

4 Explaining home ownership rates in Danish municipalities¹

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4.1 Introduction

The purpose of the present study is to establish an econometric model for the proportion of homes that are owner-occupied in Denmark during the 1999 to 2004 period within a simultaneous demand-supply framework. The standard of housing in Denmark is high, with approximately 2.6 million dwellings to a population of 5.4 million in 2005, i.e. 2 persons per dwelling. Owner-occupied housing (excl. private cooperative ownership) accounts for 52% of occupied homes (see Table 4.1 and Figure 4.1). The rate has been constant over the last decade, with a slight reduction since 2000, while other European countries have witnessed a tendency for it to continue increasing. If, however, we include cooperative private ownership, which is fairly popular, the current rate increases to 60%, showing a slight increase up to 2000 and stagnating thereafter. Part of the explanation for the popularity of private cooperative ownership is the fact that tenants can set up private cooperatives in order to buy their apartment buildings from landlords that are willing to sell. Table 4.1 shows the ownership rates for different types of housing. As might be expected, the rates are very high for detached single-family houses and farmhouses and low for multi-dwelling houses.

Denmark has a long tradition of regulating and subsidising the housing market. Most cities have rent control for apartments built before 1991 that have not been thoroughly renovated and rent regulations on subsidised non-profit housing based on cost calculations, not on market conditions or quality level. In certain areas this has led to a mismatch between supply and demand, excessive demand for rented housing and reduced mobility (Rent Act Commission, 1997; Ministry of the Interior, 2004; The Economic Council, 2001). Newer rental apartments and owner-occupied homes are traded at market prices. Owners have an imputed rent added to their taxable income, but this is offset by interest payments. Housing allowances are paid to low-income households.

Following a peak at the beginning of the 1970s Danish residential construction declined, reaching a trough in 1995, with only 13,500 completions. Since then it has recovered and completions now number around 27,000 per year. As in other European countries, housing prices have increased sharply over recent years, and a price bubble is now feared. The Danish case is interesting in the present context partly because of the increase in housing prices over

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Table 4.1 Distribution of dwellings in Denmark, 2005

	Number	Percentage	Ownership rate ¹⁾
Farmhouses	128,463	4.9	88
Detached houses	1,054,084	40.5	93
Terraced, linked or semi-detached houses	352,651	13.6	36
Multi-dwelling houses	1,010,098	38.8	13
Other	56,719	2.2	8
Total	2,602,015	100.0	52

1) Percentage of homes occupied by owner. Rates do not include private cooperative ownership.

Source: Statistics Denmark

the period, enabling the effects of prices to be investigated (including short and medium-term price lags), and partly because the market is impacted by the regulation of the rented housing market, which facilitates investigation of the impact of such phenomena on the demand for home ownership.

Theories on determinants of demand for home ownership are summarised in Section 4.2. Theoretical determinants include prices and short and medium-term price changes, official regulation (rent regulation, housing subsidies, taxation), competition from alternative forms of residence (measured by the supply of subsidised housing), the social composition of the population (age, social security recipients, household composition, civil status, education, nationality), economic capacity (income), and congestion (measured by population density and degree of urbanisation).

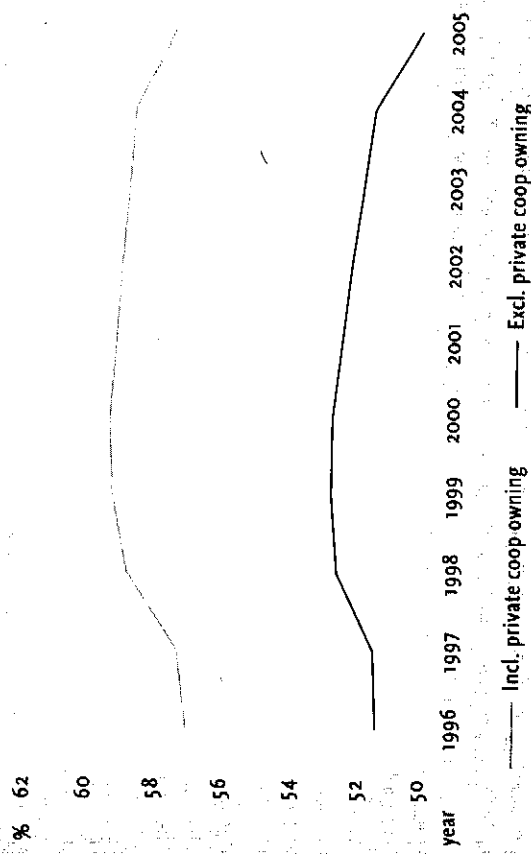
Section 4.3 considers methodological issues and the data to be used for the study. Issues related to the application of pooled cross-sectional data are discussed: this includes parametric instability over time, adjustment for dependency caused by repeated observation, and identifying the effect of prices on home ownership rates.

Section 4.4 presents the estimated results. An initial model specifies that the effects of the determinants are specific to each of the years 1999 to 2004. Within this model, adjustment for dependency across time periods is addressed using a Seemingly Unrelated Regression (SUR) model together with a Two-Stage Least Square (2SLS) approach to account for endogeneity among prices and home ownership rates. The constancy of effects over time is tested using a Wald test. It was found that parametric instability over time can be ascribed mostly to time trends in the parameters, enabling a simplified specification with common parameters across time, combined with time interactions, to be drawn up. Section 4.5 summarises the most important conclusions.

4.2 Demand for owner-occupied homes

Demand for owner-occupied homes is a proportion of the total demand for homes or residential units, the remainder being met by rented homes. The

Figure 4.1 Home ownership rates in Denmark, 1996-2005



Source: Statistics Denmark

purpose of the present study is not to estimate the absolute demand for owner-occupied homes but to find determinants for the proportion of owners, based on Danish data. The question it sets out to answer, then, is what factors significantly influence the home ownership rate, and thus the choice between owning and renting.

Basically, individuals or households choose to own the stock from which housing services flow if this is optimal or welfare-maximising, given their particular economic circumstances. Changes in the economic climate can result in a change in the optimal choice, away from or towards ownership. It follows that a listing of the decisive factors in the economic climate will also be a listing of the factors that influence the demand for owner-occupied homes. Linneman (1986), Røthemborg, et al. (1991), and Hansen and Skak (2005) put forward theoretical arguments for a range of economic determinants of home ownership. This study thus contributes to the present empirical analysis with a list of potential explanatory variables for home ownership rates.

Obviously, important determinants of home ownership are prices and price expectations. A short-term price increase is likely to reduce demand for home ownership and can result in wait-and-see behaviour on the part of prospective buyers, who may delay deciding whether to buy a home until the price increase has proven to be permanent or temporary. In contrast, price increases over several years are likely to affect demand positively, owing to stronger expectations of potential economic gains from investing in bricks and mortar.

Next, favourable tax (or subsidy) treatment of owners relative to renters is seen as an important factor in relation to ownership. For instance, a real estate tax is generally considered to disfavour housing investment compared to other investment opportunities, whereas it plays no part (or only a minor one)

in the choice between renting and owning, as it is imposed on both home owners and landlords.²

It should also be noted that landlords can be given preferential treatment separately, through favourable depreciation rates and/or direct subsidies, which in a competitive market will benefit tenants in the form of lower rents. In addition, it is important to stress that landlords' gains are only passed on in full to tenants if there is inelastic demand under perfect competition; with a housing market divided into many submarkets, monopolistic competition and oligopoly better characterise the markets, hence landlords' gains are only partly converted into lower rents.

Insofar as buying a house is costly for most consumers, another important factor influencing home ownership is the *financial capacity* of individuals or households. In industrialised countries real estate is typically financed by a combination of a downpayment and a loan to be repaid over a number of years. The property is used as collateral for the loan, which means that if a borrower fails to service the debt the lender can sell the home to recoup the capital. As such procedures can be costly and the revenue is insecure, lenders will prefer to provide loans to individuals with good credit ratings. In practice many households might prefer to be owner-occupiers but are prevented from this owing to low borrowing or financial capacity. As credit ratings increase with individuals' annual income levels (or expected future incomes), ownership rates are likely to increase with household income. Other factors that can affect credit ratings, and thus ownership rates, are educational level or job prospects, and in general a range of personal characteristics that lenders regard as important when assessing creditworthiness. In countries where lenders require a substantial downpayment, wealth will play a correspondingly important role relative to annual income (or expected future income).³ This would seem to be the case on the American housing market (see Gyourko, 2003).

Owning a home is costly, not only because of the debt servicing that typically follows after purchase, but also because the estate agents' and lawyers' fees and document charges make the purchase process expensive. Any such costs are low or non-existent for a tenant, which clearly shows that owning must have advantages that compensate for this, compared to renting. As the purchase or closing costs are high for owners, and the advantages of owning

² As regards the taxation of occupants in Denmark, the most widespread tax exemption that favours ownership is the low or non-existent tax on the imputed value of the flow of housing services to owner-occupiers (Economic Council, 2001), which gives owner-occupiers a low net rent compared to non-owners. The higher the breadwinner's marginal tax rate – or tax bracket – the lower the net rent.

³ Access to housing finance in Denmark is fairly liberal, with only a modest weight put on personal income prospects and more on the expected value of the collateral. In recent years new types of loans with low but variable interest rates and low repayment obligations have increased housing demand.

are part of the annual flow of housing services for owner-occupiers, it follows that the expected occupation time and factors that influence closing costs will also influence home ownership rates. For example, students are likely to be primarily renters, as they do not expect to stay put for many years. High closing costs also create a locking-in effect that reduces geographical mobility, as noted by Oswald (1997).

Linneman (1986) invokes differences in production efficiency between landlords and owner-occupiers as an important factor behind ownership rates. For example, landlords internalise externalities that cause problems among neighbours in multi-family structures, and they may be able to use their buying power to reduce maintenance costs. On the other hand, this higher efficiency of landlords in supplying housing services may well be more than offset by the cost of monitoring tenants and limitations on their use of the housing units – and thus the housing services that flow from the units. Linneman (1986) holds the opinion that high production efficiency by landlords in high density residences is the reason why ownership rates tend to fall as one travels from the countryside into city centres. We seek evidence for Linneman's hypothesis in the empirical analysis by testing the significance of a population density variable.

Another point that is relevant here is made by $\text{\AA}r\text{\o}$ (2002), who points to exceptionally high renovation and repair activity among home owners compared to tenants. Persons or households obviously differ with respect to the benefit they gain from individual adaptation of housing units, e.g. by changing and painting rooms to suit their preferences. Hansen and Skak (2005), in a theoretical setting, put forward a sorting mechanism in which owners are individuals with a strong preference for individual adaptation of their home. Given high rent levels in congested cities, this model also explains why ownership rates tend to fall when moving from the countryside into city centres. It does not identify or rank persons on the basis of their preference for individual home adaptation, however. Because of contracting problems? (e.g. lack of allowances or compensation to tenants for repair work), owner-occupiers have more freedom to adapt their properties, which potentially offsets the closing costs of owner-occupancy.

Accordingly, growing households (in terms of individuals), e.g. young couples with small children, are likely to opt for ownership because of the need to change the interior when children grow up and new ones are born. Along the same lines, self-employed people may be more individualistic than employees and thus have higher ownership rates than wage earners. All this has to be empirically tested in what follows.

Based on these theoretical considerations, Table 4.2 sums up the variables that, based on economic theory, are likely to influence ownership rates. In addition to the economic factors behind demand for owner-occupied homes, there are no doubt also factors of a more sociological nature involved. Two

Table 4.2 Variables affecting home ownership rates

Variable	Explanation
<i>Prices</i>	
Actual price (-)	High prices and short-term price increases make it difficult to buy a home.
One-year price change (-)	Medium-term price changes encourage the expectation that prices will increase in the future and thus the propensity to buy.
Three-year average price change (+)	
<i>Favourable tax treatment of home owners</i>	
Tax bracket (+)	Favourable tax treatment triggered by ownership tends to raise ownership rates; such treatment, e.g. a low imputed rent, is typically more valuable for the higher income tax brackets.
<i>Rent subsidy (-)</i>	
Rent control (-)	Home ownership rates are reduced if an income subsidy is triggered by renting vs. owning. If rent control keeps rents for rented homes artificially below market equilibrium this also reduces the demand for owned housing. If only a fraction of homes can be owned, e.g. for social reasons, this potentially reduces home ownership rates.
Urban restrictions on ownership (-)	
<i>Financial capacity</i>	
Income (+)	With asymmetric information on financial markets, various indicators of borrowers' (home owners') repayment ability will influence home ownership rates.
Nationality (?)	
Educational level (+)	
Other personal characteristics	
Special life events (e.g. divorce, bequest, lottery prize)	
<i>Expected occupation time</i>	
Age (-)	Ownership starts with closing or contracting costs that have to be balanced against benefits in each occupation year. If the expected number of occupation years is low, ownership rates tend to fall. Expected occupation years may also fall in the case of some job types.
Rate of 'under-education' (-)	
Job type	
<i>Production efficiency for landlords vs. owner-occupiers</i>	
Congestion (-)	Where many people live together, landlord-scale economies in the production of housing services may be pronounced.
<i>Households differ in the benefit they derive from adapting their homes</i>	
Self employed (+)	Idiosyncratic variations in the benefit households or individuals derive from adaptation of homes results in a market screening where owners benefit most. High rents reduce the net benefit to owners most and squeeze some owners into becoming renters.
More than one child (+)	
High rent area (-)	
<i>Social heritage</i>	
Parents' choice of tenure	People tend to demand the type of dwelling they used to live in as a child.
<i>Lifestyle</i>	
Rate of single households (-)	Ways of living, e.g. free single life vs. tied family life, influence ownership rates.

A (+) indicates a positive correlation between the variable and the home ownership rate.

obvious ones would seem to be particularly relevant here. First, there may be a social heritage: people may tend to demand the type of dwelling they used to live in as children, and this may also apply to their choice of tenure. The effect on the housing market may be that tenure patterns are very persistent

and only change slowly, over generations. Second, demand may arise from consumers' desire to manifest themselves as members of a particular social group and lifestyle. Behavioural patterns of this kind could produce long-lasting bubbles in tenure patterns as modes gather momentum, peak and decay. The consequence as regards an econometric analysis of tenure pattern is that today's ownership rates are influenced by yesterday's ownership rates. A more permanent effect is that a higher proportion of singles who want to remain free and mobile will tend to lower home ownership rates.

4.3 Methodology and data

Based on aggregate data from a sample of 270 Danish municipalities with annual observations from 1999 to 2004, a regression model is estimated to investigate the effects of determinants on the demand for owner-occupied homes. Owing to the nature of the data, some developments in the methodology are called for. As the data were obtained from repeated observation in consecutive time periods, adjustment for heterogeneity is required, as the residual variance of the regression model may change. Adjustment for inter-temporal correlation among observations is also necessary. These adjustments are captured using SUR regression (Zellner, 1962; Greene, 2003). Finally, an issue related to identifying the demand equations needs to be considered. The price of home ownership depresses the demand for owner-occupied housing. At the same time a shift in the demand function will affect equilibrium prices in the same direction as the shift. Hence prices and home ownership are determined simultaneously, so OLS estimation will yield biased results (Greene, 2003). A proper solution is to use instrumental estimation (Greene, 2003), where a supply-side variable is applied as an instrument for prices. For this instrument we took the number of finished buildings per capita.

The data used is aggregate cross-sectional data observed annually in 270 Danish municipalities (five municipalities on the island of Bornholm were omitted owing to data problems) from 1997 to 2004. It was collected from four sources: the Statistical Bank of Statistics Denmark; the Ministry of the Interior's Key Figure Base [Nøgletalsbaser]; the Ministry of Urban and Housing Affairs' (2000) report on rent regulation; and the Danish Tax Authority's [Told & Skat] (2004) report on property sales prices. Table 4.3 gives an overview of the data, including variable shorthands, definitions and a few descriptive statistics.

4.4 Results

Table 4.4 shows the results from the pooled SUR model with time-specific coefficients, while Table 4.5 reports on the model estimated with common co-

Table 4.3 Aggregate cross-sectional data used for the regression model

Variable	Definition	25% quartile	Median	75% quartile
PSHOOH	% of housing units (one-family and terraced houses and terrace flats) occupied by owner (cooperative housing and student hostels omitted) ⁽¹⁾	62.00	71.00	76.00
PRICE	Average sales price (real DKK) per square meter of one-family houses ⁽⁴⁾	51.86	55.73	73.48
SPRICECHANGE	Defined as $(PRICE_{it} - PRICE_{i,t-1}) / PRICE_{i,t-1}$	0.034	0.055	0.079
MPRICECHANGE	Defined as $(PRICE_{it} - PRICE_{i,t-3}) / PRICE_{i,t-3}$	0.095	0.225	0.285
PSHSUBHOU	% of population living in subsidised housing [almennyttige] ⁽¹⁾	5.00	9.00	17.00
PSHSUB	% of households receiving housing subsidies [boligydelse] ⁽²⁾	8.90	10.90	13.25
PSHRSUB	% of 15-66 year old receiving rent subsidies [boligsikring] ⁽²⁾	2.90	4.00	5.90
REGUL	Housing Regulation Act (rent control) [Boligreguleringsloven] assumed by 2000 (1=yes, 0=no) ⁽¹⁾ (Proportion of 'yes' = 0.556)			
PROPTAX	Real Property Tax (in 0/100) [Grundskyldspromille] ⁽²⁾	8.00	12.00	15.00
TAXRATE	Municipal + county tax rate (in %) [Udskrivningsprocent] ⁽²⁾	20.20	20.80	21.30
TAXBASE	Tax base [beskatningsgrundlag] per inhabitant (100.000 DKK) ⁽²⁾	9.94	10.97	12.10
POPDEN	Inhabitants per square kilometre (10000) ⁽²⁾	48	69	147
PSHURBAN	% of population living in urban areas ⁽²⁾	61	71	86

efficients for time periods, and introduces time-interacted variables. In any model the price is instrumentalised using the number of finished new buildings per capita (FINBUILD) as an instrument. Below we report the results table by table, leaving an economic overview of the results for the conclusions that follow. To make the data more readable, variable shorthands are shown in brackets in the description.

It is important when interpreting the results to keep in mind that the data is figures (averages) from municipalities, not observations of households or persons. As Table 4.4 reveals, the impact of prices (PRICE) is generally negative, as expected, although it is insignificant. The effect of short-term price changes (SPRICECHANGE) is negative in most years, while medium-term price changes (MPRICECHANGE) have the expected positive impact on OOH in most years, although this is also insignificant in most years. The low significance of prices may indicate that the price correlation between owning and renting is only slightly influenced by absolute price changes. Turning next to regulation variables, subsidised housing consists almost exclusively of rented dwellings (PSHUBHOU), and rent subsidies (PSHRSUB) are naturally for people living in rented homes. Only housing subsidies (PSHSUB) can also be granted to owner-occupiers, but, as expected, all three variables significantly reduce

Table 4-3 continued

Variable	Definition	25% quartile	Median	75% quartile
PSH716	% of population aged 7-16 ⁽¹⁾	11.90	12.90	13.90
PSH1725	% of population aged 17-25 ⁽¹⁾	8.07	9.09	10.21
PSH2635	% of population aged 26-35 ⁽¹⁾	11.74	12.82	13.89
PSH3666	% of population aged 36-66 ⁽¹⁾	40.55	42.33	44.27
PSH67+	% of population aged 67 and over ⁽¹⁾	12.00	13.50	15.00
PSHWIDOW	% of population widowed ⁽¹⁾	5.91	6.61	7.37
PSHDIV	% of population divorced ⁽¹⁾	4.86	5.82	7.40
PSHUNMARR	% of population unmarried ⁽¹⁾	41.91	43.54	44.80
PHCHO18	% of households with children over 18 ⁽¹⁾	7.68	8.76	9.88
PHWCHU18	% of households without children under 18 ⁽¹⁾	0.00	3.06	5.62
PSHEDUC	% of population with higher education ⁽²⁾	11.50	13.60	16.45
PSHEARLYR	% of population on early retirement benefit [førtidspension] ⁽²⁾	6.25	7.40	8.80
PSHSOCBEN	% of population receiving social benefits [kontanthjælp] ⁽²⁾	6.70	8.00	9.60
PSHUNEMP	% of population (17-66 year) unemployed ⁽²⁾	3.60	4.40	5.40
PSH3COUNTRY	Number of citizens from countries outside EU, Scandinavia and North America per 10,000 pop. ⁽²⁾	10.60	15.70	23.60
FINBUILD	Finished new buildings (m ² per capita) ⁽¹⁾	0.84	1.37	2.06

Sources: (1) Statistics Denmark; (2) Key Figure Base; (3) Ministry of Urban and Housing Affairs; (4) Danish Tax Authority.

the proportion of owner-occupiers. Municipalities with rent control (REGULATION) also have a higher proportion of renters. Among the three tax variables, personal income tax (TAXRATE) and income (TAXBASE) are seen to be insignificant and with varying signs, while property tax (PROPTAX) seems to contradict the theory, as it is positively correlated to OOH. Looking at the demographic variables, a high proportion of persons aged between 17 and 25 in the population (PSH1725) reduces the proportion living in owner-occupied homes (OOH), no doubt because it is indicative of a high proportion of young people in education who have a short horizon for their present living conditions and therefore opt to rent. The same sign for the coefficient for elderly people (PSH67+) can be explained by their need for smaller homes with care facilities, and the fact that they envisage a short spell in such homes. Consequently, rented dwellings form both the demand and the supply for this type of housing. A high proportion of widowed, divorced and unmarried persons (PSHWIDOW, PSHDIV, PSHUNMARR) reduces OOH; this too is as expected, given these groups' limited financial capacity. This is a factor that also seems to keep immigrants, especially from non-industrialised countries (PSH3C), in rented homes. The proportion of households with children over 18 (PSHO18) is estimated to increase the proportion living in OOH, but this may reflect an

Table 4.4 SUR model with time-specific coefficients

Year	1999	2000	2001
Constant	150.998***	148.504***	155.812***
PRICE	-0.008	-0.005	-0.002
SPRICECHANGE	-0.417	-2.454	1.120
MPRICECHANGE	-0.204	2.244	0.653
PSHSUBHOU	-0.499***	-0.482***	-0.476***
PSHSUB	-0.055	-0.050*	-0.185***
PSHRSUB	-0.243***	-0.384***	-0.333***
REGULATION	-2.071***	-1.830***	-1.745***
PROPTAX	0.049**	0.036*	0.046**
TAXRATE	-0.111	-0.156*	-0.050
TAXBASE	0.127	0.065	-0.008
POPDEN	-23.903***	-22.843***	-22.965***
PSHURBAN	-0.104***	-0.102***	-0.081***
PSH716	-0.058	-0.089	-0.282**
PSH1725	-0.627***	-0.560***	-0.729***
PSH2635	-0.371*	-0.341*	-0.562***
PSH3666	-0.231	-0.180	-0.257*
PSH67+	-0.682***	-0.726***	-0.793***
PSHWIDOW	-0.438**	-0.323*	-0.400**
PSHDIVORCED	-0.851***	-0.848***	-0.661***
PSHUNMARR	-0.500***	-0.506***	-0.484***
PSHCHO18	0.167**	0.200***	0.241***
PSHWCHUI8	1.170	1.441	0.789
PSHEDUC	-0.067	-0.063	-0.067
PSHEARLYR	-0.264***	-0.251***	-0.234***
PSHSOCBEN	-0.177***	-0.146***	-0.096**
PSHUNEMPL	0.173**	0.177**	0.085
PSH3COUNTRY	-0.010	-0.011	-0.027***
Pseudo-R-Square	0.901	0.903	0.907
Ps.-R-Sq.(adj.)	0.886	0.888	0.892

	2002	2003	2004	Wald test for parametric stability
	146.712***	138.623***	169.687***	9.191
	-0.003	-0.011	-0.004	1.050
	-5.469	11.562	-22.450*	4.356
	3.113	0.642	1.156	2.022
	-0.463***	-0.438***	-0.434***	19.417***
	-0.234***	-0.180**	-0.220***	23.971***
	-0.294***	-0.542***	-0.532***	41.976***
	-1.798***	-1.689***	-1.531***	12.159**
	0.033*	0.025	0.029	5.590
	-0.050	0.084	0.044	9.107
	-0.048	-0.001	0.058	7.719
	-23.357***	-25.247***	-23.890***	5.644
	-0.082***	-0.071***	-0.084***	13.337**
	-0.051	0.015	-0.405**	12.059**
	-0.607***	-0.364**	-0.511***	11.011*
	-0.343**	-0.305*	-0.638***	8.385
	-0.129	-0.111	-0.403**	8.437
	-0.729***	-0.719***	-1.061***	8.126
	-0.245	-0.465**	-0.331	6.497
	-0.671***	-0.410***	-0.376*	17.303***
	-0.571**	-0.606***	-0.648***	3.911
	0.121*	0.246***	0.283**	7.463
	0.777	0.583	-0.886	6.476
	-0.035	-0.023	-0.033	5.894
	-0.220***	-0.240***	-0.233**	0.682
	-0.094**	-0.045	-0.013	6.047
	0.027	0.110	0.043	7.048
	-0.023**	-0.044***	-0.036***	18.279***
	0.905	0.904	0.906	
	0.890	0.888	0.891	

Overall Wald test for parametric stability (df=143): 384.858***

Overall pseudo-R-Square: 0.916; Adjusted: 0.903

Significance indicated by *** for 1%, ** for 5%, * for 10%.

endogeneity problem due to the fact that owned homes are bigger, so teenagers live at home with their parents longer. Higher educational attainment (PSHEDU) results in better financial capacity, hence a positive correlation with OOH, but this positive correlation is not confirmed, as a negative (though insignificant) effect is estimated. Financial support to poorer households, as measured by the proportion of the population that receives social security benefit, either because they have left the labour market permanently or are unemployed and unable to receive unemployment benefit, and the unemployment rate (PSHEARLYR, PSHOCBEN, PSHUNEMPL), is a priori expected to be negatively correlated to OOH. This is partly confirmed by the significantly negative coefficients for PSHEARLYR and PSHSOCBEN, whereas PSHUNEMPL seems to be positively correlated to OOH. This latter feature may be an expression of endogeneity, as home ownership may reduce geographical mobility. The present investigation, however, includes unemployment as a control variable rather than a focus in itself, so we shall not discuss this topic any further. An interesting discussion of the endogeneity between home ownership and unemployment can be found in Munch et al. (2003).

Table 4.4 also reveals time patterns for some of the variables. Beginning with the Wald tests for parametric stability, and selecting only variables where the tests are significant at the 5% level, the impact of the regulation variables is seen to be unstable over time, where regulation variables include proportion of the population living in subsidised housing (PSHSUBHOU), subsidies for housing costs (PSHHSUB), rent subsidies (PSHRSUB), and rent control (REGUL). The coefficients for the proportion living in urban areas (PSHURBAN), the proportion aged 7-16 (PSH716), the proportion of divorced persons (PSHDIV), and residents from third countries (PSH3COUNTRY) are also seen to be unstable over time. Turning next to the estimated coefficients for these variables, we find some distinct patterns. In the case of housing subsidies (PSHHSUB) there is a fall in the coefficients, whereas in that of rent subsidies (PSHRSUB) they gain in strength over the years. No very good explanations for these opposite trends have been found. Finally, the coefficient for rent control (REGUL) loses strength over the period, which may reflect the fact that only older rental properties are subject to control and new properties have a high rent that makes owning more attractive. As regards the proportion living in urban areas (PSHURBAN), the effect is relatively high at the beginning of the period and relatively low towards the end. In the case of the proportion aged 7-16 the coefficient seems to drop over the period under consideration. As regards the proportion of divorced persons (PSHDIVORCED), the strength of the negative coefficient declines over the years, probably owing to the increased financial capacity of divorced persons, as it becomes more and more common for both spouses in a household to be working.

This suggests that interaction variables need to be added to the model. These are defined as interactions with time (defined as a time trend variable

multipled by the variable in question) for subsidised housing, housing cost subsidy, regulation, rent subsidy, urbanisation, percentage of 7-16 year-olds, proportion of divorced, and immigrants from third countries. Table 4.5 reports on the SUR model with common coefficients for all years, 1999 to 2004.

The two columns of Table 4.5 report on the model without and with time trends respectively. Particularly noticeable in the first column is that the effects of both prices and short and medium-term price changes have the expected signs, although the price is insignificant.

In the case of subsidised housing the impact is negative but gradually falls throughout the period from 1999 to 2004. The impact of housing subsidies is positive at the beginning of the period but gradually moves toward significantly negative throughout the period. Rent subsidies have a negative impact, as expected, and this effect gradually intensifies during the period from 1999 onwards. Rent regulation has the expected negative impact, but it gradually declines throughout the period.

As regards the proportion living in urban areas and the proportion of divorced, the effects are negative but significantly drop towards zero over time. When it comes to the proportion of 7-16 year-olds, the effect gradually moves from insignificantly positive/negative to significantly negative during the period. Thus these demographic variables share a common feature in that they have an effect on the home ownership rate which is significant but generally declines in magnitude during the period.

4.5 Conclusions

An econometric model based on Danish municipal data over the years 1999-2004 reveals significant factors behind the home ownership rate. The existence of parametric time patterns was investigated and accounted for. To a large extent the results provide evidence for the economic theory on home ownership reported in the urban and housing literature.

First, our results suggest that prices and short-term price changes have a negative effect on demand for home ownership, whereas we find medium-term price changes having a positive effect. Second, rent control measures also appear to increase the demand for rented dwellings and reduce home ownership rates. Third, we found an impact of financial capacity and indications that reduced capacity—as measured by rates of widows, divorced, unmarried and immigrants from third countries—also reduces home ownership rates, though the impact of the rate of divorced seems to fall over the period, probably because of gradually improving financial capacity, especially in the case of single women. Fourth, expected occupation time appears to play a role, particularly in the case of young people in education and elderly people who prefer to be renters. Fifth, we found a clear negative effect of congestion

Table 4.5 SUR models with common coefficients

Variable	Initial model	Trends added
Constant	158.409*** (10.27)	149.810*** (10.44)
PRICE	-0.006 (0.004)	-0.005 (0.004)
SPRICECHANGE	-2.428*** (0.566)	-2.222*** (0.589)
MPRICECHANGE	1.742*** (0.660)	1.678** (0.714)
PSHSUBHOU	-0.479*** (0.024)	-0.567*** (0.031)
PSHSUB	-0.087*** (0.029)	0.127*** (0.047)
PSHRSUB	-0.367*** (0.058)	-0.115 (0.098)
REGULATION	-1.581*** (0.477)	-2.725*** (0.568)
PROPTAX	0.040** (0.019)	0.036** (0.018)
TAXRATE	-0.066 (0.072)	-0.036 (0.071)
TAXBASE	0.050 (0.045)	0.008 (0.047)
POPDEN	-23.216*** (3.244)	-25.034*** (3.066)
PSHURBAN	-0.079*** (0.016)	-0.099*** (0.018)
PSH716	-0.215** (0.104)	-0.049 (0.117)
PSH1725	-0.583*** (0.106)	-0.561*** (0.106)
PSH2635	-0.486*** (0.125)	-0.391*** (0.125)
PSH3666	-0.390*** (0.113)	-0.223* (0.115)
PSH67+	-0.887*** (0.124)	-0.829*** (0.126)
PSHWIDOW	-0.249* (0.150)	-0.353** (0.152)
PSHDIVORCED	-0.763*** (0.111)	-0.965*** (0.142)

on home ownership: the economic reason for this may be either higher land-lord efficiency in densely populated areas, as proposed by Linneman (1986), or higher rents in congested areas which reduce the net gain from ownership, as suggested by Hansen and Skak (2005).

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Table 4.5 continued

Variable	Initial model	Trends added
PSHUNMARR	-0.527*** (0.076)	-0.525*** (0.081)
PHCHO18	0.248*** (0.049)	0.195*** (0.049)
PSHWCHU18	0.252 (0.418)	0.531 (0.410)
PSHEDUC	-0.007 (0.040)	-0.035 (0.038)
PSHEARLYR	-0.098 (0.075)	-0.184** (0.076)
PSHSOCBEN	-0.124*** (0.042)	-0.116*** (0.042)
PSHUNEMP	0.080* (0.046)	0.118*** (0.046)
PSH3COUNTRY	-0.041*** (0.009)	-0.020* (0.012)
PSHSUBHOU*T		0.015*** (0.003)
PSHSUB*T		-0.043*** (0.008)
PSHRSUB*T		-0.046*** (0.013)
REGUL*T		0.160*** (0.042)
PSHURBAN*T		0.003* (0.002)
PSH716*T		-0.020*** (0.007)
DIVORCED*T		0.063*** (0.014)
PSH3COUNTRY*T		-0.001 (0.002)
Pseudo-R-Square	0.868	0.932
Pseudo-R-Square(adj.)	0.866	0.929

Numbers in parentheses are standard deviations.

Significance indicated by *** for 1%, ** for 5%, * for 10%.

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