

# REGIONAL ASPECTS OF THE HOUSING MARKET

Simon Juul Hviid, Tina Saaby Hvolbøl and Erik Haller Pedersen, Economics and Monetary Policy

## INTRODUCTION AND SUMMARY

The housing market has picked up over the last three to four years. This trend is particularly pronounced in Copenhagen, where the population has been growing. Initially, new construction has not followed the upward trend, and as a result increasing demand has pushed up prices.

The Copenhagen housing market tends to set the course for the rest of Denmark, with house price movements rippling out to the rest of the country. The ripple effect of higher prices in Copenhagen will prompt more families to move to the surrounding areas, which has a stabilising impact on prices. However, there is a risk that expectation-driven house price developments in Copenhagen will thus spread to the rest of the country.

This article focuses on the housing market in Copenhagen, and a demand relation is estimated for the Copenhagen market for owner-occupied flats. Against this backdrop, it is concluded that prices in Copenhagen are high relative to incomes and interest rates. Moreover, prices may be driven by self-fulfilling expectations, cf. also the article "House price bubbles and the advantages of stabilising housing taxation", Danmarks Nationalbank, Monetary Review, 3rd Quarter 2016. Thus, there is a real risk that continuation of the real price increases of recent years may be followed by corresponding price falls. At the national level, house price developments do not give cause for concern.

The Copenhagen housing market is more vulnerable to sudden interest rate hikes than the rest of the country. The combination of high

interest rate sensitivity and house prices that are high relative to incomes and interest rates increases the risk that even a small rise in interest rates could trigger price falls. In recent years, large-scale new construction has been initiated in Copenhagen. This is a natural consequence of a growing market and provides some measure of stability to price developments in the medium term. However, expanding the housing stock takes time, and in a worst-case scenario a price drop driven by interest rate increases may be reinforced by a large supply of new housing.

## REGIONAL DIFFERENCES IN DEVELOPMENTS

### PRICE INCREASES FOR OWNER-OCCUPIED HOUSING HAVE BEEN STRONGEST IN THE MAJOR CITIES

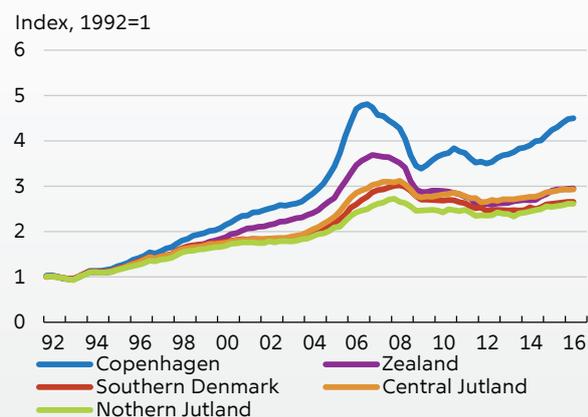
The housing market has been growing over the last three to four years after the strong downturn in the wake of the house price bubble in the mid-2000s, cf. Chart 1 (left). This growth has coincided with a general upswing in the Danish economy and has been supported by historically low interest rates and rising incomes. This trend has been particularly pronounced in the Capital Region and large provincial towns and cities, cf. Chart 1 (right).

Since the upswing began to gain momentum in 2012, price increases in Copenhagen have exceed-

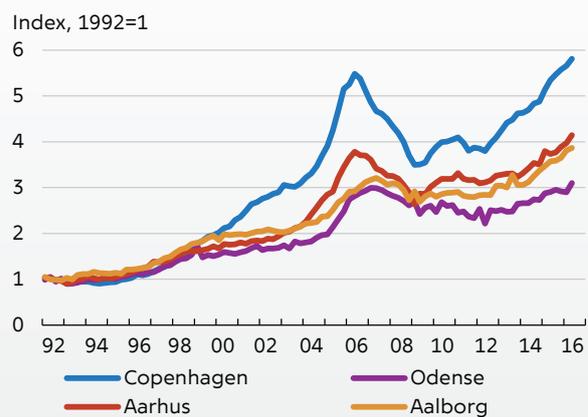
## House prices are rising in all Danish regions

Chart 1

### Nominal prices of single-family houses



### Nominal prices of owner-occupied flats



Note: The most recent observations are from the 2nd quarter of 2016.  
Source: Statistics Denmark, Housing Price Statistics and own seasonal adjustment.

ed 10 per cent p.a. for owner-occupied flats, while they have been a little lower for houses. At the same time, trading activity has been high. The annual rate of increase in prices of owner-occupied flats decelerated slightly in the first half of 2016, but remains high.

## THE HOUSING STOCK IN COPENHAGEN IS DIFFERENT FROM THAT OF THE REST OF DENMARK

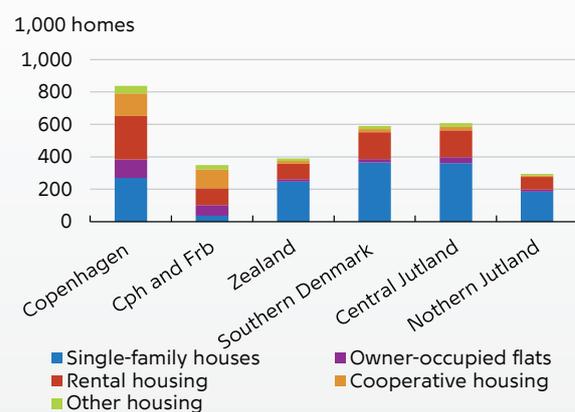
Owner-occupied housing makes up only a very limited share of the total housing stock in the Municipalities of Copenhagen and Frederiksberg. In other words, only a small share of the total number of homes can be sold freely in the market, and these are the homes that determine house prices. The possibilities of meeting the increased demand for housing by e.g. cooperative, rental or social housing are limited due to extensive public regulation of these types of housing. This is reflected in the prices of owner-occupied housing, which are pushed up further when demand for housing in the Capital Region is strong – and vice versa when demand is low. For this reason alone, price fluctuations are greater than in the rest of Denmark.

There are considerable regional differences in the composition of the housing stock in Denmark. More than half of the housing stock is made up of single-family and terraced houses, the typical type of housing outside large towns and cities, while flats and cooperative housing are primarily found

in the cities, cf. Chart 2. Just under 20 per cent of Denmark's single-family and terraced houses are located in the Capital Region, where more than half of Denmark's owner-occupied flats are also located. Most cooperative housing is also located in the Capital Region, with a further concentration in the Municipalities of Copenhagen and Frederiksberg.

### The housing composition in Copenhagen is dominated by rental and cooperative housing

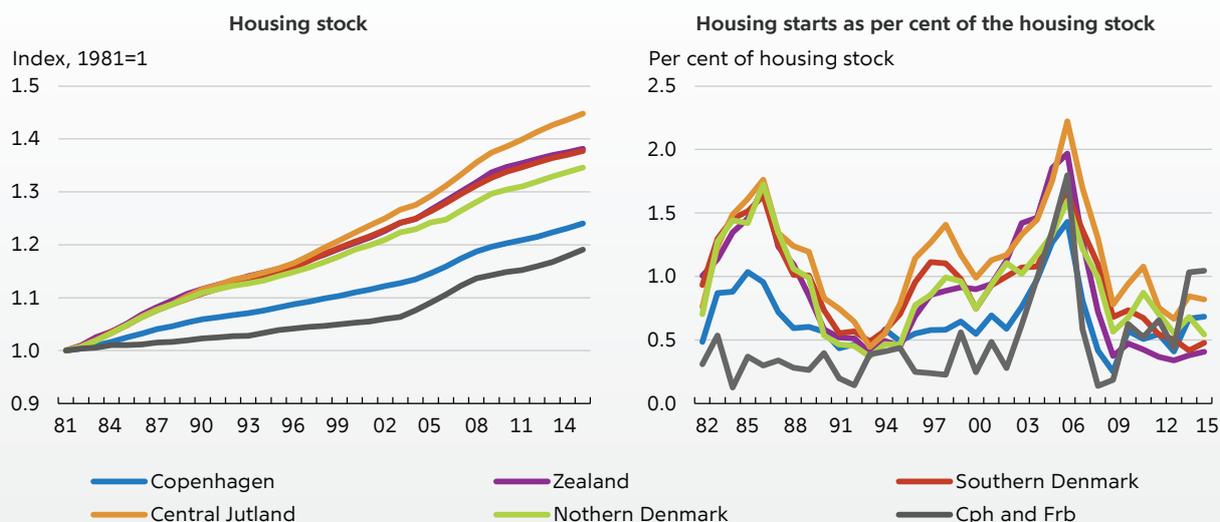
Chart 2



Note: Other housing does not include holiday homes. Owner-occupied flats and single-family houses include housing owned by private individuals, including partnerships. The composition of the housing stock is calculated at end-2015. 'Cph and Frb' denotes the Municipalities of Copenhagen and Frederiksberg.  
Source: Statistics Denmark and own calculations

## The housing stock is slowly adjusting in Copenhagen

Chart 3



Note: The housing stock and housing starts are calculated in number of square metres. The most recent observations are from end-2015. Housing starts include farmers' houses of farm properties, single family houses, terraced, linked or semi-detached houses and multi-family buildings. The most recent observations about housing starts are subject to some uncertainty.

Source: Statistics Denmark, real estate register data and own calculations.

Urban prices per square metre are higher than non-urban prices. Consequently, the urban concentration of housing wealth is higher than would be indicated by the number of dwellings. About 40 per cent of Denmark's total housing wealth is found in the Capital Region, although the region accounts for just 26 per cent of the number of owner-occupied square metres. The Municipalities of Copenhagen and Frederiksberg, where dwellings are relatively small, account for 14 per cent of Denmark's housing wealth and 9 per cent of total owner-occupied square metres.

The housing stock is currently expanded through new construction. The level of total construction in Denmark remains low in a long-term perspective. In addition to new construction, residential investment also comprises major repairs, which are closely linked to the size of the housing stock and, contrary to new construction, are not limited by the number of available construction sites. Major repairs, currently accounting for most residential investment, have proved to be highly sensitive to cyclical fluctuations and were an important explanatory factor for the high level of residential investment in connection with the house price bubble of the mid-2000s. By expanding the housing stock, new construction is a main contributor to keeping price increases at

bay when housing demand is high. Major repairs primarily impact the quality of housing and, to some extent, contribute to an upward price pressure, since improvements in the housing quality increase the willingness of households to pay.<sup>1</sup>

Since 1981, there has been a modest increase in the number of housing square metres in the Capital Region, cf. Chart 3 (left). However, in recent years, the Municipalities of Copenhagen and Frederiksberg have seen a relatively high number of housing starts, cf. Chart 3 (right). This is a natural consequence of a growing market and helps to dampen the strong price growth in the medium term.

Just over 32 per cent of the housing in the Municipalities of Copenhagen and Frederiksberg is cooperative housing, which is regulated in the sense that prices are not fully market-based<sup>2</sup>. Vacant cooperative housing can help to absorb an increase in the demand for housing. However,

1 Statistics Denmark applies a quality-adjusted price index to eliminate the effect of different housing units being sold during different quarters. However, allowance is made only for quality improvements reflected in public valuations. Thus, differences in housing maintenance and renovation are not fully captured by the price index.

2 The price of cooperative housing can be adjusted on an ongoing basis based on the assessment by a valuer. However, such valuations are voluntary and are usually performed at annual intervals.

## The Copenhagen market for cooperative housing is under pressure

Chart 4



Note: The chart comprises only sales arranged by an estate agent, and much cooperative housing is not. A 3-month moving average has been applied. The most recent observations are from October 2016.

Source: Boligsiden.dk.

the time on market for cooperative housing has dropped sharply in Copenhagen city since 2013, cf. Chart 4. Today, the average time on market for cooperative housing sold through an estate agent is down to approximately one month. More or less the same applies to the regulated segment of the rental market. If the regulated rent is lower than the market rent and is unable to adjust, the price effect, which ought to release housing, will be deactivated. Thus, part of the demand for rental housing cannot be met by the housing supply. This means that demand shifts to the market for owner-occupied housing, resulting in higher price increases, cf. Häckner and Nyberg (2000).

### THE POPULATION HAS INCREASINGLY MIGRATED TO THE CAPITAL REGION

With a population of 1.8 million, the Capital Region is the largest of Denmark's five regions. The population of the Capital Region was largely unchanged during the downturn from the mid-1980s until the mid-1990s, after which time it outpaced the national growth rate until the mid-2000s. During the boom in 2005-08, growth was halted by increasing migration from the Capital Region to Region Zealand, in particular.

From 2008, migration flows were reversed, and the Capital Region, particularly Copenhagen and Frederiksberg, saw a massive influx of inhabitants, driven by young people and people in employment, while pensioners migrated from the region. Urban migration is, to a great extent, driven by young people migrating to the cities for education purposes and increasingly tending to settle down permanently in the city. Consequently, the 25-39-year-old group, accounting for a large proportion of home buyers, is growing considerably. This group includes both first-time buyers and families in need of more space. On the other hand, the 65+ age group is decreasing, cf. Chart 5 (left). Changing family patterns, with more single households, also increase the housing demand for a given population, cf. Chart 5 (right). The relative shift in age groups is likely to have contributed to the price growth over the last 20 years.

Recent years have seen increasing migration to Copenhagen from abroad. To this should be added a large excess of births, cf. Chart 6. This excess is likely, in itself, to increase the housing demand, albeit to a lesser extent than net immigration.

If the population growth is seen in relation to the relatively modest increase in available housing, this helps to explain why prices in Copenhagen have been rising faster than in the rest of Denmark.

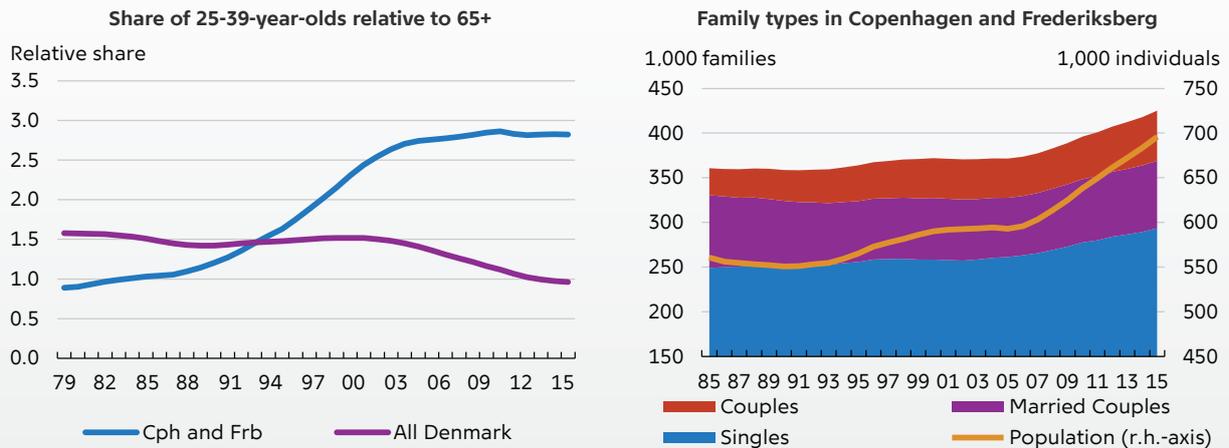
According to Statistics Denmark's population projection, the population growth is expected to continue until 2030, at which time the population of Copenhagen city is expected to be 18 per cent higher than it currently is. This should be seen against the backdrop of an underlying structural trend to urban migration.

### RIPPLE EFFECT IN HOUSE PRICES FROM COPENHAGEN

Alongside the structural movement towards a growing population in Copenhagen and the major provincial towns, the Capital Region tends to experience migration from the region during boom periods when house prices soar to levels that fewer people can afford and are willing to pay. There are strong indications that this level has been reached. After a number of years with net immigration, 2015 thus saw net migration from Copenhagen to the rest of Denmark. Box 1 describes this cyclical movement in more detail. The result is that movements in house prices, especially from the Capital Region, ripple out to

### The percentage of young people and the number of single households have increased in Copenhagen and Frederiksberg

Chart 5



Note: Couples cover cohabiting couples and registered partners. The most recent population number was calculated on 1 January 2016.  
Source: Statistics Denmark and own calculations.

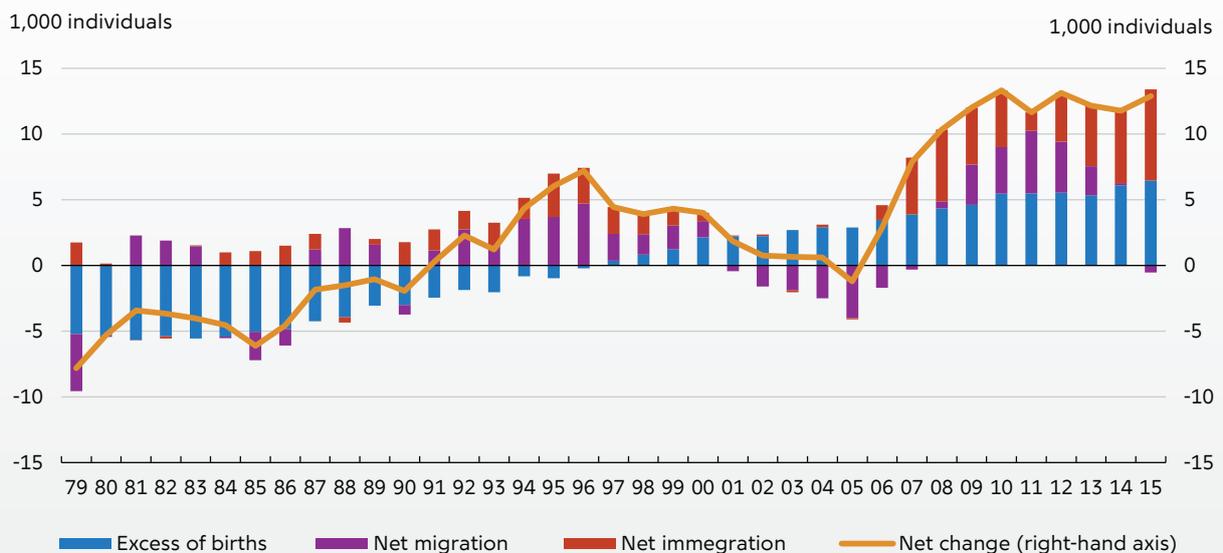
the rest of the country. The further away from Copenhagen housing is located, the longer the lag and the smaller the impact. The ripple effect of housing demand has a stabilising effect on price developments in Copenhagen. However,

price growth driven by self-fulfilling expectations in Copenhagen may also ripple out to the rest of the country.

Copenhagen currently has the highest prices per square metre, and prices clearly tend to fall

### Demographic developments in Copenhagen are dominated by an excess of births and immigration

Chart 6



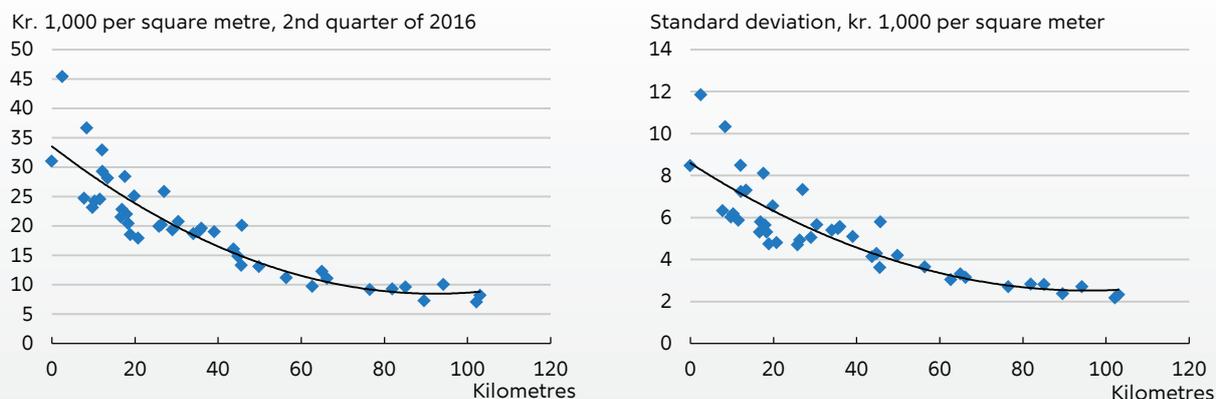
Note: The most recent observations are from 2015. A small number of corrections are disregarded.  
Source: Statistics Denmark.

proportionately with the distance to Copenhagen, cf. Chart 7 (left). Moreover, house prices in Copenhagen are more susceptible to volatility than prices in the rest of Denmark, cf. 7 (right). One

reason is the sluggish supply of housing, which causes changes in demand to have a stronger pass-through to prices.

**Zealand house prices and their volatility are falling with the distance to Copenhagen**

Chart 7



Note: Distance indicates the shortest driving distance. The chart covers municipalities in Region Zealand and the Capital Region of Denmark, less Bornholm, Lolland and Falster. The standard deviation is calculated from the 2nd quarter of 1992 to the 2nd quarter of 2016.  
Source: Housing market statistics, Krak and own calculations.

### Housing demand is spreading from areas with high house prices – the ripple effect

Box 1  
continues

Regional housing markets are interconnected in multiple ways. Firstly, national developments have a simultaneous impact on regional housing markets. For instance, a demand shock in the form of changes in housing market interest rates. Moreover, a price-driven regional substitution effect causes demand to spread out via prices over the country when house price differentials increase. A given municipality will thus experience both a direct and an indirect effect of a national demand shock to house prices. The indirect interconnectedness is described in Meen (1999 and 2001) and is referred to as the 'ripple effect'. Since a home purchase is a cost- and time-consuming process, the indirect effect is likely to be more sluggish.<sup>1</sup>

To quantify the size of the two effects, a correlation analysis of house prices has been performed on Danish regions and parts of the country, cf. the chart. The underlying regional trend towards higher house prices has been excluded, entailing that the regional cyclical variation in house prices is analysed.

If there was only a direct effect resulting from, for instance, national demand shocks, the greatest correlation between regional house prices would be in the current quarter, equivalent to the time 0 in the charts below. The other times in the chart show the correlation between regional

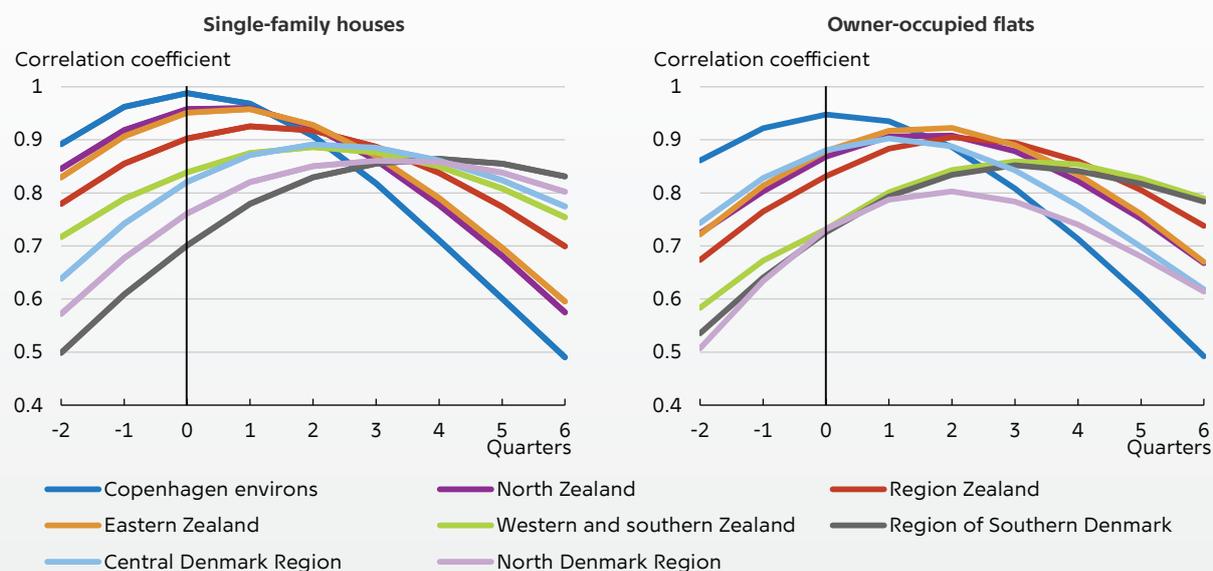
house prices and house prices in Copenhagen city for the lags of various numbers of quarters. Here, two dimensions are related to the integration of regional housing markets. Firstly, the size of the correlation and secondly the lag in the pass-through to prices. Both effects are related to the geographical distance between markets, where the Copenhagen environs have a very high correlation in the cyclical variation in the current quarter and no quantifiable lag in the pass-through. At the opposite end of the spectrum, for instance the Region of Southern Denmark, the covariation with the Copenhagen housing market is substantially lower and there is a lagged pass-through of around one year.

Thus, the ripple effect spreads out over the country, with the amplitude, measured by the size of the correlation coefficient, decreasing with the distance to the Copenhagen housing market, while the phase shift increases with the distance to the Copenhagen housing market.

The geographical ripple effect of house prices may be due to a spillover effect from household moving patterns, as described above, but other channels may also contribute to the development. Whether the ripple effect is driven by one explanation or another, there are geographical differences in how the housing market absorbs these demand shocks and thus in the regional impact of the ripple effect.

1. Heebøll (2014) has estimated a regional model, allowing a regional ripple effect of house prices, on Danish data.

### The house price ripple effect from Copenhagen city



Note: The chart shows the correlation coefficient between the price of single-family houses in Copenhagen city and other regions and parts of Denmark for various quarterly lags and leads. The series used describe the cyclical variation in prices, as the series are filtered using an HP filter with a smoothing parameter value of 400,000. Thus, geographical differences in fundamental price developments are excluded. The correlations are based on quarterly data from the 1st quarter of 1992 to the 4th quarter of 2015.

Source: Statistics Denmark and own calculations.

### DISPOSABLE INCOME DIVERGES ACROSS THE COUNTRY

Economic growth in Denmark increasingly takes place in the cities, primarily the Capital Region. This has been the case for many years and the same pattern is seen in other countries, but the trend seems to have accelerated in Denmark in recent years, driven by both demographic and cyclical factors.<sup>3</sup> Causality between population growth and regional economic growth can be bidirectional.

Part of the output of the Capital Region is generated by labour living outside the region, inter alia in Region Zealand. But if commuting is taken into account, as well as regional redistribution via the public funds, disposable per capita income is more equally distributed across the country, albeit still with considerable differences, cf. Chart 8 (left).

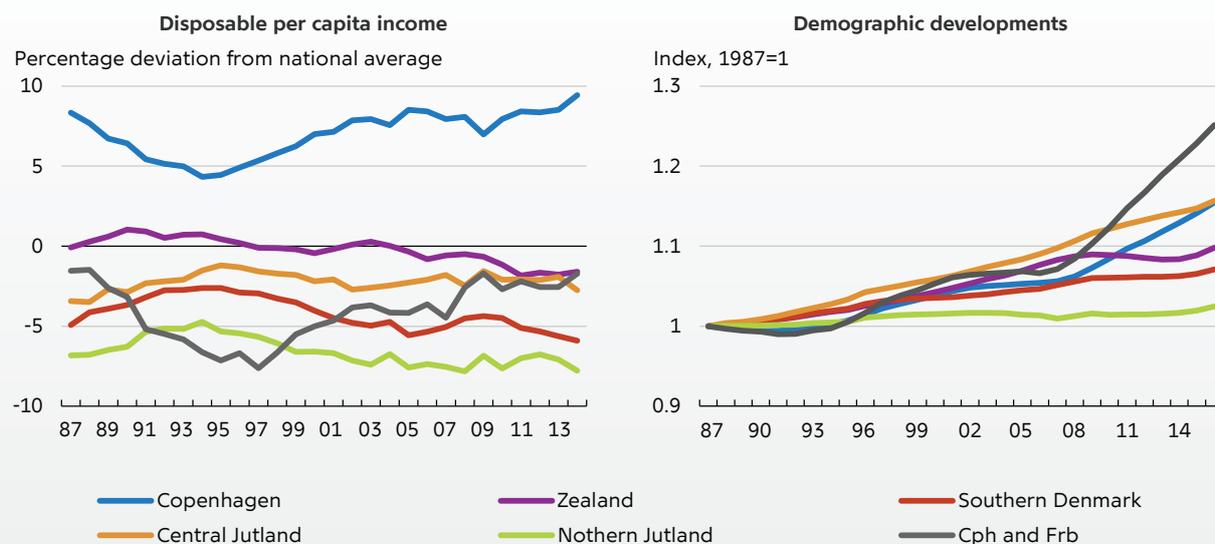
Thus, the Municipalities of Copenhagen and Frederiksberg are below the national average, while the entire Capital Region is substantially above the average. Disposable income is a measure of the payment capacity of home buyers. During the most recent upswing, the disposable per capita income has increased more in Copenhagen than in other parts of Denmark. At the same time, the population growth has been stronger in the Capital Region, cf. Chart 8 (right).

Not all home buyers live in the geographical area in which they buy a home. A case in point is 'parent purchases' (i.e. parents are buying flats for their children). Most parents buying an owner-occupied flat in Copenhagen for rental to their children live in the Capital Region outside

<sup>3</sup> Approximately 40 per cent of the Danish value creation is generated in the Capital Region. GDP per capita in Region Zealand is only just over half of that of the Capital Region. However, GDP indicates the geographical distribution of output, not purchasing power.

Disposable per capita income in Copenhagen is catching up with the national average

Chart 8



Note: Left: The most recent observations are from 2014. Right: The most recent observations are from the beginning of 2016.  
Source: Statistics Denmark and own calculations.

Copenhagen city. Thus, price developments are also impacted by developments in the disposable income across regions. However, disposable incomes in the Capital Region and in the Municipalities of Copenhagen and Frederiksberg more or less move in tandem.

### CAN THE PRICES OF OWNER-OCCUPIED FLATS IN COPENHAGEN BE EXPLAINED?

A growing population, low interest rates and rising incomes have led to higher house prices. The reason is that – despite an increase in recent years – demand for housing has outpaced supply. However, the question is whether the strong growth in house prices in recent years has pushed up prices to such an extent that they no longer reflect economic fundamentals. To get an impression of this, a relation for owner-occupied flats in the Municipalities of Copenhagen and Frederiksberg is defined and estimated.<sup>4</sup> This relation is an adjusted version of the MONA house price

relation as presented in Dam et al. (2011). As described earlier, Copenhagen sets the course for the overall Danish housing market, and thus price growth driven by self-fulfilling expectations may ripple out to the rest of the country.

House price developments are determined by a combination of supply and demand components. In the short term, the housing supply is fixed and adjustment of the supply tends to take several years. Thus, demand is the predominant driver of house prices in the short term.

Demand is assumed to be determined by the real disposable income of households and the costs of investing in a home. The disposable income of a given region is impacted by the composition of the population in the sense that it sums up the income of the individual households. This entails that a substantial portion of the population growth and the demographics of Copenhagen are captured by this variable.

Costs are a combination of user cost and first-year payments. The user cost includes the interest rate after tax on a 30-year fixed rate mortgage loan as well as administration margins payable

<sup>4</sup> The focus is on owner-occupied flats, given that single-family houses make up a relatively small percentage of the housing stock in the Municipalities of Copenhagen and Frederiksberg.

on mortgage loans, the tax rate and inflation expectations. First-year payments affect home buyers' willingness to pay, as they may be credit constrained. First-year payments are a measure of the lowest cost a home buyer has to pay to live in his or her home and include a short, flexible after-tax rate, administration margins and amortisation. In principle, home loan amortisation is a redistribution of savings and thus, in the absence of liquidity constraints, should have no implications for household housing demand. However, mortgage amortisation requirements may have been of major significance for some groups of home buyers until the introduction of deferred amortisation loans in 2003. Therefore, they are included in the first-year payments. The effective tax rate varies considerably across the country due to the nominal freeze on property value taxes in 2002, cf. Klein et al. (2016), and there are municipal differences in land tax rates<sup>5</sup>. On the other hand, administration margins, housing market rates and inflation expectations are not assumed to differ across the country.

A characteristic of the housing stock area is that an increase in the supply will have a dampening

effect on prices. The interpretation of a housing stock concept that includes quality improvements is more ambiguous, however, since major repairs improve the quality of the housing and thus tend to increase prices, cf. above. Here the number of living space square metres is used, entailing that the interpretation of the estimated coefficients is unambiguous. However, this approach is likely to overestimate the sensitivity of the price to increases in the housing stock. This approach is derived, inter alia, from data limitations and differs from other known relations, including the house price relation at the national level in Denmark's Nationalbank's macroeconomic model, MONA.

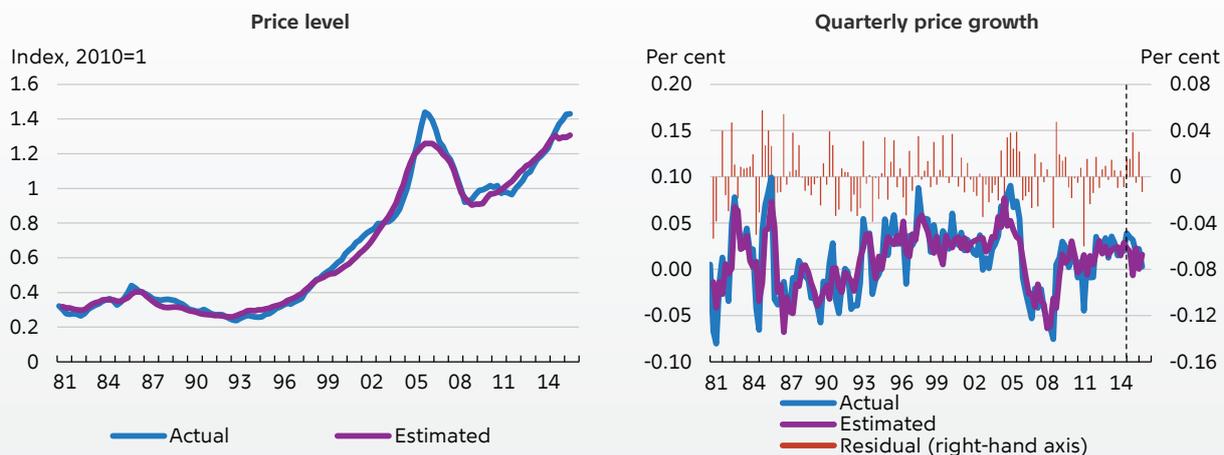
Specification and estimates are set out in Box 2.

The relation can explain a great deal of the development in house prices. It can be used to analyse whether the level of prices can be explained based on e.g. the level of interest rates and the disposable income. That way, it is possible to assess whether the current level of house prices is higher than warranted by economic fundamentals, cf. Chart 9 (left).

The analysis shows that the prices of owner-occupied flats in Copenhagen have been above

### Owner-occupied flats in Copenhagen are more expensive than warranted by the estimated relation

Chart 9



Note: The demand relation is estimated based on growth in the prices of owner-occupied flats, and the explanatory power and residuals of the model are illustrated by the right-hand chart. The estimated level in the left-hand chart is based on a dynamic simulation from the 2nd quarter of 1981, in which the predicted prices in a given period are based on predicted prices in previous periods. The simulation has been extended to the 2nd quarter of 2016.

Source: Statistics Denmark and own calculations.

5 Including the effects of the regulation ratio.

## Relation for the real price of owner-occupied flats in Copenhagen and Frederiksberg

Box 2

Household demand for owner-occupied flats is assumed to be determined by the disposable real income,  $Y$ , the real price of owner-occupied flats,  $P$ , and a combination of the user cost,  $u$ , and the lowest possible first-year payments,  $y$ . As a case in point, if interest rates decrease, housing demand will increase. As the housing stock is fixed in the short term, with a high degree of sluggishness in the adjustment, a change in housing demand will initially be reflected in the price. If the housing supply does not fully adjust in the longer run, there will be a permanent price effect. In this analysis, we do not consider the supply side, i.e. we do not define a relation for the housing stock. In other words, the analysis does not provide a full price formation model.

The relation is specified on an error correction form. The inverse demand curve for real prices of owner-occupied flats in the Municipalities of Copenhagen and Frederiksberg can be derived from the estimated relation

$$\log P = 6,9 \cdot \log Y - 27,4 \cdot \log H - 29,8 \cdot (0,3 \cdot u + 0,7 \cdot y) + \text{constant}$$

The demand relation implies that a 1 per cent increase in household disposable real income will lead to a 6.9 per cent

increase in the real price if the housing stock is not adjusted.<sup>1</sup> In the combination of the user cost and first-year payments, the main emphasis of households is on first-year payments, i.e. 70 per cent and 30 per cent on user cost. The specification of the relation entails that a semi-elasticity of costs is estimated. Thus, a combined increase in both the short-term and long-term housing market rates of 0.1 percentage points (before tax) will cause long-term house prices to be reduced by around 2 per cent if the income and housing stock remain unchanged. The size of the effect of a 0.1 per cent change in, for instance, the effective property value taxation will be approximately 3 per cent. For a similar specification of the model for single-family houses at the national level, the estimated interest rate sensitivity is around half.

In the demand relation above, all short-term components (variables that are included in changes) have been excluded from the estimated error correction model. The short-run dynamics include changes in the household disposable income, the last quarter's price increase and the change in long-term interest rates after tax,  $r$ , and the housing tax rate,  $s$ , cf. the table.

### The estimated relation

Variable		Coefficient	t-value
Real prices of owner-occupied flats, change	$\Delta \log P_t$		
Real prices of owner-occupied flats, change, lagged	$\Delta \log P_{t-1}$	0.382	5.1
Real income, change	$\Delta \log Y_{t-1}$	0.343	3.4
Interest and tax rates, change	$\Delta (s_{t-1} + r_{t-1})$	-3.465	5.3
Real prices of owner-occupied flats	$\log P_{t-1}$	-0.033	3.1
User cost	$u_{t-1}$	-0.316	1.8
First-year payments	$y_{t-1}$	-0.657	2.4
Real income	$\log Y_{t-1}$	0.226	3.1
Housing stock	$\log H_{t-1}$	-0.894	4.0
Constant		6.089	4.0
Misspecification test			
T = 1981Q2 - 2014Q4	DW = 1.940	AR(1) = 1.249	SE = 0.025
R2 = 0.61	JB = 0.973	AR(4) = 7.270	

Anm.: The data is described in more detail in the Appendix.

It should be noted that the price according to the demand relation is very sensitive to changes in income, housing stock and costs. One reason is that the relation is estimated over a period in which households have allocated a growing share of their consumption to housing consumption. House prices cannot increase more than household incomes allow in the long term. In traditional macroeconomic models such as MONA and ADAM, coefficients for income and housing stock are set to be identical (with opposing signs), entailing that housing demand increases one-on-one with real income.

Since the price index is quality-adjusted only to some extent and the volume of square metres for the housing stock is also applied, the effect of the quality improvement in Copenhagen over the estimation period is underestimated, and the coefficient estimate is thus overestimated. Despite the high sensitivity of the demand relation, the short-term sensitivity is limited, since just over 3 per cent of a deviation from the long-term level of the price is passed through to current prices, cf. the coefficient of  $\log P_{t-1}$ .

1. Studies for other western countries show that the income elasticity of prices at the national level is in the region of 0.5-3.2, and in large towns and cities results of 0.8-8.3 are seen, cf. Girouard (2006). In MONA and ADAM, the income elasticity of the price is 2.0 and 3.3, respectively, at the national level.

the level calculated by the model since the 1st quarter of 2015. In the 2nd quarter of 2016, the deviation was 9 per cent. At the peak in the 2nd quarter of 2006, the deviation was just over 14 per cent. However, the current deviation is not greater than what can be found in the estimation period.

An earlier analysis demonstrated that the increases in house prices seen in the Capital Region in recent years may be driven, in part, by expectations of higher future prices, but that increases in prices can be explained if income and interest rate developments are taken into account, cf. Klein et al. (2016). This estimated relation also shows that the price level in the Copenhagen market for owner-occupied flats is higher than warranted by economic fundamentals.

A fall in interest rates or a rise in incomes will increase the housing demand and thus prices. In the Municipalities of Copenhagen and Frederiksberg, these effects are two or three times stronger than for Denmark overall. The explanation for this is multi-faceted, and several of the elements are described above. The implication is that the market for owner-occupied housing in Copenhagen and Frederiksberg is more exposed to demand shocks than the rest of the housing market, and prices may respond strongly to, for instance, a sudden increase in interest rates.

Since 2001, nominal property value taxes have been frozen. As a result, the effective tax rate has been moving in the opposite direction of house prices, thus amplifying fluctuations. This has been especially problematic in areas such as Copenhagen where prices surged in the years leading up to the financial crisis and subsequently dropped the most. In 2002, the effective property value tax rate in the Municipalities of Copenhagen and Frederiksberg was 0.8 per cent, but in 2016 the rate had been halved to 0.4 per cent. Based on the estimated relation, it can be determined how much of the strong price increases over the past 15 years can be attributed to housing tax measures. If the property value tax rate had been retained, the prices of owner-occupied prices would thus have been close to 10 per cent lower today. At the same time, both the increases until 2007 and the subsequent sharp drop would have been lower, had the tax rate been retained.

Effective from 2003, land taxes have been subject to a regulation ratio, which has prevented

the land tax paid from following increases in land values. In 2016, due to the regulation ratio and the systematic underestimation of land values for owner-occupied flats, the land tax paid accounts for just 0.2 per cent of the market value of owner-occupied flats in the Municipalities of Copenhagen and Frederiksberg. Given that the effective rate is relatively low, the cap on the increase in land tax has had a modest impact on the prices of owner-occupied flats up until now. Thus, the freeze on land taxes in 2016 and 2017 – and potentially until 2021, which is the aspiration of the Danish government – is also likely to have a modest impact. However, for home owners in the Capital Region, the cap on the increase in land tax has a substantially greater impact.

A projection of the relation until 2018 provides an indication of house price developments. Under the given assumptions, the relation indicates that the estimated level of real house prices in the Municipalities of Copenhagen and Frederiksberg will see a decline over the projection period. This is mainly the result of the expected expansion of the housing stock, which is already underway. In addition, interest rates are expected to rise moderately. In a scenario in which housing market rates also rise more than expected, as has been the case since the summer of 2016, the price correction will be even stronger.

It can be concluded that prices of owner-occupied flats in Copenhagen are high relative to incomes and interest rates. Given that prices are already higher than can be explained by the model, there is a considerable risk that if the real price rises seen in recent years continue, they will eventually be followed by corresponding falls.

## LITERATURE

Abraham, Jesse M. and Patric H. Hendershott (1996), Bubbles in metropolitan housing markets, *Journal of Housing Research*, pp. 190-207.

Dam, Niels Arne, Tina Saaby Hvolbøl, Erik Haller Pedersen, Peter Birch Sørensen and Susanne Hougaard Thamsborg (2011), Developments in the market for owner-occupied housing in recent years – Can house prices be explained?, Danmarks Nationalbank, *Monetary Review*, 1st Quarter, Part 2.

Dam, Niels Arne, Tina Saaby Hvolbøl and Morten Hedegaard Rasmussen (2014), A multi-speed housing market, Danmarks Nationalbank, *Monetary Review*, 3rd Quarter 2014.

Girouard, Nathalie, Mike Kennedy, Paul van den Noord and Christophe André (2006), Recent house price developments: The role of fundamentals, OECD, Economics Department Working Papers, No. 475.

Häckner, Jonas and Sten Nyberg (2000), Rent control and prices of owner-occupied housing, *Scandinavian Journal of Economics*, Vol. 102(2).

Heebøll, Christian (2014), Regional Danish housing booms and the effects of financial deregulation and expansionary economic policy, Kraka – financial crisis commission.

Klein, Asbjørn, Simon Juul Hviid, Tina Saaby Hvolbøl, Paul Lassenius Kramp and Erik Haller Pedersen (2016), House price bubbles and the advantages of stabilising housing taxation, Danmarks Nationalbank, *Monetary Review*, 3rd Quarter 2016.

Meen, Geoffrey (1999), Regional house prices and the ripple effect: A new interpretation, *Housing Studies*, Vol. 14, No. 6.

Meen, Geoffrey (2001), *Modelling spatial housing markets: Theory, analysis, and policy*, Kluwer Academic Publishers.

## APPENDIX

### Data in the house price relation

Variable	Source	Notes
Prices of owner-occupied flats	Danish Customs and Tax Authority and Statistics Denmark.	Before 1992: owner-occupied flats in the Municipalities of Copenhagen and Frederiksberg
Consumer price index	The MONA data bank	
Interest rates	The MONA data bank	30-year bond yield and a short-term bond yield (average for maturities up to two years).
Interest rate deductibility	The MONA data bank	
Administration margin	Realkredit Danmark	Own calculations before 1992.
Tax rate	Statistics Denmark and the MONA data bank.	Effective tax rates (currently land tax and property value tax). From 2004: own calculations based on register data. Before 2004: revenue relative to owner-occupied housing wealth.
Amortisation ratio	The MONA data bank	
Disposable income	Statistics Denmark and the MONA data bank	The income statistics 1987-2014 (Municipalities of Copenhagen and Frederiksberg). Reversed by household disposable income at the national level from the MONA data bank (the national accounts) 1981-86, and after 2014.
Housing stock	Statistics Denmark	Register data. Calculated in square metres. Excluding institutions and businesses, shared accommodation and summer/holiday homes.