.10	0.0358
R^2	0.68		

Note: Each panel has 718 observations.

[1] Deflated with previous year's CPI.

Sources: Bloomberg; CEIC; Datastream; IMF; national data.

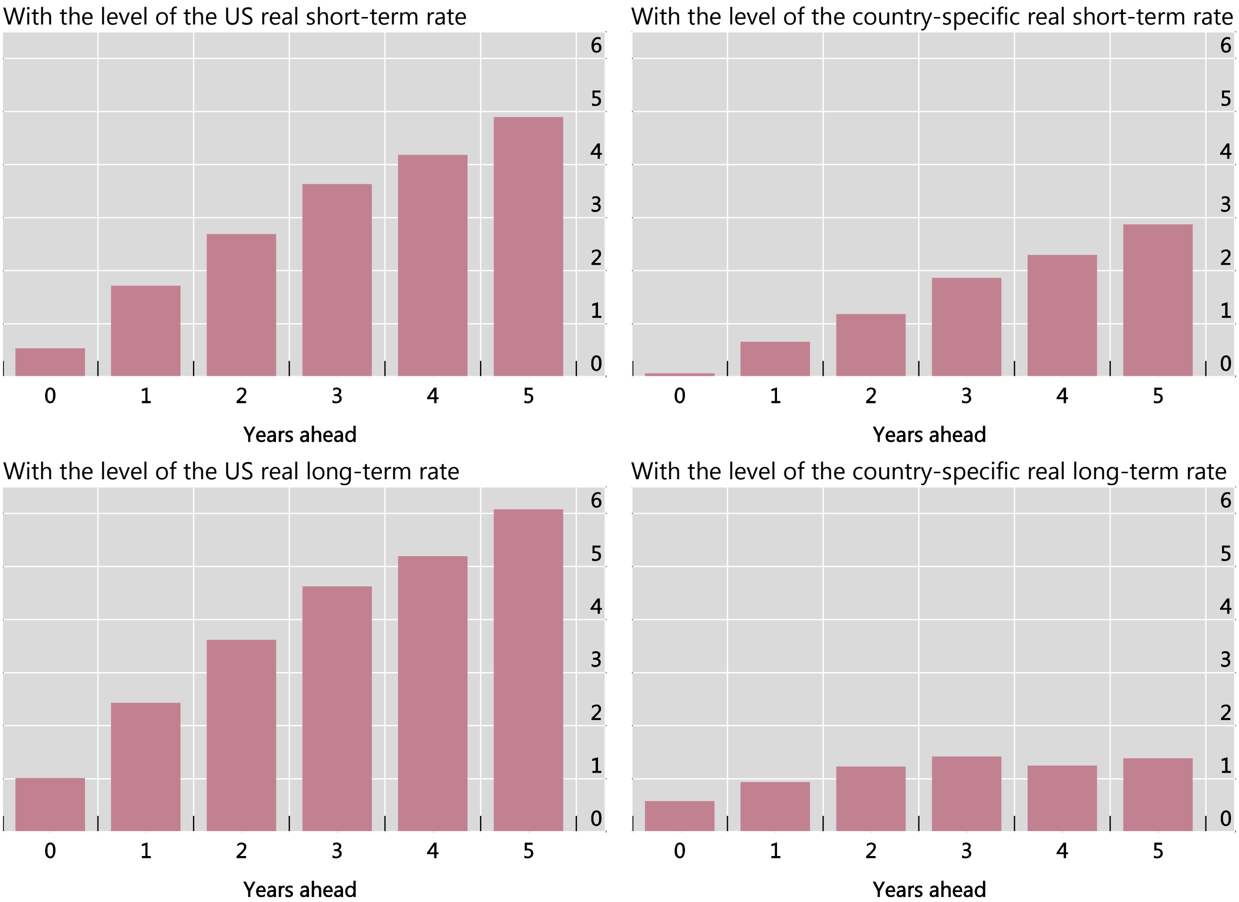
Panel B of Table 4 reports estimates of equation (1) when we replace the US short-term real interest rate with its domestic counterpart. The coefficient on the country-specific real short-term rate is slightly smaller in absolute value than the one on the US real short-term rate in Panel A, but remains statistically significant.

Interestingly, the response of real house prices to a purely domestic fall in short-term rates (Graph 10, upper right-hand panel) is smaller than the one accompanying an easing of US monetary policy (upper left-hand panel). Five years after a 100 basis-point fall in domestic short-term rates, house prices are less than 3 percentage points higher than they would have been otherwise, all else equal. This is 2 percentage points less than when domestic and US interest rates fall together.

Another interesting finding is that house prices in non-US advanced economies seem to be much less sensitive to changes in domestic short-term interest rates than they are in the United States: following a 100 basis-point cut in interest rates, they rise by slightly less than 2 percentage points after three years, compared with 5 points in the US case.

Impact of interest rates on real house prices in other advanced economies[1]

In per cent — Graph 10



[1] Cumulative impact of a 100 basis-point fall in nominal short-term rates; see Appendix 3 for details

Source: Authors' calculations.

Long-term vs short-term interest rates

The lower panels of Graph 10 show the impulse responses we obtain when we replace the estimated coefficients on short-term rates from Table 4 with their long-term counterparts from Appendix Table A4.

The lower left-hand panel shows the estimates for the US real long-term rate: we obtain a larger impact of 6% after five years. A more striking change is shown in the lower right-hand panel: when we include only domestic long-term rates, the response after five years is only about a third of that with domestic short-term rates. Thus, house prices in non-US advanced economies seem to be more sensitive to changes in short-term than in long-term interest rates. This is consistent with the view that the bank lending channel of monetary policy is relatively more important in these countries, partly because of the less widespread use of mortgage securitisation than in the United States, and partly because of the prevalence of variable-rate mortgages.

Comparison with earlier studies

Our estimates suggest that house price growth in other advanced economies is less sensitive to changes in short-term interest rates than it is in the United States, where the equivalent exercise led to a 5 percentage point increase in house prices after three years (Graph 8, upper left-hand panel). Nevertheless, the effect is not negligible. Moreover, our estimate of this effect is five times larger than that found by Crowe et al (2011), who examined the impact of policy rates on house prices in 22 countries within the context of a VAR model. They reported that an unexpected 100 basis-point rise in the policy rate was associated with only a 1 percentage point fall in house prices, relative to baseline, after five years. This small effect is even more surprising given that their VAR model included real GDP and permitted the hike in interest rates to slow down GDP growth. This should have led to a larger impact of rate hikes on house prices than in our analysis, which treats GDP growth as exogenous. We suspect that our finding reflects the inclusion of a long distributed lag of changes in domestic interest rates, and the level of the US real interest rate.

Our estimates are also relevant for discussions about how much US short-term rates would need to have been raised to have prevented, or at least delayed, the onset of the 2008–09 crisis (see Appendix 4). Jordà et al (2015) argued that US short-term rates would need to have been raised by 8 percentage points to prevent the most recent boom-bust housing cycle in the United States. They reached this conclusion mainly by studying the response of house prices to interest rates in countries other than the United States, and assuming that the relationship they found was applicable to the United States. However, our finding that real house prices respond to interest rates more strongly in the United States than they do in other advanced economies suggests that US short-term rates might need to have been raised by less than the claimed amount.

Houses vs equities: differential impact of US interest rates

To highlight the differential impact of changes in US short-term interest rates on illiquid and liquid assets, in Table 5 we replaced changes in house prices with those in equity prices in non-US advanced economies.

In sharp contrast to what we found with house price growth, the coefficient on the level of the US real short-term rate is positive and statistically highly significant. The positive coefficient is to be expected for liquid assets such as equities: favourable global economic developments that coincide with a tightening of the US policy rate are rapidly incorporated into stock prices. When we lag the real US short-term rate by one year, the coefficient falls from 0.014 to –0.002 and completely loses statistical significance.

The estimates with equity price growth also reveal what at first seems to be a surprising result: the coefficient on GDP growth lagged one year is negative and statistically highly significant. This could be caused by measurement error in GDP that is positively and contemporaneously correlated with equity prices. High measurement error in period *t–1* pushes up GDP growth from *t–2* to *t–1*, as well as equity prices in period *t–1*. Since the high measurement error is likely to be unwound in period *t*, this tends to reduce equity price growth from *t–1* to period t, all else equal.

We sometimes also get a negative coefficient on GDP growth lagged one period in regressions with real house price growth. But consistent with our view that information about fundamentals is less rapidly incorporated into house prices, the coefficient on GDP growth lagged one year is statistically insignificant in those regressions (one exception is Table 6).

Determinants of real equity price growth in non-US advanced economies, 1966–2015			Table 5
Variables	Coefficient	*t*-statistic	Probability
Real equity price growth (t–1)	0.21	4.78	0.0000
Real equity price growth (t–2)	–0.15	–3.73	0.0002
Real GDP growth	3.14	7.02	0.0000
Real GDP growth (t–1)	–3.13	–6.78	0.0000
Real GDP growth (t–2)	0.25	0.56	0.5763
Total employment growth	0.90	1.49	0.1380
Total employment growth (t–1)	–0.66	–0.98	0.3253
Total employment growth (t–2)	–0.27	–0.49	0.6258
Change in domestic short-term interest rate	–0.0166	–3.75	0.0002
Change in domestic short-term interest rate (t–1)	–0.0009	–0.17	0.8611
Change in domestic short-term interest rate (t–2)	–0.0061	–1.29	0.1992
Change in domestic short-term interest rate (t–3)	–0.0214	–5.04	0.0000
Change in domestic short-term interest rate (t–4)	–0.0109	–2.81	0.0051
Change in domestic short-term interest rate (t–5)	0.0024	0.64	0.5240
Level of US short-term interest rate, in real terms[1]	0.0142	4.27	0.0000
R^2	0.39		
Number of observations	592		

[1] Deflated with previous year's CPI.

Sources: Bloomberg; CEIC; Datastream; IMF; national data.

6. Emerging market economies

How do interest rates affect house prices in EMEs? As with advanced economies, we first look at the effects of short-term interest rates and then compare these results with what we obtain with long-term rates.

In some ways, the results for EMEs reported in Table 6 are similar to what we found for non-US advanced economies. For instance, there is again strong evidence against the random walk model for real house prices: annual house price growth lagged one period is statistically highly significant. As the coefficient on this variable is positive, house price moves in one year tend to be followed by moves in the same direction the following year. And the coefficient on the second lag of real house price growth is negative, suggesting – as in advanced economies – a reversal of real house price growth two years after a disturbance. We also find a positive and statistically significant coefficient on contemporaneous GDP growth, but not on contemporaneous employment growth.

Changes in short-term rates affect real house prices in EMEs also with long lags, and the coefficient on the level of the US real rate is negative, as expected, and significant at the 5% level. The predicted impact for a 100 basis-point fall in US and domestic short-term rates is quite large: real house prices are 5¾ percentage points higher over the course of five years (Graph 11, upper left-hand panel). This is slightly higher than in non-US advanced economies (Graph 10, upper left-hand panel).

As in other advanced economies, the response of real house prices in EMEs to a purely domestic fall in short-term rates (Panel B in Table 6 and Graph 11, upper right-hand panel) is smaller than the one accompanying the fall in US rates (Panel A and Graph 11, upper left-hand panel). Five years after a 100 basis-point fall in domestic short-term interest rates, house prices in EMEs would be about 2½ percentage points higher than otherwise, all else equal. This is less than half the impact of the fall in the

US real interest rate. It is also half a percentage point less than the equivalent impact in other advanced economies.

Determinants of real house price growth in EMEs , 1976–2015 — Table 6

Variables	Coefficient	*t*-statistic	Probability
A. With domestic and US short-term interest rates			
Constant	–0.07	–6.93	0.0000
Real house price growth (t–1)	0.30	5.54	0.0000
Real house price growth (t–2)	–0.13	–2.49	0.0132
Real GDP growth	2.12	11.27	0.0000
Real GDP growth (t–1)	–0.46	–2.31	0.0214
Real GDP growth (t–2)	0.46	2.42	0.0160
Total employment growth	0.36	1.57	0.1177
Total employment growth (t–1)	0.02	0.09	0.9266
Total employment growth (t–2)	0.12	0.55	0.5852
Change in domestic short-term interest rate	0.0006	0.22	0.8298
Change in domestic short-term interest rate (t–1)	0.0013	0.47	0.6356
Change in domestic short-term interest rate (t–2)	–0.0053	–2.04	0.0418
Change in domestic short-term interest rate (t–3)	–0.0003	–0.11	0.9141
Change in domestic short-term interest rate (t–4)	–0.0050	–2.62	0.0093
Change in domestic short-term interest rate (t–5)	–0.0007	–0.39	0.6987
Level of US short-term interest rate, in real terms[1]	–0.0063	–2.13	0.0341
R^2	0.61		
Number of observations	340		
B. With only domestic short-term interest rates			
Constant	–0.06	–6.53	0.0000
Real house price growth (t–1)	0.31	5.61	0.0000
Real house price growth (t–2)	–0.13	–2.50	0.0130
Real GDP growth	1.97	11.49	0.0000
Real GDP growth (t–1)	–0.46	–2.31	0.0215
Real GDP growth (t–2)	0.39	2.06	0.0405
Total employment growth	0.41	1.76	0.0795
Total employment growth (t–1)	0.08	0.32	0.7522
Total employment growth (t–2)	0.14	0.63	0.5260
Change in domestic short-term interest rate	0.0005	0.18	0.8560
Change in domestic short-term interest rate (t–1)	0.0013	0.48	0.6294
Change in domestic short-term interest rate (t–2)	–0.0059	–2.28	0.0234
Change in domestic short-term interest rate (t–3)	–0.0009	–0.37	0.7118
Change in domestic short-term interest rate (t–4)	–0.0048	–2.52	0.0123
Change in domestic short-term interest rate (t–5)	–0.0007	–0.42	0.6721
Level of domestic short-term interest rate, in real terms[1]	–0.0016	–0.96	0.3393
R^2	0.61		
Number of observations	340		

Note: Each panel has 340 observations.

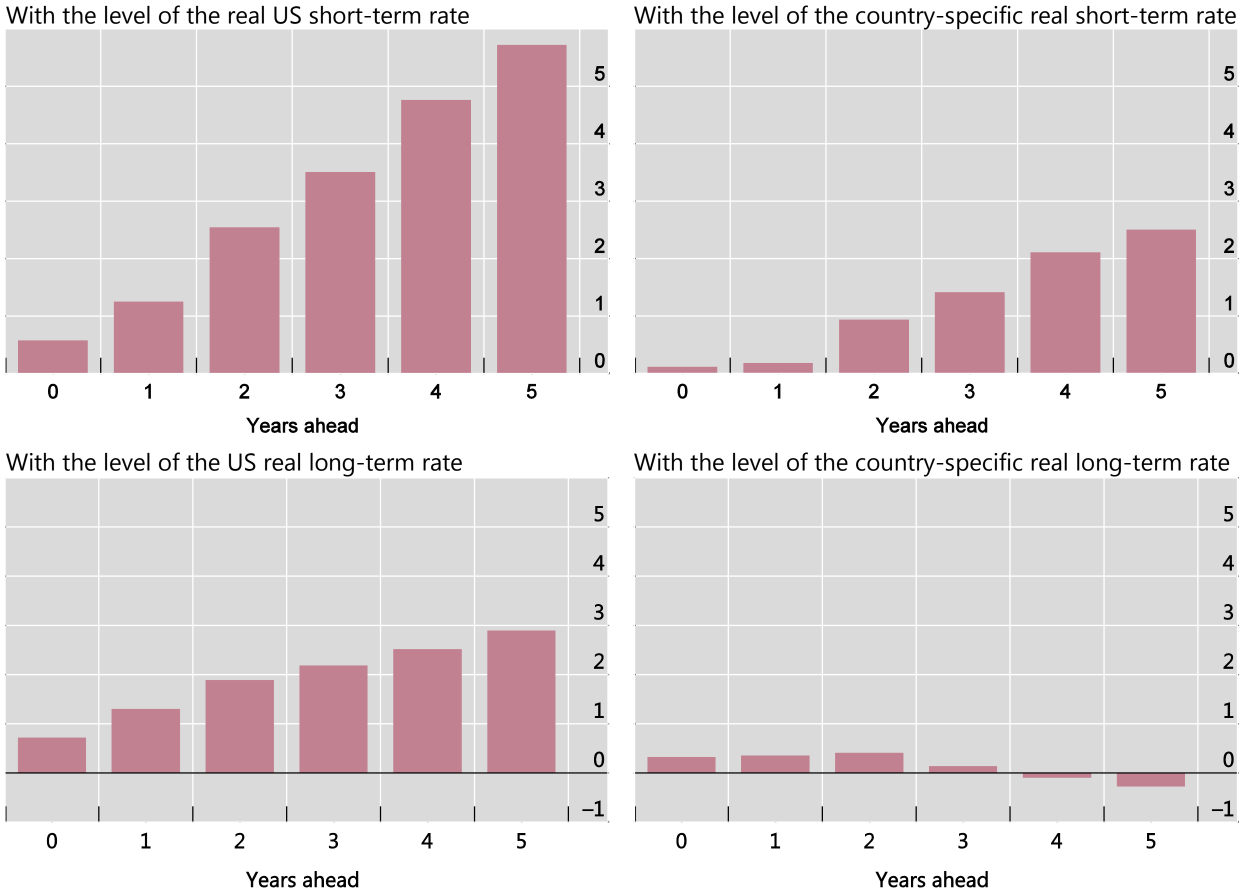
[1] Deflated with previous year's CPI.

Sources: Bloomberg; CEIC; Datastream; IMF; national data.

Impact of interest rates on real house prices in EMEs[1]

In per cent

Graph 11



[1] Cumulative impact of a 100 basis-point fall in the nominal short-term rates; see Appendix 3 for details

Source: Authors' calculations.

The lower left-hand panel of Graph 11 shows the dynamic impact we get when we replace short-term with long-term rates, including the real US long-term rate (see Appendix Table A5 for regression estimates). We get much smaller effects in this case. The lower right-hand panel shows the results when only domestic long-term rates are included in the regression. In this case, the impact turns slightly negative from the fourth year on. This suggests that short-term rates are a more important determinant of house prices in EMEs than long-term rates. Again, this is consistent with our view that the bank lending channel of monetary policy is relatively more important in countries for which securitisation of home mortgages is less prevalent. Interestingly, spillover effects from the US to EME housing markets seem strongest with US short-term rates. This is consistent with the view that shifts in US monetary policy drive capital flows to EMEs, which eventually seem to filter through to housing finance growth in EMEs.

7. Conclusion

Most empirical studies assume that short-term interest rates do not influence house price growth other than through the domestic cost of borrowing, ie by their influence on long-term interest rates. The findings in this paper suggest that this view might be mistaken: changes in short-term interest rates seem to have a strong and persistent impact on house price growth. Moreover, global, ie US short-term interest rates – not just domestic ones – seem to matter, both in advanced economies and EMEs. We interpret the relative importance of short-term interest rates in driving house prices as indicating an important role for the bank lending channel of monetary policy in determining housing financing conditions, especially outside the United States, where securitisation of home mortgages is less prevalent.

The larger effect of interest rates on house prices we find reflects in part the use in our regressions of a long distributed lag of interest rate changes. For the United States, our estimates for the period from 1970 to the end of 1999 suggest that a 100 basis-point fall in the nominal short-term rate, accompanied by an equivalent fall in the real short-term rate, generated a 5 percentage point rise in real house prices, relative to baseline, after three years. We find an even larger effect if we include the data through end-2015. For other advanced economies and EMEs, we estimate that a 100 basis-point fall in domestic short-term interest rates, combined with an equivalent fall in the US real rate, generates an increase in house prices of up to 3½ percentage points, relative to baseline, after three years.

Another reason we find larger interest rate effects is by allowing for inertia in house price movements. We find strong evidence against the random walk hypothesis: real house prices around the world tend to move in the same direction for about a year after being hit by a disturbance, then exhibit a modest reversal. We think that this inertia in house prices reflects the large search and transaction costs associated with trading residential real estate and shifting between owner-occupied and rental housing. These costs are ignored in the user cost model, which predicts a fairly high interest rate sensitivity for house prices.

Our findings also suggest a potentially important role for monetary policy in countering financial instability. While higher short-term interest rates alone cannot significantly dampen the demand for housing, slower house price growth can give supervisors more time to implement measures to strengthen the financial system. At the same time, the finding that house prices adjust to interest rate changes gradually over time suggests that modest cuts in policy rates are not likely to rapidly fuel house price bubbles.

Our paper leaves a number of unanswered questions for future research. First, why are house prices in the United States more responsive to changes in interest rates than is the case for other countries? One possibility is that house price sensitivity to interest rates is inversely related to the size of the transaction costs for trading real estate, which are relatively small in the United States. While we think this is a reasonable conjecture, we offer no direct evidence that it is true. Second, in the United States, we find a roughly equal contribution to house price fluctuations from real and nominal interest rates. While this could arise from a large number of potential home buyers suffering from money illusion, we cannot offer direct evidence that this is the case. Third, the relatively large response of house prices in EMEs to US short-term interest rates suggests that US rates may have a larger global impact than previously recognised. This could arise, for example, if house prices in EMEs were especially sensitive to global liquidity conditions.

The bank lending channel of monetary policy gives us confidence that our use of the US short-term interest rate to capture global liquidity is reasonable; however, we recognise that there are other proxies. Cerrutti et al (2014) suggest, along with other measures, the term spread as an indicator of the availability of global liquidity. A low term spread implies reduced profit opportunities from borrowing short and lending long domestically. This can encourage banks to increase their risk-taking, extending loans to those who were previously denied credit, including borrowers abroad. Another candidate is repo borrowing: Adrian et al (2015), for instance, argue that the extent of repo borrowing by the US Federal Reserve's primary dealers is a measure of their risk appetite. Bruno and Shin (2015) present evidence consistent with the view that greater risk appetite is associated with greater cross-border bank lending. And the thesis that greater cross-border bank lending would affect house prices around the world is supported by the findings of Cesa-Bianchi et al (2015).

Future research could also investigate which measures of global liquidity are most correlated with house prices in advanced economies and EMEs and how sensitive these findings are to the inclusion of the 2000–06 period in the analysis. This is for the same reason that our preferred estimates for the impact of interest rates on US house prices rely on data only through the end of 1999: the 2000–06 period may be unusual. Shiller (2008) argues that the period was associated with a feedback loop between the demand for housing and expected capital gains on housing assets: price increases fuelled demand by raising expected capital gains, and the greater demand fed back on prices. He also suggests that "new era" stories that supported boom thinking, in the United States and elsewhere in the world, played an important role in this feedback loop. Ample global liquidity arguably helped this process along, but the effects of global liquidity on house prices might be smaller in the absence of a strong feedback loop from capital gains on housing assets to demand.

Appendix

1. Data description and sources

House prices

Advanced economies

Australia: from 2003 Q3 onward: all dwellings (8 cities), pure price, NSA. From 1986 Q3-2003 Q2, all detached houses (8 cities), pure price, NSA; from 1970 Q1-1986 Q2: Median dwelling prices, capital cities. BIS code: Q:VWBA:AU:01.
Austria: Price per square meter of usable space. Based on the EUR/m2 purchase price for new and used apartments and single-family houses in Vienna. Data inputs were generated by AIB (Austria Immobilienbörse, a platform of 17 real estate agencies). BIS code: Q:VSJA:AT:44.
Belgium: from 2005 Q1 onward: all dwellings, pure price, NSA; from 1973 Q1-2004 Q4: existing dwellings, price per dwelling, NSA; from 1970 Q1-1972 Q4: Index of small- and medium-sized dwellings. BIS code: Q:VWBA:BE:01.
Canada: from 1980 Q1 onwards: National residential average price, NSA; from 1970 Q1-1979 Q4: Average price of existing homes. BIS code: Q:VWBA:CA:01.
Denmark: from 2002 Q1 onwards: all types of dwelling in the country as a whole; from 1970 Q1 to2002 Q3: single-family houses, pure price, NSA. BIS code: Q:VWBA:DK:01.
Finland: from 2010 Q1 onwards: all dwellings, pure prices, NSA; 2005 Q1-2009 Q4: existing dwellings, per m2; 1983 Q1-2004 Q4: existing flats and terraced houses, total, per m2, NSA; 1970 Q1-1982 Q4: existing flats. BIS code: Q:VWBA:FI:01.
France: from 2006 Q2 onwards: all dwellings, pure price, Q-All, NSA; 1996 Q1-2006 Q1: existing dwellings, pure price, Q-All, NSA; 1970 Q1-1995 Q4: Produits dérivés, un sous-jacent immobilier, Ministère de l'Equipement, February 1999. BIS code: Q:VWBA:FR:01.
Germany: from 2003 Q1 onwards: all owner occupied dwellings, pure price, NSA; 1975 Q1-2002 Q4: New dwellings in West Germany; 1972 Q1-1974 Q4: Average of sales prices of owner-occupied flats, per m2, in Frankfurt, West Berlin, Hamburg and Munich. 1970 Q1-1971 Q4: Construction costs. BIS code: Q:VWBA:DE:01.
Ireland: from 2005 Q1 onwards: all dwellings, pure price, NSA; 1970 Q1-2004 Q4: price index, new houses. BIS code: Q:VWBA:IE:01.
Italy: from 1990 Q1 onwards: all dwellings, pure price, NSA; 1971 Q1-1989 Q4: Bank of Italy historical residential property price index. BIS code: Q:VWBA:IT:01.
Japan: from 2008 Q2 onwards: all dwellings, pure price, NSA; 1970 Q1-2008 Q1: Land prices, residential, urban areas, per m2, NSA. BIS code: Q:VWBA:JP:01.
The Netherlands: from 2005 Q1 onwards: all dwellings, pure price; 1995 Q1-2004 Q4: all existing dwellings, pure price, NSA; from 1976 Q1-1995 Q4: existing dwellings; 1970 Q1-1975 Q4: sales of houses and flats brokered by real estate agents. BIS code: Q:VWBA:NL:01.
New Zealand: from 1979 Q4 onwards: all dwellings, per dwelling, NSA; 1970 Q1-1979 Q3: Quarterly house price index main urban areas; quotable value New Zealand Limited. BIS code: Q:VWBA:NZ:01.
Norway: from 1992 Q1 onwards: all dwellings, pure price, NSA; 1970 Q1-1991 Q4: House prices, from O Eitrheim and S Erlandsen, *House price indices for Norway, 1819-2003*, pp 349-76, 2004. BIS code: Q:VWBA:NO:01.
Portugal: from 2008 Q1 onwards: all dwellings, pure price (INE), NSA; 1988 Q1-2007 Q4: all dwellings (Confidencial Imobiliario). BIS code: Q:VWBA:PT:01.
Spain: from 2007 Q1 onwards: all dwellings, pure price, NSA; 1987 Q1-2006 Q4: all dwellings, per m2, NSA; 1975 Q1-1986 Q4: House prices in the capital city area; 1971 Q1-1974 Q4: OECD historical statistics. BIS code: Q:VWBA:ES:01.
Sweden: from 2005 Q1 onwards: all types of dwelling in the country as a whole; 1986 Q1-2004 Q4: all owner-occupied houses, per dwelling, NSA; 1970 Q1-1985 Q4: index of owner-occupied one- and two-dwelling buildings. BIS code: Q:VWBA:SE:01.
Switzerland: from 1970 Q1 onwards: unweighted average of owner occupied flats and houses in the country as a whole. BIS code: Q:VWBA:CH:01.
United Kingdom: from 1970 Q1 onwards: all dwellings (ONS), per dwelling. BIS code: Q:VWBA:GB:01.
United States: from 1975 Q4 onwards: existing dwellings, per dwelling, SA; 1970 Q1-1975 Q3: Average sale price of existing single-family homes. BIS code: Q:VWBA:US:01.

Emerging market economies

Bulgaria: from 2009 Q1 onwards: all flats, NSA; 1993 Q1-2008 Q4: existing flats in big cities. BIS code: Q:VWBA:BG:01.
Brazil: all types of new and existing dwelling in the metropolitan area. BIS code: Q:VSFA:BR:R1.
China: new residential buildings, 70 city average, CEIC, National Bureau of Statistics.
Croatia: all types of new and existing dwelling in the whole country, BIS code: Q:VSFA:HR:R1.
Czech Republic: from 2008 Q1 onward: all owner occupied dwellings, pure price BIS code: Q:VSKA:CZ:04; 1999 Q1-2004 Q1: existing flats, price per square meter (BIS code: Q:VSJA:CZ:90); from 2004 Q1-2007 Q4: existing flats, price per square meter, data compiled from tax returns (BIS code: Q:VSKA:CZ:04).
Estonia: from 2003 Q3: all flats in Tallinn, average price per square meter BIS code: Q:VSJA:EE:24. From 1997 Q1-2003 Q2: 2-room apartments in Tallinn, average price per square meter, national statistical office.
Hong Kong SAR: all types of new and existing dwelling in the country, price per square meter, weighted average of five component indices categorised by saleable areas, BIS code: Q:VSJA:HK:00.
Hungary: FHB-House-Price-Index, http://www.fhbindex.com.
Indonesia: new houses in big cities, price per dwelling, BIS code: Q:VSLA:ID:86.
Israel: owner occupied dwellings, pure price, BIS code: Q:VSJA:IL:00.
Korea: all dwellings, pure price, BIS code: Q:VSJA:KR:00.
Latvia: from 2006 Q1: new dwellings, pure price, BIS code: Q:VSLA:LV:00; from 2000 Q1-2005 Q4: flats, urban areas, price per dwelling, BIS code: Q:VSJA:LV:91.
Lithuania: all dwellings, price per square meter, BIS code: Q:VSJA:LT:00.
Morocco: existing dwellings, price per square meter, BIS code: Q:VSKA:MA:00.
Macedonia: all flats in Skopje, pure price, BIS code: Q:VSJA:MK:44.
Mexico: all dwellings, pure price, BIS code: Q:VSJA:MX:00.
Malaysia: all dwellings, price per square meter, BIS code: Q:VSJA:MY:00.
Peru: new and existing flats in high-end neighbours in Lima, BIS code: Q:VSJA:PE:44.
Philippines: flats and commercial properties in Makati (in metropolitan Manila), price per square meter, BIS code: Q:VSJA:PH:44.
Poland: from 2006-Q3: new flats in Warsaw, price per square meter, BIS code: Q:VSLA:PL:44. From 2002 Q4-2006 Q2: new flats in Warsaw, price per square meter, old definition, BIS code: Q:VSLA:PL:94.
Romania: all dwellings, pure price, BIS code: Q:VSJA:RO:00.
Russia: existing dwellings, price per square meter, BIS code: Q:VSKA:RU:10.
Singapore: all dwellings, price per square meter, BIS code: Q:VSJA:SG:10.
Slovakia: from 2005 Q1 all dwellings, price per square meter, BIS code: Q:VSJA:SK:00. 2002-2005, same series but annual data. BIS code: A:VSJA:SK:00.
Slovenia: from 2007 Q1, new dwellings, pure price, BIS code: Q:VSLA:SI:00; 2003 Q1-2006 Q4, existing dwellings, price per square meter, BIS code: Q:VSKA:SI:91.
South Africa: all middle segment dwellings, price per dwelling, BIS code: Q:VSJB:ZA:05.
Thailand: new and existing detached houses in Bangkok, BIS code: Q:VSJB:TH:32.

Inflation rates

All countries (except Australia and New Zealand): Consumer price index, BIS code: M:VEBA:cc:LZ (cc = country code), monthly.
Australia and New Zealand: Consumer price index, BIS code: Q:VEBA:cc:LZ (cc = country code), quarterly.

Real GDP

All countries (except Ireland and Morocco): gross domestic product, at market prices, volume. Source: national data via the BIS databank.
Ireland: from 1997, national data via the BIS databank. Before 1997, gross domestic product, at 2013 chained prices, Datastream code: IRGDPCON, annual.
Morocco: gross domestic product, at constant 1998 prices, Datastream code: MCGDP...C, quarterly.

All real GDP data were seasonally adjusted.

Employment

Advanced economies

Austria: Total employment, thousands of persons, Datastream code: OEEMPTOTP, quarterly.
Australia: Employed population (aged 15 and over), thousands of persons, Datastream code: AUQLFT12P, quarterly.
Belgium: National employment, thousands of persons, Datastream code: BGEMPALLO, quarterly.
Canada: Total employment, thousands of persons, Datastream code: CNEMPTOTO, monthly.
Denmark: Employment, domestic concept, thousands of persons, Datastream code: DKOAYOOPP, annual.
Finland: Total employment (15-74 years), thousands of persons, Datastream code: FNEMPTOTP, monthly.
France: Total employment, thousands of persons, Datastream code: FREMPTOTO, quarterly.
Germany: Employed population (aged 15 and over), Datastream code: BDQLFT12O, quarterly.
Ireland: Employed population (aged 15 and over), Datastream code: IRYLFT12O, annual.
Italy: Employment, domestic concept, thousands of persons, Datastream code: ITOAYOOPP, annual.
Japan: Total employment, thousands of persons, Datastream code: JPEMPTOTO, monthly.
The Netherlands: Employment, domestic concept, thousands of persons, Datastream code: NLOAYOOPP, annual.
New Zealand: Civilian employment, domestic, thousands of persons, Datastream code: NZANECD., annual.
Norway: Total employment, thousands of persons, Datastream code: NWEMPTOTP, quarterly.
Portugal: Total employees, thousands of persons, Datastream code: PTYLF007O, annual.
Spain: Total employment, thousands of persons, Datastream code: ESEMPTOTP, quarterly.
Sweden: Total employees, thousands of persons, Datastream code: SDQLF007O, quarterly.
Switzerland: Employees, thousands of persons, Datastream code: SWEMPTOTO, quarterly.
United Kingdom: Total workforce jobs, thousands of persons, Datastream code: UKEMPTOTO, quarterly.
United States: Total civilian employment, thousands of persons, Datastream code: USEMPTOTO, monthly.

Emerging market economies

Bulgaria: Total employment, thousands of persons, Datastream code: BLEMTOT.P, monthly.
Brazil: from 2002 Q1: employment (PME Survey), historical metropolitan areas, millions of persons, Datastream code: BREMPTOTP, monthly. Before 2002 Q1: total employment, thousands of persons, Datastream code: BREMPTO6P, monthly.
China: Total employment, tens of thousands of persons, Datastream code: CHEMPTOT, annual.
Croatia: Total employment, persons in paid employment in legal entities, thousands of persons, Datastream code: CTEMPALLP, monthly.
Czech Republic: Total employment, domestic concept, thousands of persons, Datastream code: CZYETP01O, annual.
Estonia: Total employment, thousands of persons, Datastream code: EOEMPTOTP, quarterly.
Hong Kong SAR: Total employment, thousands of persons, Datastream code: HKEMPTOTP, monthly.
Hungary: Employment, domestic concept, thousands of persons, Datastream code: HNYETP01O, annual.
Indonesia: Total employment, actual, Datastream code: IDEMPALL, annual.
Israel: Total employment, thousands of persons, Datastream code: ISEMPTOTO, quarterly.
Korea: Total employment, thousands of persons, Datastream code: KOEMPTOTP, monthly.
Latvia: Total employment, Labour Force Survey, thousands of persons, Datastream code: LVEMPTOTP, quarterly.
Lithuania: Total employment, thousands of persons, Datastream code: LNEMPTOTP, quarterly.
Morocco: Employment, thousands of persons, Datastream code: MCI67EP, quarterly.
Macedonia: Total employment, actual, Datastream code: MKEMPTOTP, quarterly.
Mexico: Total employment, actual, Datastream code: MXEMPTOTP, quarterly.
Malaysia: Employment, thousands of persons, Datastream code: MYEMPTOT, annual.
Peru: Employment, firms with more than 100 employees, 2010 October = 100, Datastream code: PEEMPALLH, monthly.
Philippines: Total employment, thousands of persons, Datastream code: PHEMPTOTP, quarterly.
Poland: Total employment, thousands of persons, Datastream code: POEMPTOTP, quarterly.
Romania: Registered employment, thousands of persons, Datastream code: RMEMPTOTP, monthly.
Russia: Total employment, millions of persons, Datastream code: RSEMPTOTP, monthly.
Singapore: Total employment, thousands of persons, Datastream code: SPEMPTOT, annual.
Slovakia: Total employment, thousands of persons, Datastream code: SXEMPTOTP, quarterly.
Slovenia: Registered employment, actual, Datastream code: SJEMPTOTP, monthly.
South Africa: Employees, actual, Datastream code: SAEMPTOTP, quarterly.
Thailand: Total employment, thousands of persons, Datastream: THEMPTOTP, monthly.

Short-term interest rates

Advanced economies

Austria: from 1999 Q1: 3-month Euribor rate, Datastream code: EIBOR3M, daily. Before 1999 Q1: money market rate, IMF IFS line 60b, monthly averages.
Australia: from 1976 Q2: 90-day bank accepted bills rate, BIS code: D:HEJA:AU:32, daily. Before 1976 Q2: money market rate, IMF IFS line 60b, monthly averages.
Belgium: from 1999 Q1: 3-month Euribor rate, Datastream code: EIBOR3M, daily. Before 1999 Q1: money market rate, IMF IFS line 60b, monthly averages.
Canada: 3-month prime corporate paper rate, BIS code: M:HEHA:CA:02, monthly averages.
Denmark: from 1988 Q3: 3-month interbank rate, Datastream code: CIBOR3M, daily. Before 1988 Q3: money market rate, IMF IFS line 60b, monthly averages.
Finland: from 1999 Q1: 3-month Euribor rate, Datastream code: EIBOR3M, daily. Before 1999 Q1: money market rate, IMF IFS line 60b, monthly averages.
France: from 1999 Q1: 3-month Euribor rate, Datastream code: EIBOR3M, daily. Before 1999 Q1: money market rate, IMF IFS line 60b, monthly averages.
Germany: from 1999 Q1: 3-month Euribor rate, Datastream code: EIBOR3M, daily. Before 1999 Q1: money market rate, IMF IFS line 60b, monthly averages.
Ireland: from 1999 Q1: 3-month Euribor rate, Datastream code: EIBOR3M, daily. Before 1999 Q1: 3-month fixed interbank deposit rate, BIS code: M:HEEA:IE:92, monthly averages.
Italy: from 1999 Q1: 3-month Euribor rate, Datastream code: EIBOR3M, daily. Before 1999 Q1: 3-month interbank deposit rate, Datastream code: ITINTER3, monthly averages.
Japan: from 1989 Q4: 3-month Japanese yen Libor rate, Bloomberg code: JY0003M Index, daily. Before 1989 Q4: call money rate, collateralized and unconditional, overnight, BIS code: M:HEBA:JP:92, monthly averages.
The Netherlands: from 1999 Q1: 3-month Euribor rate, Datastream code: EIBOR3M, daily. Before 1999 Q1: interest rate on 3-month cash loans to local authorities, BIS code: M:HEEA:NL:94, monthly averages.
New Zealand: 90-day bank bills rate, BIS code: D:HEHA:NZ:32, daily.
Norway: from 1986 Q1: 3-month NIBOR rate, Datastream code: NWIBK3M, daily. From 1978 Q3 to 1985 Q4: 3-month NIBOR rate, BIS code: M:HEEA:NO:02, monthly averages. Before 1978 Q3: money market rate, IMF IFS line 60b, monthly averages.
Portugal: from 1999 Q1: 3-month Euribor rate, Datastream code: EIBOR3M, daily. Before 1999 Q1: 3-month interbank deposits rate, BIS code: M:HEEA:PT:93, end-of-month.
Spain: from 1999 Q1: 3-month Euribor rate, Datastream code: EIBOR3M, daily. Before 1999 Q1: 3-month interbank rate, Datastream code: ESINTER3, end-of-month.
Sweden: from 1987 Q1: 3-month Stibor rate, BIS code: D:HEEA:SE:02, daily. From 1969 Q1 to 1986 Q4: marginal rate, BIS code: M:HBHA:SE:91, end-of-month.
Switzerland: Tom/next deposit rate, BIS code: M:HEBA:CH:02, monthly averages.
United Kingdom: from 1987 Q1: 3-month British pound sterling Libor rate, Bloomberg code: BP0003M Index, daily. From 1975 Q1 to 1986 Q4, 3-month interbank rate, Datastream code: LDNIB3M, daily. Before 1975 Q1: 3-month interbank sterling deposit rate, BIS code: M:HEEA:GB:01, end-of-month.
United States: 3-month US dollar Libor rate, Datastream code: USINTER3, monthly averages.

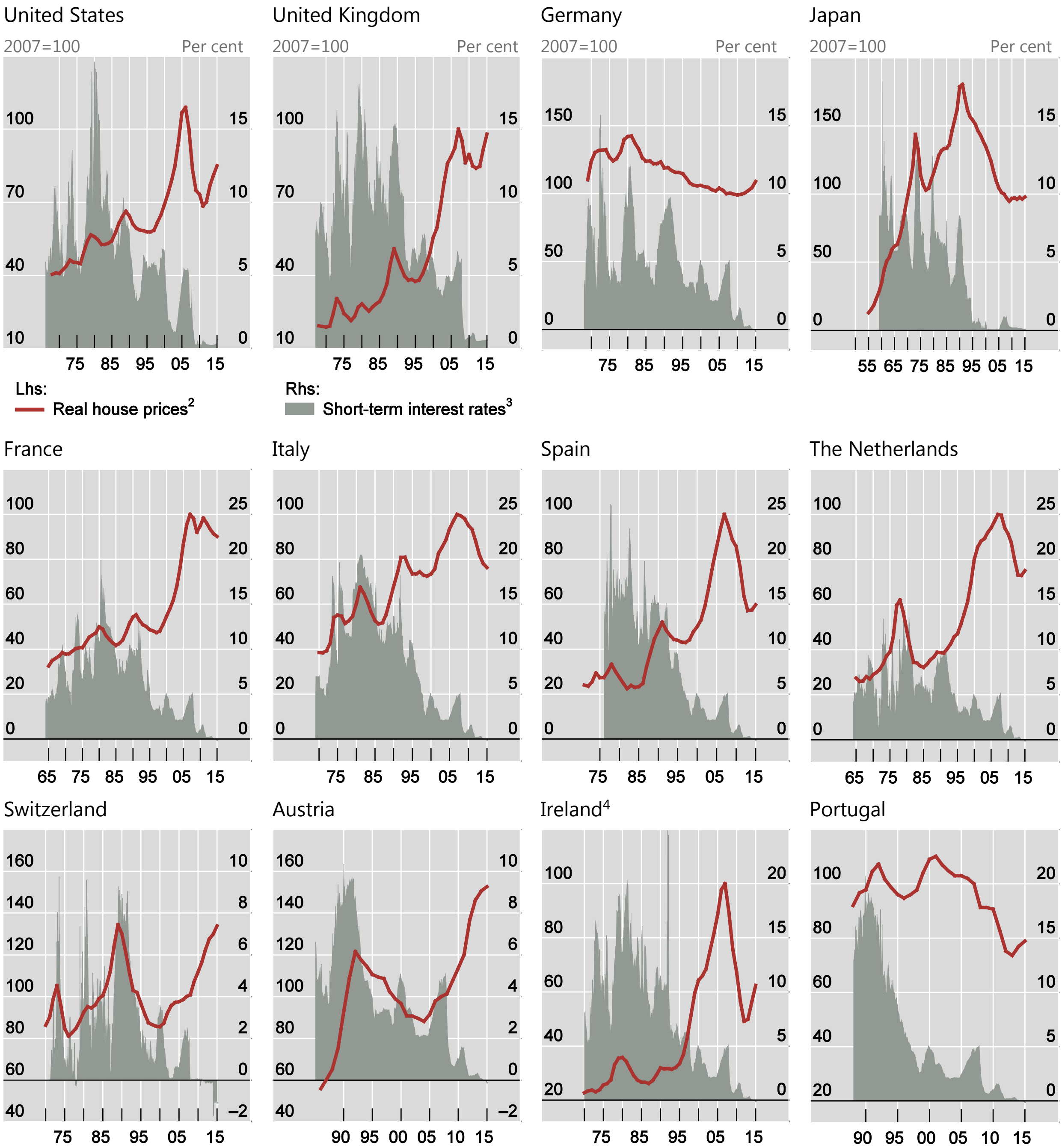
Emerging market economies

Bulgaria: from 2003 Q1: 3-month interbank rate, Datastream code: BLIBK3M, daily. From 1997 Q3 to 2002 Q4: interest rate on newly accepted deposits on the interbank money market, over 1 month, BIS code: M:HEEA:BG:75, monthly.
Brazil: 3-month Brazilian real retail certificate of deposit rate, Bloomberg code: BCCDBCE CMPL Currency, daily.
China: from 2002 Q1: 3-month interbank rate, Datastream code: CHIB3MO, daily. From 1996 Q1 to 2001 Q4: 90-days national interbank offered rate, CEIC code: 7059101 (CMOAF), monthly.
Croatia: from 2006 Q2: 3-month Zibor rate, Datastream code: CTZIB3M, daily. From 1997 Q1 to 2006 Q1: money market rate, IMF IFS line 60b, monthly averages.
Czech Republic: 3-month Prague interbank offered rate (PRIBOR), Datastream code: CZINTER3, monthly.
Estonia: 3-month Euribor rate, Datastream code: EIBOR3M, daily.
Hong Kong SAR: 3-month interbank rate, Datastream code: HKIBF3M, daily.
Hungary: 3-month interbank rate, Datastream code: HNIBK3M, daily.
Indonesia: 3-month interbank rate, Bloomberg: JIIN3M Index, daily.
Israel: 3-month Tel Aviv interbank rate, Datastream code: ILIBK3M, daily.

Korea: from 1992 Q1: 91-day negotiable security deposit rate, Datastream code: KOCD91D, daily. From 1991 Q1 to 1991 Q4: 3-month certificate of deposit rate, BIS code: M:HELA:KR:32, monthly averages. Before 1991 Q1: money market rate, IMF IFS line 60b, monthly averages.
Latvia: 3-month Euribor rate, Datastream code: EIBOR3M, daily.
Lithuania: 3-month Euribor rate, Datastream code: EIBOR3M, daily.
Morocco: Money market rate, IMF IFS line 60b, monthly averages.
Macedonia: 1-month interbank rate, BIS code: M:HEEA:MK:32, monthly averages.
Mexico: 91-day Mexico CETES rate, Datastream code: MXCTC91, daily.
Malaysia: 3-month interbank rate, Datastream code: MYIBK3M, daily.
Peru: Interbank rate, IMF IFS line 60b, monthly averages.
Philippines: 91-day Treasury bill rate, BIS code: M:HEPA:PH:72, monthly averages.
Poland: 3-month deposit rate, Datastream code: POIBK3M, daily.
Romania: 3-month interbank bid rate, BIS code: D:HEEA:RO:36, daily.
Russia: 31 to 90-day interbank rate, Datastream code: RSIBK90, daily.
Singapore: from 1999 Q3: 3-month Singapore dollar Sibor rate, Bloomberg code: SIBF3M Index, daily. Before 1999 Q3: 3-month interbank rate, Datastream code: SGIBK3M, daily.
Slovakia: 3-month Euribor rate, Datastream code: EIBOR3M, daily.
Slovenia: 3-month Euribor rate, Datastream code: EIBOR3M, daily.
South Africa: from 1981 Q1: 91-day Treasury bill rate, Datastream code: SATBL3M, daily. Before 1981 Q1: 3-month Treasury bill rate, Datastream code: SAGBILL3, end-of-month.
Thailand: 3-month interbank rate, Datastream code: THBRF3M, daily.

2. Appendix graphs and tables

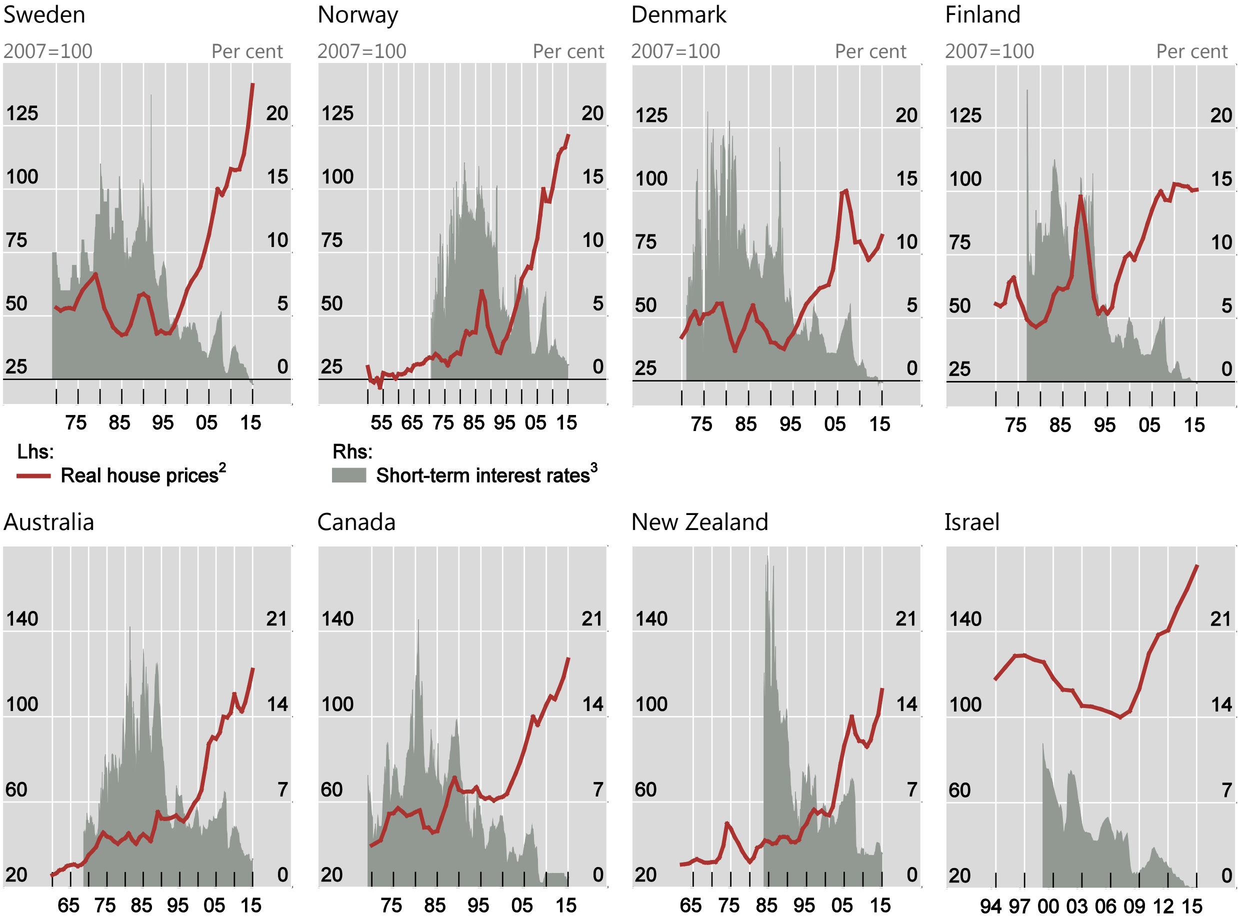
Real house prices and short-term interest rates: advanced economies[1] Graph A1



[1] Description of house prices and short-term interest rates is provided in Appendix 2. [2] CPI-adjusted annual averages. [3] Monthly averages. [4] In Ireland monthly average short-term interest rate peaked at 40% in November 1992.

Sources: Bloomberg; Datastream; IMF, *International Financial Statistics*; national data.

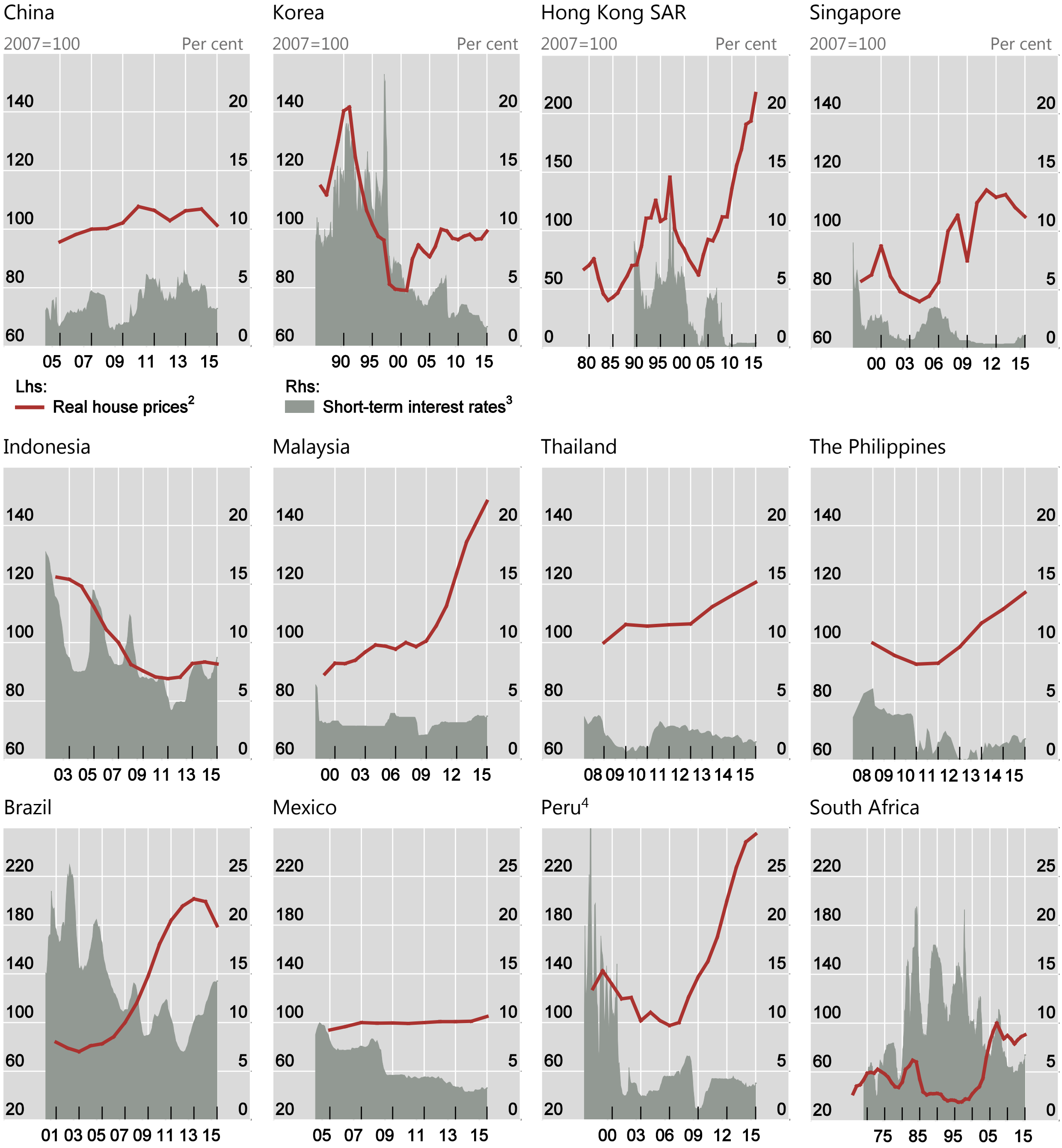
Real house prices and short-term interest rates: advanced economies[1] Graph A1 (cont)



[1] Description of house prices and short-term interest rates is provided in Appendix 2. [2] CPI-adjusted annual averages. [3] Monthly averages.

Sources: Bloomberg; Datastream; IMF, *International Financial Statistics*; national data.

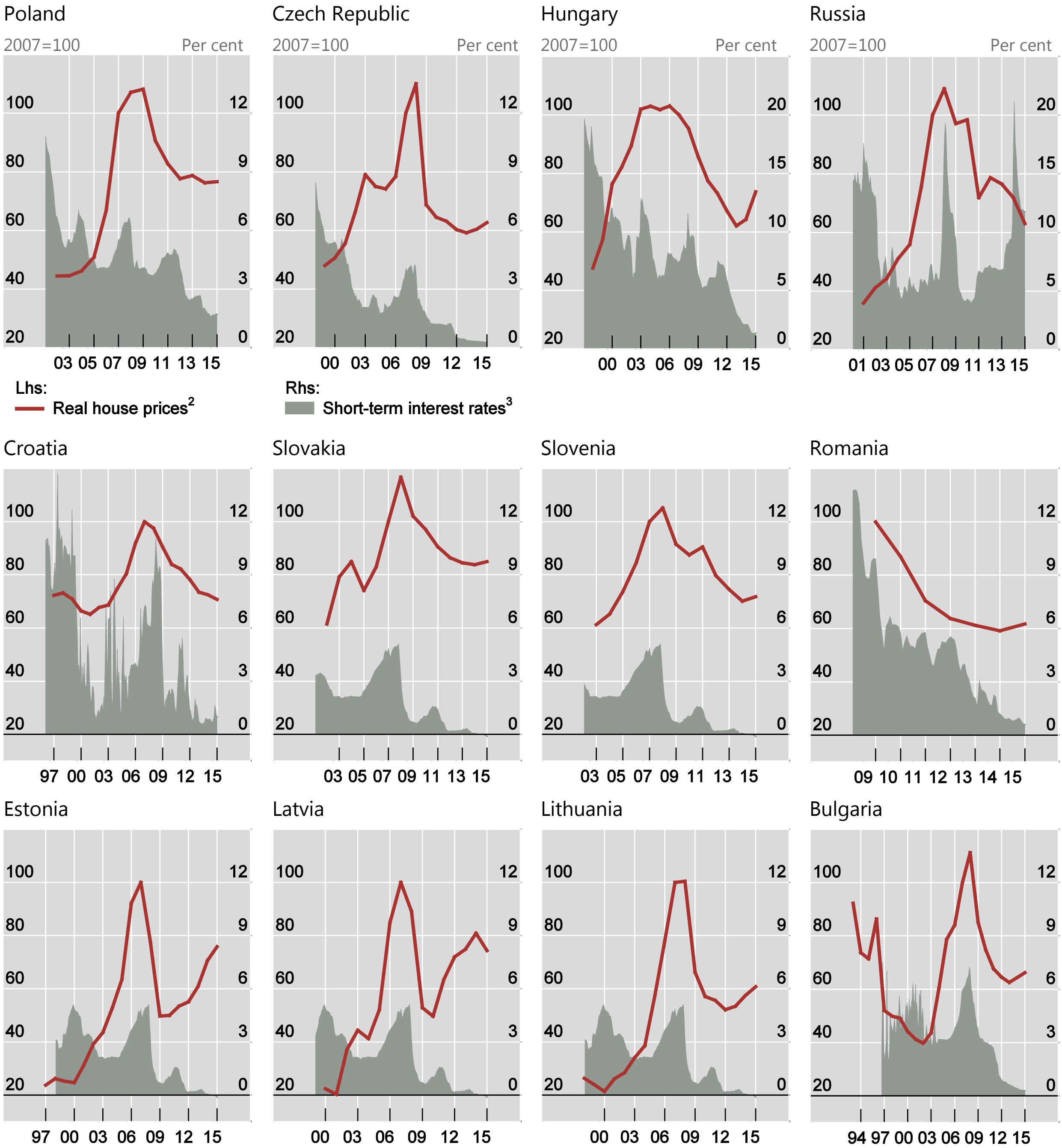
Real house prices and short-term interest rates: Emerging Asia and Latin America[1] Graph A2



[1] Description of house prices and short-term interest rates is provided in Appendix 2. [2] CPI-adjusted annual averages. [3] Monthly averages. [4] In Peru monthly average short-term interest rate peaked at 39% in September 1998.

Sources: Bloomberg; Datastream; IMF, *International Financial Statistics*; national data.

Real house prices and short-term interest rates: central and eastern Europe[1] Graph A3



[1] Description of house prices and short-term interest rates is provided in Appendix 2. [2] CPI-adjusted annual averages. [3] Monthly averages.

Sources: Bloomberg; Datastream; IMF, *International Financial Statistics*; national data.

Upswings and downswings in nominal house prices – advanced economies

Table A1

Country	Upswings[1]			Downswings[1]		
	Period	Duration		Period	Duration	
		Years	% of total[2]		Years	% of total[2]
United States	1969–90	22	87	2007–2011	5	11
	1992–2006	15				
	2012–2015	4				
Japan	1956–74	19	63	1996–2008	13	22
	1976–91	16				
	2013–2015	3				
Germany	1970–82	13	40	1996–98	3	6
	2010–15	6				
United Kingdom	1969–89	21	81	1990–93	4	8
	1994–2007	14				
	2012–15	4				
France	1966–91	26	74	1992–95	4	16
	1998–2008	11		2012–15	4	
Italy	1971–93	23	82	2012–15	4	9
	1995–2008	14				
Spain	1972–91	20	77	2008–13	6	14
	1994–2007	14				
Austria	1987–94	8	76	1998–2002	5	17
	2002–15	14				
Belgium	1960–67	8	84	1981–83	3	5
	1972–80	9				
	1984–2008	25				
	2010–13	4				
Denmark	1971–79	9	67	1980–82	3	7
	1983–86	4				
	1994–2007	14				
	2013–15	3				
Finland	1971–89	19	78	1990–93	4	9
	1996–2000	5				
	2002–08	7				
	2010–13	4				
Ireland	1971–2007	37	91	2008–12	5	11
	2013–15	3				
Netherlands	1967–78	12	72	1979–82	4	18
	1985–2008	24		2009–13	5	
Norway	1955–58	4	76	1988–92	5	8
	1960–87	28				
	1993–2007	15				
	2013–15	3				
Portugal	1989–2007	19		2011–13	3	
Sweden	1971–80	10	95			0
	1982–91	10				
	1994–2015	22				
Switzerland	1971–73	3				0
	1977–90	14				
	1991–99	9				
	2000–15	16				
Australia	1961–2010	50				0
	2013–16	4				
Canada	1971–81	11				0
	1981–89	9				
	1991–94	4				
	1999–2007	9				
	2009–15	7				
New Zealand	1963–90	28				0
	1992–97	6				
	2001–07	7				

[1] Upswings (downswings) defined as periods of three or more years of sustained increases (decreases) in nominal house prices. [2] Duration of all upswings or downswings in a given country as a percentage of years of observations in the country sample.

Source: BIS residential property price statistics; authors' calculations.

Upswings and downswings in nominal house prices – EMEs

Table A2

Country	Upswings[1]			Downswings[1]		
	Period	Duration		Period	Duration	
		Years	% of total[2]		Years	% of total[2]
China	2006–11	6	60			0
Hong Kong SAR	1985–94	10	54	1982–84	3	24
	2004–15	10		1998–2003	6	
Indonesia	2003–15	13	100			0
Malaysia	2000–15	16	100			0
Korea	1987–91	5	27	1992–95	4	13
	2000–12	3				
Philippines	2010–15	6	86			0
Singapore	2005–08	4	44	2001–04	4	22
	2010–13	4				
Thailand	2009–15	7	88			0
Brazil	2002–14	13	93			0
Mexico	2006–15	10	100			0
Peru	2007–15	9	53			0
Israel	1995–99	5	62			0
	2008–15	8				
South Africa	1967–84	18	92			0
	1987–2008	22				
	2010–15	6				
Bulgaria	1994–99	6	78			0
	2001–08	8				
Croatia	2001–08	8	44	2012–15	4	22
Czech Republic	2000–03	4	50	2009–13	5	31
	2005–08	4				
Estonia	2000–07	8	78			0
	2010–15	6				
Hungary	1999–2008	10	59	2009–13	5	29
Latvia	2002–08	7	73			0
	2011–14	4				
Lithuania	2001–08	8	65			0
	2013–15	3				
Poland	2003–09	7	50	2010–12	3	21
Romania			0	2010–14	5	83
Russia	2002–10	9	93			0
	2012–15	4				
Slovakia	2006–08	3	23	2009–14	6	46
Slovenia	2004–08	5	42	2012–14	3	25

[1] Upswings (downswings) defined as periods of three or more years of sustained increases (decreases) in nominal house prices. [2] Duration of all upswings or downswings in a given country as a percentage of years of observations in the country sample.

Source: BIS residential property price statistics; authors' calculations.

Long-term interest rates and real house price growth in the United States, 1970 Q2–2015 Q4[1]

Table A3

Variables	Coefficient	*t*-statistic	Probability
Real house price growth (t–1)	0.722	8.88	0.0000
Real house price growth (t–2)	0.119	1.20	0.2309
Real house price growth (t–3)	0.253	2.53	0.0124
Real house price growth (t–4)	–0.378	–3.72	0.0003
Real house price growth (t–5)	0.263	2.56	0.0115
Real house price growth (t–6)	–0.127	–1.25	0.2143
Real house price growth (t–7)	0.014	0.13	0.8948
Real house price growth (t–8)	–0.040	–0.49	0.6254
Real GDP growth	0.022	0.26	0.7924
Real GDP growth (t–1)	0.189	2.15	0.0336
Real GDP growth (t–2)	0.092	0.98	0.3272
Real GDP growth (t–3)	0.094	1.04	0.3020
Real GDP growth (t–4)	0.087	0.91	0.3645
Real GDP growth (t–5)	–0.088	–0.98	0.3272
Real GDP growth (t–6)	0.045	0.54	0.5898
Total employment growth	–0.066	–0.29	0.7760
Total employment growth (t–1)	–0.442	–1.78	0.0764
Total employment growth (t–2)	–0.214	–0.83	0.4063
Total employment growth (t–3)	0.250	0.98	0.3276
Total employment growth (t–4)	0.082	0.33	0.7430
Total employment growth (t–5)	0.309	1.24	0.2162
Total employment growth (t–6)	–0.249	–1.15	0.2509
Change in long-term interest rate	–0.0031	–1.96	0.0521
Change in long-term interest rate (t–1)	–0.0018	–1.06	0.2932
Change in long-term interest rate (t–2)	–0.0005	–0.27	0.7889
Change in long-term interest rate (t–3)	–0.0012	–0.69	0.4906
Change in long-term interest rate (t–4)	0.0010	0.60	0.5502
Change in long-term interest rate (t–5)	–0.0023	–1.34	0.1838
Change in long-term interest rate (t–6)	0.0007	0.41	0.6860
Change in long-term interest rate (t–7)	–0.0028	–1.63	0.1042
Change in long-term interest rate (t–8)	0.0009	0.53	0.5957
Change in long-term interest rate (t–9)	0.0012	0.73	0.4677
Change in long-term interest rate (t–10)	–0.0007	–0.43	0.6653
Change in long-term interest rate (t–11)	–0.0007	–0.42	0.6747
Change in long-term interest rate (t–12)	0.0024	1.48	0.1405
Level of long-term interest rate, in real terms[2]	–0.0005	–1.42	0.1580
R^2	0.75		
Number of observations	183		

[1] Quarter-on-quarter growth rates. [2] Nominal interest rate less the annual percentage change in the CPI for the previous quarter.

Sources: Bloomberg; CEIC; Datastream; IMF; national data.

Long-term interest rates and real house price growth in non-US advanced economies, 1966–2015

Table A4

Variables	Coefficient	*t*-statistic	Probability
A. With domestic and US interest rates			
Real house price growth (t–1)	0.61	17.05	0.0000
Real house price growth (t–2)	–0.17	–4.66	0.0000
Real GDP growth	0.88	8.83	0.0000
Real GDP growth (t–1)	–0.34	–3.29	0.0010
Real GDP growth (t–2)	0.06	0.64	0.5201
Total employment growth	0.59	3.74	0.0002
Total employment growth (t–1)	–0.19	–1.07	0.2844
Total employment growth (t–2)	0.19	1.29	0.1979
Change in domestic long-term interest rate	–0.0066	–4.17	0.0000
Change in domestic long-term interest rate (t–1)	–0.0045	–2.67	0.0078
Change in domestic long-term interest rate (t–2)	–0.0014	–0.81	0.4207
Change in domestic long-term interest rate (t–3)	–0.0017	–1.07	0.2861
Change in domestic long-term interest rate (t–4)	0.0019	1.20	0.2308
Change in domestic long-term interest rate (t–5)	–0.0035	–2.17	0.0306
Level of US long-term interest rate, in real terms[1]	–0.0035	–4.53	0.0000
R^2	0.55		
Number of observations	788		
B. With only domestic interest rates			
Constant	–0.02	–5.16	0.0000
Real house price growth (t–1)	0.56	14.94	0.0000
Real house price growth (t–2)	–0.16	–4.53	0.0000
Real GDP growth	1.20	10.58	0.0000
Real GDP growth (t–1)	0.08	0.66	0.5096
Real GDP growth (t–2)	0.11	0.92	0.3585
Total employment growth	0.69	4.35	0.0000
Total employment growth (t–1)	–0.51	–2.94	0.0034
Total employment growth (t–2)	0.16	1.02	0.3096
Change in domestic long-term interest rate	–0.0048	–2.32	0.0205
Change in domestic long-term interest rate (t–1)	0.0005	0.23	0.8220
Change in domestic long-term interest rate (t–2)	–0.0009	–0.43	0.6698
Change in domestic long-term interest rate (t–3)	0.0000	–0.01	0.9923
Change in domestic long-term interest rate (t–4)	0.0032	1.60	0.1107
Change in domestic long-term interest rate (t–5)	–0.0017	–0.83	0.4088
Level of domestic long-term interest rate, in real terms[1]	–0.0009	–0.98	0.3295
R^2	0.67		
Number of observations	791		

Note: No constant term included in Panel A because the test for redundant fixed effects indicated no fixed effects.

[1] Deflated with previous year's CPI.

Sources: Bloomberg; CEIC; Datastream; IMF; national data.

Long-term interest rates and real house price growth in EMEs, 1976–2015 Table A5

Variables	Coefficient	*t*-statistic	Probability
A. With domestic and US interest rates			
Constant	–0.06	–5.37	0.0000
Real house price growth (t–1)	0.27	4.34	0.0000
Real house price growth (t–2)	–0.20	–3.64	0.0003
Real GDP growth	2.04	10.11	0.0000
Real GDP growth (t–1)	–0.21	–0.97	0.3334
Real GDP growth (t–2)	0.45	2.22	0.0276
Total employment growth	0.53	2.20	0.0288
Total employment growth (t–1)	–0.09	–0.35	0.7257
Total employment growth (t–2)	0.36	1.64	0.1017
Change in domestic long-term interest rate	–0.0034	–0.83	0.4058
Change in domestic long-term interest rate (t–1)	–0.0002	–0.05	0.9627
Change in domestic long-term interest rate (t–2)	–0.0021	–0.60	0.5484
Change in domestic long-term interest rate (t–3)	0.0012	1.30	0.1961
Change in domestic long-term interest rate (t–4)	0.0000	–0.01	0.9932
Change in domestic long-term interest rate (t–5)	0.0003	1.52	0.1300
Level of US long-term interest rate, in real terms[1]	–0.0037	–0.91	0.3653
R^2	0.65		
B. With only domestic interest rates			
Constant	–0.07	–6.17	0.0000
Real house price growth (t–1)	0.27	4.33	0.0000
Real house price growth (t–2)	–0.20	–3.69	0.0003
Real GDP growth	1.93	10.68	0.0000
Real GDP growth (t–1)	–0.16	–0.75	0.4552
Real GDP growth (t–2)	0.49	2.42	0.0165
Total employment growth	0.56	2.31	0.0218
Total employment growth (t–1)	–0.05	–0.20	0.8449
Total employment growth (t–2)	0.35	1.60	0.1119
Change in domestic long-term interest rate	–0.0047	–1.11	0.2669
Change in domestic long-term interest rate (t–1)	–0.0009	–0.23	0.8220
Change in domestic long-term interest rate (t–2)	–0.0026	–0.75	0.4564
Change in domestic long-term interest rate (t–3)	0.0013	1.46	0.1465
Change in domestic long-term interest rate (t–4)	0.0000	–0.13	0.8935
Change in domestic long-term interest rate (t–5)	0.0003	1.62	0.1061
Level of domestic long-term interest rate, in real terms[1]	0.0015	0.68	0.4969
R^2	0.65		

Note: Each panel has 284 observations.

[1] Deflated with previous year's CPI.

Sources: Bloomberg; CEIC; Datastream; Global Financial Data; IMF; national data.

3. Derivation of house price response to changes in interest rates

To gain intuition as to how inertia in a dependent variable can increase the effect of shocks to independent variables, it is helpful to start with a simple model. Let P_t be the natural logarithm of the real price of housing at time t and i_t the nominal interest rate, either short-term or long-term, at time t (expressed in percent). Consider the following equation:

$$\Delta P_t = \alpha \Delta P_{t-1} + \beta \Delta i_t \qquad (1)$$

where Δ is the first-difference operator and the variables ΔP_t and Δi_t have had their sample means removed. Furthermore, assume that $0 \leq \alpha < 1$ and $\beta < 0$.

Let $\Delta i_t = -1$, so that the nominal interest rate at time t is 1 percentage point lower than its value at time $t-1$. Furthermore, assume that there are no additional changes in the nominal interest rate and prior to its fall real house prices were constant over time. One can easily derive that:

$$\Delta P_t = -\beta$$

$$\Delta P_{t+1} = -\alpha\beta$$

$$\Delta P_{t+2} = -\alpha^2\beta$$

$$\Delta P_{t+j} = -\alpha^j\beta$$

The (approximate) percentage increase in the real price of housing from time $t\text{-}1$ to time $t+j$ is:

$$P_{t+j} - P_{t-1} = \Delta P_{t+j} + \Delta P_{t+j-1} + \ldots + \Delta P_t$$

Simple substitution gives:

$$P_{t+j} - P_{t-1} = (-\alpha^j\beta) + (-\alpha^{j-1}\beta) + \ldots + (-\beta)$$

Thus:

$$P_{t+j} - P_{t-1} = (-\beta)[1 + \alpha + \alpha^2 + \ldots + \alpha^j]$$

Letting j increase without bound gives:

$$\lim_{j\to\infty} \{ P_{t+j} - P_{t-1} \} = -\beta/(1-\alpha)$$

As α becomes larger (real house prices display greater inertia) the long run impact from a 100 basis-point fall in the nominal rate increases. This suggests that one way to underestimate the impact of interest rates on house prices is to use estimation methods that pull estimates of α towards zero. One approach to estimation that does this is Bayesian estimation with a random walk prior for real house prices.

The impulse responses computed in the paper allow real house price growth to be affected also by the level of the real interest rate. Let r_t be the real rate at time t, expressed as a deviation from its sample mean. A simple extension of equation (1) is:

$$\Delta P_t = \alpha \Delta P_{t-1} + \beta \Delta i_t + \delta r_t \qquad (2)$$

where $\delta < 0$. Now let $\Delta i_t = r_t = -1$, so the 100 basis-point fall in the nominal interest rate at time t is associated with r_t being 100 basis points below its long-run mean at time t. Again, assume that there are no additional changes in interest rates so the real rate of interest remains 100 basis points below its long-run mean. In addition, assume that prior to the rate decline real house prices were constant over time. One can easily derive that:

$$\Delta P_t = (-\beta) + (-\delta) > (-\delta) > 0$$

$$\Delta P_{t+1} = \alpha \Delta P_t + (-\delta) \geq (-\delta) > 0$$

$$\Delta P_{t+2} = \alpha \Delta P_{t+1} + (-\delta) \geq (-\delta) > 0$$

$\Delta P_{t+j} = \alpha \Delta P_{t+j-1} + (-\delta) \geq (-\delta) > 0$

The (approximate) percentage increase in the real price of housing from time $t-1$ to time $t+j$ is:

$$P_{t+j} - P_{t-1} = \Delta P_{t+j} + \Delta P_{t+j-1} + \ldots + \Delta P_t > (j+1)(-\delta) \qquad (3)$$

As equation (3) makes clear, there is no finite limit in this case as j increases without bound. This does not imply that equation (2) is ill-specified. The reason that there is no finite limit is our assumption that r_t remains below its long-run mean over the course of the experiment. This of course is not a good assumption for an infinite-horizon response. Eventually, r_t must return to its long-run mean if it is a stationary variable, as we assume. To calculate an infinite-horizon response for equation (3), assumptions would need to be made as to how quickly r_t returns to its long-run mean after being pushed away from it. In this paper, we do not make such assumptions as we only report finite-horizon responses. The finite-horizon responses we report in the main body of the paper are derived from extensions of equation (2) that allow for more lags in the nominal rate change and real house price growth.

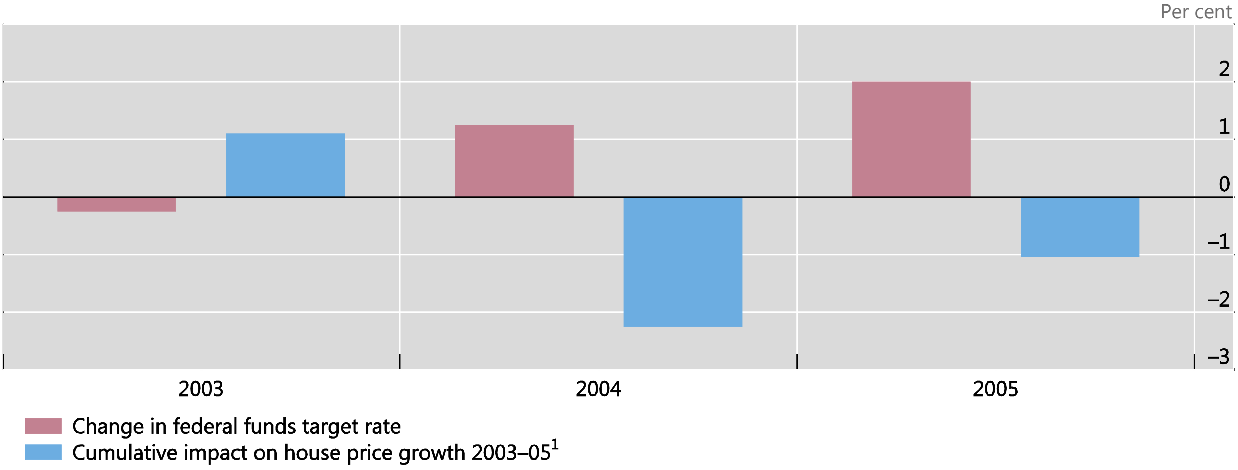
4. Short-term interest rates and the US house price bubble

One important reason to focus on the impact of short-term interest rates on house prices is that a number of studies, beginning with Taylor (2008), argue that easy US monetary policy was an important determinant of the 2000–06 US house price bubble, whose bursting contributed to the Great Financial Crisis of 2007–09. It has been suggested that tighter monetary policy in the years leading up to the financial crisis could have reduced US house price growth, perhaps even enough to have averted the worst aspects of the financial crisis. A question that naturally arises is how much higher short-term interest rates would need to have been to have reduced cumulative house price growth substantially.

US real house prices rose strongly over the 2003–05 period, increasing by a total of 35%. The target federal funds rate also rose over this period, from 1¼% to 4¼%; however, the period did not witness a steady rise in the federal funds target rate, as it actually fell by 25 basis points in 2003. Our conservative model – ie our model estimated with data up through end-1999 (Graph 8) – suggests that the 2003 cut in the federal funds rate target added a bit over 1 percentage point to US real house price growth by the end of 2005 (Graph A4). Over the course of 2004 and 2005, the Fed raised its target for the federal funds rate, in a series of actions, by a total of 325 basis points. However, this did not have a large impact on US real house price growth up through end-2005 because most of the increases came toward the end of the period. Graph A4 indicates that the cumulative effect of changes in the federal funds target rate over the 2003–05 period was to reduce real US real house price growth by about 2 percentage points over this period. In contrast, a 400 basis-point increase in the federal funds rate target at the end of 2002 would have slowed real house price growth by about 20 percentage points through end-2005 (Graph 8).

Cumulative policy rate changes and their impact on real house prices

United States: 2003–05 Graph A4



[1] Change in the federal funds target rate multiplied by the cumulative impact of a 100 basis-point fall in the nominal US short-term rate. Details of the calculation are provided in the Appendix 3.

Sources: Bloomberg; authors' calculations.

Higher short-term interest rates by themselves probably would not have significantly dampened the demand for housing and the increase in construction activity that followed the easing of credit constraints to subprime borrowers. However, lower house price growth over 2003–05 would arguably have given financial sector supervisors more time to implement measures such as tighter lending standards to strengthen the US financial system. Thus, it seems that not too large an increase in US short-term rates could have affected the course of events over 2007–09. In fact, even a hike smaller than 400 basis points may have worked, because our model treats GDP growth – which has an additional impact on house prices – as exogenous, ie unaffected by increases in short-term interest rates.

With hindsight, one could argue that the Fed should have tightened monetary policy at the end of 2002. This argument would be stronger if it had already been clear at that time that the United States was in the middle of a national house price bubble threatening financial stability. Based on data available up through 2002, Case and Shiller (2003) found that house prices in seven US states, including California and some other large states, looked increasingly bubble-like. However, the main evidence that led these researchers to conclude that there was indeed a significant bubble in US house prices was survey results for four cities, two of which are in California, showing that homebuyers had very high expectations of future house price growth in 2002. These survey responses were only available in 2003.

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