# Why Are Housing Demand Curves Upward Sloping?

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**SUMMARY** — Using a microeconomic model of housing demand, I show that the effect of price increases on demand depends on whether a household trades up or down the property ladder. For a household that trades up the cost effect of a price increase outweighs the capital gains effect of such an increase. For a household that trades down the reverse might hold which can lead – in contrast to the standard model of consumer demand – to an upward sloping housing demand curve. This result is in line with the idea that housing is both a consumption and investment good and occurs even in the absence of down-payment constraints and nominal loss aversion. Multinomial and nested logit regressions of residential mobility on housing capital gains support these findings.

*JEL–code* — R21; D11; D91
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## 1. Introduction

The standard model of consumer demand suggests that an increase in the price of a good decreases its demand. The reverse is typically found in housing markets. In particular, a common finding in the housing literature is that housing capital gains have a positive effect on housing demand and households' willingness to move. A common explanation is that this is the result of down-payment constraints (e.g. Stein, 1995; Chan, 2001; Lee and Ong, 2005; Ortalo-Magné and Rady, 2006). That is, house price increases alleviate down-payment constraints which increases the demand for housing. In a seminal paper, Dusansky and Koç (2007) show that in contrast to the standard model of consumer behavior housing demand curves may be upward sloping even in the absence of such constraints. They argue that an increase in house price may positively affect the homeowner's expectation about future price increases. Housing demand is upward sloping if the expectation effect outweighs the negative income and substitution effect of a price increase. Controlling for the effect of down-payment constraints, Dusansky and Koç (2007) show empirical evidence from the United States that support their findings.

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The Dusansky and Koç (2007) model is a two period model in which households buy a house in period one and sell their house and become a renter in period two. However, a typical homeowner stays in the owner-occupied housing sector after a move. This persistence in homeownership status is well documented. Turner and Smith (2009) for example show that of those U.S. households with a moderate degree of income about 61 percent is still homeowner after 18 years. There are many explanations for this persistency in homeownership status ranging from tax benefits to the desire to own your own house.

The persistency in homeownership has important implications for the effect of housing capital gains on housing demand. To show this, I develop a microeconomic model of housing demand along the lines of Dusansky and Koç (2007) in which a homeowner who sells his current house also simultaneously buys his next house instead of renting one. This characteristic of the model leads to interesting comparative static results (Slutsky equations) with regard to housing demand that are in line with the concept of investment versus consumption demand for housing (Ioannides and Rosenthal, 1994). An increase in house price, resulting in an increase in housing capital gains, has a positive wealth effect but a negative cost effect on housing demand. Depending on the relative size of these two effects, housing demand may be upward or downward sloping. It turns out that the relative size depends on the degree to which households trade up or down the property ladder. Especially when households trade down the wealth effect of a price increase may outweigh the costs effect of such an increase. Upward sloping housing demand curves may thus occur even in the absence of a price expectations effect.

To empirically validate these findings, a sample of about 30,000 homeowners is used from the Dutch Housing Demand Survey of 2006. The 2006 version of the dataset is used to exclude the financial crisis as a confounding factor in the empirical analysis since it is well known that housing market dynamics are fundamentally different when house prices decrease substantially (e.g. due to nominal loss aversion, see Chan, 2001; Genesove and Mayer, 2001). In addition, although a typical household in the United States has to make a down payment in order to buy a house, in most European countries down-payment requirements are less stringent or even nonexistent (Chiuri and Jappelli, 2003; Green and Wachter, 2005). With regard to the Netherlands, mortgage qualification is mainly based on income and not on down payments. As such, the Dutch data provides an ideal case study to investigate the effect of housing capital gains on housing demand in the absence of down-payment constraints or nominal loss aversion.[1]

The identification strategy is based on several unique features of the Dutch Housing Demand Survey. In particular, the dataset contains three pieces of price information: the buy price of the house, the expected selling price of the house (self-reported house value), and the price a household is willing to pay for future housing. Especially the later variable is typically not available in other datasets like the American Housing Survey, but it can be used to determine whether a household wants to trade up or down the property ladder. In addition, there is also a binary variable available whether a household would like to move within two years. This variable is used as a proxy for housing demand.

The empirical strategy is to start with a standard probit model regressing the residential mobility variable on a measure of housing capital gains (expected selling price minus buy price) controlling for several observed household and housing characteristics. Since the theoretical framework shows that it is particularly the selling price that determines the effect of housing capital gains on housing demand and the buy price can have an alternative effect, the buy price and selling price are allowed to have a different impact on the probability that a household wants to move within two years. The regressions are subsequently separated by whether a household want to trade up or down the property ladder. Besides multinomial logit estimates, a nested logit version of the model is estimated in which households decide to move in the upper nest and then, conditional on moving, whether to trade up or down (lower nest). To cope with the potential endogeneity of the expected selling price, an instrumental variable (IV) approach along the lines of Engelhard (2003) is used. In particular, aggregate house price index returns are used as instruments based on the assumption that an individual household cannot affect aggregate market prices.

The empirical results are in line with the theoretical findings. In particular, I find that an increase in the expected selling price of the house has a positive effect on residential mobility for those homeowners who want to trade down. Instead, it decreases the probability for homeowners who want to trade up. In particular, the average marginal effect of the final IV-multinomial logit model suggest that a one percent increase in the expected selling price decreases the willingness to move within two years by 1.56 percentage points for the trade up group but it decreases the probability by 0.4 percentage points for the trade down group. These effects are statistically significant at the one percent significance level and, although

[1] The average loan-to-value ratio, a proxy for the down-payment constraints, is 90 percent in the Netherlands, but it can as high as 115 percent (see Green and Wachter, 2005).

not extremely large, still relevant relative to the average probability of about 15 percent. Further results show that the buy price and selling price should indeed be incorporated separately in the regression and not aggregated in a single measure of housing capital gains.

The results in this paper are much related to the hedging demand story of Han (2008, 2010). In particular, Han (2008, 2010) shows both theoretically and empirically that households try to reduce house price risk by endogenously changing their housing demand. This hedging demand depends on the relative position a household expects to have in terms of current and future housing. In particular, Han (2010) finds that U.S. households with a high hedging demand that experience a higher level of house price risk (i.e. by one percentage point) have a 0.45 percent higher probability to make a transaction and, if they do, they also buy houses that are 1.06 percent larger. Instead, this paper does not focus on the role of house price risk but shows that even simple house price increases can already have complex effects on housing demand depending on the decision to trade up or down.

The results have several implications for the existing literature. First, there are many studies that use a composite measure of housing capital gains in residential mobility/housing demand regressions and do not take into account whether households want to move up or down the property ladder. The results in this paper suggest that this is a misspecification that can lead to considerable bias since it does not capture the full effect of housing capital gains on housing demand. Second, these results also have broader implications as they suggest that the aggregate positive relationship between prices and transaction volumes found in many countries (see Dröes and Francke, 2017) is not only determined by down-payment constraints, nominal loss aversion (Genesove and Mayer, 1997; Genesove and Mayer, 2001) or price expectations (Dusansky and Koç, 2007) but possibly also by the share of households that decide to trade up or down the property ladder. Since the decision to trade up or down typically varies across the life cycle with younger households trading up and older households trading down it is the age distribution of the population which should also be an important determinant of the relationship between prices and transaction volumes.

The remainder of this paper is organized as follows. Section 2 presents the theoretical framework. Section 3 discusses the data and empirical methodology. Section 4 provides the regression results. Section 5 concludes the paper.

## 2. The model

This paper uses a two-period housing consumption model to investigate the effect of housing capital gains on housing demand. After formulating the model, I will show some comparative static results.

Assume that in period one the homeowner buys a house. This house provides the homeowner with units of owner-occupied housing services $x_1$. Alternatively, $x_1$ may be interpreted as housing stock, where housing services are proportional to the housing stock. The marginal price of a unit of owner-occupied housing is $p_1$. Hence, $p_1 x_1$ is the total price of the house. In this paper, renting a house (the opportunity costs of owner-occupied housing) is ignored. Since the homeowner may not have enough assets to own the house outright, he may borrow an amount $m_1$ from a mortgage provider at the fixed mortgage interest rate $r_m$. The net housing equity in period one, $H_1$, consists of the previously accumulated net housing assets, $H_0$, which may include previous housing capital gains, and the net housing equity in period one, $p_1 x_1 - m_1$. The net housing equity is paid with the previously accumulated non-housing assets in period zero, $A_0$, or the homeowner's saving in period one, $s_1$. The previously accumulated non-housing assets and savings determine the non-housing assets in period one, $A_1$. The income in period one consist of labor income in period one, $y_1$, and capital income in period one, $r_a A_0$, where $r_a$ is the market interest rate. Homeowners pay transaction costs $t-1$ proportional to the value of the house, with $t>1$. Hence, a homeowner owns a house with value $p_1 x_1$, while he effectively paid $t p_1 x_1$. As a result, savings decrease with the net housing equity adjusted for transaction costs, $t p_1 x_1 - m_1$. Summarizing, period one can be formalized by the following equations:

$$\left.\begin{aligned} &A_1 = A_0 + s_1 \\ &s_1 = y_1 + r_a A_0 - (t p_1 x_1 - m_1) \\ &H_1 = H_0 + (p_1 x_1 - m_1) \\ &T_1 = A_1 + H_1 = H_0 + (1 + r_a) A_0 + y_1 + (1-t) p_1 x_1 \end{aligned}\right\}, \tag{1}$$

where $A_1$ is non-housing assets in period one, $s_1$ is saving in period one, $H_1$ is net housing assets in period one, and $T_1$ is total assets in period one.

In period two, the homeowner sells his home and repays the mortgage. In particular, the homeowner's previous housing assets, $H_1$, decrease with $p_1x_1 - m_1$. Moreover, the homeowner receives $p_2x_1 - m_1$ in his savings account, $s_2$, due to the sale of his house, where $p_2$ is the second period marginal transaction price per unit of housing. In this model, the sale of a home is not associated with any transaction costs. However, the homeowner does have to pay interest on the mortgage $r_m m_1$, where $r_m$ is the mortgage interest rate. In period two, the homeowner also buys a new home, which is associated with housing services $x_2$. As a result, his net housing assets increases by $p_2x_2 - m_2$.[2] The net housing equity is paid by the non-housing assets in period one, $A_1$, second period income, $y_2$, and the proceeds out of the sale of the house, $p_2x_1 - m_1$. Again, the homeowner pays transaction costs $t-1$ proportional to the value of the house. Hence, savings in period two decrease by more (i.e. $tp_2x_2 - m_2$) than the additional housing assets accumulated in period two, $p_2x_2 - m_2$. Summarizing, the asset accumulation in the second period is characterized by the following equations:

$$\left.\begin{array}{l} A_2 = A_1 + s_2 \\ s_2 = y_2 + r_a A_1 - r_m m_1 + (p_2x_1 - m_1) - (tp_2x_2 - m_2) \\ H_2 = H_1 - (p_1x_1 - m_1) + (p_2x_2 - m_2) \\ T_2 = A_2 + H_2 = H_0 + (1+r_a)A_1 + y_2 - (1+r_m)m_1 + p_2x_1 + (1-t)p_2x_2 \end{array}\right\}, \qquad (2)$$

where $A_2$ is non-housing assets in period two, $s_2$ is savings in period two, $H_2$ is net housing assets in period two, and $T_2$ is total assets in period two.

Based on the capital accumulation rules in (1) and (2) the total wealth constraint of the homeowner is

$$(tp_1 - p_2^*)x_1 + (t-1)p_2^*x_2 = (1+r_a)A_0 + H_0^* + y_1 + y_2^* + (r_a - r_m)m_1^*, \qquad (3)$$

[2] Since there is no third period in the model, the capital gains on the second period house and the costs of the second period mortgage are not included in the model. In addition, the model does not incorporate that the homeowner sells his second period house and repays the principal balance of the second period mortgage.

where I assume that total assets in period two, $T_2$, are zero (i.e. no bequest). The asterisk indicates that the parameter is divided by $(1+r_a)$. The right hand side of equation (3) equals lifetime wealth $W_T$.

The budget constraint has two important features. First, without transaction costs ( $t=1$) a house in period two would have a net price of zero. Hence, the existence of transaction costs is an essential feature of the model. Second, the first period house is not only a consumption good (i.e. $tp_1x_1$), but it is also an investment (i.e. $p_2^*x_1$). In this paper, it is assumed that $(tp_1-p_2^*)>0$ such that the house is a net consumption good. The main difference between the budget constraint in equation (3) and the budget constraint reported by Dusansky and Koç (2007) is that the wealth constraint in this paper includes second period owner-occupied housing demand. By contrast, the model ignores price/housing consumption uncertainty and other consumption goods.

The homeowner is assumed to maximize the following two-period utility function subject to the wealth constraint in equation (3):

$$V(W_T,p_1,p_2^*)=\max_{x1,x2} U_1(x_1)+U_2(x_2) \quad \text{s.t. equation (3),} \tag{4}$$

where $V$ is the value function. Utility is assumed to be intertemporally additively separable. For notational convenience, I will omit the utility subscript 1 and 2 in the following discussion. In addition, I assume that the discount factor is equal to one. The interior solution of this maximization problem is based on the first order conditions (see appendix A.1) characterized by the Euler equation:

$$\frac{U_{x1}}{U_{x2}}=\frac{(tp_1-p_2^*)}{(t-1)p_2^*}, \tag{5}$$

where $U_{x1}$ and $U_{x2}$ are the marginal derivatives of utility with regard to $x_1$ and $x_2$, respectively. This paper does not focus on corner solutions as a result of the wealth constraint in equation (3) or other liquidity constraints.[3]

[3] For instance, homeowners may face a mortgage qualification constraint imposed by mortgage lenders. Empirically, I will control for mortgage qualification based on income by using the loan-to-income ratio as control variable.

The above-described model is used to derive the comparative static results regarding housing consumption. I use the methodology presented by Chiang (1984). I focus on homeowners who sell their current house and, subsequently, want to buy a new house (i.e. second period housing consumption). Since housing capital gains are based on the difference between the house price of first and second period housing, I investigate the effect of a change in first and second period house prices on housing demand. For simplicity, I examine the effects of first and second period house prices separately. The effect of a first period price change on second period housing demand will highlight the "standard" effect of a price change. Subsequently, the effect of a second period price change is discussed. Since first period consumption and second period prices are directly related in the wealth constraint, a second period price change will lead to interesting comparative static results in comparison to a standard consumption model.

The effect of a change in the first period marginal price $p_1$ on the optimal choices can be investigated by totally differentiating the first order conditions evaluated at the optimum (see appendix A.2). Subsequently, Cramer's rule is used to solve for the partial derivatives. The solution of the partial derivative with regard to second period housing consumption $x_2$ is (see appendix A.3)

$$\frac{\partial \bar{x}_2}{\partial p_1} = \underbrace{\frac{t\bar{x}_1}{|J|}(t-1)p_2^* U_{x1x1}}_{\substack{Income\ effect \\ -}} - \underbrace{\frac{\bar{\lambda} t}{|J|}(t-1)p_2^*(p_2^* - tp_1)}_{\substack{Cross-price\ substitution \\ effect\ of\ a\ first\ period\ price \\ increase \\ +}} \ , \qquad (6)$$

where $J$ is the Jacobian with regard to the first order conditions and the optimal housing demand solutions are $\bar{x}_1$ and $\bar{x}_2$. The determinant of the Jacobian is positive, since this determinant equals the determinant of the bordered Hessian (i.e. second order condition).

Equations (6) is a Slutsky equation. The first term in the partial derivative $\partial \bar{x}_2 / \partial p_1$ is the income effect ($\frac{-1}{|J|}(t-1)p_2^* U_{x1x1}$, see appendix A.4). The income effect is equal to the effect of an exogenous increase in wealth on second period housing consumption. In equation (6), this effect is weighted by $-t\bar{x}_1$. The income effect is negative since $t > 1$, $\bar{x}_1 > 0$ , $p_2^* > 0$ $|J| > 0$, and $U_{x1x1} < 0$. In a standard consumption model, the sign of the income effect is indeterminate and a negative income effect is the result of the normal goods assumption. In this paper, the sign of the income effect is determined due to 1) the additively intertemporal separability of the utility function assumption, and 2) diminishing marginal utility of housing consumption (i.e. $U_{x1x1} < 0$). Based on these assumptions current (future) housing is a normal good in the model. The second part of $\partial \bar{x}_2 / \partial p_1$ is the substitution effect (see appendix A.5). The substitution effect in $\partial \bar{x}_2 / \partial p_1$ is positive since $\bar{\lambda} > 0$, $t > 1$, $|J| > 0$, $p_2^* > 0$, $p_1 > 0$, and $tp_1 > p_2^*$.

In accordance with standard results, the partial derivative $\partial \bar{x}_2 / \partial p_1$ is indeterminate since the income effect is negative and the substitution effect is positive. Hence, this result implies that a *decrease* in the first period price of housing consumption (i.e. a capital gains increase) has a positive effect on housing demand if the income effect dominates the substitution effect, but it is negative if the substitution effect is larger than the income effect. Normally, we would expect that if a homeowner can buy his house for a relatively low price the homeowner buys more of the housing good. That is, it is expected that the total effect is positive. Nevertheless, from a purely theoretical point of view, the housing capital gains effect of buying a house for a relatively low price is ambiguous and, therefore, mainly an empirical question.

High housing capital gains is usually thought to be synonymous with selling the house for a high price. Therefore, it is especially interesting to investigate the effect of a change in second period house prices on housing demand. In the model, an increase in the second period house price $p_2^*$ leads to the following change in second period housing consumption (see appendix A.6):

$$\frac{\partial \bar{x}_2}{\partial p_2^*} = \underbrace{\frac{(t-1)\bar{x}_2 - \bar{x}_1}{|J|}(t-1)p_2^* U_{x1x1}}_{\substack{Income\ effect \\ +/(-)}} + \underbrace{\frac{\bar{\lambda}}{|J|}(t-1)p_2^*(p_2^* - tp_2^*)}_{\substack{Cross-price\ substitution\ effect \\ of\ a\ first\ period\ price\ decrease \\ -}} \qquad (7)$$

$$\underbrace{-\frac{(t-1)\bar{\lambda}}{|J|}(p_2^* - tp_1)^2}_{\substack{Substitution\ effect\ of \\ a\ second\ period\ price\ increase \\ -}} .$$

The first term in equation (7) is again related to the income effect (i.e. again see appendix A.4). The last two terms capture the substitution effect (see appendix A.7). The two substitution effects in equation (7) always have a negative impact on second period housing demand. In particular, the increase in the second period price increases the price of second period housing consumption, but it simultaneously decreases the total price of first period housing consumption. The later effect is captured by the second term in equation (7). In particular, this effect is called a cross-price substitution effect since it resembles the substitution effect in $\partial \overline{x}_2 / \partial p_1$, equation (6), even though the weighting is different. The former effect is captured by the third term in $\partial \overline{x}_2 / \partial p_2^*$, which is a standard negative substitution effect (since $\overline{\lambda} > 0$, $t > 1$, $|J| > 0$).

The most interesting part of the partial derivative in equation (7) is the income effect. In particular, equation (7) implies that the income effect depends on the importance of first versus second period housing consumption. In a standard budget constraint situation the income effect would be negative (i.e. see equation (6)). However, the income effect in $\partial \overline{x}_2 / \partial p_2^*$ is positive if $\overline{x}_1 > (t-1)\overline{x}_2$. Although it is possible that this inequality does not hold, it is likely that this inequality holds if transaction cost are relatively low (*t* is close to 1). More importantly, the positive income effect of a second period price change is larger if first period housing consumption becomes larger relative to second period housing consumption. Based on this result, I conclude that especially homeowners who trade down are more likely to experience a positive income effect of a change in house price.

The intuition behind this effect is straightforward. An increase in the second period house price increases effective income since the price of first period housing consumption decreases (capital gains effect). However, the homeowner also buys a new home. The price of this home increases (cost effect). As a result, effective income decreases. If the investment in first period housing consumption is relatively high in comparison to second period housing consumption, the former (positive) income effect plays a relatively important role in second period housing demand. By contrast, the cost effect of a price increase becomes increasingly more important if the homeowner moves from a relatively small house to a large house in terms of housing consumption (i.e. he trades up).

Since the (weighted) income effect is likely to be positive, the total partial derivative $\partial \overline{x}_2 / \partial p_2^*$ may also be positive. That is, the normal goods assumption (unweighted income effect) is no longer sufficient to ensure that the total income effect of a price increase is negative. Housing demand curves may be upward sloping, the standard law of demand does not necessarily apply. Moreover, the findings also imply that buying the house relatively cheap is not the same as selling the house for a high price (i.e. equation (6) does not equal equation (7)), which I will empirically take into account and test. The result that housing demand curves may be upward sloping for those homeowners who trade down is summarized in the following hypothesis:

***Hypothesis:*** *A higher sale price of the home has a less negative or even positive effect on owner-occupied housing demand for a homeowner who wants to trade down in comparison to a homeowner who wants to trade up.*

The extent to which individual housing demand curves are actually upward sloping depends on the relative importance of the three terms on the right hand side of equation (7). This is, however, mainly an empirical question.

## 3. Data and methodology

### *3.1 Dataset*

The results in this paper are based on the Dutch Housing Demand Survey of 2006 (WoON 2006), provided by the Netherlands Ministry of Housing, Spatial Planning and the Environment (VROM). This dataset contains 64,005 respondents. These respondents were surveyed between August 2005 and March 2006. In the analysis, I focus on the 30,294 respondents (head of the household or his/her partner) who are homeowners.[4] After the removal of several outliers/coding errors and some further selections there are 25,745 homeowners that are in the final dataset.[5] Table 1 shows the descriptive statistics of the dependent and independent variables based on this dataset.

[TABLE 1 ABOUT HERE]

***Residential mobility***

In this paper, a proxy for future (second period) housing demand is used. In particular, this proxy is a dummy variable $w_i$ that captures whether homeowner *i* wants to move within two

[4] I do not estimate a tenure choice selection model since interest only lies in the house price parameter estimates for the sample of homeowners. For a comparison of the housing demand functions of renters versus owners, see Henderson and Ioannides (1989).

[5] I ignore homeowners who prefer to move to a rental house or are indifferent between moving to a rental house or buying a home. Houses that are attached to a farm, with a shop, or were of an unknown house type are also excluded from the analysis. Moreover, homeowners that did not know whether they want to move within two years or, for whatever reason, had to move were excluded from the dataset.

years. I argue that this indicator conditional on current housing characteristics will mainly pick up the variation in future housing demand. The benefit of this indicator is that it is very close to actual housing preferences. Instead, actual residential mobility is also determined by feasibility constraints which may be hard to control for. The costs of using this measure is that it does not show whether household have actually followed up on their preferences.

Table 1 indicates that about 15.1 percent of the homeowners want to move within two years. By contrast, the majority of households, 84.9 percent, do not want to move within two years. The homeowners that are part of the 'want to move' group are those homeowners who reported that they maybe want to move; want to move, but did not find a home yet; definitely want to move; just found a new home.[6] The largest subcategory, about 8.4 percent of the homeowners, is the 'maybe want to move' category. Although potentially interesting, I do not examine the differences between these subcategories in further detail.

***To trade up or trade down***

The theory section suggested that it is important to identify those homeowners who consider trading up versus those who want to trade down. Those homeowners who reported that they want to move *and* buy the next home also reported the preferred buy price of that home. In addition, all homeowners reported the expectation about the sale price of their current home. A homeowner trades up if the preferred buy price of the future house is larger than the expected sale price of the current home. Although the impact of moving up or down the property ladder is a continuous effect that depends on the extent to which homeowners trade up or down (see theory section), I will only focus on the difference in the capital gains effect between the trade-up and trade-down group. That is, I will measure the difference in the average effect between both groups.

The average homeowner's expected sale price of the current home is 251,171 euros (for the 'want to move' group). By contrast, these homeowners have an average preferred buy price of the future home of 304,274 euros. Especially the difference between these two values is of interest in this paper. Table 1 suggests that homeowners, conditional on moving, prefer an average increase in the value of the house of 53,103 euros. About 74.8 percent of the homeowners who want to move within two years also want to trade up in terms housing value.[7] [8]

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[6] Those homeowners who just found a new home reported an average length of residence of 11.7 years. Hence, these homeowners are added to the 'mover' group.

[7] About 5.1 percent of the homeowners were indifferent between moving up or down. These homeowners are included in the trade down group.

***Housing capital gains***

Besides the expected sale price of the current house and the future preferred buy price of the next house, homeowners also reported the buy price of the current home. The buy price of the current home is interpreted as a measure that captures changes in the first period price of housing, $p_1$ (see the theory section). The price $p_2^*$ in the microeconomic model is interpreted as a single-valued expectation and its variation is captured by the expected sale price of the house. The difference between the buy price and expected sale price is used as a measure of expected housing capital gains. Although expected capital gains may well differ from actual realized capital gains, it is reasonable to assume that the housing decisions of homeowners are based on their expectations regarding future circumstances. In this case, expected housing capital gains are an appropriate measure to investigate the effect of housing capital gains on housing demand. An additional benefit is that the expected housing capital gains measure is homeowner specific. By contrast, housing capital gains are sometimes constructed by means of aggregate house price indices (i.e. see Chan, 2001; Lee and Ong, 2005), which may lead to substantial measurement error. The measure used in this paper does not exhibit this problem.[9]

Unfortunately, the buy and sale price of the current house may also capture variation in current housing consumption ($x_1$) since the total price of a house equals housing services times the marginal price of those services. As a result, I will use percentage (log-differenced) housing capital gains in the analysis to filter out the effect of housing consumption. In particular, this measure captures the total variation in the marginal prices ($p_2 - p_1$) if housing consumption remains constant between the time the house is bought and the expected time the house is sold. As mentioned, a set of current housing characteristics is also added to the regressions to control for the effect of current housing consumption. To the extent that current housing consumption is not constant, the change in housing consumption is captured in the regression analysis by the intercept and a variable which represents whether housing services might have changed depending on maintenance.

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[8] In comparison, about 75 percent of the total transactions in the US (based on the PSID, 1980-1997) are homeowners that move up the property ladder (Han, 2010).

[9] Total housing capital gains are a function of the length of residence. Including the length of residence in the regression models did not change the main conclusions of this paper. More importantly, it is questionable whether the length of residence should be included as it measures the same as the dependent variable, the decision to move, used in this paper. It does, however, suggest that expected housing capital gains are potentially endogenously determined. To solve this issue an instrumental variable approach is used which is discussed in more detail in both the methodology and the results section.

With regard to the descriptive statistics of housing capital gains, Table 1 suggests that the average reported buy price of the home is about 131,650 euros. The self-reported expected sale price of the house at the time the respondents were surveyed is 283,399 euros. The average expected housing capital gains based on the difference between the buy and expected sale price of the house are 151,749 euros. The approximate (log-difference) percentage capital gains are about 91.7 percent, which is sizeable. The average length of residence of 13.8 years implies that the yearly expected capital gains have been 10,996 euros, which is about 4.8 percent (annualized compounded return) per year.

***Control variables***

Several control variables are added to the regressions. An important control variable is the loan-to-income ratio, which is utilized as proxy for mortgage qualification constraints. Households seem to pay about 15.8 percent of their taxable household income to repay the mortgage loan. The monthly taxable household income is about 4,000 euros. Income is also included in the regression as a proxy for permanent income.[10]

There are also some further control variables. First, some individual/household characteristics are included that affect the preference to move (i.e. determine the shape of the first and second period utility function). In particular, the control set includes a dummy variable whether the respondent had at least one child living at home, a variable whether the respondent obtained higher education (university/hbo degree), a gender dummy, household size, age of the respondent, and dummies for the type of household (4 categories: partners, single parents, single, other composition). The descriptive statistics in Table 1 suggest that about 46.2 percent of the homeowners have at least 1 child living at home, 36.0 percent completed higher education, 51.5 percent are female, the average household size is 2.7 persons, the average age is 48.5 years, and most respondents, about 79.6 percent, have a partner/are married.

Second, several house characteristics are used as control variables. The size of the home is used, which is on average about 145.5 $m^2$, but also dummies for the type of house. It seems that most homeowners in the sample, about 31.6 percent, own a row house. Moreover, a dummy variable for presence of a garden and a dummy capturing whether the homeowner had major maintenance (of a building-technical nature) being performed on the house are also added as control variables. The descriptive statistics suggest that about 85.5 percent of the

[10] Alternatively, Dusansky and Koç (2007) measure permanent income by the predicted income based on a hedonic (homeowner's characteristics) regression model.

houses have a garden and maintenance was performed in 23.8 percent of the cases. Finally, dummies for the month the respondents were surveyed and 40 regional (COROP-level) dummies are added to the regressions.[11] The month dummies are used to filter out the effect of changing housing market conditions over the survey period. The regional dummies measure spatial differences in the propensity to move.

### *3.2 Methodology*

The empirical analysis starts with a discussion of the parameter estimates of a relatively restricted model and, subsequently, increasingly less restrictive models are shown. The dependent variable is a dummy whether homeowners want to move within two years. In particular, the chance that this event occurs is modelled. I estimate three limited dependent variable models by means of maximum likelihood. In the first model, the focus lies on the total effect of housing capital gains, $\beta_1$, on the decision to move:

$$\left.\begin{aligned} w_i^* &= \beta_{0,1} + \beta_1[\log(p_{2,i}) - \log(p_{1,i})] + controls_i'\gamma_1 + \varepsilon_{i,1} \ , \ \varepsilon_{i,1} \sim LID(0, \pi^2/3) \\ w_i &= 1 \text{ if } w_i^* > 0 \\ w_i &= 0 \text{ if } w_i^* \leq 0 \end{aligned}\right\}, \qquad (8)$$

where a homeowner moves ($w_i = 1$) if the utility based on the future home is larger than the utility of the current home ($w_i^* = U_2(x_2) - U_1(x_1) > 0$).In addition, $\varepsilon_{i,1}$ is assumed to be standard logistically distributed, such that the model in equation (8) fully describes a logit model of the decision to move. The variance of $\varepsilon_{i,1}$ is restricted, in this case to $\pi^2/3$, to make identification of unique parameter estimates possible. As mentioned, $\log(p_{2,i})$ is captured by the logarithm of the buy price of the home and $\log(p_{1,i})$ by the logarithm of the expected sale price of the home. I use this model to estimate the chance to move, $P(w_i = 1 | p_{2,i}, p_{1,i}, controls_i) = G(\beta_{0,1} + \beta_1[\log(p_{2,i}) - \log(p_{1,i})] + controls_i'\gamma_1)$, where $G$ is the logistic cumulative distribution function. Based on the model in equation (8), I investigate the gross effect of capital gains on housing demand.

[11] The acronym COROP is named after the commission that defined these regions in 1971. The COROP regions are equivalent to the NUTS-3 classification used by the European Commission. These regions were originally defined to capture regional labor/housing markets and typically incorporate several municipalities.

This model is based on two unrealistic restrictions. In particular, an increase in the sale price of the house is assumed to have the same effect as buying a home for a relatively cheap price. Secondly, the capital gains effect is assumed to be independent of the homeowner's decision to trade up or down. Both of these restrictions do not seem realistic (i.e. see the theory section). The following two models remove those restrictions. In particular, the second model that is estimated is

$$\left.\begin{aligned} w_i^* &= \beta_{0,2} + \theta_1 \log(p_{2,i}) + \theta_2 \log(p_{1,i}) + controls_i'\gamma_2 + \varepsilon_{i,2}\ ,\ \varepsilon_{i,2} \sim LID(0, \pi^2/3) \\ w_i &= 1 \text{ if } w_i^* > 0 \\ w_i &= 0 \text{ if } w_i^* \leq 0 \end{aligned}\right\}. \quad (9)$$

The model in equation (9) strongly resembles the model in equation (8) except for the fact that it does not impose the restriction $\theta_1 = -\theta_2$. That is, a decrease in the buy price of the home does not necessarily have the same impact on the decision to move as an increase in the sale price of this home. A simple Wald test is used to test this restriction. The average marginal effects (AMEs) are also compared.

The final basic model is a multinomial logit model based on three alternatives: the homeowner does not want to move; the homeowner wants to move and wants to trade up; the homeowner wants to move and wants to trade down. Assume that each alternative *j* gives homeowner *i* the following total utility:

$$U_{tot,i,j} = \lambda_{1,j} \log(p_{2,i}) + \lambda_{2,j} \log(p_{1,i}) + controls_i'\gamma_{2,j} + \varepsilon_{i,j,3} \quad \text{j=1,2,3}\ , \quad (10)$$

where $\varepsilon_{i,j,3}$ is the stochastic part of utility and the rest, $V_{i,j}$ , is the deterministic part. Note that only case/individual-specific regressors are used (no alternative-specific regressors). In this additive random utility model, the chance that homeowner *i* chooses alternative *n* is

$$P_{i,n} = \frac{\exp(V_{i,n})}{\sum_{j=1}^{3} \exp(V_{i,j})}. \quad (11)$$

Again, the parameters are only identified up to some scale. As such, the model is underidentified. Therefore, I assume that the coefficients for the alternative "do not want to move” are equal to zero. This assumption implies that this category will be the reference category. As a result, I will measure the chance to move and trade up or the chance to move and trade down relative to not moving at all. Consequently, the two sets of parameter estimates that are shown in the results section are in essence not much more than the parameter estimates on two separate logit models. Since these models are estimated jointly in the multinomial setup, there are of course some efficiency gains in comparison to estimating these models separately. In the multinomial logit model described by equations (10) and (11), the coefficient on the expected sale price, $\lambda_{1,j}$, is of particular interest and whether this coefficient differs for those homeowners who want to trade up versus those who want to trade down.

Finally, I will show two extensions to the multinomial logit model. In the first extension, a nested logit model is estimated to deal with the independence of irrelevant alternatives assumption in the multinomial logit model. That is, I will take into account the clear nesting structure of the homeowner’s decisions (i.e. moving versus not moving; conditional on moving: trade up or trade down). In the second extension, an instrumental variable approach is used to correct for the possible endogeneity of the homeowner’s expected sale price of the home ($p_{2,i}$). Both of these extensions are discussed in more detail in the regression results section.

## 4. Regression results

### *4.1 Regression results of the baseline models*

Table 2 shows the parameter estimates based on the models in equations (8) to (10). Column 1 reports the logit regression based on equation (8). As mentioned, this model captures the total effect of capital gains on the probability that a homeowner wants to move within two years. As is evident from column 1, an increase in capital gains increases the probability that a homeowner want to move within two years, ceteris paribus. This effect is statistically significant at the one percent significance level. I also calculated the average marginal effect (AME) of a change in capital gains. The average marginal effect are used instead of the marginal effect evaluated at the mean since the regressions include relatively a lot of dummy variables. The average marginal effect suggests that a standard deviation increase in the percentage expected capital gains increases the probability that a homeowner wants to move within two years by 1.2 percentage points.[12] [13] This effect is economically sizeable against the average propensity to move of 15.1 percent. In sum, the results in column 1 suggest that, overall, housing capital gains are positively associated with the probability that a homeowner wants to move.

[TABLE 2 ABOUT HERE]

With regard to the other statistically significant coefficients in column 1, a higher loan-to-income ratio decreases the probability to move, more income increases the chance to move, those respondents that completed higher education have a higher propensity to move, females are less willing to move, older respondents are also less mobile, homeowners living in apartments easily move relatively to those respondents owning a detached house, and those homeowners who did maintenance are less likely to move. These results seem to make sense. Finally, I find that the month dummies and the regional-specific effects are statistically significant (Chi-square of 33 and $6.4*10^5$, respectively).

Column 2 estimates a similar model as in column 1, but the main two main elements of the housing capital gains – the buy price of the house and the expected sale price of the house – are incorporated as separate regressors, see equation (9). The regression results of this model suggests that a homeowner who bought his house relatively cheap, and as a result has relatively high capital gains, is more likely to move. That is, the positive income effect of a (first period) price decrease seems to outweigh the substitution effect of such an increase. The estimates suggest that a homeowner with a standard deviation lower buy price is 1.6 percentage points more likely to prefer to move.

An increase in the expected sale price of the house seems to be negative. These results are not at odds with the theoretical findings. In particular, most homeowners in the sample want to trade up and an increase in the price of housing for those homeowners is mainly a net cost. Hence, on average, it is expected that the coefficient on the sale price variable is negative. A standard deviation increase of the log of sale price expectations decreases the probability that a homeowner wants to move by 1.8 percentage points.

A further important result is that the equality of the sale price coefficient and the negative of the buy price coefficient is rejected (H0: $\theta_1 = -\theta_2$, Chi-square of 69). In addition,

[12] The actual increase in probability (based on the difference in probabilities) is relatively similar, 1.3 percentage points.

[13] In comparison, the AME of the loan-to-income variable is -0.07. It seems that a standard deviation increase in the loan-to-income ratio decreases the probability that a homeowner wants to move by about 1 percentage point.

the log likelihood of this model is somewhat higher than the log likelihood in the previous model, which suggests that the model in column 2 is indeed preferred to the previous model. In addition, the total effect, measured by the AMEs, also differ statistically significantly from each other (Chi-square of 72).[14] These results already imply that studies that only examine the effect of total housing capital gains on housing demand/residential mobility do not capture the full nature of the capital gains effect.

Finally, columns 3 and 4 show the estimates of the multinomial logit model as described by equations (10) and (11). In particular, in this model the coefficients are allowed to differ between the homeowners who want to trade up (column 3) versus those who want to trade down (column 4). With regard to the buy price of the home, the results show that a decrease in the buy price of the current home is still associated with an increase in the propensity to move, although this effect is no longer statistically significant for those homeowners who want to trade down. In particular, the AMEs suggest that a standard deviation decrease in the buy price of the house increases the chance that a homeowner wants to move by 1.5 percentage points for those homeowners who want to trade up and only by 0.1 percentage points for those homeowners who want to trade down. In accordance with the previous results, the coefficient on the buy price also differs statistically significantly from the coefficient on the sale price for both the homeowners in the trade up and trade down group (Chi-square of 168 and 79, respectively). This result also holds with regard to the AMEs (Chi-square of 192 and 110, respectively).

As mentioned, it is of particular interest whether the coefficient on the sale price expectations variable differs between the trade-up and trade-down group. The key result of this paper is that this is indeed the case. The two coefficients, as well as the AMEs, statistically significantly differ from each other (Chi-square of 220 and 214, respectively). The AMEs imply that a standard deviation increase in the expected sale price of the house *decreases* the chance that a homeowner wants to move within two years by 3.6 percentage points for those homeowners who want to trade up (versus not moving at all), while the same increase in sale price expectations *increases* the probability to move by 1.4 percentage points for those homeowners who want to trade down. These results suggest that for those homeowners who trade down the capital gains effect of a price increase seems to dominate the cost effect of such an increase in the demand for housing. Housing demand for this group is

[14] The total effect of a standard deviation change in the buy price or sale price on mobility does not differ substantially (1.6 versus 1.8 percentage points). However, the standard deviation change in the buy price is different from that of the sale price. As a result, it is more appropriate to compare the AMEs.

upward sloping. These results are in line with the main hypothesis formulated in the theory section of this paper.

The implications of these results are twofold. First, the findings again emphasize that using a measure of total housing capital gains is not appropriate when examining the effect of capital gains on residential mobility/housing demand. Second, the results in this paper imply that housing market dynamics may be fundamentally different in countries without minimum down-payment requirements in comparison to those countries with such constraints. In countries with down-payment requirements it is generally expected that increases in house prices have a positive effect on residential mobility (transaction volumes).[15] Although the results suggest that this may also be the case in the Netherlands, in many cases price increases may instead have a negative effect on housing demand.

### *4.2 The independence of irrelevant alternatives*

The previous models are based on two important assumptions. First, the odds ratio between two alternatives in the multinomial logit model is assumed to be independent of the availability of other alternatives. This is commonly known as the independence of irrelevant alternatives (IIA) assumption. Second, the homeowner's sale price expectations are assumed to be exogenous. Both of these assumptions are unlikely to hold. In this case, the previous models may lead to inconsistent estimates. This subsection focuses on the independence of irrelevant alternatives (IIA) assumption.

The IIA assumption is most clearly understood in terms of the additive random utility model which I discussed with regard to the multinomial logit model in the data and methodology section of this paper. As mentioned in the methodology section, each of the three alternatives in the additive random utility model has utility equal to a deterministic part plus an error term. One of the manifestations of the IIA assumption is that the error terms across alternatives are assumed not to be correlated. However, this assumption may be unrealistic. That is, the IIA assumption implies that the chance to trade up versus the chance to not moving at all is independent of whether the homeowner has the possibility to trade down. In particular, the (relative) increase in the respective probabilities, referred to as the pattern of substitution, is assumed to be fixed. To relax this assumption, a nested logit model is estimated.

[15] See, for instance, Hort (2000) on the positive price-turnover relationship in the United States.

In the nested logit model, the natural nesting structure in the data is taken into account. In particular, the decisions are clustered into groups. In the upper nest, the homeowner decides whether to move or not. In the lower nest, a homeowner decides to trade up or down conditional on the decision to move. The key feature of the nested logit model is that the error term in the random utility of the homeowners who trade up is allowed to be correlated with the error term for those homeowners who want to trade down. That is, the errors are allowed to be correlated within nests, but not between nests. In particular, the random utility that homeowner *i* receives when choosing alternative *j* is $U_{tot,i,j} = V_{i,j} + \varepsilon_{i,j,4}$. These alternatives are grouped in different nests $N_k$ (i.e. want to move, do not want to move). In contrast to the univariate extreme value distribution that was used in the multinomial logit model, the errors in the random utility model are assumed to be distributed in accordance with the generalized extreme value (GEV) distribution. The multinomial logit model is based on a particular form of this distribution (i.e. a particular form of the pattern of substitution) and, consequently, is also a GEV model. In the nested logit model, the error terms have the following (GEV-type) joint cumulative distribution function, $\exp\left(-\sum_{k=1}^{K}\left(\sum_{j\in N_k} e^{-(\varepsilon_{i,j,4})/\rho_k}\right)^{\rho_k}\right)$. The interesting feature of this distribution is that $\rho_k$, called the dissimilarity parameter, measures the degree of independence between the error terms within the nest *k*. If $\rho_k = 1$ the nested logit model collapses to the multinomial logit model. This will be explicitly tested. Since one of the branches (i.e. the not moving nest) is degenerate, the dissimilarity parameter in this case is set to 1. The chance, $P_{i,n}$, that homeowner *i* chooses alternative *n* (in a particular nest *k*) can be calculated based on the nested logit GEV distribution and the parameters of the model can be estimated using full information maximum likelihood (FIML).

[TABLE 3 ABOUT HERE]

Table 3, columns 1 and 2, show the nested logit estimates. The focus lies on the effect of the individual-specific variables (e.g. the expected sale price) in the lower nest. The conclusion based on these two columns is that the previous conclusions are still valid. Specifically, a decrease in the buy price of the house has a positive effect on the decision to move in both the trade up and trade down equation. In addition, a decrease in the original buy price of the house does not have the same effect as an increase in the sale price of that house.

Again, an increase in the expected sale price has a negative effect on the probability to move for those homeowners who want to trade up, while a similar increase in expected sale price has a positive effect on this probability for those homeowners who want to trade down.

Remarkably, the nested logit estimates (AMEs, tests) are very similar to the multinomial logit estimates reported in Table 2, columns 3 and 4. The estimated dissimilarity parameter with regard to the move nest is 0.787, which is lower than 1 and, consequently, in accordance with the additive random utility setup. Based on this estimate, I cannot reject the null hypothesis that the dissimilarity parameter differs from 1 (p-value 0.103). That is, the similarity of the multinomial logit and nested logit estimates is reflected in the fact that I do not find statistical evidence that the independence of irrelevant alternatives assumption is violated.

### *4.3 The endogeneity of sale price expectations*

The main independent variable, the sale price expectations of homeowners, may be endogenous. There are two interrelated reasons why sale price expectations may be endogenous. First, sale price expectations are measured by self-reported home values. Enghelhardt (2003) argues that the results on mobility may be biased (attenuation bias) if there is an error in homeowner's estimates which is systematically related to the independent variables. Second, it may be that sale price expectations itself are fundamentally determined by the homeowner's decision to move (reverse causality). In particular, Stein (1995) argues that homeowners, especially those who do not move, may have an incentive to "fish" for a relatively high selling price. In particular, the opportunity cost of fishing for these homeowners may be relatively low since the alternative of this strategy may be not moving at all.

To deal with the endogeneity of sale price expectations, I use an instrumental variable approach within the multinomial logit setup. In accordance with Enghelhardt (2003), regional house price data are used to construct an instrument for the self-reported home values.[16] In particular, the median price per municipality and type of house in 2005 is used.[17] In particular, the idea is that sale price expectations are correlated with the aggregate market price, but the market price is in itself not affected by each individual homeowner's decision to move. In

[16] Enghelhardt (2003) uses house price returns based on the Freddie/Fannie indices at the MSA level in the United States.

[17] By law, a separate organization in the Netherlands (the Kadaster), recoreds the transaction prices of all existing homes that are sold. This data is utilized to create the median price per municipality and type of house. Since I condition on regional fixed effects and the type of house, it is especially the within-regional variation in house price levels that is used to capture the exogenous variation in sale price expectations.

addition, if the results are only driven by expectations about future price increases (in line with Dusansky and Koç, 2007) conditioning on the part of price expectations related to actual (historical) market developments should results in an estimate that there is no effect on residential mobility.

The descriptive statistics of the merged instrumental variable are reported in Table 3, panel B. It seems that the average house price across homeowners is highest, about 336,218 euros, for detached houses and lowest for apartments, about 149,352 euros. In addition, the number of municipalities in which apartments are sold seems to be relatively low (i.e. 277 municipalities). Moreover, due to some missing observations in the instrumental variable, the number of observations that is used in the regression analysis decreases by a small amount to 25,452 observations.

This instrumental variable approach is used to re-estimate the multinomial logit model reported in Table 2, columns 3 and 4. In particular, a control function approach is used. That is, a first-stage regression is estimated of the expected sale price on the log of the instrumental variables and the control variables for the trade up group, trade down group, and those that do not want to move at all, and the resulting residuals are added as a control variable in the main specification. An additional benefit of the control function approach is that it is possible to test whether the expected sale price is endogenous. As always, uncorrected standard errors in this type of regression should be interpreted with caution. Consequently, the standard errors in the second stage are calculated by a nonparametric bootstrap procedure (5000 replications).

Table 3, columns 3 and 4, shows the instrumental variable regression estimates. With regard to the instrumental variable, the first-stage regression results indicate that the median house price positively and statistically significantly affects the sale price expectations of homeowners. In particular, a one percentage point increase in the median house price increases the self-reported home value by 0.46 percent in the trade up equation and 0.44 percent in the trade down equation. This effect is highly statistically significant (t-value of 15.32 and 5.11, respectively). Hence, the instrument in each of the equations is a relevant instrument. With regard to the endogeneity of the sale price expectations, the Hausman-Wu endogeneity test implies that the null hypothesis of no endogeneity is rejected for both the trade-down group and trade-up group. That is, the first-stage residuals are statistically significant in both the trade-up and trade-down equation (t-values of 31 and -19, respectively).

In comparison to the previous multinomial logit estimates, the main coefficient estimates reported in Table 3, columns 3 and 4 are substantially larger. Nevertheless, the conclusions again remain unchanged. In particular, the homeowner's sale price expectation negatively affects the probability whether homeowners want to move within two year for the trade-up group and it positively influences this probability for the trade-down group. In addition, the (negative of the) buy price coefficient again differs from the sale price coefficient in both equations although, interestingly, the buy price coefficient is no longer negative in the trade-up regression. The AMEs suggest that a one percent increase in the self-reported house value decreases the probability to move versus the probability of not moving at all by 1.56 percentage points for those homeowners who want to trade up, while it increase the probability to move by 0.4 percent for those homeowners who want to trade down. Hence, in comparison to the previous estimates the economic significance of the results seems to have increased. These outcomes are in line with the attenuation bias argument and are the final, most preferred, estimates.

## 5. Conclusion and discussion

Many studies have found that an increase in housing capital gains has a positive effect on housing demand/residential mobility especially in the presence of down-payment constraints. This paper has investigated the effect of housing capital gains on housing demand in the absence such constraints. Based on a microeconomic model of housing demand, the results suggest that the effect of housing capital gains crucially depends on the decision to trade up or down the property ladder. In particular, the effect of a house price increase may be positive, especially for those homeowners who trade down in terms of housing consumption. For these homeowners, the wealth gains effect of a house price increase may outweigh the cost effect of such an increase – housing demand may be upward sloping. For homeowners who trade up the property ladder the effect of a house price increase on housing demand is more likely to be negative.

Based on data for the Netherlands, I found that an increase in the expected sale price of the house decreases the likelihood that a homeowner wants to move within two years for those homeowners who want to trade up, while it increases the likelihood that a homeowner wants to move for those homeowners who want to trade down. Further results indicate that buying a house for a low price does not have the same effect on housing demand as selling a house for a relatively high price. These results are fully in line with the theoretical findings.

The results in this paper imply that the use of total housing capital gains to investigate the capital gains effect in the demand for housing ignores much of the underlying micro-economic foundations of the capital gains effect. Future studies on housing demand/residential mobility should take this result into account. Moreover, the findings suggest that housing market dynamics may be fundamentally different for countries without down-payment constraints in comparison to countries with such constraints. House price increases may have a positive effect on residential mobility, but it may well have a negative effect depending on the trade-up, trade-down decision. The standard result that an increase in housing capital gains has a positive effect on residential mobility in countries with down-payment constraints suggests that the down-payment effect outweighs the trade-up, trade-down effect for most homeowners. It would be interesting to examine to what extent the trade-up, trade-down effect plays a role in times were down-payment constraints are less binding/stringent in such countries.

A next step would be to have an overarching theoretical and empirical framework that takes into account down-payment constraints, nominal loss aversion, price expectations, and the trade-up, trade-down findings mentioned in this study. This would give a better idea how the different effects would quantitatively compare. In addition, the microeconomic results in this paper may explain part of the macroeconomic relation between prices and transaction volumes commonly found housing markets. The findings suggest that the aggregate effect of house price increases on housing demand depends on the trade-up, trade-down mix within the total group of homeowners. It would be interesting to see to what extent the results hold in a cross-country comparison. Since the decision to trade up or down the property ladder ultimately varies across the life cycle a dynamic version of the model presented in this paper could further increase our understanding of the relationship between prices, residential mobility, and aggregate transaction volumes.

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## Appendix A: First order conditions and proofs

### *A.1: First order conditions*

The Lagrangian associated with the utility maximization problem is

$$L = U_1(x_2) + U_2(x_2) + \lambda[W_T - (tp_1 - p_2^*)x_1 - (t-1)p_2^* x_2]. \tag{A.1.1}$$

Hence, the first order conditions are

$$\left.\begin{aligned} \frac{\partial L}{\partial \lambda} &= W_T - (tp_1 - p_2^*)x_1 - (t-1)p_2^* x_2 = 0 \\ \frac{\partial L}{\partial x_1} &= U_{x1} - \lambda(tp_1 - p_2^*) = 0 \\ \frac{\partial L}{\partial x_2} &= U_{x2} - \lambda(t-1)p_2^* = 0 \end{aligned}\right\}. \tag{A.1.2}$$

The utility subscript 1 and 2 are omitted too avoid cluttering. Based on the equations in (A.1.2) the derivation of the Euler equation is straightforward.

### *A.2: Total derivative of the first order conditions*

The first order conditions hold identically at the optimum. The total derivative of the first order conditions (evaluated at the optimum) are

$$\left.\begin{aligned} &(p_2^* - tp_1)d\overline{x}_1 - (t-1)p_2^* d\overline{x}_2 = t\overline{x}_2 dp_1 + [(t-1)\overline{x}_2 - \overline{x}_1]dp_2^* + (p_1\overline{x}_1 + p_2^*\overline{x}_2)dt - dW_T \\ &(p_2^* - tp_1)d\overline{\lambda} + U_{x1x1}d\overline{x}_1 = \overline{\lambda}tdp_1 - \overline{\lambda}dp_2^* + \overline{\lambda}p_1 dt \\ &-(t-1)p_2^* d\overline{\lambda} + U_{x2x2}d\overline{x}_2 = \overline{\lambda}(t-1)dp_2^* + \overline{\lambda}p_2^* dt \end{aligned}\right\}, \tag{A.2.1}$$

where the change in the exogenous parameters are stated on the right hand side of the equations and the change in the endogenous variables are reported on the left hand side of the equations. The bar on the endogenous variables indicates that the variable is evaluated at the optimum. The cross-derivatives $U_{x1x2}$ and $U_{x2x1}$ are zero due to the intertemporal separability of the utility function.

*A.3: The effect of a change in the first period house price, equation (6)*

Only $p_1$ changes on the right hand side of the equations in (A.2.1). Divide by $dp_1$ and interpret the ratios of differentials as partial derivates:

$$\begin{bmatrix} 0 & (p_2^* - tp_1) & -(t-1)p_2^* \\ (p_2^* - tp_1) & U_{x1x1} & 0 \\ -(t-1)p_2^* & 0 & U_{x2x2} \end{bmatrix} \begin{bmatrix} \partial\bar{\lambda}/\partial p_1 \\ \partial\bar{x}_1/\partial p_1 \\ \partial\bar{x}_2/\partial p_1 \end{bmatrix} = \begin{bmatrix} t\bar{x}_1 \\ \bar{\lambda}t \\ 0 \end{bmatrix}, \qquad \text{(A.3.1)}$$

where the first matrix is the (symmetric) Jacobian matrix (*J*) of the first order conditions (with respect to $x_1$, $x_2$ and $\lambda$, evaluated at the optimum). The partial derivatives can be solved by Cramer's rule (and cofactor expansion). With respect to $x_2$ this leads to

$$\partial\bar{x}_2/\partial p_1 = \frac{1}{|J|}\begin{vmatrix} 0 & (p_2^* - tp_1) & t\bar{x}_1 \\ (p_2^* - tp_1) & U_{x1x1} & \bar{\lambda}t \\ -(t-1)p_2^* & 0 & 0 \end{vmatrix} =$$

$$\frac{t\bar{x}_1}{|J|}\begin{vmatrix} (p_2^* - tp_1) & U_{x1x1} \\ -(t-1)p_2^* & 0 \end{vmatrix} - \frac{\bar{\lambda}t}{|J|}\begin{vmatrix} 0 & (p_2^* - tp_1) \\ -(t-1)p_2^* & 0 \end{vmatrix}. \qquad \text{(A.3.2)}$$

Based on the cross-multiplication of the diagonals in the final matrices (to calculate the determinants of the matrices), the derivation of equation (6) is straightforward.

*A.4: The income effect of an exogenous increase in wealth, equation (6) and (7)*

Assume that only $W_T$ changes on the right hand side of the equations in (A.2.1). Divide by $dW_T$ and interpret the ratios of differentials as partial derivates. In matrix notation this leads to

$$\begin{bmatrix} 0 & (p_2^* - tp_1) & -(t-1)p_2^* \\ (p_2^* - tp_1) & U_{x1x1} & 0 \\ -(t-1)p_2^* & 0 & U_{x2x2} \end{bmatrix} \begin{bmatrix} \partial\bar{\lambda}/\partial W_T \\ \partial\bar{x}_1/\partial W_T \\ \partial\bar{x}_2/\partial W_T \end{bmatrix} = \begin{bmatrix} -1 \\ 0 \\ 0 \end{bmatrix}. \qquad \text{(A.4.1)}$$

where the first matrix is still the Jacobian matrix. Based on Cramer's rule we get

$$\partial\overline{x}_2 / \partial W_T = \frac{1}{|J|}\begin{vmatrix} 0 & (p_2^* - tp_1) & -1 \\ (p_2^* - tp_1) & U_{x1x1} & 0 \\ -(t-1)p_2^* & 0 & 0 \end{vmatrix} = \frac{-1}{|J|}\begin{vmatrix} (p_2^* - tp_1) & U_{x1x1} \\ -(t-1)p_2^* & 0 \end{vmatrix}. \qquad \text{(A.4.2)}$$

Based on the cross-multiplication of the diagonals in the final matrix (to calculate the determinant of the matrix), the income effect is

$$\partial\overline{x}_2 / \partial W_T = \frac{-1}{|J|}(t-1)p_2^* U_{x1x1}. \qquad \text{(A.4.3)}$$

***A.5: The substitution effect, equation (6)***

The substitution effect can be obtained by using the envelope theorem and constant utility:

$$dV / dp_1 = \partial L / \partial p_1 \big|_{optimum} = -\overline{\lambda} t \overline{x}_1 = 0. \qquad \text{(A.5.1)}$$

This suggests that $\overline{x}_1 = 0$ (since $\overline{\lambda} > 0$ and $t > 0$). After substitution of $\overline{x}_1 = 0$ in the solution for the partial derivative in appendix A.3 (i.e. equation (6)), the substitution effect in equation (6) is straightforward.

***A.6: The effect of a change in the second period house price, equation (7)***

Only $p_2^*$ changes on the right hand side of the equations in (A.2.1). Divide by $dp_2^*$ to obtain

$$\begin{bmatrix} 0 & (p_2^* - tp_1) & -(t-1)p_2^* \\ (p_2^* - tp_1) & U_{x1x1} & 0 \\ -(t-1)p_2^* & 0 & U_{x2x2} \end{bmatrix}\begin{bmatrix} \partial\overline{\lambda} / \partial p_2^* \\ \partial\overline{x}_1 / \partial p_2^* \\ \partial\overline{x}_2 / \partial p_2^* \end{bmatrix} = \begin{bmatrix} (t-1)\overline{x}_2 - \overline{x}_1 \\ -\overline{\lambda} \\ (t-1)\overline{\lambda} \end{bmatrix}. \qquad \text{(A.6.1)}$$

Based on Cramer's rule we get

$$\partial \bar{x}_2 / \partial p_2^* = \frac{1}{|J|}\begin{vmatrix} 0 & (p_2^* - tp_1) & (t-1)\bar{x}_2 - \bar{x}_1 \\ (p_2^* - tp_1) & U_{x1x1} & -\bar{\lambda} \\ -(t-1)p_2^* & 0 & (t-1)\bar{\lambda} \end{vmatrix} =$$

$$\frac{(t-1)\bar{x}_2 - \bar{x}_1}{|J|}\begin{vmatrix} (p_2^* - tp_1) & U_{x1x1} \\ -(t-1)p_2^* & 0 \end{vmatrix} + \frac{\bar{\lambda}}{|J|}\begin{vmatrix} 0 & (p_2^* - tp_1) \\ -(t-1)p_2^* & 0 \end{vmatrix} \qquad \text{(A.6.2)}$$

$$+\frac{(t-1)\bar{\lambda}}{|J|}\begin{vmatrix} 0 & (p_2^* - tp_1) \\ (p_2^* - tp_1) & U_{x1x1} \end{vmatrix}.$$

Based on the cross-multiplication of the diagonals in the final matrices (to calculate the determinants of the matrices), the derivation of equation (7) is straightforward.

### *A.7: The substitution effect, equation (7)*

The substitution effect can be obtained by using the envelope theorem and constant utility:

$$dV / dp_2^* = \partial L / \partial p_2^* \Big|_{optimum} = -\bar{\lambda}[\bar{x}_1 - (t-1)\bar{x}_2] = 0. \qquad \text{(A.7.1)}$$

This suggests that $\bar{x}_1 - (t-1)\bar{x}_2 = 0$ (since $\bar{\lambda} > 0$ and $t > 0$). After substitution of $\bar{x}_1 - (t-1)\bar{x}_2 = 0$ in the solution for the partial derivative in appendix A.6 (i.e. equation (7)), the substitution effect in equation (7) is straightforward.

## Table 1: Descriptive statistics

| Variable | Mean | Std.dev. | p25 | p50 | p75 |
|---|---|---|---|---|---|
| **Main dependent variable** | | | | | |
| Want to move within two years (1 if prefer to move) | 0.151 | 0.358 | 0.000 | 0.000 | 0.000 |
| Maybe want to move | 0.084 | 0.277 | 0.000 | 0.000 | 0.000 |
| Want to move, but cannot find a home | 0.007 | 0.081 | 0.000 | 0.000 | 0.000 |
| Definitely want to move | 0.040 | 0.197 | 0.000 | 0.000 | 0.000 |
| Just found a new home | 0.020 | 0.140 | 0.000 | 0.000 | 0.000 |
| Definitely do not want to move | 0.849 | 0.358 | 1.000 | 1.000 | 1.000 |
| Length of residence | 13.76 | 11.57 | 5.00 | 10.00 | 20.00 |
| **Conditional on whether households want to move** [a)] | | | | | |
| Trade up? (1 if yes, preferred price – expected sale price>0) | 0.748 | 0.434 | 0.000 | 1.000 | 1.000 |
| Preferred buy price – Expected sale price (Euros) | 53,103 | 107,494 | 0 | 50,000 | 100,000 |
| Preferred buy price of the future home (Euros) | 304,274 | 133,220 | 211,000 | 279,000 | 350,000 |
| Expected sale price of the current home (Euros) | 251,171 | 120609 | 175,000 | 222,500 | 295,000 |
| **Main independent variables** | | | | | |
| Expected capital gains (log sale price expectation – log buy price) | 0.917 | 0.727 | 0.293 | 0.810 | 1.319 |
| log(Homeowner's sale price expectation) | 12.45 | 0.44 | 12.18 | 12.43 | 12.74 |
| log(Buy price current home) | 11.54 | 0.75 | 11.09 | 11.61 | 12.07 |
| Expected capital gains, (Euros) | 151,749 | 128,753 | 57,228 | 129,706 | 205,580 |
| Homeowner's expected sale price of the current home (Euros) | 283,399 | 141,247 | 195,000 | 250,000 | 340,000 |
| Buy price current home (Euros) | 131,650 | 94,767 | 65,798 | 110,000 | 175,000 |
| **Controls** | | | | | |
| Mortgage Loan payment To Taxable Household Income (fraction) | 0.158 | 0.135 | 0.065 | 0.134 | 0.219 |
| Mortgage Loan Payment (monthly, Euros) | 551 | 446 | 250 | 500 | 750 |
| Mortgage (Euros) | 125,317 | 111,270 | 50,823 | 106,638 | 178,000 |
| Taxable Household Income (monthly, Euros) | 4,000 | 2,731 | 2,472 | 3,571 | 4,937 |
| Child (1 if child living at home) | 0.462 | 0.499 | 0.000 | 0.000 | 1.000 |
| Higheduc (1 if completed higher education) | 0.360 | 0.480 | 0.000 | 0.000 | 1.000 |
| Female (1 if female) | 0.515 | 0.500 | 0.000 | 1.000 | 1.000 |
| Household size (nr.) | 2.70 | 1.30 | 2.00 | 2.00 | 4.00 |
| Age (years) | 48.5 | 14.4 | 37.0 | 47.0 | 58.0 |
| Householdtype1 (1 if partners) | 0.796 | 0.403 | 1.000 | 1.000 | 1.000 |
| Householdtype2 (1 if single parent) | 0.030 | 0.172 | 0.000 | 0.000 | 0.000 |
| Householdtype3 (1 if single) | 0.167 | 0.373 | 0.000 | 0.000 | 0.000 |
| Householdtype4 (1 if other composition/unknown) | 0.007 | 0.081 | 0.000 | 0.000 | 0.000 |
| Current house size (m2) | 145.5 | 67.9 | 100.0 | 132.0 | 176.0 |
| Houseclass1 (1 if detached) | 0.204 | 0.403 | 0.000 | 0.000 | 0.000 |
| Houseclass2 (1 if semi-detached) | 0.193 | 0.394 | 0.000 | 0.000 | 0.000 |
| Houseclass3 (1 if corner) | 0.146 | 0.353 | 0.000 | 0.000 | 0.000 |
| Houseclass4 (1 if row) | 0.316 | 0.465 | 0.000 | 0.000 | 1.000 |
| Houseclass5 (1 if apartment) | 0.141 | 0.348 | 0.000 | 0.000 | 0.000 |
| Garden (1 if the house had a garden) | 0.855 | 0.352 | 1.000 | 1.000 | 1.000 |
| Techmaint (1 if tech. maint. conducted within the last half year) | 0.238 | 0.426 | 0.000 | 0.000 | 0.000 |
| Nr. of observations | 25,745 | | | | |

Note: The results in this table are based on WoON 2006. Only the dummy=1 condition is specified (0 otherwise). The variables that are left aligned are directly used in the regression analysis. We use taxable household income in thousands of euros and the current house size per 10 m2. a) Sample size of 3,879 observations.

## Table 2: Regression results of the basic models, equations 8-10

| | Equation (8) Capital gains Want to move | Equation (9) Buy/sale price Want to move | Equation (10) Trade up Want to move | Equation (10) Trade down Want to move |
|---|---|---|---|---|
| **Main independent variables** | | | | |
| Expected capital gains (log sale price expectation – log buy price) P2-P1 | 0.142*** (0.032) | - | - | - |
| log(Homeowner's sale price expectation) P2 | - | -0.347*** (0.061) | -0.878*** (0.079) | 0.802*** (0.084) |
| log(Buy price current home) P1 | - | -0.181*** (0.033) | -0.221*** (0.034) | -0.059 (0.059) |
| **Average marginal effects (AME)** | | | | |
| Expected capital gains (log sale price expectation – log buy price) P2-P1 | 0.0168***(0.004) | - | - | - |
| log(Homeowner's sale price expectation) P2 | - | -0.041*** (0.007) | -0.081*** (0.007) | 0.032*** (0.003) |
| log(Buy price current home) P1 | - | -0.021*** (0.004) | -0.019*** (0.003) | -0.001 (0.002) |
| **Controls** | | | | |
| Mortgage Loan payment To Taxable Household Income (fraction) | -0.618*** (0.138) | -0.328** (0.156) | -1.231*** (0.259) | 1.089*** (0.261) |
| Taxable Household Income (monthly, Euros, in thousands) | 0.042*** (0.010) | 0.060*** (0.012) | 0.092*** (0.018) | -0.012 (0.025) |
| Child (1 if child living at home) | 0.023 (0.088) | 0.011 (0.087) | 0.072 (0.084) | -0.032 (0.181) |
| Higheduc (1 if completed higher education) | 0.389*** (0.050) | 0.432*** (0.052) | 0.584*** (0.060) | 0.047 (0.080) |
| Female (1 if female) | -0.126*** (0.046) | -0.119*** (0.046) | -0.211*** (0.056) | 0.067 (0.075) |
| Household size (nr.) | -0.022 (0.036) | -0.011 (0.036) | 0.043 (0.035) | -0.123 (0.081) |
| Age (years) | -0.049*** (0.002) | -0.047*** (0.002) | -0.062*** (0.003) | -0.017*** (0.003) |
| Householdtype2 (1 if single parent) | 0.183 (0.134) | 0.149 (0.136) | 0.094 (0.157) | 0.343 (0.184) |
| Householdtype3 (1 if single) | 0.075 (0.069) | 0.036 (0.066) | 0.073 (0.078) | -0.001 (0.135) |
| Householdtype4 (1 if other composition/unknown) | 0.136 (0.219) | 0.149 (0.216) | -0.378 (0.306) | 0.846*** (0.300) |
| Current house size (m2, per 10 m2) | -0.005 (0.003) | 0.003 (0.003) | 0.003 (0.004) | 0.0004 (0.005) |
| Houseclass2 (1 if semi-detached) | 0.317*** (0.069) | 0.187*** (0.072) | 0.533*** (0.088) | -0.030 (0.113) |
| Houseclass3 (1 if corner) | 0.470*** (0.080) | 0.259*** (0.083) | 0.651*** (0.106) | -0.073 (0.120) |
| Houseclass4 (1 if row) | 0.553*** (0.071) | 0.306*** (0.070) | 0.677*** (0.113) | -0.006 (0.111) |
| Houseclass5 (1 if apartment) | 0.924*** (0.136) | 0.624*** (0.134) | 1.083*** (0.180) | -0.163 (0.175) |
| Garden (1 if the house had a garden) | -0.129 (0.088) | -0.116 (0.089) | -0.080 (0.104) | -0.168 (0.137) |
| Techmaint (1 if tech. maint. within the last half year) | -0.200*** (0.051) | -0.215*** (0.050) | -0.220*** (0.055) | -0.240*** (0.075) |
| Intercept | -0.266 (0.199) | 6.188*** (0.782) | 12.942*** (1.044) | -11.329***(1.081) |
| Nr. of observations | 25,745 | 25,745 | 25,745 | |
| # explanatory variables | 64 | 65 | 65 (in each equation) | |
| Pseudo R-squared | 0.080 | 0.083 | 0.109 | |
| Log likelihood | -10,035 | -10,002 | -11,674 | |
| **Tests** | | | | |
| Joint sig. month of questioning dummies (Chi2) | 33 | 30 | 16 | 16 |
| Joint sig. region (COROP) dummies (Chi2) | 6.4e+05 | 4.1e+05 | 2.7e+08 | 3.1e+09 |
| Equality -buy price coef. vs sale price coef. (Chi2) | - | 69 | 168 | 79 |
| Equality -buy price AME vs sale price AME (Chi2) | - | 72 | 192 | 110 |
| Equality coef. Trade up vs trade down equation (Chi2) | - | - | 2.3e+06 | |
| Equality sale price coef. trade up vs trade down (Chi2) | - | - | 220 | |
| Equality sale price AME trade up vs trade down (Chi2) | - | - | 214 | |

Note: The regression results in this table are based on WoON 2006. Standard errors are in parentheses. We use clustered (per region) standard errors. ***, **, *, 1%, 5%, 10% significance, respectively. The reference group for the type of household is householdtype1 (1 if partners). The reference category for the type of house is detached houses. All specifications include month of questioning and region (COROP) dummies.

## Table 3: Nested logit and instrumental variable approach

| | Nested logit | | IV approach | |
|---|---|---|---|---|
| | **Trade up** **Want to move** | **Trade down** **Want to move** | **Trade up** **Want to move** | **Trade down** **Want to move** |
| **Main independent variables** | | | | |
| log(Homeowner's sale price expectation) P2 | -0.812*** (0.124) | 0.659*** (0.179) | -20.614*** (0.670) | 10.986*** (0.569) |
| log(Buy price current home) P1 | -0.209*** (0.036) | -0.089* (0.052) | 3.209*** (0.114) | -1.831*** (0.112) |
| **Average marginal effects (AME)** | | | | |
| log(Homeowner's sale price expectation) P2 | -0.077 (-) | 0.028 (-) | -1.561*** (0.037) | 0.414*** (0.028) |
| log(Buy price current home) P1 | -0.020 (-) | -0.0037 (-) | 0.243*** (0.007) | -0.069*** (0.005) |
| **Controls** | | | | |
| Mortgage Loan payment To Taxable Household Income (fraction) | -1.057*** (0.280) | 0.808* (0.449) | 0.476 (0.302) | 0.252 (0.265) |
| Taxable Household Income (monthly, Euros, in thousands) | 0.087*** (0.018) | -0.005 (0.021) | 0.493*** (0.025) | -0.234*** (0.029) |
| Child (1 if child living at home) | 0.057 (0.077) | -0.009 (0.162) | -0.278*** (0.086) | 0.218 (0.161) |
| Higheduc (1 if completed higher education) | 0.558*** (0.063) | 0.114 (0.094) | 1.419*** (0.059) | -0.485*** (0.084) |
| Female (1 if female) | -0.198*** (0.051) | 0.042 (0.078) | 0.178** (0.048) | -0.187** (0.072) |
| Household size (nr.) | 0.034 (0.039) | -0.104 (0.071) | 0.609*** (0.041) | -0.409*** (0.075) |
| Age (years) | -0.059*** (0.004) | -0.023*** (0.007) | 0.105*** (0.006) | -0.103*** (0.006) |
| Householdtype2 (1 if single parent) | 0.105 (0.147) | 0.298* (0.190) | -0.747*** (0.148) | 0.812*** (0.207) |
| Householdtype3 (1 if single) | 0.067 (0.075) | -0.004 (0.118) | -0.672*** (0.088) | 0.406*** (0.133) |
| Householdtype4 (1 if other composition/unknown) | -0.286 (0.304) | 0.714** (0.308) | 0.446 (0.288) | 0.026 (0.283) |
| Current house size (m2, per 10 m2) | 0.004 (0.004) | -0.0004 (0.005) | 0.234*** (0.009) | -0.122*** (0.009) |
| Houseclass2 (1 if semi-detached) | 0.464*** (0.102) | 0.020 (0.120) | -4.013*** (0.199) | 2.488*** (0.177) |
| Houseclass3 (1 if corner) | 0.566*** (0.122) | 0.014 (0.151) | -6.249*** (0.255) | 4.177*** (0.279) |
| Houseclass4 (1 if row) | 0.592*** (0.118) | 0.090 (0.146) | -7.386*** (0.287) | 4.938*** (0.313) |
| Houseclass5 (1 if apartment) | 0.971*** (0.167) | 0.049 (0.285) | -9.504*** (0.381) | 5.784*** (0.386) |
| Garden (1 if the house had a garden) | -0.084 (0.098) | -0.160 (0.123) | 0.442*** (0.098) | -0.403** (0.168) |
| Techmaint (1 if tech. maint. within the last half year) | -0.220*** (0.054) | -0.233*** (0.065) | -0.621*** (0.054) | -0.072 (0.089) |
| Residual first-stage regression | - | - | 20.741*** (0.679) | -10.889*** (0.579) |
| Intercept | 12.029***(1.670) | -8.798*** (2.794) | 213.361***(6.932) | -115.753***(5.886) |
| Nr. of observations | 77,235 (25,745 cases) | | 25,452 | |
| # explanatory variables | 65 (in each equation) | | 65 (in each equation) | |
| Pseudo R-squared | - | | 0.229 | |
| Log likelihood | -11,672 | | -9,997 | |
| **Tests** | | | | |
| Joint sig. month of questioning dummies (Chi2) | 17 | 15 | 16 | 23 |
| Joint sig. region (COROP) dummies (Chi2) | 8.7e+07 | 3.9e+08 | 1.0e+03 | 311 |
| Equality -buy price coef. vs sale price coef. (Chi2) | 54 | 9 | 948 | 372 |
| Equality -buy price AME vs sale price AME (Chi2) | - | - | 1.8e+03 | 226 |
| Equality coef. trade up vs trade down equation (Chi2) | 7.0e+06 | | 1.9e+03 | |
| Equality sale price coef. trade up vs trade down (Chi2) | 28 | | 1.2e+03 | |
| Equality sale price AME trade up vs trade down (Chi2) | - | | 1.7e+03 | |
| Coef. log regional house price, first-stage IV regression | - | - | 0.462*** (0.030) | 0.440*** (0.086) |
| Dissimilarity parameter move nest (not move ρ = 1) | 0.787 (0.201) | | - | - |
| LR test for IIA, ρ = 1 move nest (Chi2) | 2.67 (p-value 0.103) | | - | - |

| **Panel B Descriptive statistics IV** | Nested logit | Av. | Std. | Av. log | Std. | Nr. Mun. |
|---|---|---|---|---|---|---|
| Med. House price per mun. (euros), apartments | - | 149,352 | 24,997 | 11.9 | 0.166 | 277 |
| Med. House price per mun. (euros), row houses | - | 201,986 | 44,769 | 12.2 | 0.226 | 402 |
| Med. House price per mun. (euros), corner houses | - | 211,272 | 53,998 | 12.2 | 0.247 | 388 |
| Med. House price per mun.(euros),semi-det. houses | - | 250,525 | 100,215 | 12.4 | 0.317 | 422 |
| Med. House price per mun. (euros), detached houses | - | 336,218 | 127,631 | 12.7 | 0.327 | 424 |

Note: The regression results in this table are based on WoON 2006. Standard errors are in parentheses. In the second stage IV approach, we use bootstrapped standard errors (5000 replications). In the nested logit model, the IIA test could not be computed based on the clustered standard errors. Hence, this test is based on the nested logit estimates without clustered standard errors. ***, **, *, 1%, 5%, 10% significance, respectively. The reference group for the type of household is householdtype1 (1 if partners). The reference category for the type of house is detached house. All specifications include month of questioning and region (COROP) dummies.