Evaluating Dutch Housing Market Regulation

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Abstract

Although the primary goals of post war housing policy in The Netherlands have been accomplished, the Dutch housing market remains highly regulated. This paper develops a static partial equilibrium model to investigate the effects of deregulation on the free market prices and the allocation of houses among households. We focus on three policy measures: individual rent support, social housing projects and the fiscal rules for owner occupied houses. We conclude that abolishing fiscal rules for owner occupant do not affect net yearly expenses on housing. Decreasing individual rent support increases prices on the whole housing market. Finally, less social housing hardly affects market prices, but lowers the inefficiency of the distribution of the stock of houses among households.

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1 Introduction

In the post war period the Dutch housing market is characterized by a high degree of the government regulation (see Dieleman, 1994; Oosterhaven, 1989). The key objective of government policy in this period has been providing sufficient housing at the best possible quality (Feddes, 1995: chapter 7). Prices were to be kept low to support the policy of wage-moderation. By correcting unwanted market outcomes and alleged market failures policy-makers have tried to fulfill these main goals of the Dutch public housing policy.

According to Van Schaaijk (1996) the most important goals of the post war housing policy have been realized. The critical need for housing has been met, the share of owner occupied houses has increased and the quality of the housing has improved considerably. Affordable rental houses are attainable for everyone, through social housing projects, individual rent support or a combination of both. All these goals have been accomplished in spite of strong increases in the population, changes in household composition and decreases in the average number of occupants per house. However, subsequent administrations have shown no intention to deregulate the Dutch housing market. For political reasons the ruling coalition of liberals and social democrats wishes to maintain tax deducible interest payment on mortgages and planned to increase the budget for social housing and individual rent support with 125 million guilders (approximately 60 million dollar). Additionally, a subsidy for low-income owner occupants will be introduced as a complement to the tax deductibility of interest payments for these groups.

In this paper we address the question how deregulation of the housing market would affect the allocation of houses among households and the price of houses. From a policy point of view it would be optimal if houses were equally distributed over income; the household with the highest income should live in the most expensive house and the household with the lowest income should live in the cheapest house (see Dieleman, 1994). It turns out that the distribution of houses over income is skewed. For example, in 1998 17% of the tenants living in a cheap house did not belong to the lowest income category. While, on the other hand, 5% of the tenants living in an expensive house belongs to the lowest income category.[1] This places a high burden on the government budget. The skewed distribution may partly reflect individual preferences and high costs of moving. However, to a large extend it is caused by government market interventions, which opens up the possibility for welfare improvements if the housing market would be deregulated.

To analyze the effects of market regulation we develop a static, microeconomic partial equilibrium model. We assume homogeneous preferences and the standard assumptions of Marshallian consumer theory apply. Equilibrium on the housing markets implies that prices are such that every household occupies a house and has no incentives to move. When ignoring the cost of moving, this equilibrium is Pareto efficient. In this model deregulation of the housing market may reduce the skewness of the housing distribution and therefore Pareto improvements may be realized.

The structure of this model is suggested by Smith, Rosen and Fallis (1988), who do however not incorporate such a model. Previous studies of the Dutch housing market concentrate on the demand side of the market and ignore the supply side, so price adjustments can not be analyzed (see Jurriëns, Kikstra and Suijker, 1992). Some simulation models are able to analyze price adjustments, but do not take into account the interactions between the market for rental houses and the market for owner occupied houses (see Van Schaaijk, 1986, 1996). These are essential features and we show that the results of previous studies are amended when using a partial equilibrium model of the housing market that includes both rental and owner occupied houses.

In the economic literature, most papers on regulation on the housing market

[1] All data used in this paper is from the Ministry of Public Housing, Spatial Planning and Environmental Issues (1999).

focus on the rental part of the housing market. For example Rapaport (1992) studies the effects of rent regulation in New York. The reduced form estimation results in this study show that rent control reduces the inflow into a vacancy, but does not affect the expected duration of vacancy. Anas (1997) derives a static equilibrium model for the rental housing market, which is divided in a rent-controlled market and a free market. The framework in this study differs from ours as Anas considers households having the same income but who are heterogeneous in their utility function. He shows that introducing a central matching agency may improve household welfare as it reduce search costs.

We are aware of the limitations of our model. The most important restriction is the static structure and our equilibrium assumption that every household lives in an 'optimal' house, i.e. the houses are ranked by quality and assumed to be distributed over income accordingly. Furthermore, in addition to the government regulation incorporated in our model, there are many other frictions on the housing market, like the high costs of moving. Households only move if the extra utility derived from the 'new' house compared to the 'current' house compensates the moving costs. A logical extension of our model is therefore a dynamic model in which households search for houses that yield higher utility. Such a model has similarities with search models applied on the labor market. Wheaton (1990) derives a dynamic framework like this and concentrates in the presence of search frictions on the relation between vacancies and prices. Van der Vlist, Rietveld and Nijkamp (1998) extend this framework to an equilibrium framework including residential choice and mobility.

These limitations make our model unsuitable for detailed quantitative policy analysis and we are not able to say anything about the transition path after deregulation. However, the partial equilibrium character of the model and the fact that we take into account the entire housing market using endogenous prices, enables us to analyze the main effects of housing market deregulation in a theoretically consistent manner. Therefore, the model contributes to a better understanding of the functioning of the housing market. We are able to indicate which deregulation policies are most likely to generate welfare gains. The results are presented by comparing the analytical outcomes of the model in the current regulated situation as opposed to a completely deregulated housing market. A simulation analysis is added to illustrate the results.

We focus on three policy measures: individual rent support (IRS), social housing programs and the fiscal rules for owner occupied houses (tax deductible interest payments and the rentable value). We show that the effects of government regulation are twofold. First, social housing projects reallocate houses among households, i.e. low-income households end up living in high quality houses at low expenses. Second, individual rent support decreases the price of both owner occupied and rental houses, while the current fiscal rules for owner occupants do not affect the yearly net expenses of any household.

The outline of this paper is as follows. Section 2 gives a description of some of the institutional aspects of the Dutch housing market. Some theoretical background on how regulation might affect household behavior on the housing market is presented in Section 3. In section 4 we subsequently introduce the baseline model, the model including regulation and we evaluate the effect of government regulation. A simulation analysis in which we mimic deregulation of the housing market is included to illustrate the results. Section 5 concludes.

2 Institutional aspects

The Dutch housing market is characterized by a relatively high share of rental houses. Although recently the share of owner occupied houses increased to a little over 50%, within the European Community The Netherlands, after Germany, still have the smallest share of owner occupied houses. Family houses are most often owner occupied, while apartments are almost always occupied by tenants. Three out of four rental houses are rented by a housing corporation or municipal housing company. Most of the direct subsidizing in the housing market is in the market for rental houses. Subsidized owner occupied houses make up only a small part of the housing market. Prices in the social housing sector are considerably lower than in the free market sector. In 1999 the rental price in the free market sector was about 29% higher than in the social housing sector, corrected for heterogeneity between houses.

From a government point of view it is optimal if households tune their housing consumption to their income. Low-income households should live in cheap (rental) houses – to limit expenses on individual rent support – and high-income households should live in the more expensive houses to limit the demand for social housing. However, as is shown in table 1 the distribution of tenants is highly skewed.

Negative skewness of the household distribution is caused by households who do not belong to the lowest income category, but who live in a cheap rental house.[2] If low-income households live in an expensive house, the distribution of households is positively skewed. Since 1986 the distribution of household by income over the stock of houses has become less positively skewed. However, in 1998 still 30% of the expensive houses was occupied by low-income households. The number of households with a relatively high income living in a cheap house slightly increased in recent years. In 1998, 39% of the cheap rental houses was occupied by a tenant with a relatively high income.

In The Netherlands virtually all aspects of the housing market are affected by government policy. Price building is affected by rent control, subsidies and tax laws. The (local) government decides in which areas to build houses and influences the supply of houses by housing corporations. In that way it directs

[2] The lowest-income category is defined as $<$ 27.595 guilders annual income for a single-person household or $<$ 37.629 guilders annual income for a multi-person household. Cheap rent is defined as $<$ 701 guilders per month, while rent is considered as expensive if $>$ 939 guilders per month. These thresholds prices relate to 1998.

the supply of houses. Residence permits and income limits influence the allocation of existing houses. Finally, the government has a wide range of instruments to influence the quality of new and existing houses. Table 2 shows the fiscal and budgetary impact of some of the housing market regulations that we evaluate in this paper.

In 1996 tax deductible interest payments resulted in a tax outlay of 8.4 billion guilders. This was compensated by 2.2 billion guilders tax levy due to the rentable value. In The Netherlands all interest payments are tax deductible at the marginal tariff, while all owner occupants are taxed for the rentable value of their house. Due to the favorable conditions at the housing market both fiscal outlays and revenues have increased strongly in recent years. Because the fiscal outlays due to the tax deductibility of interest payments are higher than tax revenues due to the rentable value and the real estate transfer tax (which for ever transaction has to be paid by the buyer of a house), the fiscal treatment of houses of owner occupants can be seen as an indirect government subsidy.[3]

In line with the decreased positive skewness of the tenants distribution the number of households receiving IRS decreased in recent years (from 949.000 in 1990 to 922.300 in 1996). The total expenditures on IRS have been rising, as a result of the increased amount of IRS per household. The average amount of IRS per household rose from 149 guilders per month in 1990 to 199 guilders per month in 1996. Households are only entitled to IRS if their rent does not exceed 1.107 guilders a month and the household income does not exceed 47.750 guilders annually (see Koning and Ridder (1997) for a more extensive discussion on the Dutch IRS system) .

In recent years the total net subsidy for owner occupants and the direct subsidy for tenants (the IRS) are more in balance. While in 1990 net tax outlays for

[3] Owner occupants are also taxed by local governments for real estate and there are a number of dwelling subsidies that try to stimulate renovation and energy saving investments by owner occupants. In the remainder of this paper we do not consider these local government regulations.

owner occupants were more than twice as high as the total spending on IRS, in 1996 the total subsidy for owner occupants is about 60% higher than the total subsidy for tenants.

3 Theoretical background on housing market regulation

Regulation of the housing market influences the behavior of households and suppliers of houses in may ways. Several authors have developed models to explain and quantify these effects. On theoretical grounds a number of effects can be expected. Subsidizing of houses, by means of IRS or through fiscal policy, increases demand for housing services (see Koning and Ridder, 1997). At a given or inelastic supply this leads to price increases. Rent increases in the social housing market are limited by rent control. As a result the supply of houses increases at a much lower rate than the demand. Consequently, there becomes a shortage of houses in this particular segment of the market. More people start to look for an owner occupied house, which leads to higher prices in the owner occupied segment of the housing market too. Because tenants in the social housing sector pay a price that is below the equilibrium price, they are less inclined to move. This limits mobility at the housing market, which is especially negative for young people with a low income who enter the housing market. Finally, we note that housing market regulation generates transaction costs that have a negative influence on the functioning of the market mechanism. This type of regulation exists at both the demand and the supply side of the housing market (see Venti and Wise, 1984). Transaction costs may for example be priority rules for particular types of households by municipalities and other demand regulating rules for tenants. On the market for owner occupied houses the most important form of transaction costs in The Netherlands is the transfer tax that has to be paid by buyers. At the supply side of the market the many legal permits that are required for building (social) rental and owner occupied houses raise transaction costs.

A first attempt to model the Dutch housing market is made by Van Schaaijk (1986). In an experimental micro simulation model he shows how liberalization of the market for rental houses and the resulting behavioral reactions can be modeled. The model has both a demand and a supply side with adjustment processes for prices and quantities. The model does not take into account the effects that price adjustment in the rental market have on the prices of owner occupied houses. Van Dugteren (1995) only considers the demand side of the housing market. Like Van Schaaijk (1996) the supply side is assumed to be exogenous. Both studies use a hedonic pricing method to account for heterogeneity between houses. Jurriëns, Kikstra and Suijker (1992) developed a dynamic model of the housing market where exogenously determined incomes of households are used to explain movements between rental houses and five types of owner occupied houses. They consider the effect of policy measures on the balance between rental houses and the five types of owner occupied houses. Jurriëns, Kikstra and Suijker (1992) take prices on the housing market as exogenous. Especially for owner occupied houses this is a serious limitation, notably because it prevents them from modeling utility maximizing agents as suggested in Smith, Rosen and Fallis (1988). Such an approach allows prices to be endogenous.

4 Modelling the housing market

4.1 The baseline model

In this section we present the model that we use to evaluate the effects of deregulating of the Dutch housing market. We mainly focus on how deregulation affects equilibrium prices and the allocation of houses on the free housing market. In subsection 4.2 we introduce government regulation into the model. Subsection

4.3 shows how government regulation affects the equilibrium prices on the free housing market and we conclude this section with a simple computational example.

The model we use is a single period partial equilibrium model. The demand side of the model consist of households, which are assumed to maximize utility. On the supply side of the model, the sellers and landlords of houses are assumed to maximize the price of their houses. In our setting, the housing market is assumed to be a competitive market, implying that none of the suppliers of houses has sufficient market power to influence equilibrium market prices. To compare owner occupied houses with rental houses we focus on yearly gross housing expenses of a household and refer to this as the price of a house. This approach is legitimate because the expenses of owner occupied houses are linked to the price through interest and redemption payments on the mortgage.

A house[4] is characterized by its quality, which is a single variable denoted by h. Although this variable is unobserved, it can be interpreted as a function of observed characteristics of the house, like the number of rooms, age and location. The use of a single variable to denote the quality of houses allows us to rank houses. A higher value of h means that the house is more attractive to households. We assume the quality of houses to be bounded, $h = \overline{h}$ is the house with the highest quality and $h = \underline{h}$ is the house with the lowest quality. Note that this is not a restrictive assumption if the number of houses is finite. The total stock of houses consists of M houses, M_1 owner occupied houses and $M - M_1$ rental houses, distributed on the interval $\left[\underline{h}, \overline{h}\right]$ according to the distribution function $G(h)$. In this subsection we only distinguish between owner occupied houses and rental houses. In the next subsection we introduce social housing as a third type of houses. We make the simplifying assumptions that owner occupied houses have a higher quality than rental houses, so the quality of a owner occupied house lies

[4] Apartments and single rooms that can be let are also considered as houses.

in the interval $\left[G^{-1}\left(\frac{M-M_1+1}{M}\right), \overline{h}\right]$ and the quality of a rental house in the interval $\left[\underline{h}, G^{-1}\left(\frac{M-M_1}{M}\right)\right]$. A owner occupied house can not be let and also rental houses can not be sold.

A household can spend its income y on housing denoted by h or on other consumption denoted by c. Households are assumed to be homogeneous in their preferences, which are expressed by a Cobb-Douglas utility function,

$$u(h,c) = h^{\alpha}c^{1-\alpha} \tag{1}$$

Let the price (yearly expenses) of a house with quality h be denoted by $p(h)$ and without loss of generality the price of other consumption is normalized to 1. The household's budget restriction equals

$$p(h) + c \leq y \tag{2}$$

Maximizing the utility function (1) subject to the budget restriction (2) gives the maximum price that a household with income y is willing to pay for a house with quality h,

$$p(h,y) = y - \gamma h^{-\frac{\alpha}{1-\alpha}} \tag{3}$$

where $\gamma > 0$ is an unknown parameter, which describes the sensitivity of the price with respect to the quality of a house. The derivation of this equation can be found in Appendix A.

Households are assumed to be homogeneous in their preferences, consequently they only differ in their income y. Household's incomes are assumed to lie in the interval $\left[\underline{y}, \overline{y}\right]$, where $\underline{y}$ can be interpreted as the minimum welfare benefit. The household's incomes are distributed on this interval according to the distribution function $F(y)$. The number of households equals N and is assumed to be smaller than the total number of houses M but larger than the total stock of owner occupied houses M_1. This assumption is crucial for the remainder of the model. The justification lies in the idea that if the market price of (rental) housing increases, more house-owners are willing to let a part of their house. This increases the stock of rental houses available. Hence, if the market prices are sufficiently high, the stock of houses available exceeds the number of households. Thus, the total stock of houses is fixed, however the part of this stock which is occupied depends on the prices.

As mentioned earlier both landlords and sellers of houses operate in a competitive market and maximize the price paid for their house. Letting a house gives some costs to the landlord, for example administration and maintenance costs. These costs denoted by b are assumed to be sunk and independent of h. A landlord only lets his house if the price exceeds b. The profit function of a landlord is then given by

$$W_l\left(h\right) = \max\left(p\left(h\right) - b, 0\right)$$

An owner occupant has yearly expenses on mortgage $p\left(h\right)$. The mortgage payments consists of interest and renumerations. Let η be the fraction of the annual mortgage that consists of interest. Then the profit of the seller of an owner occupied house is given by

$$W_o\left(h\right) = g\left((1-\eta)p(h)\right)$$

in which $g(\cdot)$ is a strictly increasing function that links yearly expenses on mortgage to actual selling prices.

Equilibrium on the housing market is reached through price adjustment. The following three propositions are used to characterize the equilibrium:

Proposition 1 *Consider household i with income y_i living in a house with quality h_i. In equilibrium, every household $j \neq i$ with income $y_j < y_i$ lives in a house with quality $h_j \leq h_i$.*

Proposition 2 *Houses with quality in the interval $\left[\underline{h}, G^{-1}\left(\frac{M-N}{M}\right)\right]$. remain unoccupied.*

Proposition 3 *Let* $h' = G^{-1}\left(\frac{M-N+1}{M}\right)$, *then under the condition that* $G(h)$ *is a well-behaved function* $p\left(h'\right) \downarrow b$ *as* $N \to \infty$.

The prove of these propositions can be found in Appendix B. In the remaining we suppose that N is sufficiently large, such that we can use the approximation $p(h') = b$ in Proposition 3.

Proposition 1 shows that the ranking of households by income is similar to the ranking of households by the quality of their house, which is the idea of Pareto efficiency in the model. According to Proposition 2 houses with the lowest quality remain unoccupied. Combining these two propositions gives the relation between the household's income and the quality of the occupied house. To be more precise, the quality of a household's house follows from finding the house with the same ranking as the household's income, i.e. equalizing the number of houses with a higher quality and the number of households with a higher income. Consider the household with income y, then there are $N(1-F(y))$ households with a higher income. The quality of this household's house can be found by finding h, such that the number of houses with a higher quality $M(1-G(h))$ equals $N(1-F(y))$,

$$h(y) = G^{-1}\left(\frac{N}{M}F(y) + \frac{M-N}{M}\right) \tag{4}$$

For the household with the lowest income $\underline{y}$, there are $N-1$ households with a higher income, i.e. $F(\underline{y}) = \frac{1}{N}$. From substituting this into the equation above and using Proposition 3 follows that $p\left(G^{-1}\left(\frac{M-N+1}{M}\right), \underline{y}\right) = b$. Thus using equation (3) we can compute the equilibrium value of the parameter γ,

$$\gamma = \left(\underline{y} - b\right) G^{-1}\left(\frac{M-N+1}{M}\right)^{\frac{\alpha}{1-\alpha}} \tag{5}$$

Finally, substituting equation (5) and (4) into equation (3), gives the price that a household with income y pays in equilibrium for their house,

$$p(y) = y - \left(\underline{y} - b\right) G^{-1}\left(\frac{M-N+1}{M}\right)^{\frac{\alpha}{1-\alpha}} G^{-1}\left(\frac{N}{M}F(y) + \frac{M-N}{M}\right)^{-\frac{\alpha}{1-\alpha}}$$

The equation shows that decreasing the cost of letting b also decreases the price of housing for all households.

4.2 The model including regulation

In this subsection we modify the model such that it allows for three types of government regulation: individual rent support (IRS), fiscal rules for owner occupied houses, and social rental housing projects. From now on we distinguish between the gross price (yearly gross expenses) and the net price (yearly net expenses) of a house. The yearly net price takes into account the amount of money received from IRS and from tax returns due to fiscal rules.

To be eligible for IRS a household must live in a rental house and have an income below a certain threshold value $\tilde{y}$.[5] The amount of IRS depends on the difference between the household's income and the threshold income $\tilde{y}$, the household size and the rent. For simplicity we assume that the amount of IRS is a fraction ν of the difference between the household's income y and $\tilde{y}$, so that it equals $\nu(\tilde{y} - y)$.

Fiscal rules for owner occupants are comprehensive. The most important fiscal rules are tax deduction of interest payments on mortgages and tax addition for the rentable value. Tax deduction of the interest payments on mortgages lowers the gross price of an owner occupied house with a fraction κ_1, while tax addition for the rentable value increases the gross price with a fraction κ_2. De facto the fiscal rules for owner occupied houses lowers gross prices of owner occupied houses with a fraction $\kappa = \kappa_1 - \kappa_2$, such that the gross price of an owner occupied house with quality h equals $(1 - \kappa)p(h)$.

To evaluate the impact of social housing projects we distinguish between social housing let by housing corporations or municipal housing companies, and private houses let by landlords. Social housing has a quality h in the interval $\left[\underline{h}_s, \overline{h}_s\right]$, with $G^{-1}\left(\frac{M-N}{M}\right) < \underline{h}_s < \overline{h}_s < G^{-1}\left(\frac{M-M_1}{M}\right)$. Within this interval social housing is a fraction δ of the stock of houses, so that $M_s = \delta M\left(G\left(\overline{h}_s\right) - G\left(\underline{h}_s\right)\right)$ is the

[5] The conditions are slightly modified (see section 2), a more extensive discussion on IRS in The Netherlands is given in Koning and Ridder (1997).

total stock of social housing. The household's income must be lower than the threshold income $\tilde{y}$ to be eligible for social housing. Therefore $N_s = NF(\tilde{y})$ households are eligible for social housing. We make the following assumptions: (i) The number of households eligible for social housing is larger than the number of social houses, $N_s > M_s$, (ii) the rent of a social house is much below the market price (see section 2), such that every household eligible for social housing accepts it when is offered, and (iii) each household eligible for social housing has an equal probability to occupy.

Supplying social housing decreases the stock of private housing. Because every household actually accepts a social house when offered, also the number of households occupying private houses decreases. Social housing causes the ranking of households based on income to deviate from the ranking based on the quality of the house and hence deviates from the Pareto efficient situation. Note that the free housing market, which consists of owner occupied houses and private-owned rental houses, contains $M - M_s$ houses. The quality of the houses on the free market is distributed according to

$$G^*(h) = \begin{cases} G(h)/(1-\tau) & \underline{h} \leq h < \underline{h}_s \\ (\delta G(\underline{h}_s) + (1-\delta)G(h))/(1-\tau) & \underline{h}_s \leq h \leq \overline{h}_s \\ (G(h)-\tau)/(1-\tau) & \overline{h}_s < h \leq \overline{h} \end{cases}$$

with

$$\tau = \delta\left(G\left(\overline{h}_s\right) - G(\underline{h}_s)\right)$$

Fiscal rules for owner occupied houses and IRS only influence the budget restriction of the household. We distinguish three segments: owner occupants, tenants with IRS and tenants without IRS. For each segment the shape of the budget restriction is given by

$$\begin{array}{ll} \text{Owner occupants:} & (1-\kappa)\,p(h) + c \leq y \\ \text{Tenants without IRS:} & p(h) + c \leq y \\ \text{Tenants with IRS:} & p(h) + c \leq y + \nu(\tilde{y} - y) \end{array} \tag{6}$$

It is important to stress that IRS does not affect the ranking of the households by income including IRS compared to the ranking by income excluding IRS. Maximization of the utility function (1) under the new budget restriction (6) gives the maximum gross price a household is willing to pay for a house with quality h

$$\begin{array}{ll} \text{Owner occupants:} & p(h,y) = \frac{1}{1-\kappa} y - \gamma_1 h^{-\frac{\alpha}{1-\alpha}} \\ \text{Tenants without IRS:} & p(h,y) = y - \gamma_2 h^{-\frac{\alpha}{1-\alpha}} \\ \text{Tenants with IRS:} & p(h,y) = y + \nu(\tilde{y} - y) - \gamma_2 h^{-\frac{\alpha}{1-\alpha}} \end{array} \tag{7}$$

Propositions 1, 2 and 3 are still valid on the free market and can be used to establish the equilibrium. Thus, establishing the equilibrium is quit similar to subsection 4.1 and is not discussed at length again. The household with the lowest income $y_{\min}$ that was not offered a social housing, rents the house with quality $G^{-1}\left(\frac{M-N+1}{M}\right)$ and pays a rent equal to b. Moreover it should be noted that as $y_{\min}$ is smaller than $\tilde{y}$, which means that the household is eligible for IRS.[6] Analogous to (5), using (7) we can compute γ_2 as

$$\gamma_2 = (\nu\tilde{y} + (1-\nu)\,y_{\min} - b)\,G^{-1}\left(\frac{M-N+1}{M}\right)^{\frac{\alpha}{1-\alpha}} \tag{8}$$

When determining the equilibrium value of γ_1, consider the household living in the highest quality rental house and the household living in the lowest quality owner occupied house. In equilibrium both households prefer their house at the market price above the other household's house at the market price. The owner occupant living in the lowest quality house has income $F^{-1}\left(\frac{N-M_1}{N}\right)$ and the quality of the house is $G^{-1}\left(\frac{M-M_1}{M}\right)$. Therefore γ_1 equals

$$\gamma_1 = \frac{\gamma_2}{1-\kappa} \tag{9}$$

[6]Above we assumed that if a household is eligible for IRS it is also eligible for living in social housing. We assumed that the number of social housing M_s is smaller than the number of households eligible for social housing N_s, so that even in the free housing market there are households receiving IRS.

So far we assumed that $y_{\min}$ is known. However, this is not the case because $y_{\min}$ depends on the allocation of social housing among households. $y_{\min}$ is defined as the household with the lowest income that did not obtain social housing. The allocation of social housing is a stochastic process in which each households has an equal probability of obtaining social housing. Therefore, $y_{\min}$ is a stochastic variable with expectation

$$\mathbb{E}\left[y_{\min}\right] = \sum_{k=0}^{M_s} F^{-1}\left(\frac{k+1}{N}\right) \frac{\begin{pmatrix} N_s - k - 1 \\ M_s - k \end{pmatrix}}{\begin{pmatrix} N_s \\ M_s \end{pmatrix}} \tag{10}$$

Substituting (10) into (8) and (9) allows us to compute the expected equilibrium values of γ_2 and γ_1. And using Proposition 1, equation (7), $\mathbb{E}\left[\gamma_1\right]$ and $\mathbb{E}\left[\gamma_2\right]$ we are able to determine the expected equilibrium prices on the free housing market. The resulting formulas are not very transparent, so we do not present them.

4.3 The effects of regulation

In this subsection we investigate the effects of government regulation on the expected model outcomes.[7] We start with the effects of IRS, then we consider changing fiscal rules for owner occupants, and finally we focus on social housing. We also pay attention to changes in the costs of letting b on the gross and net equilibrium prices.

Earlier we argued that IRS does not affect the ranking of households based on income, which implies that the allocation of houses among households is also unaffected. Moreover, IRS affects gross equilibrium market prices of both rental houses and owner occupied houses. To investigate the effect of increasing IRS ($\nu \uparrow$), we focus on the first derivatives of the gross equilibrium market price (see

[7]We omit the expectation operator in the remainder of the section, although the regulation effects refer to expected regulation effects.

equation (7)). If a household receives IRS, it obtains an extra income by IRS, but also the gross price of their house changes. The sum of these two effects is the net price $p(h,y) - \nu(\tilde{y} - y)$, with the first derivative

$$\frac{\partial p(h,y) - \nu(\tilde{y} - y)}{\partial \nu} = \frac{\partial y - \gamma_2 h^{-\frac{\alpha}{1-\alpha}}}{\partial \nu} = -h^{-\frac{\alpha}{1-\alpha}} \frac{\partial \gamma_2}{\partial \nu}$$

Note that this equals the effect of IRS on the gross prices of houses occupied by households who are not eligible for IRS (see equation (7)). The first derivative of the gross price of owner occupied houses with respect to ν equals $-h^{-\frac{\alpha}{1-\alpha}} \frac{\partial \gamma_1}{\partial \nu}$. From equation (9) follows that $\frac{\partial \gamma_1}{\partial \nu} = \frac{1}{1-\kappa} \frac{\partial \gamma_2}{\partial \nu}$, so that the sign of the derivative is the same, i.e. IRS has a similar effect on owner occupied houses as on rental house. As $\tilde{y}$ is larger than $y_{\min}$, from equation (8) follows that the derivative of both γ-parameters with respect ν is larger than 0. Increasing IRS decreases the gross price of houses in which households live that are not eligible for IRS. The gross prices of houses occupied by households eligible for IRS may increase, but the increase is smaller than the extra amount of IRS that the household collects. The intuition of this result is that IRS makes housing cheaper for low-income households, which has spillover effects to the more expensive segments of the housing market. It must be stressed that this is just a partial effect, we did not take into account how IRS is financed by the government. Because The Netherlands have a progressive tax system, most likely the major part of the additional tax to finance IRS comes from the high-income households. IRS is therefore merely an instrument for income redistribution with the positive side-effect that it decreases net prices on the housing market.

The fiscal rules for owner occupied houses only affect the gross price of owner occupied houses, i.e. γ_2 is independent of κ (see equation (8)) so $p(h,y)$ of rental houses is unaffected by changes in fiscal rules (see equation (7)). Consider the case where κ increases. The first derivative of the gross price of owner occupied houses with respect to κ equals

$$\frac{\partial p(h,y)}{\partial \kappa} = \frac{1}{(1-\kappa)^2} y - h^{-\frac{\alpha}{1-\alpha}} \frac{\partial \gamma_1}{\partial \kappa}$$

$$= \quad \frac{1}{(1-\kappa)^2}\left(y - \gamma_2 h^{\frac{\alpha}{1-\alpha}}\right) = \frac{1}{1-\kappa} p(h,y)$$

This first derivative is non-negative. More generous fiscal rules for owner occupants increase the gross prices of their houses. However, also the tax returns of owner occupants increase. The total tax returns equal $\kappa p(h,y)$, with the first derivative

$$\frac{\partial \kappa p(h,y)}{\partial \kappa} = p(h,y) + \kappa \frac{\partial p(h,y)}{\partial \kappa} = \frac{1}{1-\kappa} p(h,y)$$

This is exactly equal to the first derivative of the gross price of the house. In turns out that fiscal rules for owner occupants do not affect net prices on housing for any household. In this context fiscal rules are useless. However, the amount of tax returns provided by the government must be paid by the tax payers. Because mortgages have to be higher, mortgagors have more turnover and thereby profit from these fiscal rules.

During the most recent election in The Netherlands (May 1998), it was suggested to introduce a threshold price of the house for the deductability of interest payments. Hence κ has a relatively high value up to this threshold price and above this threshold price κ has a lower value. In the line of reasoning given above a lower deductability above the threshold value only affects the gross prices of houses above this threshold price. Also in this setting net prices remain unaffected.

We now turn on social housing. First we focus on decreasing the stock of social houses, which is represented by decreasing δ. If the number of social rental houses M_s decreases the expected income of the household with the lowest income not living in a social rental house decreases. A lower value of $y_{\min}$ leads to a decline of γ_1 and γ_2, so that the gross prices of houses increase. However, social housing also affects the number of houses and the number of households on the free market, which decreases the gross prices on the free housing market. Which effect dominates depends on the shape of $G(h)$ and $F(y)$. Within the rental sector of the housing market the allocation of households over houses also changes. Households living in a private rental house with a quality lower than $\overline{h}_s$ obtain a house with a better quality. Households living in a house with a quality higher than $\overline{h}_s$ stay in the same house.

Second we focus on an extreme option concerning the deregulation of the social housing market. Suppose that we could enforce an 'optimal' allocation of the social housing among households (i.e. there exists no positive and negative skewness of the tenants distribution). This implies that social houses are distributed to the households with the lowest incomes, instead of the current system where a number of households with low income have an equal probability of obtaining social housing. In this extreme case $y_{\min}$ becomes nonstochastic and the value of $y_{\min}$ increases the expected value in any other case.[8] As mentioned above, increasing the value of $y_{\min}$ decreases the gross prices of houses. Such a policy can be stimulated by decreasing the threshold income $\tilde{y}$.

The government can make letting of houses more attractive, for example by lowering administrative obligations, etcetera. Such policies decrease the value of the parameter b. Note that the gross price of houses only depends on b via the γ-parameters. The first derivative of γ_1 with respect to b equals the first derivative of γ_2 with respect to b. Decreasing the value of b has a similar effect on the gross price of owner occupied houses and rental houses. As

$$\frac{\partial \gamma_i}{\partial b} = -G^{-1}\left(\frac{M-N+1}{M}\right)^{\frac{\alpha}{1-\alpha}} < 0 \qquad i = 1, 2 \tag{11}$$

decreasing the value of b increases the value of γ_i and therefore decreases the gross prices of both rental houses and owner occupied houses.

4.4 A simple example

In this subsection we use some fixed values of the parameters to illustrate the effects of government regulation. Most numbers in this example are from the

[8]To be more precise the value of $y_{\min}$ equals the maximum value with a positive probability in any other situation.

Ministry of Public Housing, Spatial Planning and Environmental Issues (1999). The values of the remaining parameters are fixed such that the situation with regulation coincides as much as possible with the current situation on the Dutch housing market. We assume that there are 6 million households and 8 million houses of which 3.2 million are owner occupied houses. The minimal household's income $\underline{y}$ equals 25000 guilders and household's incomes are distributed according to a lognormal distribution with the modus at 40000 guilders. Households with an income lower $\tilde{y} = 36000$ guilders are entitled to IRS and eligible to social housing. The quality of houses is also distributed according to a lognormal distribution function, $\underline{h}$ is normalized to 0 and social housing is 60% of all houses in the quality interval [0.03; 0.1]. The parameter α of the utility function is set to 0.01 and the costs of letting a house b are assumed to equal 2000 guilders. The fiscal rules parameter κ equals 0.25 and the amount of IRS is 10% of the difference between the household's income and $\tilde{y}$. Given these parameter values we consider three situations, (*i*) the situation without any government regulation, (*ii*) the situation in which there is only IRS and (*iii*) the situation with all existing government regulation.

As is mentioned earlier, none of the regulations has any effect on the ranking of households based on their income. Therefore, the difference in the allocation of houses among households only exists because part of the rental houses are in to the social housing segment. Households living in a house with quality above $\overline{h}_s$ are not affected by social housing.

In the Figures 1 and 2 we show the effects of government regulation. We distinguish between net and gross expenses on the housing. The example shows that in the owner occupied segment of the housing market (yearly net income above 38000 guilders) the gross expenses in the regulated situation exceed those in the other situations (see Figure 1). However, the net expenses are lower in the regulated situation (see Figure 2). When comparing the fully regulated situation with the situation where there is only IRS, the net expenses for owner occupants do not differ.

IRS causes the net yearly expenses on housing to decrease for all households. On average the net expenses decrease with 3000 guilders, while the quality of housing remains unaffected. Finally, social housing does not seem to have a big impact on the gross and net prices of houses. Abolishing social housing causes a small decreases in prices on the cheapest part of the rental segment.

5 Conclusion

The Dutch housing market is highly regulated, virtually all aspects of the housing market are affected by government policy. This paper gives a short overview of the government regulations, and analyzes how the most important regulations affect the prices an distribution of houses. To evaluate the effects of regulation we have derived a static microeconomic model. Our approach differs from other studies because we consider equilibrium on both the rental and the owner occupied segment of the housing market. A clear advantage is that prices are endogenous and determined by the demand and supply of housing.

Equilibrium on the housing market implies a perfect sorting between households and houses. This is mainly due to the static structure of the model and thereby the absence of frictions on the housing market. Of course this perfect sorting does not occur on the Dutch housing market. For example negative skewness (high-income households living in cheap rental houses) occurs relatively often. Two main explanations are transaction costs involved in moving to a more expensive house and the existence of the social sector. A household living in the social (rental) segment is not obliged to move if this household does not meet the eligibility requirements anymore, for example after an increase in income. Although frictions largely determine the equilibrium on the housing market, we think that our simplified model is able to give an indication of the effects of regulation.

The theoretical results show that social housing is the only government policy that affects the allocation of houses among households. Some low-income households benefit, because they live in a relative high-quality house at a price which is below the equilibrium price. The other regulations considered only affect equilibrium prices, but do not influence the distribution of high- and low-quality houses. Individual rent support decreases the prices of both rental houses and owner occupied houses, while the fiscal rules for owner occupants increase the gross yearly expenses of owner occupants. Although, fiscal rules do not affect the net yearly expenses of households on housing, even not in the owner occupied segment. We conclude that there are potential welfare gains when simultaneously deregulating the owner occupied and rental houses segment of the Dutch housing market. This conclusion is even stronger if we also take into account that these regulation must be financed by the government. Individual rent support is merely a policy instrument for redistributing income with a positive side-effect that it decreases expenses on housing. Fiscal rules only oblige households to take higher mortgages. In this light fiscal rules for owner occupants are an indirect subsidy of the tax payers to the mortgagors.

The framework developed in our paper shows that the equilibrium prices on the owner occupied segment of the housing market depend on the equilibrium prices on the rental sector of the housing market. Therefore government policies aimed at the rental sector affect not only prices on this segment but also on the owner occupied segment. This stresses the importance of modeling both segments of the housing market simultaneously.

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A Analytical derivation of the model

The Lagrange function of the optimization of the Cobb-Douglas utility function (1) under the budget restriction (2) equals,

$$\mathcal{L} = h^{\alpha} c^{1-\alpha} - \lambda \left(p\left(h\right) + c - y \right)$$

with the first order conditions

$$\begin{aligned}
\frac{\partial \mathcal{L}}{\partial h} &= \alpha \left(\frac{c}{h} \right)^{1-\alpha} - \lambda \frac{\partial p\left(h\right)}{\partial h} = 0 \\
\frac{\partial \mathcal{L}}{\partial c} &= \left(1-\alpha\right) \left(\frac{h}{c} \right)^{\alpha} - \lambda = 0 \\
\frac{\partial \mathcal{L}}{\partial \lambda} &= p\left(h\right) + c - y = 0
\end{aligned}$$

Solving these equations gives the differential equation

$$p\left(h\right) = y - \frac{1-\alpha}{\alpha} h \frac{\partial p\left(h\right)}{\partial h}$$

with the unique solution

$$p\left(h, y\right) = y - \gamma h^{-\frac{\alpha}{1-\alpha}} \tag{12}$$

where $\gamma > 0$ is an unknown parameter.

The equilibrium value of the parameter γ can be computed. We know that the household with the lowest income $\underline{y}$ rents the house with quality $G^{-1}\left(\frac{M-N+1}{M}\right)$ against price b. Substituting this into equation (12), gives

$$b = \underline{y} - \gamma G^{-1} \left(\frac{M-N+1}{M} \right)^{-\frac{\alpha}{1-\alpha}}$$

which we can solve for γ

$$\gamma = \left(\underline{y} - b \right) G^{-1} \left(\frac{M-N+1}{M} \right)^{\frac{\alpha}{1-\alpha}}$$

B Prove of the propositions

Prove of Proposition 1 *Recall that $y_i > y_j$. Household $k = i, j$ lives in a house with quality h_k with price p_k. Consider that $h_i < h_j$. Note that in equilibrium both households prefer their situation – quality of housing with the price – over the situation of all other households. It is obvious that $p_i \geq p_j$ can not be the case in equilibrium, household i than lives in a lower quality house and pays at least the same price as household j, therefore $p_i < p_j$. From the household's budget restriction follows $p_j < y_j$, such that $p_i < p_j < y_j < y_i$. An utility maximizing household consumes all income that is not spend on housing, which means that $c_k = y_k - p_k$, $k = i, j$. Now focus on the equilibrium condition that both households prefer their situation over the situation of the other household. Therefore the equilibrium conditions that must hold equal: $h_i^\alpha (y_i - p_i)^{(1-\alpha)} \geq h_j^\alpha (y_i - p_j)^{(1-\alpha)}$ and $h_j^\alpha (y_j - p_j)^{(1-\alpha)} \geq h_i^\alpha (y_j - p_i)^{(1-\alpha)}$. Combining these equilibrium conditions, gives the following inequality which must hold:*

$$\frac{y_i - p_j}{y_i - p_i} \leq \left(\frac{h_i}{h_j}\right)^{\frac{\alpha}{1-\alpha}} \leq \frac{y_j - p_j}{y_j - p_i}$$

Recall that $p_j > p_i$, which implies that the function $\frac{y-p_j}{y-p_i}$ strictly increases in every $y > p_i$. Because $y_i > y_j > p_i$, the equilibrium conditions do not hold in case $h_j > h_i$. This proves that in equilibrium, if $y_i > y_j$ then $h_i \geq h_j$.

Prove of Proposition 2 *Consider the case in which a house with quality $h^* > G^{-1}\left(\frac{M-N}{M}\right)$ is unoccupied. In that case there is at least one household living in a rental house with a quality lower than h^*. Recall that this household is paying at least a price b to live in the house. However, when paying a similar price this household can also live in the higher quality house h^*, which they obviously prefer. Therefore, in equilibrium only the lowest quality houses remain unoccupied, which are the houses with quality in the interval $\left[\underline{h}, G^{-1}\left(\frac{M-N}{M}\right)\right]$.*

Prove of Proposition 3 *Propositions 1 and 2 show that the household with the lowest income $\underline{y}$ lives in the house with quality $h' = G^{-1}\left(\frac{M-N+1}{M}\right)$. If the owner of* *this house asks a price which is too high, the household can threat to move to the unoccupied house with quality* $h^* = G^{-1}\left(\frac{M-N}{M}\right)$ *which can be rented against price* b. *Using the household's utility function we are able to determine the maximum price* $p(h')$ *the owner of the house with quality* h' *can ask such that the household prefers his house. This is given by solving the equality:* $h^{*\alpha}(\underline{y}-b)^{1-\alpha} = h'^{\alpha}(\underline{y}-p(h'))^{1-\alpha}$. *Moreover, if*

$$p(h') \leq \left(\frac{h^*}{h'}\right)^{\frac{\alpha}{1-\alpha}} b + \left(1 - \left(\frac{h^*}{h'}\right)^{\frac{\alpha}{1-\alpha}}\right) \underline{y}$$

with

$$\frac{h^*}{h'} = \frac{G^{-1}\left(\frac{M-N+1}{M}\right)}{G^{-1}\left(\frac{M-N}{M}\right)}$$

Note that if h^* *converges to* h', *then* $p(h')$ *converges to* b. *Sufficient conditions for the convergence of* h^* *to* h' *are that* $G(h)$ *is a continuous function and* $N \to \infty$ *(as we assumed* $M > N$*).*

		1986	1990	1994	1998
Positive skewness					
	households	188	162	106	111
	% of expensive houses	45	41	29	30
Negative skewness					
	households	639	728	738	666
	% of cheap houses	34	38	40	39

Table 1: Positive and negative skewness of tenants distribution (numbers $\times$ 1000).

	Owner occupants				Tenants	
	tax deduction interest payments	rental value	real estate transfer tax	net tax outlays	total IRS	monthly IRS per household
1990	5.862	1.102	1.190	3.651	1.698	149
1996	8.361	2.212	2.560	3.589	2.199	199

Explanation: All amounts except monthly IRS per household are in billion guilders.

Table 2: Tax outlays and subsidies for housing market policies.

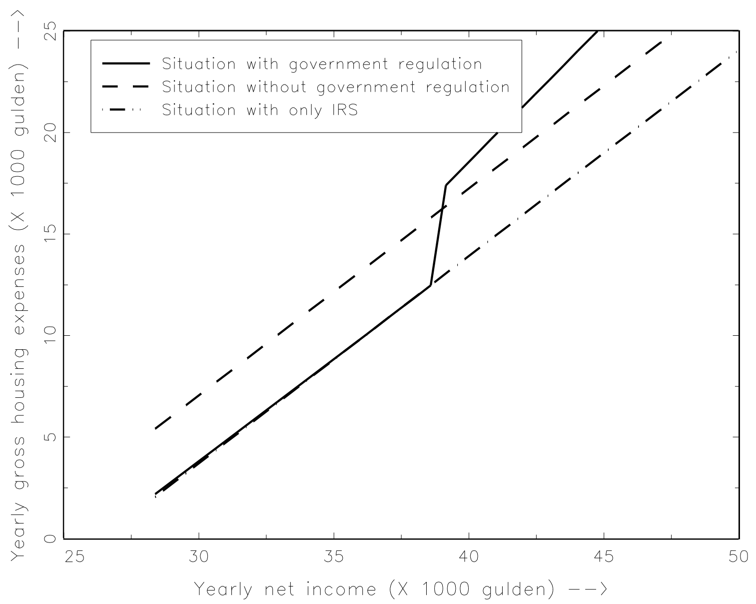

Figure 1: The yearly gross expenses of households on housing as a function of the yearly net income.

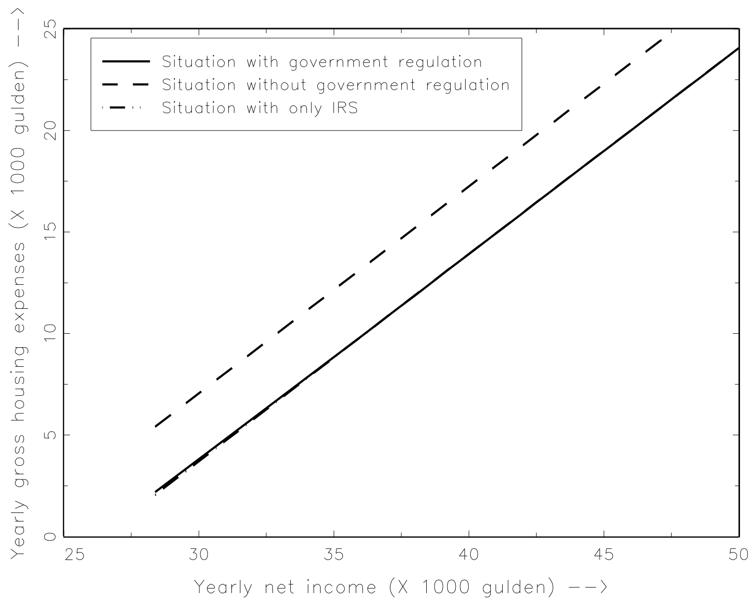

Figure 2: The yearly net expenses of households on housing as a function of the yearly net income.