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The Impact of Financial Arrangements and Institutional Form on Housing Prices

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Abstract Dwellings in housing cooperatives constitute 15% of the Norwegian housing property market. The price paid for such dwellings consists of two elements: An equity price and a share of the mutual debt held by the cooperative. The interest rate paid on the housing cooperative's mutual debt is in Norway lower than the interest rate paid on private loans. This gives rise to an "interest discount effect". We find convincing empirical support for the interest discount effect, which contributes to a higher equity price for dwellings in housing cooperatives than for self-owned dwellings. On the other hand, we also find empirical support for a co-op discount of 9.3%. The co-op discount work in the direction of making cooperative dwellings more affordable.

Keywords Housing prices · Cooperative housing · Condominiums · Credit rationing

JEL Classification G21 · R21

Introduction

Policy makers often emphasise that households should have the possibility to own their homes. In order to achieve this goal, housing policies in many countries aim at reducing the cost of housing, easing the extent of credit rationing, etc. The Scandinavian housing cooperatives provide an interesting market based mechanism in this respect. We examine price formation for dwellings in housing cooperatives

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(co-ops). Thereby we also gain insights into the role that housing cooperatives may play in increasing the rate of homeownership, through the use of market mechanisms rather than government subsidies and interventions.

Homeowners in Scandinavian housing cooperatives have about the same command over their home as those living in self-owned apartments. The prices of both types of dwellings are determined in competitive markets.[1] The two types of homeownership are, however, different in two important respects. First, they differ in how the housing units are financed. Second, they differ in institutional form, i.e. in legal status and how collective decisions affecting all units in the housing community are taken. In the present paper we examine how financial arrangements as well as institutional form affect the prices of cooperative housing, compared to self-owned housing.

The impact of institutional form on the prices of co-ops relative to self-owned dwellings has been investigated by Goodman and Goodman (1997), Kelly (1998), and Schill et al. (2007). They all find that there is a co-op discount, i.e. that co-ops are sold at lower prices than physically identical condominiums at equally attractive locations. Smith et al. (1984),[2] Kelly (1998), and Hjalmarsson and Hjalmarsson (2009), have investigated how financial arrangements affect housing prices. Smith et al. (1984) find that differences in financial arrangements between housing units are far from fully discounted into the prices of dwellings, and Hjalmarsson and Hjalmarsson (2009) arrive at similar conclusions. These results stand in sharp contrast to Kelly (1998), who found that interest rate differences between cooperative and self-owned dwellings are excessively discounted into the prices of co-ops, i.e. that for each dollar the interest on the mortgage of a co-op increases, the price of the dwelling drops by more than one dollar.

Kelly (1998) is to our knowledge the only paper that provides simultaneous estimates of how financial arrangements as well as institutional form affect the prices of co-ops relative to condominiums. The fact that his result concerning the impact of financial arrangements is out of line with what most other researchers have found means that it is still an unresolved issue whether differences in financial arrangements are "correctly" discounted into housing prices. In the present paper we therefore try to resolve this issue by exploiting a Norwegian data set for examining the simultaneous impact of institutional form and financial arrangements on dwelling prices. Notice also that except Hjalmarsson and Hjalmarsson (2009), who use Swedish data, all papers referred to above are based on data from the United States. By using a Norwegian data set we complement previous research, and provide a basis for contrasting the role of co-ops across different countries.

Some households may be credit rationed in the market for self-owned dwellings. Due to the differences in the financial arrangements between the market for co-ops and the market for self-owned dwellings, those who are credit rationed may escape from this by turning to the market for cooperative dwellings. In this way, Norwegian-type cooperative housing may make it possible to become homeowners for households who would otherwise have been renters. The differences between the

[1] The legal status of self-owned dwellings is very similar to condominiums in the United States.

[2] This paper does not examine the price formation of co-ops, but the analysis of the impact of financial arrangements on dwelling prices is highly relevant also in our context.

markets for the two types of housing are likely to be of great political and practical relevance beyond the Norwegian context.

The remainder of the article is organised as follows. We first give a brief account of Norwegian housing cooperatives, followed by a more detailed description of the financial arrangements. Next, we establish a theoretical model which is used to discuss price differences between cooperative and non-cooperative housing. An econometric specification of the model is then provided, and the data used for estimating the model are described. Estimation results are then presented, discussed and compared with previous research. Finally, main results are summarised, and some suggestions for further research are provided.

The Main Features of Housing Cooperatives

In total, housing cooperatives constitute 15% of the dwellings in Norway. The variation is large, though. In the capital, Oslo, 40% of the dwellings are in housing cooperatives, while the share is zero in many smaller urban settlements and in the countryside. Typically, an average Norwegian housing cooperative consists of about 50 homes, but some are much larger. Norwegian housing cooperatives are regulated by a separate law. Each cooperative is organized as an individual entity, but many housing cooperatives are members of cooperative housing associations. Most housing cooperatives are in fact initiated by a housing association acting as a property developer. Also, the associations serve in most cases as facility managers for the housing cooperatives, and as brokers in the second-hand market for co-ops.[3]

The person holding a co-op dwelling formally owns a share in the cooperative. Through purchasing a share, the shareholder obtains an exclusive right to use a specific housing unit in the property owned by the cooperative, for an unlimited time period.[4] A new shareholder has to be recognized by the board of the cooperative, but Norwegian laws secure that this is mainly a formality. As long as a person intends to use the apartment as a dwelling for him-self or her-self, the board has virtually no power not to accept the new shareholder. This is quite different from for instance the American context, where the boards of co-ops have considerable discretion, and can refuse to accept new shareholders for various reasons, including financial matters. In Norway, the boards of housing cooperatives do not even have the right to request information from entrants about their economic situation, or how they will finance the purchase of the dwelling.

A shareholder in a housing cooperative has the right to sell his unit by transferring his or her share to a new shareholder. Other shareholders in the housing cooperative or the housing association of which the cooperative is a member, have a pre-emption right, but the transactions will in any case be carried out at the full market price. Each shareholder in a cooperative holds one vote in the annual general assembly, which elects the board of directors. All members of the board are elected from the shareholders of the cooperative. The board has the general responsibility for the

[3] Norske Boligbyggelag (2007) provides additional information on cooperative housing in Norway.

[4] This is unlike what is the case in the United States, where there typically is a time limit of 99 years for which shareholders in housing cooperatives have the right to the apartment affiliated with their share.

management of the housing cooperative, but facility management is usually carried out by a housing association or a lawyer.

In a given housing cooperative, the value of the share will only depend on the size of the housing unit. Each shareholder is required to pay a monthly fee that covers a proportionate share of the cooperative's operating expenses, inclusive of interests and down-payment of the mutual debt carried by the cooperative. If a shareholder is unable to pay the monthly fee, he has to leave the cooperative and sell his share. We now turn to a more detailed discussion of the financial arrangements for co-ops.

Financial Arrangements and Segmentation in the Housing Market

Purchasing a home is for most households the largest investment of their lifetime. A substantial part of housing investments is financed through loans. Rather than fully accommodating risk in the interest rate charged on loans, credit institutions frequently ration credit to borrowers considered to be less credit-worthy. As demonstrated by Stiglitz and Weiss (1981), the practice of credit rationing may be due to problems of asymmetric information, which may lead to problems concerning moral hazard and adverse selection.

Retsinas and Belsky (2002) distinguish two borrowing constraints that may play an important role for low-income home buyers. First, there may be a wealth constraint, which is the part of the purchasing price that the bank requires the home-buyer to raise him-self or her-self. Second, there may be an income constraint, which is the minimum income required in order to obtain the loan of a specified amount. Norwegian banks are often willing to lend a person purchasing a new home the full amount of the investment. Hence, there is normally no wealth constraint in Norway. Income constraints are, however, commonly applied: Norwegian financial institutions usually require a debt-to-income ratio less than 3.[5] As the (real) house prices in Norway in recent years have increased substantially, an increasing number of individuals, in particular young persons, have been denied loans due to the income constraint. In Norway, a binding income constraint is thus the primary cause of credit rationing.

In principle, credit rationing may occur in all segments of the housing market, but it is likely to be much more important in the market for self-owned dwellings than in the market for dwellings in housing cooperatives. The reason lies in the different financial arrangements in the two market segments. In the market for self-owned dwellings, the buyer has to finance the full value costs of purchasing the dwelling. In the market for co-op dwellings, by contrast, the price paid for dwellings contains two elements: First there is an equity price, which is the payment for one share in the housing cooperative, which gives the right to occupy a specific dwelling. The equity price is determined through a normal competitive bidding process. Second, each dwelling in a housing cooperative carries a share of the mutual debt held by the cooperative. The share of the cooperative's debt is over time paid down by the owner through monthly instalments. Hence, the mutual debt does not require any funding

[5] The risk appraisal has recently become more sophisticated in some banks, as they may also consider the customers credit history, current income, income history, debt, place of residence, etc.

by the buyer. Consequently, the amount of money an entrant to a housing cooperative has to raise by him-self or her-self, either by drawing on a savings account or by obtaining a loan in a credit institution, corresponds to the equity price. The market value of the dwelling consists, however, of the sum of the equity price and the share of the mutual debt. That is, if the mutual debt is high the equity price will be low. Through purchasing a dwelling with a low equity price, but a high mutual debt, a low income household may get access to credit. This is so because credit institutions do not consider the share of the mutual debt as the personal debt of the shareholder. This practice is due to the fact that shareholders in housing cooperatives have a mutual responsibility for each others part of the mutual debt. However, since only a negligible number of shareholders fail to serve their debt through the monthly instalments, and since the housing cooperatives through the housing associations are insured against losses of rent incomes, the mutual responsibility for each others mutual debt is more of a formality. Hence, the financial arrangement used in cooperative housing in effect provides a way of circumventing credit rationing due to the income constraint. In this way housing cooperatives may reduce the extent of credit rationing. This in turn may make it possible for more households to become home owners, cf. Haurin et al. (1997).

A final point related to the financing of Norwegian cooperative dwellings is that financial institutions consider the mutual debt of housing cooperatives as low-risk debt. Consequently, the interest paid on such loans is usually lower than the interest on individual mortgage loans. Moreover, in Norway the loan that finances large parts of the mutual debt is in many instances provided by the state-owned housing bank (Husbanken). Due to its exceptional solidity, the state housing bank is able to obtain loans in the market at very favourable interest rates. This interest rate advantage is passed over to its customers. In addition, the interest rate that the state bank charges the housing cooperatives may contain a small element of subsidy. To conclude, the interest rate on the mutual debt of Norwegian housing cooperatives is lower than the market rate paid by individual home buyers. This is quite different from what is the case in for instance the United States, where there usually is a higher interest rate on the mutual debt of co-ops than on the mortgages of condominiums, cf. for instance Goodman and Goodman (1997).

Whatever the reason for the lower interest rate on mortgage loans, standard economic theory tells us that a rational buyer will discount the lower interest rate on mutual debt in the price he or she is willing to pay for the dwelling. In the next section we model this in detail. Only through careful modelling is it possible to make precise predictions of how co-op prices, through the interest discount effect, will be affected by the existence of mutual debt. Careful modelling also turns out to be most useful as a basis for specifying the econometric model.

A Theoretical Model of Price Differences

In modelling price differences between co-ops and self-owned dwellings we take an approach related to the cash equivalence model, which has been extensively used in the literature on creative financing. Let us consider a household about to purchase a dwelling. Assume that the choice is between two dwellings possessing exactly the same physical and location attributes. One dwelling is self-owned (S), the other is a co-op (C). In order to simplify the exposition, assume initially that institutional form does not in itself affect the price of a dwelling. In accordance with the previous section, the two dwellings are assumed to differ in their mode of financing. In the sequel of this section we examine how different financial arrangements give rise to different equilibrium prices for the two types of dwellings.

Under the assumptions made so far a difference in user costs is the only possible source of price difference between a self-owned and a co-op dwelling. McFadyen and Hobart (1978) distinguish six components of the user costs of housing: the alternative cost of money invested in the dwelling, depreciation, costs of maintenance and repair, property taxes, property insurance, and capital gains. User costs are affected positively by the first five of these components, but negatively by capital gains. We lump depreciation, costs of maintenance and repair, and property insurance, together in one variable. For brevity this variable is called depreciation (D). The depreciation variable is assumed to be constant over time and independent of institutional form. Annual taxes levied on properties are denoted by Z_S for self-owned dwellings and Z_C for co-ops. In accordance with the Norwegian tax laws, taxes are assumed to be different for the two forms of dwellings, with $Z_S > Z_C$. We make the simplifying assumption that taxes in both cases are constant over time. To simplify further we abstract from inflation and assume invariable interest rates over time.[6] With E denoting the price, for self-owned dwellings we then have $E_S^t = E_S^0$ at any time (t). The alternative cost of the money invested in a self-owned dwelling will then be equal to $i_p E_S^0$, where i_p is the (real) interest rate on a bank loan, which is taken to be equal to the (real) interest rate on deposits. Under our assumptions user costs are therefore unaffected by whether the purchase of a self-owned dwelling is financed through a bank loan, by drawing on a savings account, etc. To conclude, the annual user cost for the self-owned dwelling $\left(K_S^t\right)$ can now be written:

$$K_S^t = i_p E_S^0 + Z_S + D. \qquad (1)$$

For a co-op dwelling, depreciation and taxes enter the user cost equation in exactly the same way as for a self-owned dwelling. The alternative cost of the money invested in the dwelling, and the capital gains component, play, however, a more complex role than for a self-owned dwelling. This is because a person who purchases a co-op dwelling will benefit from a lower interest rate on the mutual debt than his or her alternative cost of money. We shall demonstrate that the benefit of a low interest rate on mutual debt, ceteris paribus, will command an equilibrium price *inclusive of mutual debt* that is higher than the price of an identical self-owned dwelling. The mutual debt is, however, paid down as time passes. When a co-op dwelling is sold, the lower mutual debt will therefore lead to a capital loss, which in turn reduces the price. However, even if we want to examine the net effect on the

[6] Kelly (1998) assumes that interest rate differentials between mutual loans held by housing cooperatives and mortgage loans for condominiums may vary over time. This may be important in the United States. In Norway, however, most loans used to finance housing investments have floating interest rates, with approximately constant interest rate differentials between different types of loans over time.

equilibrium price of both the low interest rate on mutual debt and the capital loss, we first focus on the annual user cost of the co-op dwelling *exclusive of capital loss*:

$$\widetilde{K}_C^t = i_P E_C^t + i_M M^t + Z_C + D. \tag{2}$$

The tilde on the cost variable indicates that we for the moment focus on annual user costs exclusive of capital loss. E_C^t is the amount of money invested by the holder of a co-op at time t, M^t is the mutual debt resting on the dwelling at time t, and i_M is the interest rate on the mutual debt. In accordance with the arguments previously made we assume that $i_M < i_p$. As the mutual debt (M^t) is paid down, the amount of privately invested capital $\left(E_C^t\right)$ increases, but under our assumptions the sum $\left(\Pi^0\right)$ of mutual debt and privately invested capital will be constant over time. Hence, for all values of t, $E_C^t + M^t = \Pi^0$. From this it follows that the amount of capital invested in a co-op dwelling up to time t is related to the equity price $\left(E_C^0\right)$ originally paid for the dwelling, and the initial and remaining debt resting on the dwelling, as follows: $E_C^t = E_C^0 + M^0 - M^t$. Substituting this for E_C^t in Eq. 2 yields:

$$\widetilde{K}_C^t = i_P E_C^0 + i_P M^0 - (i_P - i_M) M^t + Z_C + D. \tag{3}$$

Let us next consider the capital loss when a co-op dwelling is sold. The non-discounted capital loss (L^t) is the difference between the invested sum of money $\left(E_C^t\right)$ and the market price (P^t) at time t. Hence:

$$L^t = E_C^0 + M^0 - M^t - P^t. \tag{4}$$

Next, let us discount to $t=0$ the sum of the annual user costs (exclusive of capital loss) given by Eq. 3 and the capital loss when the dwelling is sold, conditional on it being sold at the end of the dwelling's life span, Ω. Assuming that Ω is infinitely large would simplify some of the subsequent derivations, but this is an unnecessary and unwarranted assumption that we will not incur. Discounting user costs (including capital loss) yields the expression on the l.h.s. of Eq. 5 below, where $d_t = \left(1 + i_p\right)^{-t}$. In equilibrium, this present value of the user costs of a co-op dwelling must be equal to the present value of the user costs of a self-owned dwelling, which appear on the r.h.s. of Eq. 5.

$$\begin{aligned} &\sum\nolimits_{t=0}^{\Omega} d_t \left(i_p E_C^0 + i_p M^0 - \left(i_p - i_M\right) M^t\right) + \sum\nolimits_{t=0}^{\Omega} d_t Z_C + \sum\nolimits_{t=0}^{\Omega} d_t D + d_\Omega L^\Omega \\ &\quad = \sum\nolimits_{t=0}^{\Omega} d_t i_p E_S^0 + \sum\nolimits_{t=0}^{\Omega} d_t Z_S + \sum\nolimits_{t=0}^{\Omega} d_t D. \end{aligned} \tag{5}$$

In a perfect market a prospective buyer of a dwelling will not at any point in time obtain a benefit in the form of a reduced user cost by purchasing a co-op dwelling rather than a self-owned dwelling. Consequently the market will at $t=0$ arrive at a unique equilibrium equity price, E_C^0. This equilibrium equity price at $t=0$ will be independent of when the dwelling is sold, and on how many owner-changes there will be in the future. In order to *calculate* this equity price in the simplest possible way, we assume that the dwelling is sold exactly at the point in time when the mutual debt has been paid down (T). In a competitive market the dwelling will then be sold at the same price as a self-owned dwelling with exactly the same attributes, except for a correction for future tax benefits. From Eq. 4, the owner of a co-op dwelling will then incur a capital loss of $L^T = E_C^0 + M^0 - E_S^0 - \sum_{t=T}^{t=\Omega} d_t(Z_S - Z_C)$, where the two last terms taken together are equal to the price (P^t) of a self-owned dwelling, corrected for the present value of tax differences. Inserting this into Eq. 5, and deleting the two equal depreciation terms yields:

$$\begin{aligned}&\sum_{t=0}^{T} d_t\left(i_p E_C^0 + i_p M^0 - \left(i_p - i_M\right) M^t\right) + \sum_{t=0}^{T} d_t Z_C + d_T(E_C^0 + M^0 - E_S^0 \\ &\quad - \sum_{t=T}^{t=\Omega} d_t(Z_S - Z_C)) = \sum_{t=0}^{T} d_t i_p E_S^0 + \sum_{t=0}^{T} d_t Z_S.\end{aligned} \tag{6}$$

Equation 6 can be solved for the equilibrium equity price that the purchaser of a co-op dwelling will pay at time $t=0$:

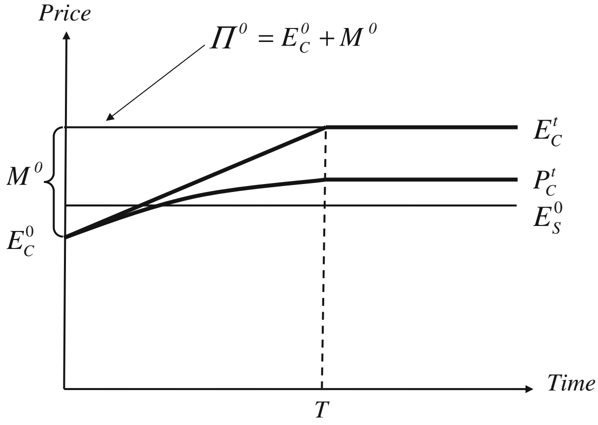
$$E_C^0 = E_S^0 - M^0 + \frac{\left(i_p - i_M\right)\sum_{t=0}^{T} d_t M^t}{d_T + i_p \sum_{t=0}^{T} d_t} + \frac{\sum_{t=0}^{\Omega} d_t(Z_S - Z_C)}{d_T + i_p \sum_{t=0}^{T} d_t}. \tag{7}$$

The interpretation of Eq. 7 is simple: A person who at $t=0$ purchases a co-op dwelling will pay the same as he or she would have to pay for a self-owned dwelling, minus the mutual debt resting on the co-op dwelling, plus a correction term capturing the interest discount effect of the mutual debt, plus a correction term for the tax benefits affiliated with the dwelling. The magnitude of the interest discount effect depends on the interest rate discount on mutual debt ($i_p - i_M$), the discount factors, d_t, the time path for the down payment of the mutual debt, and the remaining time before the mutual debt is paid down. Notice, that the interest discount effect measures the impact of the interest rate discount when the capital loss is taken into account. Capital loss is intimately linked to the presence of the interest discount effect.

If there is no mutual debt, it follows from Eq. 7 that the equity price of a co-op dwelling at $t=0$ will be equal to the price of a self-owned dwelling plus the present value of the tax benefits of a co-op. If there is a mutual debt, but no interest rate discount ($i_p = i_M$), the equity price of a co-op dwelling will be equal to the price of a self-owned dwelling minus the mutual debt plus the tax benefits. If there is a mutual debt and the interest rate discount on mutual debt is positive, the third term on the r.h.s. of Eq. 7 will be positive. The full price, $\Pi^0 = E_C^0 + M^0$, of a co-op dwelling at time $t=0$ will in this case exceed the price of an identical self-owned dwelling. The price difference between the two types of dwellings is due to the interest discount effect and the tax benefits of dwellings in housing cooperatives.

The relationship between the price of a self-owned dwelling and an identical co-op at different points in time is illustrated in Fig. 1. The horizontal line E_S^0 represents the time-invariant price of a self-owned dwelling. The straight upward-sloping line starting from E_C^0 shows, for a person who at $t=0$ acquires a co-op dwelling, how the amount of money invested increases as the mutual debt is paid down. At t = T, when the mutual debt is fully paid down, the line kinks and becomes horizontal at the level $\Pi^0 = E_C^0 + M^0$. The price that the co-op dwelling can be sold for is illustrated by the curve labelled P_C^t. For any value of $t>0$, the P_C^t-curve lies below the kinked

Fig. 1 Prices, money invested, and mutual debt at different times



curve showing the investment in the co-op dwelling. This is due to the capital loss a person who at $t=0$ purchases the dwelling will incur when it is sold at $t>0$. If he or she sells the dwelling soon after it has been purchased, the capital loss will be small. If the dwelling is sold at t = T the capital loss will be maximal. Due to the interest discount effect the P_C^t-curve is close to the investment-line for small values of t. For t > T the distance between the P_C^t-curve and the E_S^0-line corresponds to the present value of tax benefits affiliated with a co-op dwelling, compared to a self-owned dwelling. In drawing Fig. 1 we have implicitly assumed an infinite life span of dwellings, which implies that the P_C^t-curve and the E_S^0-line become parallel for t > T.

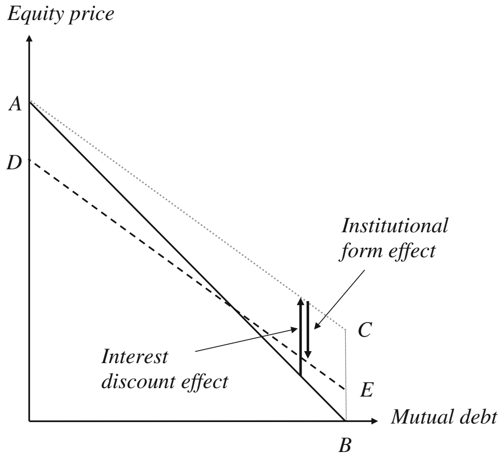
We have so far abstracted from inflation and based the analysis on the assumption that the (nominal and real) price of a self-owned dwelling is constant over time. If there is inflation matters become slightly more complex, but it can be taken into account by measuring all variables, including interest rates, in nominal terms. It can then be demonstrated that the higher the inflation, the smaller will be the magnitude of the interest discount effect. This is due to the fact that inflation causes the real value of the mutual debt to dwindle away.

Let now P^{0j} denote the price of a dwelling at time 0, irrespective of whether it is self-owned or a co-op, with j = 1,...,J indexing dwellings. Let $P^{0j} = E_S^0$ if the dwelling is self-owned, and $P^{0j} = E_C^0$ if it is a co-op. Assume also that the price of a self-owned dwelling is determined by the hedonic price function $f(X^{+j})$, where the vector X^{+j} is a complete measure of all dwelling attributes. Denoting the vector of discount factors by d, the vector (M^0....M^T) of mutual debt variables for dwelling j by M^j, and the present value of the tax difference by Z_Δ^{0j}, the price of a dwelling can be written:

$$P^{0j} = f(X^{+j}) - M^{0j} + g\left(d, M^j, \left(i_p - i_m\right), T\right) + Z_\Delta^{0j} \quad (j = 1, \ldots, J). \tag{8}$$

We denote the first term on the r.h.s. of Eq. 8 "the attribute term", the second "the mutual debt term", the third "the interest discount term", and the last "the tax benefit term". The impact of these terms on the price of a dwelling is illustrated in Fig. 2. Point A gives the price of a dwelling with the attribute vector X^{+j} and no mutual debt. With increased mutual debt the price will drop along the 45^0-line AB if there is

Fig. 2 The interest discount effect and the institutional form effect



neither a tax effect nor an interest discount effect. If there is an interest discount effect, however, this rotates the price function from position AB to AC.

The dwelling attributes contained in the vector X^{+j} are assumed to capture all relevant differences between dwellings, including the physical differences, differences in neighbourhood characteristics, etc. Some elements of the X^{+j}-vector may be hard to measure, and may be distinctly different for co-ops and self-owned dwellings. Let us consider two examples.

It is well known that households of different social status often segregate into different neighbourhoods. Let us consider two physically identical dwellings at equally attractive locations where one dwelling is self-owned while the other is a co-op. The fact that the financing arrangement is likely to lead to a self selection of low-income and credit-rationed households into the housing cooperative may result in a lower socio-economic status for these dwellings. This in turn may result in a reduced demand and a lower market price for dwellings in housing cooperatives than for self-owned dwellings.

Another difference lies in the laws and by-laws governing decisions in housing cooperatives and neighbourhood associations of self-owners. In general the regulations for housing cooperatives are somewhat stricter than is the case for self-owned dwellings. For example, renting the dwelling to another person requires an approval from the board of the cooperative. Such restrictions on dwellings in housing cooperatives will often be perceived as a negative element. On the other hand, it also implies that those living in a co-op enjoy a stronger protection against neighbours behaving non-cooperatively. Hence it is not a priori possible to say for sure which direction differences in the manner housing cooperatives and self-owned dwellings are governed affect the equity price.

We lump together tax benefits of holding a co-op and the hard-to-measure factors like mode of governance and social status into an institutional form effect. Although the tax benefit is positive, it is probably too small to prevent the institutional form effect from shifting the price function in Fig. 2 downwards. Hence, we hypothesize that the prices of co-op dwellings with mutual debt will follow the line DE instead of

AC. We denote the institutional form variable by $I^j(X^{\omega j})$ where $X^{\omega j}$ contains the tax benefit plus all the elements of X^{+j} that are not included in X^j, and let δ be the impact parameter of the institutional form variable. Eq. 8 then takes the form:

$$P^{0j} = f(X^j) + \delta I^j(X^{\omega j}) - M^{0j} + g\left(d, M^j, (i_p - i_m), T\right) \qquad (j = 1, \ldots, J). \quad (9)$$

Econometric Model and Estimation

In specifying a version of Eq. 9 that can be estimated, we have to take into account the nature of the data which will be used in the estimation. We will use cross section data on sales of dwellings. With such data, the mutual debt in some co-op dwellings will be paid down in a few years, while the down-payment period will be long for other dwellings. In other words, the variable T in Eq. 9 will in a cross section sample take different values for different dwellings. Accounting for this, and adding to Eq. 9 a constant term (α_0) and a stochastic error term (ε^j) with zero expectation we obtain:

$$P^{0j} = \alpha_0 + f\left(X^j\right) - M^{0j} + g\left(M^j, D, T^j, i_p - i_m\right) + \delta I^j + \varepsilon^j \quad (j = 1, \ldots, J). \quad (10)$$

We consider two main alternatives for the debt terms in Eq. 10. In both alternatives we take into account that the remaining mutual debt at the beginning of period t in general will be a function of the mutual debt at the beginning of period 0, the interest rate on mutual loans, the total number of years (T^j) for the down-payment of the mutual loan, and whether the loan is a serial loan or an annuity loan (κ). Hence, formally: $M^{tj} = h(M^{0j}, i_m, T^j, t, \kappa)$. For a serial loan (with equal annual down-payments) it is evident that the $h(\cdot)$-function is separable in M^{0j} and the remaining arguments. By induction it can be demonstrated that separability holds also for an annuity loan. Hence, for the relevant types of loans we can without loss of generality write $M^{tj} = M^{0j}\widetilde{h}(i_m, T^j, t, \kappa)$. Furthermore, since we limit ourselves to consider a cross-section of dwellings that are sold within a time period of 1 year, it is reasonable to assume that i_m will be the same for all dwellings. Hence, we can write: $M^{tj} = M^{0j}\,\approx\!\!\!\!h(T^j, t, \kappa)$. Using this, the two debt terms in Eq. 10 can be written:

$$\begin{aligned} -M^{0j} + g\left(M^j, D, T^j, i_p - i_m\right) &= -\left[1 - \frac{(i_p - i_M)\sum_{t=0}^{T^j} d_t \overset{\approx}{h}(T^j, t, \kappa)}{d_T + i_p \sum_{t=0}^{T^j} d_t}\right] M^{0j} \\ &= k(T^j, t, \kappa) M^{0j} \qquad (j = 1, \ldots, J). \end{aligned} \quad (11)$$

The k-function in this expression depends on the length of the (remaining) down-payment period (T^j), the magnitude of the dummy variable κ capturing whether the loan is a serial loan or an annuity loan, and finally on the interest rates that are incorporated in the functional symbol. Hence, k is not a constant. However, on the assumptions that all housing cooperatives face the same interest rates we have, for a serial loan with equal annual down-payments, carried out simulations to assess how the magnitude of k varies with the length of the down-payment period, with $T \in [1, 30]$. Normally, the mutual debt of housing cooperatives consists of annuity loans that are paid down over the first 30 years after the dwelling was built. The simulation results show that the magnitude of k varies between 0.99 (for T=1) and 0.89 (for T=30). For an annuity loan, simulations show that k varies between 0.99 (for T=1) and 0.88 (for T=30).

We tackle the problem of a non-constant k by estimating two variants of the specification based on Eq. 11. In the first specification, we simply treat k as if it were a constant. In the second specification we assume $k = k^0 + \psi\widetilde{T}^j$, where k^0 and ψ are parameters to be estimated, while $\widetilde{T}$ is a proxy for the number of years remaining before the mutual debt is paid down. Based on the simulations described above we expect $\psi < 0$, and this prediction will be tested. Finally, note that if k takes the value 0.9 it means that the buyer of a co-op dwelling will have to pay an "overprice" amounting to 10% of the mutual debt resting on the dwelling at the time of purchase. This is due to the interest discount effect—the buyer has to pay a price for the benefit of a mutual loan with a low interest rate.

We will also estimate a specification where the debt-terms are given by:

$$-M^{0j} + g\left(M^j, D, T^j, i_p - i_m\right) = \beta_1 M^{0j} + \beta_2 Max\left\{\left(M^{0j} - \tau_M\right), 0\right\} \quad (j = 1, \ldots, J). \tag{12}$$

Specification (12) will be used to test for the possibility that mutual debt may have a non-linear impact on the price of a dwelling. Notice, however, that the two terms on the r.h.s. of Eq. 12 are not equivalent to the third and fourth terms on the r.h.s. of Eq. 10. We expect $-1 < \beta_1 < 0$ and $\beta_2 > 0$, and will test for this.

Consider next briefly the specification of the standard hedonic part of the price function, $f(X^j)$. This function is likely to be nonlinear in some of its arguments, particularly in variables like the size and the age of dwellings. These variables are not at our primary focus, but in order to obtain an undistorted estimate of the impact of mutual debt on price it is important to model appropriately the influence of size and age. Non-linearity in size and age is often accounted for by Box-Cox transformations, or by using polynomials. We follow instead Poirier and Garber (1974) and approximate non-linearity by means of spline functions. Let x_k^j be a variable for which we use a spline function, and define the associated variable $x_{k+1}^j = Max\left\{\left(x_k^j - \tau_k\right), 0\right\}$. The dependent variable (P^{0j}) can then, through variables x_k^j and x_{k+1}^j, be made a piecewise linear function of x_k^j, with the slope of the function changing at $x_k^j = \tau_k$. If we let x_1^j and x_3^j denote the size and age of the dwelling, let τ_B and τ_A represent the kink points in the size (B) and age (A) variables, and let $x_2^j = Max\left\{\left(x_1^j - \tau_B\right), 0\right\}$ and $x_4^j = Max\left\{\left(x_3^j - \tau_A\right), 0\right\}$, the hedonic price function takes the form:

$$f\left(X^j\right) = \alpha_1 x_1^j + \alpha_2 x_2^j + \alpha_3 x_3^j + \alpha_4 x_4^j + \sum\nolimits_{k=5}^{K} \alpha_k x_k^j \quad (j = 1, \ldots, J). \tag{13}$$

We will try to estimate τ_M through a grid-search. Principally, it would be possible to estimate also τ_B and τ_A through a grid-search. However, since the basis for making a priori choices of τ_B and τ_A is fairly good, we will simply fix these parameters at τ=50 and τ_A=24.[7] Once the model is estimated, sensitivity analysis can be carried out to examine if another choice of parameters τ_B and τ_A would change the results significantly. In particular, it is important to examine whether the choice of τ_B and τ_A affect the impact coefficients of the debt variables.

Four variants of the econometric model will be estimated. First, we estimate a linear baseline equation (Specification A), where we include only a plain debt-variable as specified in Eq. 11 along with the basic control variables for size, age, dummies for block/non-bloc building and cooperative/non-cooperative, and location dummies. Second, we estimate Specification B, which is similar to Specification A, except that spline functions are used for the size and age of dwellings, and the block/non-bloc dummy in Specification A is replaced by an interaction term between size and the block/non-block dummy. Third, we estimate Specification C, which is similar to Specification B, except that we also include an interaction tem between the mutual debt and a proxy for number of years remaining before the mutual debt is paid down. Fourth, we estimate Specification D, which is similar to Specification B, except that a spline function is used also for the mutual-debt-variable. All specifications will be estimated by OLS, but we will try to estimate τ_M in Specification D through a grid-search.

Data Collection and Descriptive Statistics

We use data on transactions of dwellings in Kristiansand, the fifth largest city in Norway, with a population of 80,000. The housing market in Kristiansand is representative of the Norwegian housing market. According to Statistics Norway (2001), 77% of the housing units in both Kristiansand and in the country as a whole were owned by their occupants. Of those living in their own dwellings, about 20% of the households in Kristiansand lived in housing cooperatives, while the corresponding figure for Norway as a whole was 18%. Furthermore, 21% of the housing units in Kristiansand, and 19% in the country as a whole, were in blocks of apartments.

We collected data in two rounds. In the first round we registered all properties announced for sale in newspapers and property leaflets during 2004, including a number of attributes. Subsequently the properties in the sub-sample of self-owned dwellings were matched with the corresponding sales prices from the public register

[7] The clue in determining the value of the parameter τ_B in the spline function for size is that the marginal cost of building is likely to be a declining function of size. The decline in the marginal cost of size is, however, likely to be stepwise. A complete but compact dwelling with a living room, one bedroom, kitchen, bathroom, and a small hall cannot be much smaller than 50 m^2. When dwellings become larger, the increase in size basically comes about through increasing the size of each room, then by dividing the bedroom area in several rooms, and eventually adding another (often quite basic) bathroom. From this, it is likely that the spline function for the size variable will have a kink at approximately 50 m^2 , implying a lower marginal price on each square meter above 50 than for the area below 50 m^2. Consequently, we choose τ_B=50.

The clue in determining the magnitude of τ_A in the spline function for age is that major rehabilitations of dwellings usually occur with intervals of 20–30 years. From this, it is likely that the price of a dwelling will drop significantly during the first 20–30 years after it has been constructed. A 50 year old dwelling is likely to be sold at a somewhat lower price than a 25 year old dwelling, but since a 50 year old building is likely to have gone through at least one major rehabilitation the price difference is unlikely to be dramatic. Similarly, the price difference between a 75 year old and a 50 year old dwelling is likely to be moderate. Consequently, we chose τ_A=24, which for our data implies that the kink of the spline function for the age variable occurs in 1980.

of properties. This generated a data set of 2,068 housing units, covering more than 80% of all market transactions in 2004.

In the second round of data collection information on transactions of co-op dwellings in 2004 was recorded. Since sales prices of such dwellings are not recorded in the public register of properties, these data had to be collected separately. The two housing associations that are active in the Kristiansand market provided data on the price and main attributes of each housing unit.

Taken together, the data provides a reasonably complete account of housing transactions in Kristiansand in 2004. There are a few minor deficiencies, though. First, some self-owned dwellings advertised for sale towards the end of 2003 that were sold in 2004, are not included in the sample. The number of units in this category is, however, likely to be very small, since the average time-on-market in Kristiansand in that period was only 3 weeks, and very few dwellings are advertised for sale in December. Another problem is that the data on co-ops may include some transactions that were not the result of a competitive bidding process, mainly due to sales within the family and transfer of property rights by inheritance.[8]

There are no detached houses in Norwegian housing cooperatives. Hence, all detached self-owned houses were excluded from the sample. We also excluded cases where the price or the size of the dwelling was not observed. Finally, we excluded two self-owned luxury apartments of a quality unmatched by apartments in housing cooperatives.[9] After these exclusions, we were left with a sample of 894 housing units for which we have complete information on all variables used in the empirical part of the paper. Of these, 490 are in housing cooperatives, and 404 are self-owned dwellings.

Table 1 contains descriptive statistics for the basic variables used in the empirical analysis, except dummy variables of location, which are not of primary interest. The span in sales price, size and age is substantial, for both self-owned and co-op dwellings. The span in size is larger for self-owned housing units. Since the first Norwegian housing cooperatives were established after World War II, some of the self-owned dwellings are considerably older than the co-ops. Self-owned dwellings carry no mutual debt, but this is also the case for 4% of the co-ops. Among the co-op dwellings, 54% carry a mutual debt in the interval 0–100,000 NOK, 40% in the interval 100,000–500,000 NOK, and 2% in the interval 500,000–1,000,000 NOK. No dwelling carried a mutual debt exceeding 1,000,000 NOK, and the minimum equity ratio (equity price divided by the sum of the equity price and the part of the mutual debt resting on the dwelling) is 0.15. The fact that only a small share of the dwellings in the sample carries a large mutual debt may result in difficulties in identifying a possible non-linearity of the debt-function. We return to this in the next section. Finally, notice that 74.5% of the co-ops and 70.5% of the self-owned dwellings are in bloc buildings.

Table 2 contains the correlation matrix for the main independent variables that will be used in estimating hedonic price functions. The partial correlations are

[8] According to the Norwegian tax laws also transactions due to inheritance have to be made at market prices, but we cannot rule out that prices in some cases may be slightly lower than would be the result of a competitive bidding process. Since such non-market transactions are not included in the data on self-owned dwellings, they should not be included in the data on cooperative housing units either. We have, however, no way of detecting non-market transactions. The number of such transactions is small, though.

[9] These two dwellings were sold for 5.2 and 4.3 million NOK (8 NOK ≈ 1 EURO). By comparison, the most expensive unit in a housing cooperative was sold for 1.9 millions, and carried in addition a mutual debt of 1 million.

Table 1 Descriptive statistics (N=894)

	Minimum	Maximum	Mean	St. deviation
Total sample				
Price	170,000	3,300,000	1,071,248	407,881
Mutual debt	0	1,000,000	70,012	125,334
Size	22	239	79.78	28,86
Age	0	111	34.16	18.13
Not bloc	0	1	0.7271	0.4457
Co-op subsample				
Price	170,000	1,900,000	878,805	255,256
Mutual debt	0	1,000,000	127,735	145,938
Size	22	155	71.59	20.49
Age	0	65	34.88	11.18
Not bloc	0	1	0.7449	0.4364
Self-owned subsample				
Price	400,000	3,300,000	1,304,658	435,826
Mutual debt	0	0	0	0
Size	21	239	89.71	33.99
Age	0	111	33.29	23.99
Not bloc	0	1	0.7054	0.4564

moderate, perhaps except the correlation between mutual debt and the dummy variable for institutional form (Co-op), which amounts to 0.5075.

Estimation Results

Estimation results for Specifications A and B are shown in Table 3, while the results for Specifications C and D are displayed in Table 4. Exact variable definitions are provided in the Appendix. In the baseline equation in Table 3, the independent variables explain 69% of the variation in sales prices, while they in Specification B explain 71.5%. The adjusted R-square of the two more complex specifications in Table 4 does not exceed that of Specification B. Also, in all the estimated equations the coefficients carry the expected signs, and except for a few of the location dummies, most of the coefficients of

Table 2 Correlation matrix of main variables

	Size	Age	Not bloc	Mutual debt	Co-op
Size	1.0000	−0.2017	0.1476	0.0300	−0 .3126
Age		1.0000	0.0767	−0.2459	0.0436
Not bloc			1.0000	0.0773	0.0441
Mutual debt				1.0000	0.5075
Co-op					1.0000

Table 3 Estimation results for baseline equation and simplified spline-equation[a]

	Specification A baseline equation	Specification B restricted spline-equation
AREA	7697.227***(321.1463)	18768.7***(1857.760)
AREA>50	–	−11122.62***(1985.248)
AGE	−5048.687***(532.9491)	−12252.85***(1550.050)
AGE>24	–	10874.38***(2142.710)
NOBLOCK	−52186.68* (20744.36)	–
ARNOBLOC	–	−930.3279***(244.2351)
CO-OP	−127713.5***(22007.56)	−82192.2***(23442.93)
DEBT	−0.766799***(0.083093)	−0.899653***(0.082645)
SQUARE-B	−140661.6***(51077.10)	−105183.9* (49342.84)
EG	−140009.8 (72269.87)	−165761.3* (69539.87)
RAVN	−314822.0***(51160.82)	−322115.8***(49381.14)
SETESD	−406873.0***(58358.14)	−412136.1***(56316.95)
HØIE	−751924.8***(77352.64)	−728512.8***(74521.70)
VÅGSB-A	−468575.4***(58536.16)	−466252.6***(56269.80)
VÅGSB-B	−430608.7***(52483.20)	−404050.6***(50748.36)
VÅGSB-C	−545877.7***(64573.43)	−467573.0***(64036.68)
VÅGSB-D	−534817.1***(76062.25)	−492776.1***(73402.89)
VÅGSB-E	−612449.2***(52286.95)	−582818.7***(50578.74)
VÅGSB-F	−620082.7***(52475.45)	−569763.0***(52154.51)
VÅGSB-G	−548359.3***(70789.26)	−484250.0***(68588.25)
VÅGSB-H	−400341.5***(50583.63)	−373512.8***(48901.09)
LUND	−8196.866 (46683.56)	−23088.8 (44505.58)
KONGSG	−72063.8 (55736.55)	−84610.5 (53603.61)
GIMLEK	−323822.6***(61755.01)	−281625.6***(59218.84)
JÆRNES	−859577.6***(68605.77)	−769987.9***(67718.15)
SØM	−488421.1***(50765.22)	−406494.2***(51814.76)
HÅNES	−519369.9***(60340.64)	−488956.8***(58004.64)
FIDJE	−348314.6***(85460.45)	−356206.6***(82056.97)
OTHER	−518779.2***(123131.9)	−477394.7***(118496.1)
CONST	1149297 (48831.05)	689461.8 (96278.99)
R^2	0.6911	0.7154
R^2-adj.	0.6818	0.7062
F	74.60	77.65

[a] Standard errors in parentheses

An * indicates that the coefficient is significantly different from zero at the 5% level, ** at the 1% level, and *** at the 0.1% level

primary interest are statistically significantly different from zero at the 5% level or better. From these observations it seems reasonable to focus mainly on Specification B. Specifications C and D will, however, be used to test for the more complex mutual-debt-effects discussed earlier.

Table 4 Estimation results for regressions with alternative debt-terms[a]

	Specification C	Specification D
AREA	18956.3***(1875.576)	18752.1***(1882.194)
AREA>50	−11324.3***(2004.491)	−11104.5***(2012.289)
AGE	−12007.8***(1585.645)	−12266.9***(1570.863)
AGE>24	10550.5***(2187.790)	10895.6***(2177.024)
ARNOBLOC	−914.7***(245.2112)	−930.5***(244.3938)
CO-OP	−76169.2** (24829.74)	−82697.6***(25118.97)
DEBT	−1.010214***(0.171154)	−0.891812***(0.162104)
DEBTPERIOD	−0.005145 (0.006974)	–
DEBT>300K	–	−0.016177 (0.287638)
SQUARE-B	−107657.3* (49469.58)	−105037.4* (49439.99)
EG	−170064.7* (69802.37)	−165477.4* (69762.83)
RAVN	−322848.8***(49404.14)	−322089.3***(49411.87)
SETESD	−411885.6***(56332.82)	−412439.6***(56607.11)
HØIE	−729285.5***(74548.70)	−728773.3***(74708.36)
VÅGSB-A	−467790.6***(56323.23)	−466228.5***(56303.89)
VÅGSB-B	−404036.2***(50761.73)	−404077.2***(50779.82)
VÅGSB-C	−462619.1***(64404.59)	−468283.8***(65308.10)
VÅGSB-D	−493777.0***(73434.77)	−492841.8***(73454.52)
VÅGSB-E	−586313.7***(50813.39)	−582621.2***(50729.67)
VÅGSB-F	−570069.2***(52169.90)	−569727.9***(52188.31)
VÅGSB-G	−492261.4***(69460.47)	−483956.2***(68826.37)
VÅGSB-H	−374246.9***(48924.10)	−373473.6***(48934.24)
LUND	−24489.7 (44557.79)	−23050.6 (44536.44)
KONGSG	−82907.2 (53667.43)	−84772.8 (53712.13)
GIMLEK	−284437.4***(59356.94)	−281479.8***(59309.68)
JÆRNES	−765168.0***(68050.34)	−770528.6***(68436.03)
SØM	−397549.8***(53227.60)	−407099.1***(52948.55)
HÅNES	−491494.5***(58121.82)	−488709.3***(58204.57)
FIDJE	−355767.4***(82080.76)	−356269.3***(82111.86)
OTHER	−479323.3***(118556.2)	−477381.8***(118564.7)
CONST	677576.1 (97642.70)	690370.5 (97680.09)
R^2	0.7156	0.7154
R^2-adj.	0.7060	0.7058
F	74.95	74.89

[a] Standard errors in parentheses

An * indicates that the coefficient is significantly different from zero at the 5% level, ** at the 1% level, and *** at the 0.1% level

Let us first consider how mutual debt affects the price of a dwelling. In Specification B (the restricted spline equation), the magnitude of the mutual debt parameter is estimated to −0.89. The estimate is contained in the quite narrow interval we found in the earlier mentioned simulations, and it is significant at standard levels of statistical significance. Also, the precision with which the impact coefficient of the debt variable is estimated in Specification B is slightly better than in Specification A. Hence, it seems that correct modelling of the impact of size, age and type of dwelling (bloc vs. non-bloc) is important in order to obtain a reliable estimate of the mutual debt parameter, which is the main focus of the present paper.

In Specification C, for which the results are given in Table 4, the estimated coefficient of the remaining down-payment-period term is not significant at standard levels of statistical significance. Hence, there is no evidence that the time remaining before the debt is paid down has any influence on the debt coefficient.

Consider next the results for the full spline equation, shown as Specification D in Table 4. Compared to Specification B this equation contains an additional debt-term, which captures a possible non-linearity in the impact of mutual debt. The estimation results for the full spline function (Specification D) shown in Table 4 are obtained by choosing τ_M=300,000, and then estimating the remaining parameters by OLS.[10] With such a choice of τ_M we obtain a statistically significant coefficient affiliated with one of the debt terms. Comparing the results for the full spline equation in Table 4 and the restricted spline-equation in Table 3 we also notice that the results for the estimated coefficient of the mutual-debt-variable in the two equations differ very little. The same is the case for the coefficients of other control variables. The *F*-statistic is, however, higher for Specification B, which implies that there seem to be little reason to prefer Specification D over the restricted spline-equation. Hence, we conclude that there is no evidence of a non-linear relationship between mutual-debt-variable and the price of dwellings.

Co-ops are, according to the results for Specification B, sold at prices that on average are 82,000 NOK lower than the prices for identical self-owned dwellings, cf. the coefficient affiliated with the CO-OP-dummy, which is significantly smaller than zero at standard levels of statistical significance. This clearly suggests that there is an institutional form effect. Comparing the institutional form coefficients across all the estimated specifications we can conclude that the correct estimation of the magnitude of this effect depends critically on correct modelling of the impact of size and age on price. On the other hand, the results for the institutional form effect seem to be robust with respect to the specification of the debt terms.

Finally, let us briefly consider the results for the control variables size, age of building, type of dwelling, and location dummies. For the size variables the results for Specification B in Table 3 imply that the marginal price of each m^2 below 50 m^2 is 18,768 NOK, while it for area above 50 m^2 is 7,646 NOK (=18,768

[10] We also tried to determine the value of τ_M through a grid-search. This resulted in τ_M=15,000 but the optimal value of τ_M was very poorly identified. Moreover, at the optimal τ_M the impact coefficients of both debt variables turned out to be insignificantly different from zero at standard levels of statistical significance. There are probably three factors contributing to this result. First, for "small" τ_M-values the two debt variables become strongly correlated. Second, our data contain few cases with high levels of debt, and without a sufficient number of such cases it is difficult to identify deviations from a simple linear relationship between mutual debt and the equity price. Third, the underlying deviation from simple linearity is likely to be relatively small, if there is non-linearity at all.

−11,122). Similarly, the marginal reduction in price per year that has elapsed since the building was built is 12,252 NOK up to an age of 24 years, but only 1,378 NOK (=12,252−10,874) for each year exceeding 24. Notice also that the negative coefficient of the ARNOBLOCK-variable implies that dwellings that are not in block houses are sold at lower prices than dwellings in block houses, and that the price difference between block and non-block dwellings is much larger for large dwellings than for small. A likely reason for this is that non-block houses in Norway usually are made of wood, while block-houses are made of concrete. The negative sign of the ARNOBLOCK-variable is in accordance with the fact that in Norway wooden buildings are cheaper to build. Finally, the negative coefficients of all the location dummies imply, as expected, that prices of dwellings outside the city centre are lower than prices in the city centre. The relative magnitudes of the location coefficients roughly correspond to the distance from the city centre, but differences in neighbourhood characteristics also play a role. The few coefficients of location dummies that are not statistically significant are affiliated with popular areas relatively close to the city centre. The centre of the city is the left-out baseline category.

Discussion

In the preferred specification (Specification B) the coefficient of the mutual debt variable was estimated to −0.89. This estimate is fairly stable towards variations in the specification of the regression. Moreover, the estimated parameter is contained in the interval established through simulations. The interpretation of a mutual debt coefficient of −0.89 is that an increase in the mutual debt of 1 NOK reduces the price of a co-op by 0.89 NOK. Our estimate of the mutual debt coefficient is smaller than −1 because the purchaser of a Norwegian co-op benefits from a mutual loan with a low interest rate.

The result that mutual debt is almost perfectly discounted into housing prices provides strong evidence that the local Norwegian housing market we have studied is indeed efficient. We see no particular reasons why this result should not be valid also for the Norwegian market in general. It is of great interest also to compare our results with those obtained by Hjalmarsson and Hjalmarsson (2009), who studied the market for Swedish co-ops. They found that only 75% of future rent differentials, which depend on down-payments and interest payments on mutual loans due in the years to come, were discounted into the sales prices of dwellings. Hence, they concluded that the market for Swedish co-ops does not seem to be efficient. In our view it is rather surprising to find such diverging results for the Swedish and Norwegian markets for co-ops. We doubt that the two markets are so different that the results might indicate. Presumably, different types of data, and different data quality, may explain the different results. Specifically, we will maintain that our data are of high quality, and that this in particular is the case for our concise measure of mutual debt. The variable used by Hjalmarsson and Hjalmarsson (2009) for measuring future obligations in serving the mutual debt is possibly more noisy. This may be one of the reasons why the results based on Swedish data differ from our results.

Based on US data, Kelly (1998) found excessive discounting of future financial obligations, while Smith et al. (1984) and most other researchers have arrived at the opposite conclusion. Our results lie in-between these two extremes. The widely diverging results obtained from US data may be due to differences in data and estimation procedures. For instance, the data and methods used by Kelly (1998) and Smith et al. (1984) differ in various respects. It seems that additional studies are needed in order to sort out whether the diverging results are due to special properties of the data or the estimation methods.

Next, let us turn to the institutional form effect. In the preferred specification, for a self-owned block dwelling of average size, average age, with an "average" location dummy of magnitude −450,000, we can (on the basis of Specification B) calculate the sales price to 1,096,199 NOK. By comparison, for an identical co-op dwelling, with zero mutual debt, the estimation results tell that the price will be 82,192 NOK lower. Consequently, we find a co-op discount of 9.3%. This result is robust towards variations in the specification of the regression. Our estimate of the co-op discount in Norway lies amazingly close to the 9% co-op discount reported by both Kelly (1998) and Goodman and Goodman (1997), and the 8.7% reported by Schill et al. (2007).[11] Hence, we conclude that there in Norway as well as in the US seems to be a co-op discount of similar magnitude.

With an estimated co-op discount of 82,192 NOK and a mutual debt parameter of magnitude −0.89, our empirical results are almost perfectly mirrored in Fig. 2. If there had been no co-op discount and the price of a co-op had been reduced by 1 NOK for each 1 NOK increase in mutual debt, the relationship between the mutual debt and the sales price would have followed the line AB. With the estimated mutual debt parameter of −0.89, the price-debt schedule is flatter, as illustrated by the line AC. Finally, the co-op discount shifts the price-debt schedule down from AC to DE.

Our estimation results imply that second-hand buyers of dwellings have to pay a price for mutual loans carrying low interest rates. When viewed separately, the interest-discount effect makes co-ops more expensive than comparable self-owned dwellings. This suggests that subsidising interest rates on mutual debt will give distributional effects in the first hand market that do not carry over to the second-hand market. On the other hand, the co-op discount of 82,192 NOK works in the opposite direction, making co-ops cheaper than a self-owned dwelling. Taken together these two effects imply that a new co-op dwelling, with a high mutual debt, may be more expensive than a new self-owned dwelling. By contrast, an old co-op dwelling, with a small mutual debt, will be cheaper than a self-owned dwelling of comparable age, size, etc.

[11] We have calculated the co-op discount from the right column of Table 3 in Goodman and Goodman (1997). Schill et al. (2007) report that a typical condominium sells at a premium of 15.5%, compared with a co-op. Converting this to a co-op discount we obtain 8.7% (100/115.5=0.087).

Concluding Remarks

Our goal has been to examine the impact of institutional form and financial arrangements on housing prices. For this purpose we developed a theoretical model well suited for studying the relationship between equilibrium sales prices for self-owned and co-op dwellings. We have found convincing empirical evidence for the existence of an interest-discount effect on the prices for cooperative housing. The magnitude of the interest-discount effect corresponds almost perfectly to results we obtained through simulations, and suggests that the housing market we studied is efficient. This striking result stands in contrast to the diverging results found in other studies.

We have also found strong evidence for the presence of an institutional form effect in the form of a co-op discount. The co-op discount was in our case estimated to 9.3%, and corresponds very well to what other researchers have found. It seems that the co-op discount in Norway is of the same magnitude as in the United States.

It should be mentioned that there may be an alternative explanation for what we have called the interest discount effect. The alternative explanation takes as a starting point that home buyers do not understand the role of mutual debt, and fail to take it fully into account. If this is the case, one would expect the equity price to behave in a similar manner as in our model, but for very different reasons. We find this explanation less appealing, however, as the mutual debt and monthly instalments on mutual debt are clearly announced in the sale prospects for co-op dwellings. Hence, the buyer should be well informed of the costs incurred due to the mutual debt.

Our interest in how prices for co-ops are formed, and for how they compare with the prices of self-owned dwellings, rests on the presumption that housing cooperatives may offer opportunities for low-income households to purchase their own dwelling. We have argued that the Norwegian form of housing cooperatives may make this possible, through circumventing credit rationing restrictions. Our empirical analysis was, however, based on a data set that contained no information on the type of households occupying co-ops and self-owned dwellings. An obvious next stage in the research on these issues would be to use a data set containing information on the households living in both self-owned and co-ops, and examine the demand for the two forms of dwellings. Unfortunately such data have so far not been available to us. We expect, however, that exploitation of this type of data could be very informative.

Another extension of our research would be to carry out a more comprehensive comparison of the Norwegian system of cooperative housing with the systems of housing in United States and other European countries. Through this kind of research it might be possible to better assess which institutional forms that are most conducive in increasing home-ownership.

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Appendix

Table 5 Variable definitions

Variable name	Definition
AREA	Size of the dwelling measured in m^2
AREA>50	Size of the dwelling measured in m^2 minus 50 if AREA > 50, otherwise 0
AGE	Years since the building of the dwelling was constructed
AGE>24	Years since the building of the dwelling was constructed minus 24 minus 24 if AGE > 24, otherwise zero
NOBLOCK	Dummy variable equal to 1 if the dwelling is not in a bloc building, otherwise 0
ARNOBLOCK	Product of AREA and NOBLOCK
CO-OP	Dummy variable equal to 1 if the dwelling is part of a housing cooperative, otherwise 0
DEBT	Mutual debt resting on the dwelling, measured in NOK
DEBTPERIOD	REMAINYEARS × DEBT, where REMAINYEARS = (30—AGE) if AGE < 30, and REMAINYEARS = 0 if AGE ≥ 30.
DEBT >300	Mutual debt resting on the dwelling, measured in NOK minus 300,000 if DEBT > 300,000, otherwise zero

All remaining variables are location dummies, with the left-out category being the most central part of the town

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