

The determinants and regional dependencies of house price increases since 2010

Residential property prices in Germany have been rising significantly since 2010, driven mainly by an increase in housing demand that has been greater than would be expected during an economic upswing. This turnaround on the housing market has been due, in part, to sound economic growth and sustained improvements on the labour market in recent years, which have given rise to renewed confidence in the performance of the German economy. The impact of the financial and sovereign debt crisis should not be underestimated either. The extremely low interest rates for mortgage loans are likely to belong in this context. Real estate investments are also appearing in a different light owing to the very low returns on alternative investments and the heightened uncertainty in the financial markets. This has bolstered demand for apartments in particular.

So far, price increases have been concentrated on property markets in urban areas. Measured by the longer-term demographic and economic determinants, property in these areas is currently likely to be overvalued by between 5% and 10%. In the attractive large German cities, the upward deviations are, in some cases, as high as 20%, which is especially true of apartments. By contrast, the prices of single-family houses in both urban and rural areas do not appear to differ perceptibly from their fundamental level.

There are indications that the price rises are spreading from towns and cities to their surrounding areas. These spatial effects are, in part, due to determinants that have an impact going beyond regional borders. Given that there is also evidence of purely price-based transmission channels, it cannot be ruled out that overly optimistic expectations or speculation motives are fostering the regional dispersion of price impulses. Moreover, it is unlikely that the price pressure on the housing markets will ease in the short term. Despite the robust growth in housing construction, the expansion in the housing supply is still not sufficient to meet the additional demand for housing. Incentives to invest have to be in line with the market mechanism.

At present, no substantial macroeconomic risks are arising from the price structure on the housing market. The observed price movements reflect the lagged expansion of the housing supply. Possible price corrections could give rise to perceptible wealth losses for households, but growth in mortgage loans is still sluggish on the whole.

Finally, it should be noted that the results presented here are subject to considerable estimation uncertainty. First, available data for property markets still contain gaps, despite substantial improvements made over the past few years. Second, there is uncertainty regarding the price effect of key determinants. At the current end, this is mainly affecting interest rates.

Pick-up in demand in the German housing market

Trend reversal in the housing market supported by cyclical and structural factors, ...

The year 2010 saw a trend reversal in the German housing market, which was reflected in a sharp rise in prices, a greater number of transactions and buoyant construction activity. The trend reversal came at a time when the overall economic recovery was beginning to gain traction following the severe recession in the fourth quarter of 2008 and the first quarter of 2009, and optimistic economic and income expectations were again prevailing throughout large parts of the country. Besides the cyclical momentum, there were structural factors, which

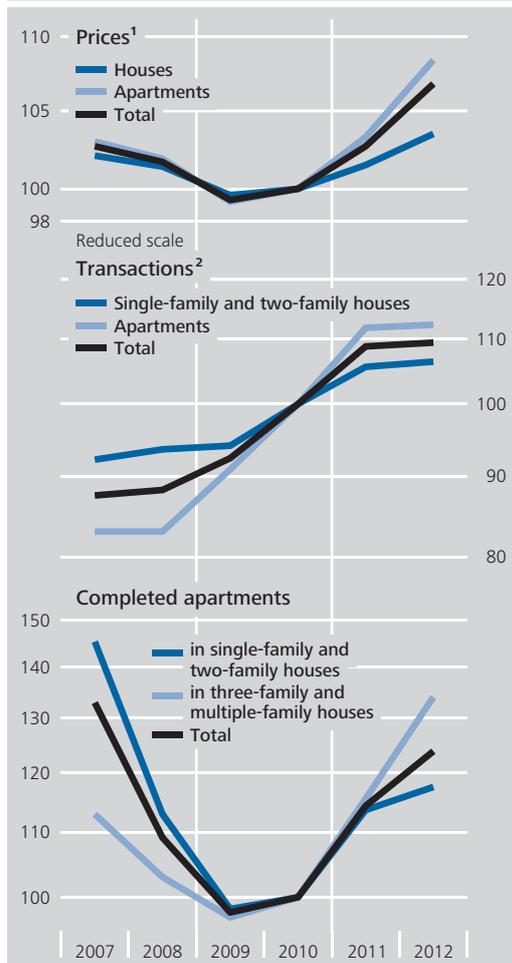
either bolstered or, at least, no longer hindered an upturn in the housing market. The arduous adjustment process, for instance, which corrected the exaggerations in housing construction following German reunification, was completed by the second half of the last decade, if not earlier.¹ In addition, the side-effects of the structural reforms were no longer placing a strain on household incomes. Rather, the sustained success in the labour market brought about by wage moderation and structural reforms have led to renewed confidence in the performance of the German economy.

Moreover, influences which are either directly or indirectly connected with the global financial crisis and the subsequent sovereign debt crisis in the euro area should also be borne in mind. Thus, the German property market, which had been calm for many years, suddenly became attractive for international investors after the bursting of the property market price bubbles in the US and a number of European housing markets. Furthermore, the incentives to invest in real estate also increased as the returns on financial assets decreased in relative terms, especially as investment decisions in an environment shaped by the crisis were characterised to a greater extent by a quest for safer assets. The belief that the value of assets can be best secured by property ownership was, for many households, certainly an argument for considering the acquisition of property. The exceptionally favourable financing conditions are likely to have played a key role, even though the interest rates for mortgage loans have risen again slightly in recent months from their historic low.

... but also affected by the financial and sovereign debt crisis

Price and activity indicators for the housing market

2010 = 100, log scale



¹ Bundesbank calculations on the basis of data provided by BulwienGesa AG. ² Extrapolation provided by the vdp Research GmbH on the basis of data from surveyor committees.

According to data provided by BulwienGesa AG, prices for houses and apartments have risen by a total of 8¼% over the past three years, or by an average of 2¾% per year. Although this increase in prices followed a period

Price hikes triggered by steep rise in the demand for property

¹ See also Deutsche Bundesbank, Extended investment cycle with stable prices: supply and demand in the German housing market from a longer-term perspective, Monthly Report, June 2010, pp 47-58.

of stagnation spanning a decade and a half and has been exceptionally moderate to date compared with growth observed during boom periods in other countries, it has been attracting a great deal of attention. This is likely to be due mainly to the marked difference in the dynamics of property prices between urban and rural areas. However, the finding that the price of apartments on an average of seven major German cities² has risen in total by more than one-quarter since 2010, is giving rise to fears of a broad-based property price boom if the price impulses that are currently having an impact at the local level should spread across the entire country.

Price movements in the housing markets in light of demographic and economic determinants

The observed price movements do not, on their own, make it possible to derive any potential overvaluation or undervaluation. A benchmark would be required, but it cannot be specified unambiguously from a conceptual point of view, nor can it be observed directly. In practice, commonly used indicators, such as the relationship between prices and rents or between prices and household incomes, often do not provide a uniform assessment. Furthermore, these indicators do not allow an overall assessment, but throw light from different angles on whether the actual property price developments are justified by the fundamentals. In the case of assessment indicators based on econometric methods the associated estimation uncertainty has to be taken into consideration.

One problem is that, up until just a few years ago, the statistical recording of price developments in the German housing markets was flawed by a number of shortcomings, such as low observation frequency, limited representativeness and incomplete quality adjustment. Price data going far back into the past contain statistical breaks and, owing to a lack of re-

gional coverage, are representative of the German housing market as a whole only to a limited extent. This impairs the interpretation of the standard indicators, which, in a macroeconomic context, are usually evaluated in relation to their long-term averages. Studies based on time-homogenous data, which can be carried out for short periods of time, are incomplete as they do not, or only inadequately take account of medium and long-term trends which are of major importance for property markets.

The theoretical basis of the price-to-rent ratio is the present value model of asset prices. In this model, the purchase price of a property is calculated from the discounted expected (net) rent payments. Assuming that the discount rate is constant, housing prices and rents should follow the same trend over the long term and the ratio of the two variables should fluctuate around a constant average value over time. Under these circumstances, the purchase of a property is considered as an investment decision for which the no-arbitrage condition between buying and renting is decisive. However, given the many different motives that people have for buying property, this reasoning appears somewhat short-sighted. Furthermore, the assessment of profitability will depend on whether new or existing rents are being considered and which required interest rate is being used. There is much to suggest that return expectations on real estate investments may have fallen in light of the financial market setting in recent years.

That residential property prices as a whole have continued to develop largely in line with the prices of new lettings in recent years is, on the whole, a plausible assessment. Nevertheless, deriving a concrete longer-term yardstick for this relationship in order to assess current developments presents considerable problems. Based on data provided by BulwienGesa AG, apartment prices and rents for new lettings can

Present value model only partially suitable for property price analyses

Price movements still in line with rent developments

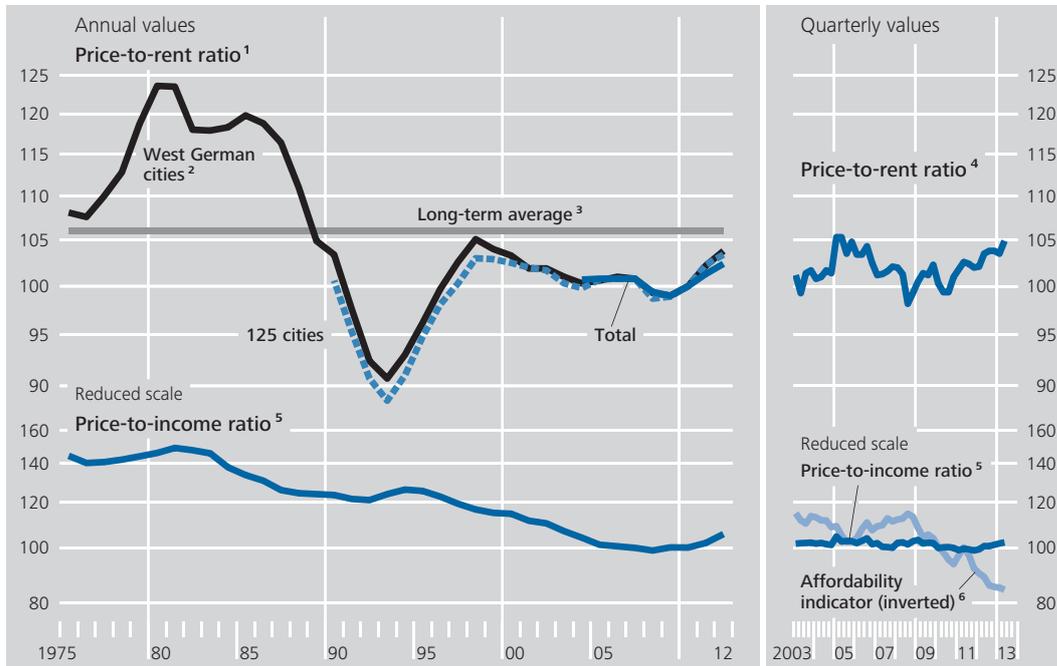
Price exaggerations difficult to diagnose from a conceptual viewpoint ...

... and subject to statistical uncertainty

² These include Berlin, Hamburg, Munich, Cologne, Frankfurt am Main, Stuttgart and Düsseldorf.

Standard indicators for the valuation of property

2010 = 100, log scale



Sources: BulwienGesa AG for annual figures and vdp for quarterly figures on prices and rents. **1** Prices and rents for new lettings of new apartments. **2** 50 cities up to 1989, 100 cities from 1990; excluding (West) Berlin from 1995. **3** Calculated on the basis of data for west German cities. **4** Prices and rents for new lettings of apartments. **5** Prices for owner-occupied property in relation to disposable income per household. Until 1990 West Germany; from 1991, Germany as a whole. **6** Annuity of a mortgage loan with a fixed interest rate (between five and ten years) and a hypothetical term of 30 years in relation to household income.

Deutsche Bundesbank

be compared dating back to 1975. In the period prior to German reunification, the data only comprise information for 50 west German towns and cities. After reunification, survey data included 125 towns and cities, 99 of which are in west Germany. Data for the country as a whole have only been available since 2004. The striking differences between urban and rural areas and the western and the eastern parts of the country raise doubts as to whether the heterogeneous data series can be linked together in order to calculate long-term averages. Interpretation difficulties also occur when comparing the price-to-rent ratio for Germany as a whole at the current end with the average calculated solely on the basis of selected data for west Germany.

shocks, macroeconomic trends, interest rate movements, expectation effects and economic policy measures. Overly optimistic expectations give rise to upward pressure, especially on prices. If, however, rents rise substantially against this backdrop as well, the price-to-rent ratio may remain largely unchanged. Conversely, the price-to-income ratio would shoot upwards. This variable can therefore be used to ascertain whether property prices are developing in line with households' current economic situation. From a theoretical perspective, this is based on a simple test to assess the financial sustainability of home financing. Attempting to interpret the price-to-income ratio relative to its long-term average is complicated by the fact that this variable has – cyclical fluctuations aside – been trending downwards since the mid-1970s. It is fair to assume that the statistical weaknesses, especially in earlier years, meant that the property price index used – the only index available for this period – did not

Household incomes as the long-term common "anchor" of prices and rents

Prices and rents play a role in establishing an equilibrium in the property and rental markets. Owing to the numerous different interactions between these market segments, both variables are generally influenced by exogenous

fully capture the long-term price trends in the housing market.³

Affordability of housing in recent years has benefited from interest rate reductions, in particular

Property price statistics have enjoyed better coverage over the past ten years. The price index for owner-occupied housing, which is published by the Association of German Pfandbrief Banks (Verband deutscher Pfandbriefbanken or vdp), provides a quarterly indicator for the period from 2003 onwards, which is characterised by a broad coverage, high representativeness and sound quality adjustment. This data source shows that property prices have developed in line with the disposable income of an average household. If the interest rate conditions for new mortgage loans, which have also been recorded since 2003, are taken into account when conducting a comprehensive assessment of affordability, a substantial improvement can be observed since the outbreak of the financial crisis. Assuming that the downpayment share is constant, the annuity of a mortgage loan with a ten-year fixed interest rate and a hypothetical term of 30 years places one-quarter less of a strain on household income at present than in the summer of 2008, even though the need for external financing has increased significantly owing to the rise in purchase prices.

Current interest rate level unsuitable as a benchmark for assessing long-term debt sustainability

This, however, is a special situation. It is highly unlikely that the interest rates for mortgage loans will remain at the current level throughout – what is typically – a very long repayment period. Furthermore, extrapolating a historically favourable interest rate environment for property purchases is not an appropriate way of adequately portraying the risks stemming from a sharp rise in property prices. This is clearly demonstrated by developments in the euro-area member states in recent years. If the assessment of affordability is therefore focused more on an interest rate level adjusted for cyclical fluctuations and special factors, the situation does not appear to be quite so favourable. Overall, however, purchasing property in Germany – measured in terms of the strain exerted by the long-term debt service burden on cur-

rent income – does not appear to have become more expensive of late than throughout long stretches of the past decade.

Comparatively simple indicators, such as the price-to-rent ratio or the price-to-income ratio often mask numerous factors that have an impact on the housing markets. Econometric approaches can be used as a way of modelling these factors more explicitly. These allow a more comprehensive analysis of the extent to which current price developments have departed from the historic fundamentals. Finally, regional developments can also be considered more specifically in this context. The main determinants of the demand for property include current household income and the financing conditions. Given that buying an apartment or a house is a decision that households make as a medium to long-term commitment, expectation variables also play a major role. Forward-looking effects can be modelled based on the growth or income expectations derived from surveys. In addition, demographic variables (eg number of inhabitants and households, age structure of the population) and macroeconomic indicators (eg unemployment rate) should also be considered as demand-side determinants in the housing market. The supply factors are generally reflected in residential construction, with availability and prices of building land and construction costs playing an important role. On balance, a stock-flow equilibrium model can be specified for the housing market in which a large part of the short-term balancing of supply and demand occurs via the property price.

Formation of prices using a stock-flow equilibrium model for the housing market

In the empirical implementation, an equation is usually estimated for the equilibrium property price using econometric procedures. In order for the estimation to be based on the broadest possible database, the price information of all administrative districts and urban municipal-

Use of econometric procedures

³ For more details, see Deutsche Bundesbank, Price indicators for the housing market, Monthly Report, September 2003, pp 45-58.

An approach to estimating fundamental house prices based on regional data

The theoretical framework for the econometric estimations is a stock-flow model for the real estate market.¹ In this model, the current stock of housing is taken as the housing supply.² Housing demand typically reflects households' economic situation and prospects as well as financial parameters and demographic conditions.

Real rents – whether measured directly on the rental housing market or inferred in the case of owner-occupied homes – bring about a periodical balancing of supply and demand on this market. Using the simple present-value asset pricing model, it is further assumed that the price of residential property is equal to the sum of discounted expected future rent payments. Accordingly, the price-to-rent ratio depends positively on expected future rent increases and negatively on real interest rates. A fundamental (partial) equilibrium on the real estate market additionally requires that the ratio of rent payments to income should remain more or less constant.

Replacing equilibrium rent payments by the house price, taking account of long-term growth expectations and real interest rates, yields a fundamental equilibrium house price. For a given level of demand, a larger housing stock and higher real interest rates will dampen prices, while higher demand due to changes in current or expected future socioeconomic factors will tend to drive up residential property prices.

The theoretical model framework can be used to derive an equation for determining house prices, depending on a number of explanatory variables. The relationship can be estimated using a panel approach based on price information for apartments and terraced houses at the level of Germany's administrative districts:³

$$p_{it} = \beta_0 + \beta_1 s_{it} + \beta_2 y_{it} + \beta_3 a_{it} + \beta_4 d_{it} + \beta_5 u_{it} + \beta_6 r_t + \beta_7 g_t^e + c_i + \varepsilon_{it}$$

The econometric model relates the real house price in district i to the housing stock at the beginning of period s_{it} , real mortgage rates r_t ⁴ and survey-based growth expectations for real GDP g_t^e . District-specific demographic and economic factors which may have an impact on housing demand include current real *per capita* income y_{it} , population density d_{it} , the fraction of the population aged between 30 and 55 a_{it} (as property is typically acquired by this age cohort) and unemployment u_{it} . Moreover, c_i denotes an unobserved time-invariant district-specific effect and ε_{it} represents an error term, which is subject to the assumption of strict exogeneity.

The regional dataset makes use not only of the variation over time, but also of variations in the cross-section of German districts to determine the relationship between house prices and their explanatory factors. Experience has shown that estimation approaches based on the relatively short aggregate time series for the German real estate market do not provide sufficiently reliable results. By contrast, the comparatively greater dispersion of prices and vari-

¹ See D DiPasquale and W Wheaton, 1992, The markets for real estate assets and space: a conceptual framework, *Journal of the American Real Estate and Urban Economics Association* 20, 181-197, and J McCarthy and R Peach, Monetary policy transmission to residential investment, *Federal Reserve Bank of New York Economic Policy Review*, May 2002, pp 139-158.

² The housing stock is assumed to be given in the observation period. The housing stock may change from one period to another as a result of residential investment or demolition and conversion.

³ See F Kajuth, T A Knetsch and N Pinkwart, Assessing house prices in Germany: Evidence from an estimated stock-flow model, *Deutsche Bundesbank Discussion Paper*, No 46/2013, forthcoming.

⁴ With a term of 10 years adjusted using survey-based inflation expectations.

ables across districts is likely to lead to estimated effects of the explanatory factors that are more in line with the basic structural relationships of the real estate market. In addition, the regional dataset opens up the possibility of determining fundamental equilibrium house prices not only for Germany as a whole, but also for different regional subsets.

For a consistent aggregation of the estimation results it is required that the regression coefficients are invariant across districts and that the model equation is linear. District-specific explanatory factors must, moreover, be included as *per capita* variables.⁵

The estimation takes the form of a panel model with random effects using the instrumental variables estimator suggested by Hausman and Taylor.⁶ Explanatory variables that might be correlated with the unobserved effect are replaced by instrumental variables, which are based on suitable transformations of the model variables. To this end, the means of the district-specific regressors classed as exogenous are used alongside the deviations of the district-specific variables from their mean.

A first variant comprises house price data and explanatory factors at the level of the 402 districts in the period from 2004 to 2010. For the subset of 93 towns and cities for which price information is available since 1996, additional estimations are carried out over this longer time horizon. This primarily serves to seek evidence as to whether the residential real estate markets were, on balance, undervalued in the years 2004 to 2010.

The results based on both estimation periods suggest that the effects of demographic variables such as the population's middle-aged groups and population density are quantitatively significant. *Per capita* income has only a moderate impact on property prices in the shorter estimation period, while no statistically significant effect is evident over the longer horizon. All other things being equal, a higher housing supply lowers prices significantly. The unemployment

⁵ The inverted population density is therefore used in the estimation.

⁶ See J Hausman and W Taylor, 1981, Panel data and unobservable individual effects, *Econometrica* 49 (6), pp 1377-1398.

Estimation results of the residential property price equation

As a percentage for a 1% change in the variable, in relation to the average for Germany as a whole¹

Variable	Annual data for the period 2004-2010 for 402 districts		Annual data for the period 1996-2010 for 93 towns and cities	
	Apartments	Terraced houses	Apartments	Terraced houses
Housing stock ²	-0.62** (0.08)	-0.33** (0.09)	-1.23** (0.09)	-0.20** (0.05)
Income ²	0.06** (0.02)	-	-	-
Population density	0.27** (0.03)	0.26** (0.07)	-	0.11** (0.03)
Population aged between 30 and 55 years ³	2.95** (0.10)	1.92** (0.12)	1.03** (0.17)	0.29** (0.09)
Unemployment ³	-	-	-0.12* (0.05)	-
Growth expectations ⁴	0.07** (0.01)	0.05** (0.01)	0.39** (0.01)	0.24** (0.01)
R ²	0.15	0.22	0.15	0.18

¹ Standard deviation of the coefficients in brackets. ² Per inhabitant. ³ As a percentage of the total population. ⁴ Based on average real GDP growth over the following ten calendar years. *, ** significant at 5%, 1% level.

ment rate has a significant impact on house prices only in the longer sample period.

In the alternative calculations using the longer period, the weight of the information from the time-series dimension increases relative to that from the cross-section. In particular, the effect of growth expectations on house prices is now approximately five times higher, and the result is also more reliable as this variable does not vary across districts. By contrast, the effects of district-specific regressors now appear less precise. The estimation fit is satisfactory overall, with the explanatory power for terraced houses slightly better.

One remarkable finding is that, in all estimations, real interest rates have no economically plausible and statistically measurable influence. They closely shadow growth expectations in the sample period, which means that their partial effect on house

prices cannot be determined with sufficient statistical accuracy.⁷

On the basis of this econometric approach, house prices in Germany, which have risen sharply in some areas since 2010, can be compared with their estimated fundamental equilibrium levels. The district-specific estimation residuals, which are aggregated to create different regional sub-aggregates and a figure for the economy as a whole using population shares, serve as a measure of overvaluation or undervaluation.⁸

⁷ See F Kajuth, T A Knetsch and N Pinkwart, 2013, op cit, for an analysis of the effect of interest rates under a calibration approach.

⁸ For some explanatory variables, data are currently only available to end-2010. Figures for the years 2011 and 2012 were extrapolated by assuming that the rate of change for the district-specific shares of the explanatory factors in the economy as a whole recorded in 2010 continued to apply in the two subsequent years. Price data, by contrast, are available up until end-2012.

ities, which has been available on an annual basis since 2004, is used within the framework of a panel model for the purpose of the study presented here. The specification is chosen in such a way that the assessment of price trends in relation to the development of fundamental factors can be performed not only for Germany as a whole, but also for regional subaggregates. (A more detailed description of the model structure and details of the econometric estimations can be found in the box on pages • to •.)

Broad regional database, but with a short time dimension

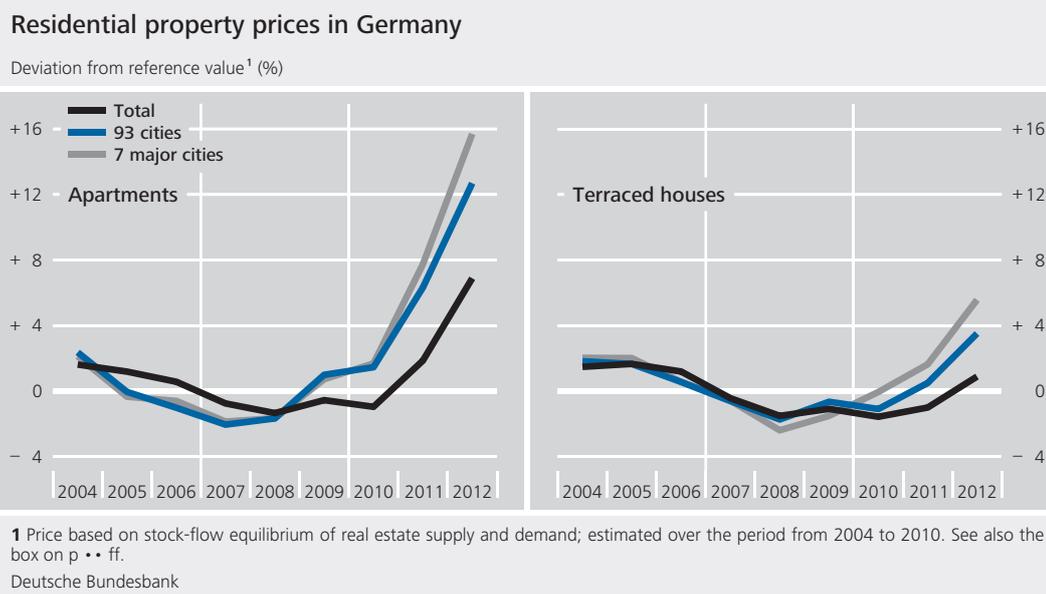
Using the model structure, it is possible to determine for each region to what extent prices of apartments and houses are related to the selected demographic and economic determinants. The deviation of the observed prices from this reference value can be indicated as an over or undervaluation. The econometric procedure requires that the deviations for each district – and thus also for each aggregate – offset each other throughout the estimation period from

2004 to 2010.⁴ This makes it more difficult to interpret the results directly, as it cannot be ruled out *a priori* that residential property was undervalued on an average of the past ten years.

If the empirical finding is initially assessed purely with regard to price dynamics, it is apparent that the prices of houses in the past three years have risen broadly in line with changes in the fundamentals. This is not just the case for Germany as a whole, but also for those regions with an urban character. By contrast, prices of apartments have risen more strongly than the reference derived from the model. From 2010 onwards, and for Germany as a whole, the actual upsurge in prices in this segment exceeded the trend that can be ex-

Since 2010, price developments of apartments in cities stronger than development of fundamentals

⁴ The estimation period is selected in a way which ensures that the property price rises in the years 2011 and 2012, the assessment of which is the focus of the analysis, are not already incorporated when determining the reference value.



plained by demographic and economic factors by a total of 7½ percentage points. The increase was, in fact, twice as high for the seven major German cities. This would suggest that, especially in the urban centres, price rises have occurred which are difficult to justify in terms of fundamental factors.⁵

have been overvalued by around 10% in 2012. In the seven major German cities, prices could even have exceeded their long-term equilibrium level by as much as 15% to 20% of late (ie including the price rises in the first half of 2013). When classifying the results, it is important to bear in mind that the estimations are based on a model specification in which the real interest rate does not have any autonomous influence. When deriving property prices that are justified by the fundamentals, the considerable interest rate reduction in recent years is of negligible significance, which makes the results all the more plausible against the backdrop of the special situation reflected in this development. Furthermore, the estimations are subject to the empirically well-substantiated condition that apartment prices over the past three years have shifted significantly upwards from a largely balanced level.

If apartments are currently discernibly overvalued, then only in urban centres

Reduced long-term growth expectations reflected in property price developments

The price dynamics would have led to a perceptible overvaluation only if property prices in the urban centres were not significantly undervalued in the second half of the past decade. One way of checking this condition is provided by the estimation of the model using data for 93 towns and cities from 1996 onwards.⁶ To this end, part of the information has to be foregone from a regional perspective. The extended estimation period does, however, allow a better assessment of the trend in property prices. The quite considerable decline in real property prices between 1996 and 2006 can thus be matched with the deterioration in long-term growth expectations that was also tending to occur during this period. The impact of expectations on house prices can also be demonstrated using other model classes and with respect to other countries (see the box on pages • to •).

Looking at the 93 urban municipalities, the model calculations show that apartments could

⁵ Provided that the model specification and the selection of variables were correct, this finding is significant from a statistical perspective.

⁶ These are those towns and cities for which price information has been available since the mid-1990s (115 in total) and which can be identified as independent districts or municipalities in the administrative regional breakdown.

The influence of growth expectations and interest rates on house prices in Germany

Growth expectations and real interest rates are key macroeconomic variables that should affect activity and prices on the real estate markets. However, causal relationships are often difficult to identify in empirical analyses. First, these variables are forward-looking factors, which are difficult to measure. Second, the endogeneity of the variables also makes the application of econometric estimation methods a challenging task. In a theoretical model, however, the effects of growth expectations and interest rates on house prices can be explicitly modelled and examined.

We present simulations based on a real stochastic growth model which focuses on households' behaviour on the goods and real estate markets. Households demand consumption goods and housing. They also differ in terms of whether they wish to be lenders or borrowers. Households may therefore lend directly to one another.¹ Furthermore, some house buyers are subject to credit constraints, which can be eased through the provision of collateral.

Households make their decisions in the light of anticipated future developments. A central element of the model is that private consumption will adjust in the current period, if higher *per capita* income is expected, as households try to smooth consumption over time. Although a change in demand conditions on the real estate market results in adjustments to housing stock, housing supply is typically less elastic than the provision of consumer goods, meaning that relative house prices rise. An increase in the value of collateral in the form of real estate assets provides credit-constrained

households with a larger financing volume, thus leading to additional demand and heightened price pressure on the real estate markets. The model considers an open economy in which the real interest rate depends on conditions outside the economy, such as the world market interest rate or a monetary union's key interest rate. An unexpected interest rate rise causes households to reduce their expenditure because saving yields higher returns, thereby dampening demand and prices for houses.

Expected growth in *per capita* income is mainly determined by future productivity gains. In the model, households' current demand for housing depends on their assessment of the trend productivity growth. If they adjust their perception of this trend, prices on the housing markets will change. It is assumed that households initially base their expectations on their assessment of trend growth in the previous period and adapt them taking into account the current change in productivity. To form expectations, permanent changes must be separated from temporary effects.²

A study³ shows that this approach can explain a significant portion of the evolution in house prices in the United States from 1991 to around 2005. In particular, a large

¹ For the sake of simplicity, a financial sector that accepts savings and grants loans is not explicitly modelled.

² In the model the trend productivity growth is derived using the Kalman filter.

³ See M Hoffmann, M U Krause and T Laubach, 2012, Trend Growth Expectations and U.S. House Prices before and after the Crisis, *Journal of Economic Behavior & Organization* 83, pp 394-409.

proportion of the price increases during this period seems to be consistent with a reaction to improved growth expectations at the time. However, after 2005, house prices deviate from the path that would have been justified based on perceptions of productivity at the time. Aspects that the model does not capture could play a role in these deviations. These aspects include financing instruments that appeared very liquid at the time, the easing of lending conditions and expectations that were no longer in line with fundamental economic factors.

The same model framework can be used to analyse the extent to which house prices in Germany since reunification depend on economic growth prospects. The model is adapted to the situation in Germany using data on hourly productivity. There is a high degree of co-movement between the trend growth in productivity derived from the model and survey-based growth expectations. This confirms the impression that *per capita* income expectations continuously deteriorated until around 2006. Since then, they seem to have stabilised at a low level.

In a first variant of the model (baseline scenario), the interest rate is assumed to be constant in order to isolate the effect of growth expectations on house prices. According to the results, the model is able to replicate fluctuations in house prices fairly well on the basis of productivity expectations alone. While growth prospects appeared to have a smaller impact on house prices during the upturn of 2006-07, the price index has largely moved in line with the model results since 2009. This suggests that the comparatively sharp increases in house prices since 2009 are largely due to the trend reversal of declining productivity and income prospects.

House prices and macroeconomic growth expectations



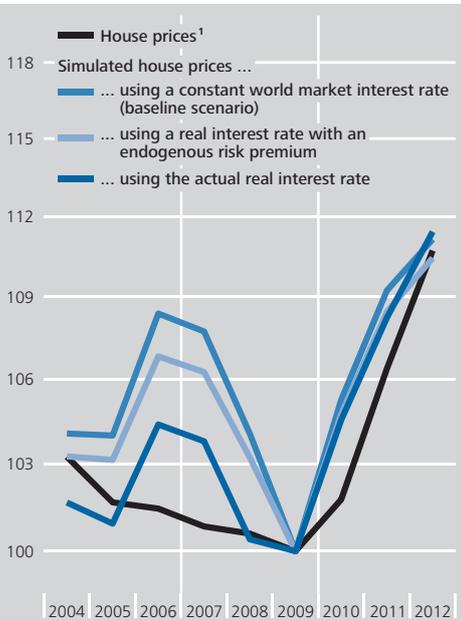
1 Bundesbank calculations based on data provided by Bulwiengesa AG for 125 towns and cities, relative to the GDP deflator.
 2 Expected growth in real GDP *per capita* over the following ten years based on data collected by Consensus Forecasts, actual population growth and the 12th coordinated population projection.
 Deutsche Bundesbank

To incorporate the effect of interest rates, the constant real interest rate used in the baseline scenario is replaced by a variable interest rate in a second variant of the model. This is based on a risk premium that fluctuates over time and can be derived from the model relationships. In a third scenario, the model contains the actual real interest rates.⁴ In this case, the interest rates may be affected by factors that originate outside the model framework, particularly since the beginning of the financial crisis. Although the interest rate paths in the three model variants differ significantly, from 2010 onwards, there is practically no difference between the house price increases derived from the various scenarios. Thus, interest rates seem to play a subordinate role in determining house prices in the

4 For the pre-euro period, this is the short-term real interest rate on the German money market; from 1999, the short-term real interest rate in the euro area is used.

House price paths in various real-interest-rate scenarios

real, 2009 = 100, log scale



¹ Prices for apartments and terraced houses relative to the GDP deflator. Bundesbank calculations using data provided by BulwienGesa AG for 125 towns and cities.
 Deutsche Bundesbank

selected model approach. Instead, the recent price increases are more likely the result of households' productivity and income expectations.

Spatial dependencies in residential property price movements

Residential property price rises so far regionally confined, ...

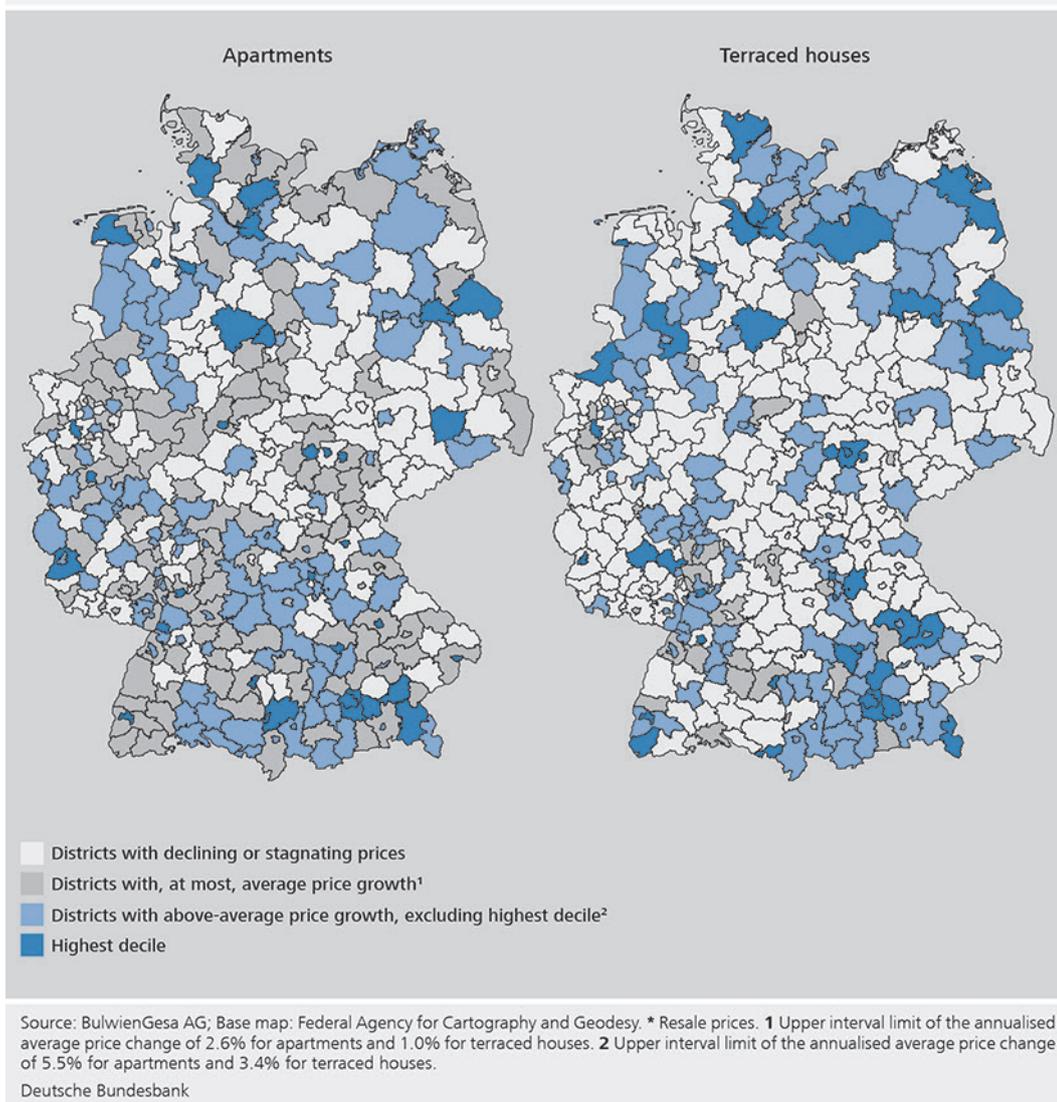
The steep rise in prices – in some cases associated with a risk of overvaluations – has so far been largely confined to regions with an urban character. On the whole, apartments have been affected to a greater extent than houses. Price rises for apartments have typically been the highest in the urban centres, while in the surrounding areas, the largest price increases have often been those for houses. Furthermore, demand relative to supply seems to have been focused more on newly constructed housing than on resale property.

... but with a clear tendency to spread

The spatial distribution of the rise in prices for residential property clearly shows a dispersion from towns and cities to their surrounding areas. With regard to the future stability of the residential property market as a whole, it is therefore of key importance to investigate the

spatial transmission channels of price impulses in greater depth. Generally speaking, this necessitates a geographical breakdown of the entire area, as well as the specification of an (abstract) interrelationship between individual regions. From a statistical perspective, the administrative regional breakdown of Germany into 402 administrative districts and urban municipalities has the advantage that data on residential property prices and the existing housing stock as well as the main demographic and economic determinants are available. One disadvantage with regard to the economic interpretation, however, is that the administrative units cannot be construed in every case as independent property markets. Ambiguities arise, for instance, when the residential outskirts of an urban municipality lie beyond its borders. Moreover, a spatial relocation of housing demand might be accompanied by a shift in the preference for a particular type of property. However, this aspect is not taken into consideration in the context of the spatial analyses

Geographical distribution of the price changes for residential property in the years 2010 to 2012*



documented in this article, which, owing to data restrictions, can only be analysed separately for apartments and houses.⁷

for the possibility of a spreading across the entire area, and also accommodates feedback effects.

Administrative regional breakdown at the district level used

The spatial dependencies between districts are identified by the common assumption in the literature that there is a direct relationship between two regions if they share a common border.⁸ In the first round, the potential spillover effect of a city or a district is therefore solely restricted to its neighbouring districts. In the second round, the impact typically spreads in a weaker form to the neighbours of the neighbouring districts, which also includes the region of origin. The model therefore provides

⁷ It would, in principle, be possible to compare the prices of inner-city apartments with those of houses around inner-city locations. This would, however, shift the perspective towards a specific behavioural pattern. From an analytical perspective, the more convincing approach is to use regional price series, in which the individual data for apartments and houses are weighted together using the respective transactions. However, these data are not available.

⁸ The lengths of the borders and the population density along the border areas are not taken into account. There are not enough statistical data available for this approach to be adopted.

Regional structure of property price changes in the years 2010 to 2012

	Apartments		Houses	
	New properties	Resales	New properties	Resales
Central values ¹				
Average value, weighted by inhabitants	3.3	2.6	1.7	1.0
Average value, unweighted	2.4	1.9	1.2	0.4
Median	2.0	1.7	0.6	0.0
Districts with above-average price growth				
Number	133	148	128	156
as a percentage of all districts	33.1	36.8	31.8	38.8
as a percentage of the population	45.2	43.6	40.9	48.2
of which with an urban character ²	102	102	101	108
Districts with, at most, average price growth				
Number	167	129	87	38
as a percentage of all districts	41.5	32.1	21.6	9.5
as a percentage of the population	37.7	30.3	22.3	10.2
of which with an urban character ²	116	85	66	34
Districts with declining or stagnating prices				
Number	102	125	187	208
as a percentage of all districts	25.4	31.1	46.5	51.7
as a percentage of the population	17.1	26.1	36.8	41.7
of which with an urban character ²	35	66	86	111

1 Annualised average price change in %. 2 Population density of at least 150 inhabitants per square kilometre.
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Spatial dispersion takes time

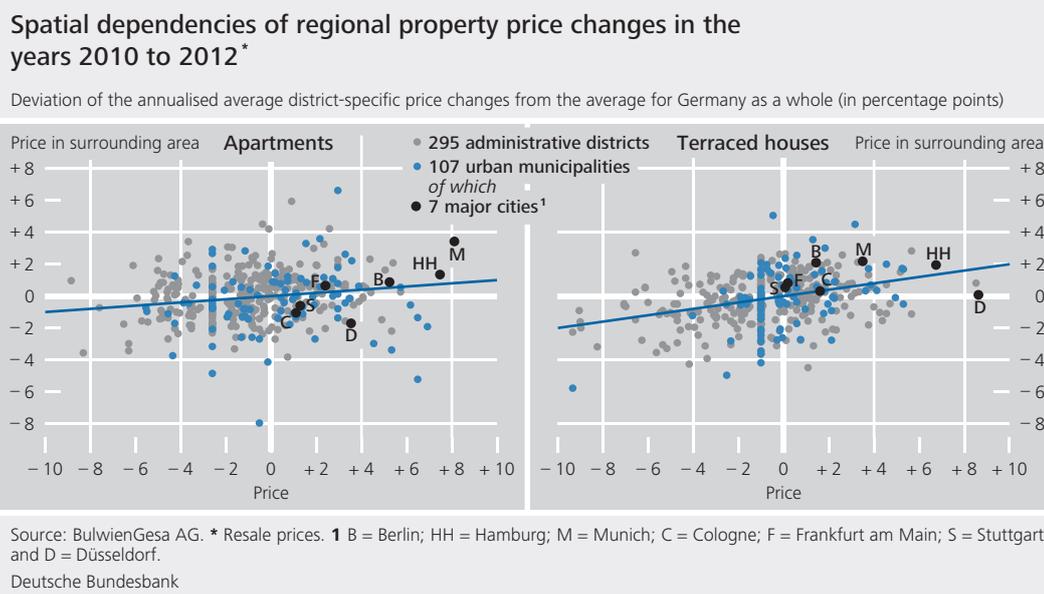
It stands to reason that it takes time for spillover effects to spread throughout a geographical area. Considering the spatial and temporal dimension of the spillover effects in a harmonised manner, however, presents an analytical challenge. Moreover, there are limitations with regard to data availability, as such complex model structures can be estimated with any reasonable degree of accuracy only if the statistical basis is extensive along both dimensions. For reasons of simplicity, the temporal aspect is disregarded in the remainder of this article. In order to take account of the fact that, in reality, these spatial effects do not occur contemporaneously, the studies are based on data which span time periods of several years.

Positive correlation between price changes in neighbouring regions

For the past three years, it can be confirmed statistically that there has been a positive correlation between property price changes in a given region and in its neighbouring regions. In considerably more than half of the administrative districts and urban municipalities, the

changes in prices and prices in the surrounding areas⁹ were together either above or below average (56% for apartments and 64% for houses), measured against the average for Germany as a whole. Furthermore, statistical tests clearly reject the hypothesis that an above or below-average change in property prices in the neighbouring districts occurs independently of the respective price movements in the district itself, both for apartments and houses. The correlations between the rates of price changes in a district and those in the surrounding areas are highly significant at 0.16 for apartments and 0.33 for houses. The seven major cities all show above-average price rises for resale apartments and houses. In their surrounding areas, the prices of houses, in particular, have risen more strongly than the average for Germany as a whole. In the case of apartments, above-

⁹ The price in the surrounding area – similar to the identification pattern in the case of spatial dependencies – is calculated as the unweighted arithmetic average of property prices of all the directly neighbouring districts.



average price growth was recorded solely in the neighbouring districts of Berlin, Hamburg, Munich and Frankfurt am Main.

common factors influence the property prices in neighbouring property markets. This could include interregional characteristics such as attractiveness for tourists or transport infrastructure. The common price effect may also be caused by unobserved phenomena, such as overly optimistic expectations and growing tendencies to speculation, which are seen as a trigger of price exaggerations.

Interregional price effects of demographic and economic determinants

The positive correlation between residential property prices in towns and cities and their surrounding areas can be due to various factors. The district-specific characteristics of demographic and economic determinants can be significant for neighbouring regions. Such exogenous interaction effects in the geographical breakdown according to administrative districts and urban municipalities could, for example, be due to district borders intersecting regional property markets. As a result, income gains are also likely to drive up the demand for housing, not least in the attractive outskirts of the urban areas. If the spatial price relationship is purely the result of exogenous interactions, there is no danger that the overheating of local property markets will spread to other areas as long as the determinants themselves are characterised by sustainable developments.

To investigate whether the regional dependencies in the prices for residential property are of an exogenous or an endogenous nature or whether they are based on correlated effects, the model relationship between property prices and demographic and economic determinants presented in the previous section is estimated, taking account of spatial transmission channels. In econometric terms, it is a cross-sectional analysis of property prices for the 402 administrative districts and urban municipalities, averaged over the observation period of the years 2004 to 2010.¹⁰ The exogenous interaction effects are captured in the model specification in

Cross-sectional analysis provides strong evidence ...

Interaction via the price channel itself and unobservable factors

By contrast, endogenous interaction effects are referred to if property prices themselves are the transmission channel. For instance, the pricing structure in a district could be based on the price structure of the neighbouring districts. From an analytical perspective, this mechanism can hardly be separated from the case where

¹⁰ In contrast to the panel approach described in the box on pp. 26, population density is not applied as an exogenous factor. This is because population density generally correlates strongly with the housing stock per inhabitant. The fact that these two factors temporarily exhibit different lines of development and can thus trigger price effects is one aspect which can be illustrated by the panel approach, but not by the cross-sectional analysis.

Spatial price effects of demographic and economic variables

As a percentage given a 1% change in the variable, measured in terms of the average for Germany as a whole¹

Explanatory variable	Apartments				Houses			
	Price effect	direct ²		indirect ³	Price effect	direct ²		indirect ³
			of which Feedback effect					
Housing stock ⁴	0.19 (0.12)	0.26** (0.04)	-0.01 (0.12)	-0.07 (0.11)	-0.54** (0.07)	-0.24** (0.03)	-0.02 (0.07)	-0.29** (0.07)
Income ⁴	0.34* (0.17)	0.02 (0.03)	0.02 (0.08)	0.32* (0.15)	0.17 (0.15)	0.01 (0.03)	0.01 (0.06)	0.16 (0.13)
30 to 55 year-olds ⁵	0.75** (0.16)	1.39** (0.22)	-0.05 (0.23)	-0.64* (0.25)	1.89** (0.23)	1.04** (0.18)	0.05 (0.19)	0.84** (0.28)
Unemployed ⁵	-0.27** (0.07)	-0.33** (0.04)	0.01 (0.13)	0.06 (0.08)	-0.47** (0.05)	-0.26** (0.03)	-0.01 (0.11)	-0.21** (0.06)
<i>Memo item</i> Price in surrounding area ⁶	0.56** (0.05)				0.55** (0.05)			

1 Standard deviation of the coefficients in brackets. 2 Price effect of changes in the explanatory variable in the district itself. 3 Price effect of changes in the explanatory variable in the surrounding districts. 4 Per inhabitant. 5 As a share of the population. 6 Unweighted average of the prices in the neighbouring districts. *, ** Significant at 5%, 1% level.

Deutsche Bundesbank

such a way that the property price level can be influenced by the determinants of the neighbouring districts. If the price in the surrounding area has a statistically significant explanatory power in the form of an endogenous spatial lag in the regression, there is evidence of an endogenous interaction and/or correlated effects.

... of spatial effects

Compared with a cross-section estimation excluding spatial effects, the endogenous and exogenous spatially lagged variables yield, in some cases, considerable improvements in terms of explaining district-specific property prices. In the case of houses, three-quarters of the regional price differences can be explained using the spatial model, compared with about two-thirds when using only the characteristics of the determinants from the district itself. For apartments, the explanatory power of the model increases only marginally to just under half of the observed price differences. The results support the hypothesis that exogenous

interaction effects matter. Furthermore, it is shown that the prices that are attained in the neighbouring districts are also an important explanatory factor.

Exogenous interaction effects form the basis of the price effects generated by the demographic and econometric determinants of the neighbouring regions. These indirect effects augment the direct effects, which are caused by the same exogenous factors in the district itself. On the whole, the indirect effects are perceptible and are often of no less significance than the direct effects. This applies to the prices of houses,¹¹ in particular, where half of the overall impact of the housing stock, the age structure and the unemployment rate can be attributed to direct effects, on the one hand, and half to indirect effects on the other. Per capita income,

Cross-district effects of exogenous variables

¹¹ One reason for this could be that the search radius of households interested in single-family houses tends to be greater than in the case of potential apartment buyers.

however, has neither a direct nor an indirect impact on the prices of houses. Per capita income does, however, help to explain apartment prices – primarily via the indirect channel.¹² The impact of other exogenous variables on apartment prices seems to be primarily of a direct nature.

present could, however, be around one-tenth higher than the level which can be explained by demographic and economic factors alone. According to the model calculations presented in the article, the price deviations for the particularly attractive major cities are estimated at up to one-fifth.

Impact of purely price-based transmission channels

According to the regression results, property prices in the surrounding areas also play an essential role. The econometric analysis leaves open the question as to whether this is to be regarded as more of a purely price-based transmission channel or as a significant effect of inter-regional, non-observable characteristics. The risk that expectation-driven processes and speculative behaviour foster the regional dispersion of price impulses cannot, therefore, be ruled out entirely. Consideration also has to be given to the fact that potential spillover effects weaken significantly. According to the estimation results, the price impulses are weakened by around one-half each time a district-border is crossed. Furthermore, in line with the model structure, the impact of the effects decreases all the more, the greater number of regions it affects. For each round – on an average of all the districts under consideration – there is a spillover effect on five neighbouring districts. The considerable dampening impact in the regional dispersion can be seen, *inter alia*, in the feedback effects. These are markedly small on the whole (in absolute terms), although the triggering indirect effects are sometimes perceptible.

It is nevertheless very unlikely that any substantial macroeconomic risks are already emerging from the current price structure on the housing markets. The observed price movements are a reflection of the lagged expansion of the housing supply. Furthermore, the volume of mortgage loans granted to households has risen only moderately since 2010 and, according to the Bank Lending Survey, banks have reported a tightening of their lending standards in this line of business.

Regional price peaks do not harbour any considerable macroeconomic risks at present

Price pressure is not expected to ease, at least not in the short term. The fact that 115,000 construction permits for new apartments were granted in the first half of 2013 points to a further marked rise in residential construction activity. The resulting expansion of the housing supply will, however, still not be sufficient to meet the anticipated additional demand for housing, especially in light of ongoing large-scale immigration. A housing supply imbalance already exists, especially in the case of apartments. Robust growth in the construction of multiple-family houses beyond the base level reached at the end of the past decade will only take off when investors perceive enough yield potential in the buy-to-let market. Against this backdrop, restricting the amount by which rents can be increased is counterproductive.

Price pressure unlikely to ease over the short term, however

■ Outlook

No overvaluation of property prices for Germany as a whole

The empirical findings indicate that, so far, there have not been any substantial overvaluations in the German property markets as a whole. Prices in the urban housing markets at

¹² This could reflect the fact that persons with a higher income typically prefer less densely populated residential areas, which are often not located in cities themselves, but in their surrounding area.

