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Why are the commuting distances of power couples so short?

An analysis of the location preferences of households

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1. Introduction

The share of double-income households in the household population has increased considerably over the past few decades. This means that there are now many more households with two commutes, which presumably complicates the realization of a satisfactory employment-housing arrangement. It is, therefore, easily conjectured that the rising share of double-income households has contributed to congestion problems by increasing the average length of commutes. Formal analysis – for instance, joint search theory (see Guler et al., 2009) – confirms this idea. The more complex work-home location decision is especially severe for the higher-educated, as suggested by Costa and Kahn (2000). Higher-educated may have more specialized skills or can be more career oriented, finding a good job match might therefore be more difficult (or is more important) for them in comparison with lower educated.

As a consequence, commutes of double-income households and especially of power couples must be expected to be longer than those of single-earner households. However, several

studies hit upon the fact that a worker belonging to double-income households do not commute more (see for instance Rouwendal and Rietveld (1994) and van Ham and Hooimeijer (2009)). This evidence is not necessarily conclusive as all these studies have several potentially important shortcomings. For instance, some estimate male and female commutes in a single equation although mainly due to the division of tasks in the households, the determinants of the travel patterns of the two genders are different (see for example Madden, 1981 and Singell and Lillydahl, 1986). Moreover, they do not distinguish between power couples and other double income households. However, the consistency of the finding suggests that many double-income households are indeed able to overcome the disadvantages of having to adjust the residential location to two work locations. A further illustration of this phenomenon is provided in Table 1, which shows the results of a linear regression of the log of the commuting distance of a male worker and a female worker on a number of characteristics. Gender, age, education and working hours are all highly significant and complies with the results of others find in the literature. With respect to the male worker, the effect of a working spouse is not significant. Having a working spouse however, does influence the average commuting distance of female workers. Female workers belonging to a double-income household commute 16 per cent longer.

Table 1 Commuting distance

	Male		Female	
	Coefficient	Std. Error	Coefficient	Std. Error
Age	-0.004	(0.001)	0.000	(0.001)
Secondary education	0.151	(0.031)	0.161	(0.042)
Higher education	0.245	(0.022)	0.309	(0.036)
University education	0.493	(0.027)	0.527	(0.050)
Working hours/40	0.180	(0.040)	1.167	(0.062)
Single worker	-0.223	(0.035)	-0.007	(0.052)
Double-income worker	0.009	(0.020)	0.158	(0.041)
Power couple ^a	-0.061	(0.050)	0.133	(0.107)
Double-income worker * power couple ^a	0.057	(0.053)	-0.063	(0.106)
Power single ^b	0.001	(0.052)	0.032	(0.065)
R ²		0.040		0.074
N		29,725		14,335

The table reports estimates of a OLS. The independent variable is the natural logarithm of the commuting distance (measured in kilometres). The regression includes, besides the variables mentioned above: number of children aged 0-5, 6-11 or 12-17; number of days a week when the respondent commutes. The number of observations includes only those respondents who work more than 12 hours, and have a positive commuting distance. The standard errors are in parentheses. Statistically significant effects (at the 5 per cent level) are in bold. Source: Housing Needs Survey of 2002.

a) Power couples are couples of which both spouses are higher-educated.

b) Power singles are single workers who are higher educated.

Clearly these results do not confirm the earlier finding that there is no effect of belonging to a double-income households, but the absence of a separate effect of belonging to a power couple is quite surprising in view of the strong results about the importance of the co-location problem of such couples reported in the literature. Belonging to a power couples does not appear to influence the average commuting distance of both the male and female workers. Also the cross-effect of being a power couple and a double-income worker is not significant.¹

How can we explain that the commuting distance of male and female workers who belongs to a power couples are not longer than double-income households and other household types? An explanation could be that the location behaviour of power couples differs from that of double-income households and other household types, and that power couples use their purchasing power to locate at their preferred location. An important reason for adopting this hypothesis is that Costa and Kahn (2002) and Compton and Pollak (2004) provide strong evidence that the co-location problem of power couples leads them to concentrate in metropolitan areas. Their analysis implies that households strategically choose a residential location so as to ensure good career opportunities for both partners. This goal can only be realized in dense and diversified metropolitan labour markets. It seems probable that power couples do not just keep career opportunities in mind but also commuting distances to their present and possible future jobs. Table 1 shows a strong effect of a worker's education on the commuting distance (which may have to do with the highly specialized skills of many of the higher-educated), but the effect of couples, of which both members are higher-educated (power couples) is insignificant. Apparently, power couples are able to solve their co-location problem in such a way that the average commutes of both spouses do not differ significantly from single-workers with otherwise comparable characteristics (power singles).

This reasoning suggests that strategic location choice could be an important factor explaining relatively short commutes of power couples. Indeed the trend towards the increased concentration of power couples in metropolitan areas observed by Costa and Kahn for the US is also present in the Netherlands, as shown in Rouwendal and van der Straaten (2004). It is the purpose of this paper to investigate the suggested relationship between household location choice and proximity to employment in greater detail by developing and estimating a

¹ The share of female workers who belongs to a power couple *and* of which both spouses works, is 78 per cent (and hence, 22 per cent of the female worker who belongs to a power couples is a single-earner household). The share of male workers who belong to a power couple *and* of which both spouses work is 77 per cent.

household location choice model. The model will be introduced in the next section, where we also discuss some related literature. The data are introduced in Section 3. Estimation results are presented in Section 4. Finally Section 5, concludes.

2 A household location choice model

2.1 General discussion

Households can choose their residential location from among a given number, N , of alternatives. The number of houses available in each alternative is taken as given.² Prices equilibrate demand and supply. Households have preferences over all available alternatives, which – by assumption – can be described by logit choice probabilities. There are N households, and we denote the deterministic part of the utility that household i attaches to choice alternative n as V_{in} . The housing stock of alternative n is S_n . Demand equals supply if:

$$\sum_{i=1}^N \frac{e^{V_{in}}}{\sum_{k=1}^N e^{V_{ik}}} = S_n, \quad n = 1, \dots, N. \quad (1)$$

We assume that total demand equals total supply ($\sum_n S_n = N$).

The deterministic part of the utility function is further specified as:

$$V_{in} = \beta_{i0} P_n + \sum_{m=1}^M \beta_{im} x_{mn} + \xi_n. \quad (2)$$

In this equation P_n is the housing price in choice alternative n ; x_{mn} is the value of the m -th characteristic of location n ; and ξ_n is a term that reflects unobserved (by the researcher) characteristics of choice alternative n .

Equation (1) defines a market equilibrium, and the prices P_n should therefore be interpreted as functions of the factors that affect supply and demand:

$$P_n = P_n(x, S, \xi). \quad (3)$$

In this equation we have expressed the exogenous variables as a matrix x and two vectors, S and ξ , in a self-explanatory notation.

² This assumption can be justified by the tight spatial planning regime in the Netherlands to which our empirical analysis refers. The development of residential areas is slow and hardly responds to market forces (see Vermeulen and Rouwendal, 2007).

It is well known that, in this context an identification problem arises which is similar to that in traditional supply and demand equations, and was first analysed by Berry (1994) and Berry et al. (1995). The strategy they suggested to attack this problem is to use the equilibrium condition (1) to compute a vector of mean utilities of the choice alternatives δ , and then use 2SLS or a similar technique to deal with the endogeneity of the prices. In what follows, we make use of the exposition in Bayer et al. (2004), which adapts the approach to housing market analysis.³ Like these authors, we assume that the heterogeneity of preferences is related to individual household characteristics z , in the following way:

$$\beta_{i,m} = \beta_m + \sum_{k=1}^K \beta_{m,k} (z_{i,k} - \bar{z}_k), \quad m = 0, \dots, M. \quad (4)$$

This equation states that the individual β -s are linear functions of the K demeaned household characteristics. Clearly, β_m is the population average of the coefficients $\beta_{i,m}$. If $\beta_{m,k}$ is positive, households with a higher than average score on characteristic k derive more utility than other households from location characteristic m . The discussion in the introductory section suggests that power couples attach more weight than other households to employment accessibility, and specification (4) clearly allows us to capture this effect in our model.

Substitution of (4) into (2) gives:

$$\begin{aligned} V_{in} &= \left(\beta_i + \sum_k \beta_{0,k} (z_{i,k} - \bar{z}_k) \right) P_n + \sum_m \left(\beta_i + \sum_k \beta_{m,k} (z_{i,k} - \bar{z}_k) \right) x_{mn} + \xi_n \\ &= \left[\beta_i P_n + \sum_m \beta_i x_{mn} + \xi_n \right] + \sum_k \beta_{0,k} (z_{i,k} - \bar{z}_k) P_n + \sum_m \sum_k \beta_{m,k} (z_{i,k} - \bar{z}_k) x_{mn} \\ &= \delta_n + \sum_k \beta_{0,k} (z_{i,k} - \bar{z}_k) P_n + \sum_m \sum_k \beta_{m,k} (z_{i,k} - \bar{z}_k) x_{mn} \end{aligned} \quad (5)$$

In the last line of (5), δ_n denotes the expression in square brackets in the second line, which gives the average utility of location n .

Estimation of the model proceeds in two stages. The first one starts by setting all coefficients in (5) equal to zero. Then (1) is used to get an initial set of values for the δ_n 's using the contraction mapping suggested in the appendix of Berry et al. (1995). After substituting these values into the third line of (5) the remaining parameters (the β 's) are obtained by estimating the logit. Then new values of the δ_n 's are calibrated conditional on the β 's, and the procedure is continued until convergence is reached. See Bayer et al. (2004) for further discussion.

³ Note, however, that we, in contrast to Bayer et al. (2004), do not intend to study how the socio-demographic composition of residential locations affects residential choice behaviour.

The second stage is a 2SLS regression on the δ_n 's, using the M location characteristics as explanatory variables. Due to the endogeneity of the price variable, the use of instrumental variable techniques is necessary.

2.2 *Further issues*

The model introduced above will be applied to the location choice of households in the Netherlands, and we use municipalities, which often coincide with the town in which a household lives, as our basic spatial entities. We use the number of municipalities that existed in 2007, which means that the alternative number of residential locations is 443.

In the Netherlands almost 40 per cent of the housing stock consists of rented housing (CBS). Almost 80 per cent of the rented houses are social rented houses. The social rent is controlled at the national level, and depends on a number of administrative points that have no geographical component (VROM, 2007). As a consequence, rented houses with the same characteristics have the same rents throughout the country, a result that is also found in our analysis. It is therefore not surprising that there is huge excess demand for rented housing in the large urban areas where housing prices are high. In this analysis we assume that the allocation mechanism on the rental market is part of the unobserved term ξ for rental choice alternatives. For instance, a huge excess demand for rented housing in the urbanized part of the country makes it less attractive to choose this alternative, the low rent notwithstanding, and this results in a lower value of ξ .⁴ In our model, therefore, a household chooses between an owner-occupied house or a rented house in a municipality in the Netherlands.

3. Data

3.1 *The Housing Needs Survey*

The data we use is obtained from the Housing Needs Survey (HNS) (in Dutch: Woon Onderzoek – usually abbreviated as WoON) of 2006. The survey contains a wealth of information about household characteristics and the housing situation of a large sample of Dutch households. We exclude households with no working person (a working person is defined as one who works 12 hours or more), and households with a negative disposable

⁴ An alternative way to deal with this is to concentrate on the owner-occupied market by assuming that households take their decision about tenure choice at an early stage, i.e. before they choose a residential location. This implies the assumption that the large differences in the ratio of the house price and rent over the country has no effect on the tenure choice of households locating in a particular municipality.

income or with an income higher than € 400,000 per year. The total number of observation is 32,734. If we divide households by education level, Table 2 shows that the majority of households consist of couples, of which both members are lower-educated. The share of power couples, couples of which both members are higher-educated is equal to 10 per cent.

Table 2 Descriptive statistics of the household characteristics

	Mean	Min.	Max.	Std. dev.
Share of households, by educational level				
Single, low-educated	31.07	0.00	1.00	0.463
Single, higher-educated ' <i>power singles</i> '	10.51	0.00	1.00	0.307
Couple, both partners low-educated	35.29	0.00	1.00	0.478
Couple, one spouse higher-educated	13.25	0.00	1.00	0.339
Couple, both partners higher-educated ' <i>power couples</i> '	9.88	0.00	1.00	0.298
Share of households, by labour market participation				
Single worker	30.25	0.00	1.00	0.491
Single-earner couple	29.33	0.00	1.00	0.455
Double income couple	40.42	0.00	1.00	0.459
Other household characteristics				
Households with children	0.405	0.00	1.00	0.491
Income (x1000)	34.556	0.14	393.25	19.615
Age of head of household	42.610	18.00	95.00	10.995

The number of households is 37,343. The descriptives of the household characteristics are weighted using the household weight, provided by the HNS (2006).

If we divide households on the basis of labour market participation, the majority of households are double-income households, that is 40 per cent. Single-earner households and single workers both form 30 per cent of the household population.⁵ 40 per cent the households have children younger than 18 years. The average disposable income of the household is equal to € 34,556 per year. The average age of the head of the household is 43 years.

Table 3 gives the spatial distribution of households over municipalities that differ in size using the Housing Needs Survey. It shows the estimation results of a logit model. Double-income couples and single workers are more likely to live in one of the larger urban areas than single-earner households, which is taken as the reference category. Also the chance that power couples and power singles live in large urban areas is large.

⁵ Most power couples (72 per cent) are double-income workers. However, if we only look at double-income workers, one out of four is a power couples.

Table 3 Distribution of households over municipalities that differ in size

	20,000 – 50,000 inhabitants	50,000 – 100,000 inhabitants	100,000 – 150,000 inhabitants	150,000 – 250,000 inhabitants	At least 250,000 inhabitants
Constant	1.022 (0.067)	0.618 (0.072)	0.197 (0.078)	-0.270 (0.091)	-0.124 (0.087)
Single worker	0.262 (0.058)	0.407 (0.062)	0.698 (0.066)	0.648 (0.076)	1.067 (0.071)
Double-income household	0.029 (0.040)	0.026 (0.043)	0.193 (0.049)	0.173 (0.058)	0.160 (0.056)
Power couple	0.079 (0.057)	0.158 (0.061)	0.658 (0.065)	0.610 (0.076)	0.792 (0.071)
Power single worker	-0.135 (0.095)	0.199 (0.096)	0.501 (0.098)	0.490 (0.109)	0.750 (0.099)
Household with children	-0.008 (0.038)	-0.024 (0.041)	-0.058 (0.045)	0.078 (0.052)	0.022 (0.050)
Income household (x1000)	-0.000 (0.000)	-0.001 (0.001)	-0.007 (0.001)	-0.008 (0.002)	-0.002 (0.001)
Age of head of household	0.001 (0.001)	-0.002 (0.002)	-0.002 (0.002)	-0.005 (0.002)	-0.012 (0.002)

The table reports estimates of a multinomial logit regression. Municipalities with the lowest number of inhabitants (0 – 20,000 inhabitants) is chosen as the reference category. Standard errors are given in parentheses. Statistically significant effects (at the 5 per cent level) are in bold.

Number of observations is equal to 37,343 and includes both tenants and owner-occupied households.

Source: Housing Needs Survey of 2006.

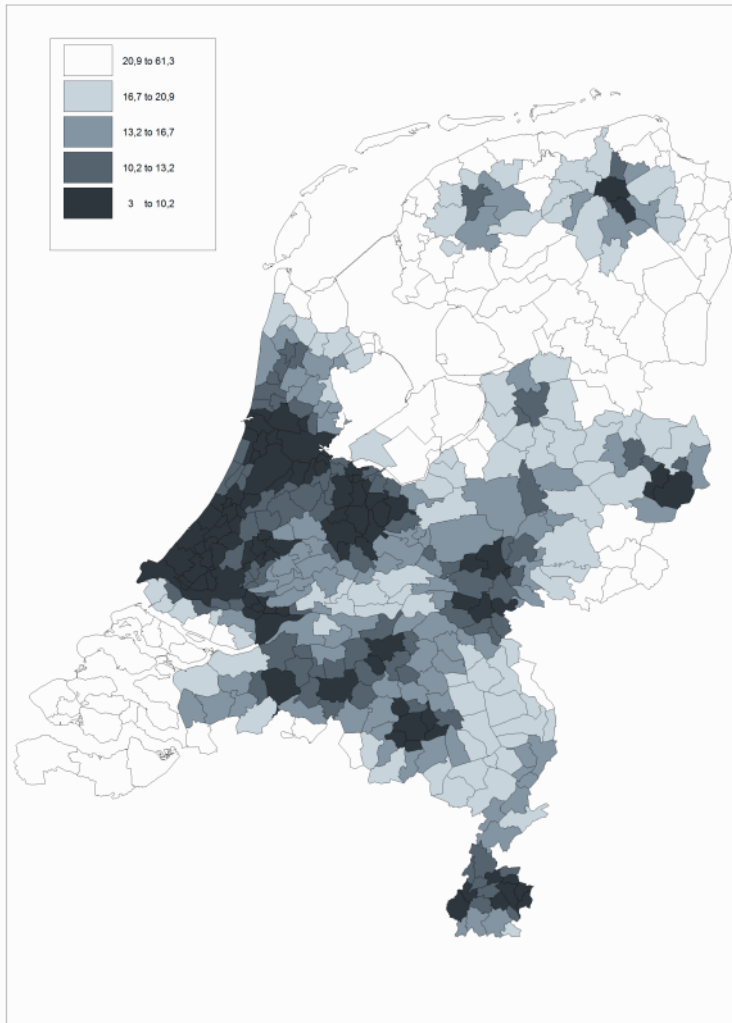
3.2 Characteristics of the residential location

Using different data sets, we include four types of location characteristics: (1) accessibility; (2) regional wage difference; (3) amenities; and (4) the cost of living. The list of variables, their sources, and definitions are summarized in Table A.1 in Appendix A, the Data Appendix.

(1) Accessibility of the residential location: The accessibility variables include the accessibility to large labour market and the accessibility to transportation facilities.

The relation of the location of residence and the size of the labour market is taken into account with the variable of the (Euclidean) distance to 100,000 jobs. If the distance to the jobs is low, it means that the residential location is located close to a large labour market. Figure 1 shows that in the Randstad and around cities the distance to the labour market is low. With respect to the accessibility to transport facilities, we use the nearest (Euclidean) distance to the motorway slip road and the (Euclidean) distance to the nearest inter-city railway station. Because the intercity railway stations are usually located in the city centre of the main city, this variable also reflects the distance to urban amenities. The Randstad and the municipalities that include a large city have short distances to these amenities. (For a fuller discussion on the accessibility variables, see Appendix A, the Data Appendix.)

Figure 1 Distance to 100 000 jobs (km)



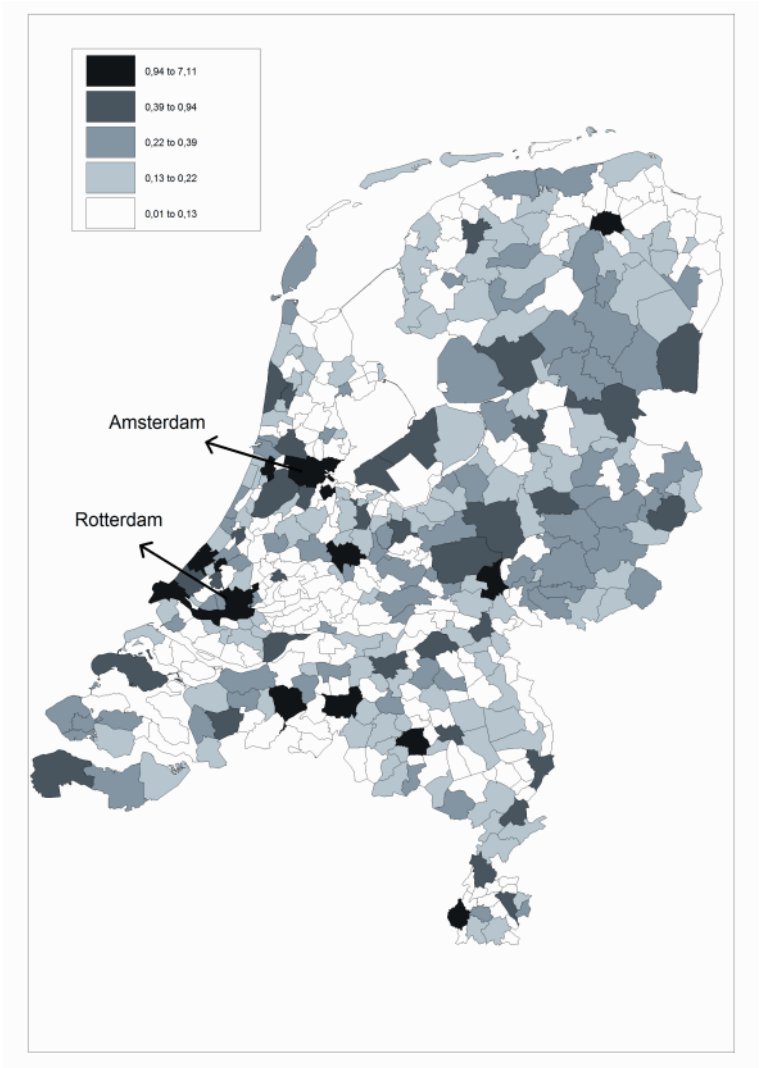
(2) Regional wage difference: The existence of an urban wage premium in the United States (US) is well established (see, for instance, Glaeser and Maré, 2001). Groot et al. (2009) show that, as in the US, in the Netherlands the wage of a standard worker is highest in the most urbanized regions and the lowest in the peripheral areas. In their analysis, the Mincer regression is used, in which the natural logarithm of the hourly wage is explained by the employee's characteristics such as age, gender, being an immigrant or not, part-time worker, education level, occupation, and the NUTS 3-work location. (For a fuller description, see Appendix A, the Data Appendix.)

(3) Amenities of the residential location: The variables that indicate the amenity of the residential location include the percentage of nature coverage and the urban attractivity index. The percentage of nature coverage gives an indication about the outdoor-recreation facilities

of the location. Nature includes natural areas, such as dunes, heath, and forests. The largest percentages of nature coverage are located in the East, Middle and South of the Netherlands, and along the coast. The lowest coverage of nature occurs in the centre of the Randstad, also called The Green Heart. These municipalities mostly consist of agricultural land.

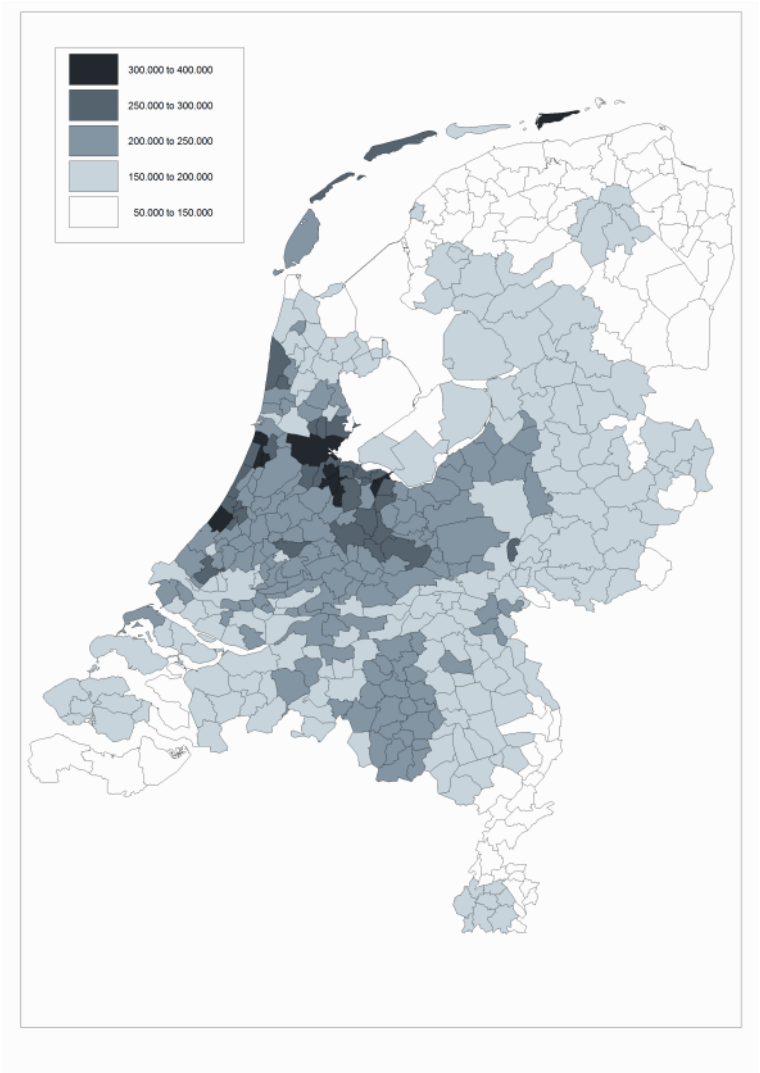
The urban attractivity index describes the availability of cultural, catering, and retail facilities. The urban attractivity index includes three categories: (1) the number of social and cultural facilities: namely, theatres, museums and cinemas; (2) the number of retail facilities; and (3) the number of catering facilities, namely hotels and restaurants. (For a fuller description, see Appendix A.) As shown in Figure 2, large cities, like Amsterdam and Rotterdam, have a high urban attractivity.

Figure 2 Urban attractivity index



(4) Cost of living: To give information about the cost of living in a municipality, we include the regional price of a standard house. Because the rental sector is highly regulated in the Netherlands, we distinguish between the price of a standard owner-occupied house and the price of a standard rented house and estimate two separate hedonic price functions (HPF). The coefficients of the municipality-dummies of each HPF were used to calculate the price a standard house in each municipality. For a fuller description of these variables and the results, see Appendix A, the Data Appendix. The average price of a standard owner-occupied house is € 184,534. The results are shown in Figure 3. It clearly shows that the prices are highest in the Randstad and lowest in the Periphery.

Figure 3 Price of a standard owner-occupied house



With respect to the HPF of rented houses, the coefficients of the municipalities were all insignificant, which implies that there is no regional difference in the price of a standard rented house. This result is not surprising given that almost 80 per cent of the rental houses consist of social rented houses, whose rent is controlled at the national level and does not depend on the location of the dwelling. Therefore the price of a standard rented house in each municipality is set equal to 1.

Table 4 gives an overview of the average values of the residential characteristics in the Netherlands, the Randstad, the Intermediate Zone and the Periphery. With respect to the accessibility of the location, regional wage and the urban amenities, the Randstad is the most attractive place. The highest percentage of nature coverage is found in the Intermediate Zone. Please note that the accessibility variables and the variable with respect to the regional wage difference, can include information about surrounding municipalities.⁶

Table 4 Average values of the variables of the residential location

	The Netherlands	Randstad	Intermediate Zone	Periphery
Accessibility of the location				
Distance to large labour market (km)	15.586	12.372	15.178	20.543
Distance to motorway slip road (km)	5.528	4.535	4.937	7.656
Distance to railway station (km)	10.327	7.725	10.810	13.297
Regional wage difference				
Regional wage differences	6.626	9.745	5.267	4.559
Amenities of the location				
Percentage of nature (%)	12.326	9.079	16.665	11.249
Urban attractivity index (x100)	0.226	0.259	0.224	0.183
Price of living				
Price of a standard owner-occupied house	184534	215387	183853	142825

The number of municipalities in the Netherlands is 443; 167 in the Randstad; 155 in the Intermediate Zone; and 121 municipalities in the Periphery (in the year 2007).

4 Heterogeneity in preferences of location characteristics

The first step in estimating the model proposed in Section 2 is the estimation of a logit model on the basis of the equilibrium equation (1). The sample is person-based, and weighting is therefore needed in order to get a representative sample of the household population. The weights, provided by the Housing Needs Survey, also correct for differences in response

⁶ For example a municipality with only a few jobs can have a short distance to a large labour market if it is located close by a municipality with more than 100,000 jobs.

rates.⁷ The independent variables of the logit estimation include the 886 alternative specific constants and 42 interaction variables of the characteristics of the location⁸ with the household characteristics.⁹ The coefficients of the interaction parameters of the conditional logit estimation are shown in Table 5. These results are used, together with the estimation results of the second step, to estimate the heterogeneity in the willingness-to-pay (WTP) of households in their preferences for location characteristics.

Table 5 Interaction parameters estimation of the weighted conditional logit estimation

	Double-income household	Power couple	Single worker	Power single worker	Household with children	Age of head of household
Distance to large labour market (km)	-0.0025 (0.0035)	-0.0139 (0.0045)	0.0073 (0.0045)	-0.0318 (0.0058)	0.0040 (0.0032)	0.0001 (0.0001)
Regional wage differences	0.0070 (0.0047)	0.0020 (0.0058)	0.0017 (0.0062)	-0.0158 (0.0076)	0.0027 (0.0043)	0.0009 (0.0002)
Distance to motorway slip road (km)	-0.0007 (0.0039)	-0.0068 (0.0054)	-0.0101 (0.0053)	0.0229 (0.0076)	-0.0032 (0.0036)	-0.0001 (0.0036)
Distance to railway station (km)	0.0020 (0.0030)	-0.0149 (0.0041)	-0.0166 (0.0041)	-0.0264 (0.0059)	0.0072 (0.0028)	0.0006 (0.0001)
Urban attractivity index (x100)	-0.0024 (0.0011)	0.3568 (0.0123)	0.4843 (0.0130)	0.1299 (0.0128)	-0.0276 (0.0098)	-0.0044 (0.0004)
Percentage of nature (%)	-0.0024 (0.0011)	0.0034 (0.0013)	-0.0025 (0.0015)	-0.0015 (0.0018)	0.0018 (0.0010)	0.0002 (0.0000)
Price of a standard house (/1,000)	0.0009 (0.0002)	0.0035 (0.0002)	0.0061 (0.0003)	0.0032 (0.0004)	0.0012 (0.0002)	0.0000 (0.0000)

The table reports the coefficients of the interaction parameters of a weighted conditional logit estimation. The regression is weighted using the household weight, provided by the HNS. Parameter estimates are reported with all variables normalized to have mean zero. Standard errors are in parentheses. Statistically significant effects (at the 5 per cent level) are in bold. Number of observations is equal to 32,734.

Source: Housing Needs Survey of 2006.

The interaction of power couples with the distance to a large labour market is significantly negative. Apparently, the fact that power couples prefer to have a shorter distance to a large labour market fits the data better than a positive interaction. This result complies with the hypothesis that locations close to a large labour market are attractive for the higher-educated.

⁷ As a result, the share of weighted observations of households living in a particular municipality in our sample is identical to the share of households in the Dutch population living in that municipality. However, our selection of households with at least one worker and an annual income below 400,000 may have slightly disturbed this identity. It can also not be guaranteed that it holds for both the owners and for the tenants.

⁸ The characteristics of the residential location include: the distance to large labour market, wage differences, the distance to a highway slip road, distance to a railway station, percentage of nature coverage, the urban attractivity index, and the price of a standard house.

⁹ The household characteristics include: double-income households, power couples, single worker, power single worker, households with children, and age of the head of the household.

The interpretation of the alternative specific constants (which equal the cross-effect of living in an owner-occupied house or a rented house and the residential municipality) are less intuitive to interpret. The coefficients represent the average household's utility of living in an owner-occupied house or a rented house in one of the 443 municipalities. The utility of living in an owner-occupied house in the Netherlands is larger than the mean utility of living in a rented house in the Netherlands, as can be seen in Table 6. The highest (average) utility of living in an owner-occupied house is found in the Intermediate Zone.

Table 6: Average of the estimation results of the specific choice variable of mean indirect utility

Choice variable	Mean	Min.	Max.	Std. dev.
Owner-occupied house in a municipality in the Netherlands	0.606	-3.458	3.709	1.957
Rented house in a municipality the Netherlands	-0.606	-3.422	3.517	2.229
Owner-occupied house in a municipality in the Randstad	0.499	-2.266	3.591	2.063
Rented house in a municipality in the Randstad	-0.511	-3.102	3.517	2.357
Owner-occupied house in a municipality in the Intermediate Zone	0.797	-2.001	3.709	1.816
Rented house in a municipality in the Intermediate Zone	-0.422	-3.109	3.301	2.090
Owner-occupied house in a municipality in the Periphery	0.508	-3.458	3.108	1.947
Rented house in a municipality in the Periphery	-0.973	-3.422	2.375	2.150

The number of municipalities in the Netherlands is 443; 167 in the Randstad; 155 in the Intermediate Zone and 121 municipalities in the Periphery.

The second step consists of a weighted two-stage-least-squares estimation, with the dependent variable being the estimated coefficients of the alternative specific constants of the first step. To give large municipalities more influence, the numbers of households of each municipality in 2006 are used as weights. Due to the absence of regional price differences of a standard rented house, we only include the regional price of the (standard) owner-occupied houses as the indication of the cost of living.¹⁰ To solve the endogeneity problem, we include instrumental variables. These variables are equal to the average of the characteristics of the municipalities of the adjacent municipalities, also called 'first neighbouring communities'.¹¹ The estimation results of the first step of the 2SLS are given in Appendix B, Table B.1. The results of the (second) estimation are shown in Table 7.

¹⁰ The data set does not have an observation for an owner-occupied house in the municipality of Schiermonnikoog, therefore the number of municipalities is 442.

¹¹ The municipalities of Ameland and Texel are (officially) islands in the Wadden Sea and therefore do not have adjacent neighbouring municipalities. Their instrumental variables are set equal to zero. The instrumental variables include the distance to a large labour market, distance to the nearest highway slip road, distance to the nearest railway station, percentage of nature coverage and the urban attractivity index. Because the regional wage differences are estimated at the COROP-level, this variable is not used as instrumental variable.

Table 7 Estimation results of implied marginal willingness-to-pay

	Coefficient	Standard error
Constant	31.1819	12.0873
LN (price of house)	-2.4877	1.0058
Distance to large labour market (km)	-0.0552	0.0151
Regional wage differences	0.0591	0.0293
Distance to motorway slip road (km)	0.0125	0.0140
Distance to railway station (km)	-0.0536	0.0104
Urban attractivity index (x100)	0.0928	0.0382
Percentage of nature (%)	0.0080	0.0055

The table reports the second stage estimation results of a 2SLS. Standard errors are in parentheses. Statistically significant effects (at the 5 per cent level) are in bold. The number of observations is equal to 442. (Because our data does not have an observation of an owner-occupied house in the municipality of Schiermonnikoog, the number of municipalities is 442 instead of 443.)

Using the results of the first and second step we are able to calculate the average marginal willingness-to-pay (MWTP) and the heterogeneity in the MWTP for characteristics of the residential location. The results are shown in Table 8.

The first column shows the MWTP; and the standard errors of the marginal prices are given in parentheses. On average, households are willing to pay € 4,093 to live 1 km closer to a large labour market. On average, households are indifferent to being located closer to a motorway slip road. The explanation for this might be that the average distance to the nearest motorway ramp is only 5.5 km.¹² Households prefer to live close to an intercity railway station, because stations are mostly located in the centre of major cities, and this might also reflect the distance to urban amenities. Households are willing to pay € 4,381 in order to have a higher regional wage. The WTP of a household in order to have a higher urban attractivity index is equal to € 6,882. (However one must take into account that a marginal change of the urban attractivity index has a large influence).¹³ With respect to nature, households are willing to pay € 591 in order to have 1 per cent more nature in their residential location.

These results show that households find it important to have good accessibility to large labour market, railway station and urban amenities, and that they are willing to pay a higher price for that.

¹² Although our results show that accessibility to the motorway slip road is not an important location characteristic for households, van Oort et al. (2007) showed that in the case of firms accessibility to the motorway slip road is one of the most important location factors.

¹³ The index is the summation of three ratios (each accounting of 1/3 of the total value). The ratio of each category is equal to the number of facilities (for example, retail facilities) divided by the total number of facilities in the Netherlands. Hence, a marginal change of the value of the index implies a large influence of the facilities in the municipality.

Table 8: Heterogeneity in marginal willingness-to-pay (MWTP) for characteristics of the residential location

	(1) mean MWTP	(2) Double- income couple	(3) Power couple	(4) Single worker	(5) Power single worker	(6) House- hold with children	(7) Average age + 10 years
Accessibility							
Distance to large labour market (km)	-4,093 (1,258)	-263	-2,339	-1,550	-9,484	-49	77
Distance to motorway (km)	925 (1,213)	6	-289	-386	3,520	-96	-46
Distance to railway station (km)	-3,973 (1,857)	-61	-2,391	-3,583	-11,640	113	389
Regional wage difference							
Regional wage difference	4,381 (1,151)	472	1,440	2,490	3,526	387	703
Amenities							
Urban attractivity index (x100)	6,882 (2,699)	842	31,482	46,129	93,919	-907	-3,194
Percentage of nature (%)	591 (283)	-85	457	101	224	118	166

The first column shows the MWTP of the characteristic of the residential location of the average household (the mean MWTP). Columns (2) to (7) show the deviation with respect to the mean MWTP of the corresponding household characteristic. The standard errors of the mean MWTP have been computed on the basis of the 2SLS standard errors using the delta method, and are given in parentheses in the first column.

a) hh stands for household.

Columns (2) to (7) show the deviation of the MWTP of a household characteristic with respect to the first column, the mean MWTP.¹⁴ Column (3) shows that power couples are willing to pay € 2,339 extra (above € 4,093) in order to be located close to a large labour market. Living close to a railway station and urban attractivity are also important characteristics for power couples, and they are willing to pay € 2,391 extra in order to be located close to a railway station, and € 31,482 extra to have more urban facilities. Power single workers show the same preference for residential characteristics as power couples. Power single workers are willing to pay € 9,484 extra to live close to a large labour market and € 11,640 extra to be located closer to a railway station. Urban attractivity is also important for power singles: they are willing to pay € 93,919 extra for this. Compared with power couples, power single workers are willing to pay more to be located close to large labour markets, transport facilities and urban amenities. The explanation for this might be that 10 per cent of power single workers have children under the age of 18 who are living at home,

¹⁴ Please note that due because the estimation method involves two separate regressions, we are not able to calculate the standard error of the marginal prices of the heterogeneity of the WTP of the characteristics.

compared with 50 per cent of the power couples. Our results show that households with children are willing to pay more in order to be located further away from the railway station and to have less urban amenities. An interesting research topic for the near future would be to analyse the influence of the lifetime of households and its implications with respect to their location preferences.

These results can be applied to compare the WTP of households for living in municipalities that differ in characteristics. We compare the municipality of Amsterdam with the municipality of Almere. Almere, which was built in the 1970s, was designated as a growth centre to accommodate the population growth of Amsterdam. In Table 9 the distance to a large labour market, distance to railway station, regional wage difference and the urban amenity index is shown for Amsterdam in column (1), and for Almere in column (2). The variables distance to motorway slip road and nature are left out because the coefficients of these variables were not significant, see Table 7. Column (3) shows the differences between column (1) and column (2), and it can be seen that the distance to a large labour market is 12 km less in Amsterdam than in Almere. Also the number of urban facilities is much higher in Amsterdam than in Almere. Column (4) shows the WTP of the average household for a marginal change of the characteristics; the marginal willingness-to-pay (MWTP). If we assume that the changes with respect to the characteristics are marginal, we are able to calculate the WTP, which is shown in column (5). The total willingness-to-pay (TWPT) of the average households to be located in Amsterdam instead of Almere, is shown in the last line of column (5). An average household is willing to pay € 135,125 extra to be located in Amsterdam instead of Almere. This result complies with the difference in price of a standard house in Amsterdam and Almere, which is equal to € 128,971.¹⁵

¹⁵ The price of a standard owner-occupied house in Amsterdam is € 285,846. The price of a standard owner-occupied house in Almere is € 156,875.

Table 9 Application: WTP of living in Amsterdam and Almere

	(1) Amsterdam	(2) Almere	(3) Difference [=(1)-(2)]	(4) MWTP average household	(5) WTP average household [=(3)*(4)]	(6) MWTP power couple	(7) WTP Power couple [=(3)*(6)]
Distance to large labour market (km)	4.79	17.29	-12.5	-4,093	51,163	-5,643	70,539
Distance to railway station (km)	2.34	2.17	0.17	-3,973	-675	-6,364	-1,082
Regional wage difference	13.17	4.14	9.03	4,381	39,560	5,820	52,558
Urban amenity index (x100)	7.1	0.55	6.55	6,882	45,077	38,364	251,287
<i>Total WTP (euro)</i>					135,125		373,302

Column (6) of Table 9 shows the MWTP of power couples with respect to the residential characteristics. The last column (7) shows the WTP of power couples to be located in Amsterdam instead of Almere. The last line shows that power couples are willing to pay € 373,302 to be located in Amsterdam instead of Almere.

With respect to the heterogeneity of preferences between households, we can conclude that power couples have a strong preference for being located closer to a large labour market and urban amenities. Both preferences imply a higher housing services demand, which means that power couples are willing to pay extra for their house. Therefore, we can conclude that, in order to solve their co-location problem and because of their preferences for urban amenities, power couples do indeed use their purchasing power to outbid others, so they can locate close to large urban areas. This result complies with the hypothesis that power couples strategically choose their residential location. It should be noted that these results are in line with the results found by van Ham et al. (2000), who find that suburban locations in between major employment centres are clearly superior for households with highly-skilled workers. However, our results show that, besides accessibility towards the labour market, also the presence of urban amenities is regarded as important in the location choice of the higher-educated.

5 Conclusions, implications and further research suggestions

This paper has focussed on the location choices of power couples and analyse whether power couples, differ with respect to their preferences for various characteristics of their residential location in order to solve their co-location problem. Own analyses and those of others do show that power couples are more likely to be located in areas with good labour market facilities. However, the choice of a residential location is a result of a trade-off between the many aspects involved. Therefore, in the residential sorting model, we include, besides labour market characteristics, several other characteristics of the residential location such as transport facilities, recreational facilities, urban facilities and the cost of living.

The results show that an average household would like to live close to a large labour market; close to a railway station; in municipalities with a higher regional wage, and to have urban facilities. Household are indifferent with respect to the distance to the highway slip road and the amount of nature in the area.

In comparison with the average households, double-income couples do not deviate with respect to their preference for the various characteristics. However, power couples are willing to pay more than average to be located close to large labour markets and a railway station, and to have good urban facilities in their residential location. These results are in line with our hypotheses that power couples use their purchasing power to locate at their preferred location in order to solve their the co-location problem.

The results show that the location choice is not simply more connected with just the working place. Although accessibility to the workplace is still important, the amenities that the location offers are also regarded as important, especially for power couples and (power) single workers. This explains why they are more likely to live in large urban areas.

A possible research topic for the near future would be to correct for differences in the diversity of the labour market. Although large urban areas offer more potential job matches, and hence the probability of drawing a good initial match, or a subsequent match, is higher, a 'dense' labour market by itself is not necessarily more attractive to power couples as a solution for their co-location problem. In a dense labour market, there are not only more jobs, but also more workers, and, as a result, there will be more competition for jobs. In an empirical analysis of the overqualification of the trailing spouse and its relation to the size of

the location, McGoldrick and Robst (1996) found no significant relationship between population size and the likelihood of the trailing spouse (women) being overeducated. The authors suggest that it is not the market's size which is important but its job composition, although more research is needed to answer this question.

Our analyses have focussed on the regional scale, but it would also be interesting to apply future analyses on the more detailed scale of neighbourhoods. Especially in large cities there can be much heterogeneity at a lower spatial level, and, hence, the neighbourhood level might be more relevant than the municipality. However, estimating the model at the neighbourhood level would imply a huge increase in the number of choice alternatives, and, moreover, some data is not available at that level. Another interesting application of the model would be to analyse the differences between the lifetime of households and the implications with respect to their location preferences.

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Appendix A: Data appendix

Table A.1 Variable definition and sources

Variable	Definition	Source
Household characteristics		
Double-income couple	Couple both member of which work 12 hours or more.	HNS (2006)
Single-earner couple	Couple one member of which works 12 hours or more.	HNS (2006)
Single worker	Single who works 12 hours or more.	HNS (2006)
Power couple	Couple of which both members are higher-educated.	HNS (2006)
Power single worker	A higher-educated single.	
Household with children	Household with child(-ren) under the age of 18.	HNS (2006)
Income (x1000)	Average disposable income of the household.	HNS (2006)
Age of head of household	Age of the head of the household.	HNS (2006)
Accessibility of the location		
Distance to large labour market	= The (Euclidean) distance to 100,000 jobs.	Ruimte-scanner (2000)
Regional wage differences	= Regional wage difference of a standard worker.	CBS
Distance to motorway ramp (km)	= The (Euclidean) distance to the nearest highway slip road.	ABF (2005)
Distance to railway station (km)	= The (Euclidean) distance to (intercity) railway station.	ABF (2000)
Amenities of the location		
Percentage of nature	= Percentage of nature coverage in the residential municipality	ABF (2003)
Urban attractivity index (x100)	= The urban attractivity index includes three categories: (1) the number of social and cultural facilities, such as theatres, museums and cinemas; (2) the number of retail facilities; and (3) the number of catering facilities, such as hotels and restaurants. For each category the national share of the number of facilities are calculated and weighted by one-third. The value of the urban attractivity index of a location always lies between 0 and 1. Because the average value of the index is very low (namely, 0.002), we multiplied the index by 100.	ABF/CBS (2007)
Cost of living		
Price of standard owner-occupied house	= The regional price of a standard owner-occupied house. The standard house is a terraced house, with a volume of 361 m ³ , a floor area of 121 m ² , built in the period 1971-1980 and sold in the months April to July.	NVM (2006)
Price of standard rented house	= The regional price of a rented house. Due to the fact that the regional price differences are absent in the rental sector, the regional price of the rented house is set equal to 1.	HNS (2006)
Notes: HNS: Housing Needs Survey, which is conducted every four years. The survey includes information about the household characteristics and the housing situation of a large sample of Dutch household in the Netherlands.		
Ruimtescanner: Land Use Scanner; a framework for Land Use change modelling.		
CBS: Central Bureau of Statistics in the Netherlands.		
ABF: ABF Research		
NVM: Netherlands Association of Real Estate Agents. The data includes housing transaction data of owner-occupied houses in the Netherlands recorded by the NVM-agents.		

1. Distance variables: The distance variables to jobs, the nearest highway slip road and the nearest intercity railway station describes the Euclidean distance of the municipality to the characteristic concerned. If the distance is larger, this means that the municipality is located further away from the characteristic. The value is a weighted average of the relevant value for the 4-digit postal code areas of the municipality. Each value of the 4-digit postal code is weighted according to the number of inhabitants in the corresponding postcode area, in order to give highly populated postal-code areas more weight. The average distance to a large labour market is 15.5 km; the average distance to the nearest highway ramp is only 5.5 km; and the average distance to the railway station is 10.3 km. In the Randstad the average distance to all these things is lower than in the Intermediate Zone and the Periphery.

2. Regional wage difference: Groot et al. (2009) use a large labour market micro-data set consisting of 200,000 observations, provided by Statistics Netherlands (CBS). The data set is rich in employee characteristics, such as age, educational level, and jobs characteristics, e.g. pre-tax hourly wage, work location, and sector classification of the job type. The Mincer regression is used to analyse the regional wage differences and includes the workers' characteristics, job characteristics, and the work location.¹⁶ The regional wage difference is calculated for the European NUTS-III level, known as the COROP regions, of which there are 40 in the Netherlands. These regions contain one large city, and a number of adjoining municipalities. The borders have been chosen so as to minimize interregional commuting. COROP regions resemble functional labour market regions (Corvers et al., 2009). The coefficients of the 40 NUTS 3 work locations, the COROP regions, are used to calculate the difference in the wage of a standard worker in each COROP region. The method and full estimation results are given in Groot et al. (2009). The average regional wage difference is equal to € 6.6 per hour. The highest wage premium is found in the COROP-region of The Hague and is € 13.25 per hour.

3. Urban attractivity index: The urban attractivity index describes the availability of cultural, catering, and retail facilities. The urban attractivity index includes three categories: (1) the number of social and cultural facilities, such as theatres, museums and cinemas; (2) the number of retail facilities; and (3) the number of catering facilities, such as hotels and restaurants. For each category the national share of the number of facilities are calculated and weighted by one-third. This means that the value of the urban attractivity index always lies between 0 and 1. Because the average value of the index is very low (namely, 0.02), we

¹⁶ The regression includes employees' characteristics such as age, gender, immigrant or not, part-time worker and education dummies, occupation, and year and work location.

multiplied the index by 100 in the analyses. The municipality of Amsterdam has the highest urban attractivity index: 7.10.

4. Cost of living: To provide information about the cost of living in a municipality, we include the regional price of a standard house. Because the rental sector is highly regulated in the Netherlands, we distinguish between the price of a standard owner-occupied house and the price of a standard rented house. We estimate two separate hedonic price functions (HPF). The first HPF refers to the owner-occupied house, and we use the individual housing transaction data from the Netherlands Association of Real Estate Agents (NVM) for 2006. The records of the NVM provide data on the transaction price and on the physical characteristics of the house: for instance, volume, floor area, type of the house, building period, and the location. The results of the HPF are in line with the results found in the literature and are given in Appendix A, Table A.2. Using the coefficient of the municipality-dummies, we calculated the price a standard house for each residential location. We chose a terraced house, with a volume of 361 m³, a floor area of 121 m², built in the period 1971-1980, and sold in the months April to July as a standard house. The average price of a standard house is equal to € 184,534. The price of a standard house is lowest in the residential location Reiderland, which is located in the North-east of the Netherlands.

Because the NVM-data set only consists of owner-occupied houses, we used the HNS of 2006 to calculate the regional price of a standard rented house. Almost 80 per cent of the rented houses are social rented houses. The social rent is controlled at the national level, and depends on a number of administrative points. These administrative points mainly refer to the characteristics of the residence (e.g. the number of rooms), and less to residential amenities, distance to shops etc. (see VROM, 2007). The number of administrative points determines the maximum rent. Because the administrative points, and hence the rent, do not depend on the location, it is not surprising that the coefficients of the regional dummies in the HPF are not significant. Therefore, we conclude that there are no regional differences in the price of a standard rented house, and therefore the price of a standard rental house in each municipality is set equal to 1.

Table A.2 Estimation result of the hedonic price regression of an owner-occupied house

	Coefficient	Std. error
Constant	7.175	(0.023)
Log (m ³)	0.455	(0.004)
Log (floor area)	0.417	(0.004)
Terraced house	-0.062	(0.002)
Linked house	0.034	(0.005)
Semi-detached house	0.120	(0.002)
Detached house	0.302	(0.003)
Apartment	0.009	(0.002)
Monument	0.137	(0.007)
Building period 1945–1959	-0.043	(0.002)
Building period 1960–1970	-0.096	(0.002)
Building period 1971–1980	-0.065	(0.002)
Building period 1981–1990	-0.018	(0.002)
Building period 1991–2000	0.074	(0.002)
Building period 2000–2006	0.129	(0.002)
Month of sale: April–June	0.019	(0.002)
Month of sale: July–September	0.025	(0.002)
Month of sale: October–December	0.031	(0.002)
443 Municipality dummies		included
R ²		0.796

The table reports estimates of the hedonic price regression with the dependent variable the natural logarithm of the transaction price. A corner house, building period before 1945, and month of sale: January–May is taken as the reference category. Standard errors are given in parentheses. The number of observations is 145,747. Source: NVM (2006).

Appendix B: Results of the 2SLS

Table B.1 First stage estimation results of the 2SLS

	Coefficient	Std. error
Constant	12.4033	0,0307
Instrumental Variable of the distance to large labour market (km)	-0.0175	0,0027
Instrumental Variable of the distance to motorway ramp (km)	-0.0031	0,0027
Instrumental Variable of the distance to railway station (km)	-0.0097	0,0035
Instrumental Variable of the percentage of nature (%)	0.0026	0,0009
Instrumental Variable of the urban attractivity index (x100)	0.0305	0,0310
R ²		0.3770

The table reports the first stage estimation results of a 2SLS. The dependent variable is equal to the natural logarithm of the regional price of a standard owner-occupied house. The instrumental variables are equal to the average value of the corresponding variable (for example, distance to large labour market) of the neighbouring municipalities. The number of observations is 442.