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## Living-arrangement and university choice of Dutch prospective students

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6 Abstract: This paper analyses the nature of university choice and living-arrangement  
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8 decisions of Dutch prospective students. A random utility maximization nested logit  
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10 model of living-arrangement and university-choice decisions is estimated. Estimation  
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12 results show that distance deters both prospective students living at the parental home  
13  
14 and those living elsewhere. Dutch youngsters appear not to be guided by investment  
15  
16 motives. They attend the university where their high school peers go. Tight housing  
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18 markets lower the probability of choosing a given university. Male and low-income  
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20 students stay longer with their parents in comparison to prospective students with non-  
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22 Dutch parents.  
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28 Keywords: living arrangements, university choice, random utility maximization, nested  
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33 JEL: C25, D85, I2, R00  
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## 1 Introduction

In industrialized countries of the Western world, a wide range of trends indicates a decline in family support and commitment, as the increasing desire for privacy and autonomy overcome the role of family and community. In a time where individualism prevails over traditional values, we observe a remarkable tendency for the age at which young people leave home to increase. During the 1980s, home-leaving patterns in The Netherlands were characterized by high, increasing probabilities of leaving home at younger ages, but lately the country has been moving towards a different model: Dutch young adults are leaving home ever later (SCP, 2000).

This fact has several implications for the lives of these young people. Although many of those living outside of the parental home are not truly independent because they depend on their parents' money transfers, we expect the act of leaving the parental home to contribute to speed up the timing of independence, by creating what MULDER and CLARK (2002) call a 'taste for independence'. But the late home leaving also has important implications for individuals' educational careers. Specifically, the higher education institution choice of prospective students living with their parents is more likely to be geographically constrained than the choices of other students.

The economics of household behaviour has emphasized the interrelation between human capital investments, labour supply, and family status decisions of household members, but in most studies human capital decisions and family arrangements are treated separately, or, at most, family status is taken as exogenous.

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3 There are only a few recent studies that jointly model these decisions. GIANNELLI and  
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5 MONFARDINI (2000, 2003) model the joint decision of working, studying, and living  
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7 arrangements of Italian youth, by means of a multinomial probit model, with work and  
8  
9 living with parents, work and not living with parents, and study and living with parents  
10  
11 as the available choice set. MARTINEZ-GRANADO and RUIZ-CASTILLO (2002) use a  
12  
13 trivariate probit model to simultaneously analyse three important decisions that Spanish  
14  
15 youth make in their transition into adulthood: whether to work, whether to study, and  
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17 whether to live at the parental home. All these analyses, however, take the studying  
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19 decision as dichotomous, with students deciding between studying and not studying,  
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21 and they ignore the role of school characteristics.  
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28 The present study is an attempt to bring together the literature on university  
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30 choice and the literature on the decision on whether or not to leave the parental home.  
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32 Our primary focus is to investigate the effect of individual and university characteristics  
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34 on students' living-arrangement and university choices, with reference to the Dutch  
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36 higher education setting. The perspective of a potential student is approximated using a  
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38 nested logit model, where special attention is given to university location attractiveness,  
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40 perceived university quality, and peer effects.  
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46 Our analysis departs from the existing literature, as we pose some questions not  
47  
48 (fully) dealt with in previous studies. First, how does university choice relate to home  
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50 leaving decisions? This question calls for the intersection of two lines of research: the  
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52 leaving home and the higher education choices literature. Several studies have analysed  
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54 the leaving home decision and related its timing with the increasing enrollment in higher  
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3 education. MULDER and CLARK (2002), CHRISTIE (2007) and TURLEY (2006) analyse the  
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5 process of leaving home for college. MULDER and HOOIMEIJER (2002) point out the  
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7 education expansion as a major reason for the accelerated rate of home-leaving,  
8  
9 whereas CHRISTIE (2007) and TURLEY (2006) stress that parents play an important role  
10  
11 in supporting their adult children decisions, namely the leaving home decision. On the  
12  
13 other hand, a number of previous studies address the determinants of university  
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15 choices, but just a small number of studies model the choice of a higher education  
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17 institution from a discrete set of alternatives. Exceptions are KOHN et al. (1976) and  
18  
19 OOSTERBEEK et al. (1992), who, however, do not consider the living-arrangement  
20  
21 decision and do control for a small set of higher education institution characteristics.  
22  
23 Recently, AVERY and HOXBY (2003) and LONG (2004) have analysed the determinants of  
24  
25 college choice in the US by exploiting the advantages of conditional logit models in  
26  
27 dealing with a large number of alternatives. MONTGOMERY (2002) employs nested logit  
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29 techniques to the study of the determinants of the choice for a graduate school. Again,  
30  
31 the living-arrangement choice is not explored, and the analysis is confined to the  
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33 particular set of business schools. Furthermore, the nested logit formulation he uses is  
34  
35 not compatible with a random utility maximization approach. In view of the above, our  
36  
37 study makes two improvements to the previous literature regarding the model  
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39 formulation. On the one hand, we jointly model decisions on living arrangements and  
40  
41 higher education institution choice within a nested logit framework, which enables us to  
42  
43 look at factors that might explain the fact that Dutch young adults are leaving the  
44  
45 parental home at a higher age, and analyse the university attributes they take into  
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3 account when choosing a university. The nested logit model establishes a link between  
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5 the university choice and the decision on living arrangements, and captures any  
6  
7 feedback between the two simultaneously made decisions. It accommodates the  
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9 violation of the Independence of Irrelevant Alternatives (IIA) assumption, but does not  
10  
11 make any behavioural assumption regarding the choice process (HENSHER et al., 2005).  
12  
13 On the other hand, we estimate the model by re-scaling utilities in such a way that the  
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15 random utility maximization framework applies.  
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21 Second, what are the determinants of students' decisions? What is the role of  
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23 distance in university choice? Are investment motives at work in the Dutch higher  
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25 education market, in line with the human capital theory? As referred to by LONG (2004),  
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27 studies on higher education-related choices tend to focus too much on price and its  
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29 impact on higher education enrolment and college choice (see, for instance, MOORE et  
30  
31 al., 1991), while other relevant university/college characteristics are often neglected.  
32  
33 KOHN et al. (1976) and MANSKI and WISE (1983) point out the positive impact of quality  
34  
35 and the negative impact of distance to the likelihood of choosing a particular college.  
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37 LONG (2004) extends those results and finds that, over time, distance to college has  
38  
39 become a less important aspect, while quality has turned into a more important factor  
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41 in university choice. OOSTERBEEK et al. (1992) show that distance from home and good  
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43 academic reputation are among the determinants that Dutch students consider  
44  
45 important in choosing an economics department. Our analysis extends their study by  
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47 considering all university departments, rather than just economics departments; it is in  
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49 line with these other studies by considering several university-related attributes such as  
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3 quality and diversity of study programmes. We also analyse the impact of distance to  
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5 the university on students' choices.  
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8 Third, what is the relevance of university location for university choice? Are  
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10 students guided by consumption motives when choosing a university? SÁ et al. (2004)  
11  
12 introduce university localization aspects in the analysis of students' mobility decisions,  
13  
14 at an aggregate level. OOSTERBEEK et al. (1992) include a dummy variable for the  
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16 attractiveness of the city in which the five university economics departments in their  
17  
18 study are located. The present study disentangles the impact of location on university  
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20 choice by distinguishing the effects of several pull factors to the universities, like the  
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22 local supply of leisure activities, housing costs, and local labour market factors.  
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28 Finally, are Dutch high school graduates influenced by their peers? Under  
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30 uncertainty, it might be reasonable to use the knowledge acquired from interactions  
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32 with other decision makers, such as colleagues, friends, or neighbours, who had to  
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34 decide in comparable situations. Furthermore, individuals tend to try to make sure that  
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36 they are thinking in a reasonable way. Recent research has highlighted the existence of  
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38 peer effects in higher education, but most studies take peer academic ability as the  
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40 observed peer characteristic that might influence the others' behaviour (WINSTON and  
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42 ZIMMERMAN, 2004). Therefore, peer choices are included in our model, where  
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44 individuals who attend the same high school form groups of interacting agents.  
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51 The remainder of this paper is organized into four sections. Section 2 sets up the  
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53 framework of analysis. It presents the model that integrates the university choice and  
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55 the living-arrangement decision. Section 3 explains the Dutch institutional context, the  
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3 variables, and the data. The empirical strategy is discussed as well. Section 4 presents  
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5 and analyses the nested logit model results. Section 5 concludes.  
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## 10 11 12 2 Modelling living-arrangement and university decisions 13

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15 The university choice and living-arrangement decisions are modelled in the  
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17 context of a random utility maximization (RUM) approach. We consider that individual  $i$   
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19 is in the last year of secondary education and has already decided to go to university in  
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21 the next school year. He faces a number of university options, as well as having to  
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23 choose between living and not living with his parents, making a total of  $J$   
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25 combinations/alternatives in his choice set. Individual  $i$  first evaluates the indirect  
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27 utility conditional on each alternative considered. That is, from individual and parental  
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29 characteristics (e.g. human capital stock at entrance, and income) and university-specific  
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31 and location attributes (e.g. institution's quality, housing, and labour market conditions)  
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33 prospective students can attach to each university its additional value for human capital  
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35 investment and the consumption goods it offers. Having evaluated the indirect utilities  
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37 associated with all combinations  $(V_{ij}, \forall j = 1, \dots, J)$ , the student chooses the one that  
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39 provides him with the highest value added.  
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48 Formally, a random utility model consists of deterministic and stochastic  
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50 elements, reflecting the observable and unobservable attributes of the individual  
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52 choice. Let the non-random part of the utility be a linear function of individual  
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54 characteristics  $(X_i)$  and university attributes  $(V_j)$ , all represented by  $Z_{ij}$ . The utility  
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function is then specified as:

$$v_{ij} = v_{ij}(X_i, Y_j) = \beta_1 X_i + \beta_2 Y_j + \varepsilon_{ij} = \beta Z_{ij} + \varepsilon_{ij}, \quad (1)$$

where  $\varepsilon_{ij}$  captures variations in individual preferences due to unobservables,  $i = 1, \dots, N$  represents the individual, and  $j = 1, \dots, J$  stands for each choice available in the choice set. An individual  $i$  chooses alternative  $j$  if and only if it gives him the highest utility, that is, if  $v_{ij} > v_{ik}, \forall k \neq j$ .

Different assumptions on the distribution of  $\varepsilon_{ij}$  lead to a variety of discrete choice models. Our empirical approach uses the nested multinomial logit model, which can be justified with two main arguments. First, it offers a method of linking the university choice with the decision on living arrangements, and of capturing any feedback between the two simultaneously made decisions. Second, we suspect that unobserved utilities associated with the at-home university choices are correlated, as are the unobserved utilities associated with the out-of-home choices, violating the Independence of Irrelevant Alternatives (IIA) assumption.

Let all combinations of living arrangements-university be grouped into two nests (or branches), represented by  $B_m$ , one for at-home alternatives ( $m = 1$ ) and the other for out-of-home options ( $m = 0$ ), such that each alternative  $j$  belongs to only one nest. The probability of choosing alternative  $j$  given a particular type of living arrangement is the one of a conditional logit model for nest  $m$  alternatives, and is given by:

$$\Pr(\omega = j | \omega \in B_m) = \frac{\exp\left(\frac{v_{ij}}{\tau_m}\right)}{\sum_{k=1}^J \exp\left(\frac{v_{ik}}{\tau_m}\right)}, \quad (2)$$

where  $\tau_m = \sqrt{1 - \rho_m}$ , and  $\rho_m$  is the correlation coefficient for all choices within nest  $m$ . The coefficient  $\tau_m$  represents the dissimilarity between all alternatives in nest  $m$ .<sup>1</sup> Probabilities given by Eq. (2) differ from the non-normalized nested logit model because the utilities are re-scaled by  $\frac{1}{\tau_m}$ .<sup>2</sup> Without this normalization, utilities in each nest would be scaled by a different factor and not comparable across nests. Unlike the non-normalized nested logit model, the formulation presented and estimated here is based on a RUM approach.<sup>3</sup> Hereafter, following HEISS (2002), we refer to our model as a random utility maximization nested logit (RUMNL) model.

The denominator in Eq. (2) is a (re-scaled) measure of the attractiveness of each branch  $m$ . In this literature, the log of that expression is called 'inclusive value',  $IV_m$ :

$$IV_m = \ln \sum_{k=1}^J \exp\left(\frac{V_{ik}}{\tau_m}\right). \quad (3)$$

If all  $\tau_m$  lie in the unit interval, the model is compatible with a RUM formulation.<sup>4,5</sup>

The probability of staying at home is also a conditional logit probability for the choice between living and not living with parents, and is given by:

$$\Pr(\omega \in B_m) = \frac{\exp(\tau_m IV_m)}{\sum_{m=1}^2 \exp(\tau_m IV_m)}. \quad (4)$$

The probability that a student chooses a combination  $j$  of living arrangements-university is equal to the product of probabilities in Eqs. (2) and (4):

$$\Pr(\omega = j) = \Pr(\omega = j | \omega \in B_m) \times \Pr(\omega \in B_m) = \frac{\exp\left(\frac{V_{ij}}{\tau_m}\right)}{\exp(IV_m)} \times \frac{\exp(\tau_m IV_m)}{\sum_{m=1}^2 \exp(\tau_m IV_m)}. \quad (5)$$

The package NLOGITRUM developed by HEISS (2002) for STATA is used to estimate the

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3 model by full information maximum likelihood. It only allows explanatory variables to  
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5 directly enter the conditional probabilities of the (elemental) alternatives (Eq. (2)). In  
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7 this way we avoid the difficulty of selecting nest-specific and alternative-specific  
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9 variables, which several applications solve in an ad hoc, artificial way. Furthermore, "for  
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11 the RUMNL model it does not make a difference at all if a nest-specific variable is  
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13 specified for a nest or for all alternatives within that nest" (HEISS, 2002: 248).<sup>6</sup>  
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18 The estimated coefficients are not directly interpretable, as in most discrete  
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20 choice models, and so the computation of marginal effects and/or elasticities is  
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22 required. More detailed explanation on the computation of marginal effects is provided  
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24 in the Appendix.  
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### 32 3 Empirical issues

#### 35 3.1 Institutional background

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38 The Dutch higher educational system is a dual system with universities and  
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40 professional colleges as the main education providers. Since the present study is  
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42 confined to the university sector, we highlight its main features. In principle, students  
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44 from the secondary education academic track (VWO, Voorbereidend Wetenschappelijk  
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46 Onderwijs) have free access to any of the 13 publicly funded universities, and they can  
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48 apply for university education right after they get the high school diploma. Only for  
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50 some university study programmes, such as for instance medicine, dentistry and  
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52 veterinary science, the number of admissions is limited at the national level and/or at  
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3 the institutional level in order to assure that the number of enrolled students do not  
4 exceed the (prospective) number of jobs available in the labour market, and due to  
5 capacity constraints, respectively. In order to help universities in the following school  
6 year preparation, during their last year in high school students report to the Central  
7 Office for Higher Education Application and Student Financial Support (IBG, Informatie  
8 Beheer Groep), what are the two universities and the two studies they prefer. These are  
9 intentions, which might differ from students' actual choices. The choice of the study  
10 programme depends on the profile the student chooses in secondary education: science  
11 and technology, science and health, economics and culture, language and culture. As a  
12 result of the policy of geographical decentralization of the university system up to the  
13 1970s, the average geographical accessibility of the university system is relatively high,  
14 as there are about three universities per 100 by 100 km grid cell. The city of Amsterdam  
15 has two universities, the VU University and the University of Amsterdam, while all the  
16 remaining university cities have just one institution.

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Students have to pay fees, which are not very high and do not vary according to the study programme or the institution. Regular full-time students are eligible for student support. All university students are entitled to a basic grant, which amount depends on whether they live with their parents or on their own. Students from low-income families can apply for a supplementary grant. Irrespective of parental income, students can take out loans, to be repaid within fifteen years of the end of the period of study, if they can afford to do so. Free transportation passes are provided to Dutch students.

### 3.2 Data and variables

The nested logit model presented in Section 2 is based on a tree structure consisting of two branches, one for each type of living arrangement. Under each branch there are 13 university (elemental) alternatives, that is, all publicly funded universities. We discuss in last part of Section 4.3 the appropriateness of this nested structure. For the present analysis it is important to keep in mind that the model does not assume the sequentiality of the two decisions.

Variables and data sources are presented in this section. The exogenous variables in Eq. (1) can be grouped into three categories: university-specific and location attributes, matched high school-university characteristics determining the university choice, and individual characteristics determining the living-arrangement choice. Table 1 summarizes the variable definitions.

< Place Table 1 here >

#### *Dependent variable.*

The Central Office for Higher Education Application and Student Financial Support provides background and actual decision information on the 2003 cohort of high school graduates. These are administrative data on first-time entrants; students who transfer to another higher education institution or change study programme are omitted from the dataset. Only students who graduate from the academic track in secondary education (VWO) are included in the sample, as only they can directly apply for university education.

After eliminating missing data on all the independent variables presented below,

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3 there are 17,973 students remaining in the sample. This represents about 46% of the  
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5 Dutch university applicants for 2003, and 79% of the university applicants with a VWO  
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7 diploma.<sup>7</sup> To get the final sample, we deleted from the data all observations referring to  
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9 students following study programmes with numerus clausus, as for them university is  
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11 more a matter of chance, rather than a matter of choice. Estimations presented below  
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13 are performed with a sample of 16,006 students.  
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18 Information on each student's actual choices comprises university and living-  
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20 arrangement decisions. The latter are actual living arrangements as indicated by the  
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22 student when applying for a scholarship. We concentrate on what FORD et al. (2002) call  
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24 'student pathways', that is, a planned exit from family home to attend higher education.  
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26 Combining the 13 available university alternatives with two living arrangement types,  
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28 students end up choosing among a set of 26 pairs of options.  
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35  
36 *University-specific and location attributes.*  
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38 Table 2 summarizes the main university(-related) characteristics that are  
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40 assumed relevant in students' university choice.  
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43 < Place Table 2 here >  
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45 In order to test for investment motives, we include a measure of the overall  
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47 university quality. Measures of university attributes needed to construct such a quality  
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49 index are taken from the annual survey conducted by the weekly magazine ELSEVIER  
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51 (2003). In 2003, 23 study programmes were evaluated for the Elsevier ranking by  
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53 interviewing a stratified sample of 3,071 university students. The respondents are asked  
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to give points from 1 (for extremely poor) to 10 (for extremely good) to the quality of their academic studies with respect to teaching facilities, curriculum, tutors and lectures, teaching quality, examination, and communication between the higher education institution and the student. For each university, a limited number of study programmes is evaluated, as a rule those with many students. That is, there is information by programme and attribute, based on which we want to infer the overall institutional quality. We combine the scores of the six attributes in a composite overall index for educational quality of the university as:<sup>8</sup>

$$qualityindex_j = \prod_{k=1}^K \left( 0.5 + \frac{\exp\left(\frac{y_{kj} - \mu_k}{\sigma_k}\right)}{1 + \exp\left(\frac{y_{kj} - \mu_k}{\sigma_k}\right)} \right), \quad (6)$$

where  $y_k$  are different university attributes,  $\mu_k$  and  $\sigma_k$  are the mean and the standard deviation of each attribute, respectively, and  $K = 6$ .<sup>9</sup>

Literature on returns to college quality on labour market outcomes suggests several other measures for quality. BEHRMAN et al. (1996) and LONG (2004), among others, refer to the median SAT score of the college student body, instructional expenditures, student-faculty ratio, and percentage of faculty with a PhD. The student-teacher ratio is available for all Dutch universities, but not usable, as it is highly correlated with the diversity index we use to measure the university scope and to distinguish between specialized and 'general' universities. In fact, because of the nature of the study programmes offered by universities that show low diversity in their study offer (specialized universities), the use of labs is often required and students are

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3 grouped in smaller classes. On the other hand, the percentage of faculty with a PhD  
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5 does not by itself fully capture institutional quality in all its dimensions.<sup>10</sup>  
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9 In an attempt to control for consumption motives, that is, to account for the fact  
10 that students consume cultural and recreational products, our analysis includes a proxy  
11 for the supply of leisure activities in each municipality which has a university. As:  
12  
13 "Facilities like sport halls, university theatres, music ensembles, multimedia workshops  
14  
15 and cinemas, depend crucially on the students' demand" (VAN DEN BERG and RUSSO,  
16  
17 2004: 5), leisure is proxied by the proportion of higher education students in the  
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19 municipality. It could be argued that in bigger cities, like for instance in Amsterdam, the  
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21 number of students represents a small proportion of the total population, although it is  
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23 a leisure-type city. This is not, however, what emerges from the data. In fact, the higher  
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25 education sector comprises not only the 13 universities dealt with in our study, but also  
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27 54 professional colleges attended, in 2003, by 338,830 students (HBO-RAAD, 2005),  
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29 several of which are located in university cities.<sup>11</sup>  
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39 University location also determines the housing market and the labour market  
40  
41 constraints students face, which in turn affect living-arrangement, schooling and  
42  
43 working decisions (MARTINEZ-GRANADO and RUIZ-CASTILLO, 2002: 319). For the  
44  
45 present study, we obtained data from a survey on room prices, conducted in 2003, by  
46  
47 the Dutch National Union of Students (LSVb, 2003).<sup>12</sup> Our model specification includes  
48  
49 rents as the average housing price per square metre in euros, and allows it to have two  
50  
51 coefficients, one for at-home and another one for out-of-home alternatives. This means  
52  
53 that at-homers' and out-of-homers' choices are both influenced by housing rents, but  
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3 their impact may be different between groups. While for students not living with their  
4  
5 parents room rents refer to the housing costs they actually pay, for the other students  
6  
7 they represent how much they will have to pay, if later they decide to leave the parental  
8  
9 home.  
10

11  
12 In spite of focussing on demand issues, the analysis takes into account supply  
13  
14 constraints that may be important in the university matching process. An attempt to  
15  
16 control for supply-side influences is the inclusion of the diversity of study programmes in  
17  
18 each university. The Central Funding of Institutions Agency (CFI, Centrale Financien  
19  
20 Instellingen) supplies data on the total number of students by institution and field of  
21  
22 study (CFI, 2005), which is used to compute a Shannon-Wiener diversity index of the  
23  
24 study programme areas<sup>13</sup>  
25  
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29

$$Diversity_s = - \sum_{m=1}^M p_m \log p_m \quad (7)$$

30  
31 where  $M = 9$  is the number of areas of study offered by Dutch universities, and  $p_m$  is  
32  
33 the proportion of study programme type  $m$  in a given university.<sup>14</sup>  
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40  
41 The peculiarities of some universities make them more attractive to certain  
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43 groups of students, and they tend to have national recruitment markets (SÁ et al.,  
44  
45 2004). Some universities have private denominations as their creation was supported by  
46  
47 a religious group (namely, the University of Nijmegen, Tilburg University, and the VU  
48  
49 University). The religious origin of some universities is controlled for by means of a  
50  
51 dummy variable. There is also some variety in terms of university spatial location, with  
52  
53 some regions being strongly oriented towards a university, whereas, in other regions,  
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the universities face the competition of other institutions nearby. We control for the competition that each university faces by means of a centrality index, that is:

$$\text{Centrality}_j = \sum_{\substack{m=1 \\ m \neq j}}^M \frac{P_m}{d_{jm}}, \quad (8)$$

where  $m$  represents a destination rather than  $j$ ,  $P_m$  is the total number of students in university  $m$ , and  $d_{jm}$  is the distance between university  $j$  and university  $m$ .<sup>15</sup> Large values of the centrality measure are associated with universities in proximity to many other universities, and small values are associated with isolated universities. A positive sign for the coefficient of this variable implies that agglomeration forces are present, whereas a negative sign indicates the presence of competition effects and means that universities in close proximity to other universities are less attractive. The coefficient is 0 whenever there is no hierarchical destination choice and the location of a university relative to the other universities is not important. The relevance of centrality to the individual decision-making process might have something to do with students' forward-looking behaviour. This implies that students might choose more central universities, which are located in more urbanized areas, because they intend to settle there after graduation, and more central locations are associated with higher probabilities of finding a job within commuting distance.

Concerning labour market conditions, lower unemployment rates in some university cities might then be a reason for leaving the parental home and for choosing certain institutions. But unemployment is also suggestive of limited economic resources, and therefore it can also be associated with a reduced probability of leaving home and

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2  
3 can be seen as an additional constraint in university choice. In order to test which of  
4  
5 these two forces is at work in The Netherlands, individual utilities take into account the  
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7 unemployment rate in the university municipality.  
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9

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11  
12  
13 *Matched high school-university characteristics determining university choice.*  
14

15 The individual-level data includes information on students' previous education,  
16  
17 specifically the high school attended and its address. We computed two variables based  
18  
19 on the postcode of the high school and its name. Table 3 shows the descriptive statistics  
20  
21 for these variables.  
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23

24  
25 < Place Table 3 here >  
26  
27

28 Geographical distance is computed as the straight line distance (in km) between  
29  
30 the postcodes for each high school/university pair.<sup>16,17</sup> In general, the longer the  
31  
32 distance to the university, the higher the costs students experience, and thus the lower  
33  
34 the chance they select that university. For both at-homers and out-homers, distance  
35  
36 captures the cost of gathering information about each university in the choice set.  
37  
38 Furthermore, distance means costs: namely, the monetary costs associated with  
39  
40 travelling.<sup>18</sup> There is also a psychic cost associated with distance, as individuals may feel  
41  
42 less comfortable in places with which they are less familiar. Furthermore, distance  
43  
44 necessarily involves establishing new social and interpersonal relationships. For these  
45  
46 reasons, we expect a negative impact of distance on university choice, although distance  
47  
48 perceptions might differ between at-homers and out-homers.  
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55 Individuals, especially those with little information or experience, obtain  
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3 information from the decisions of others, which points to the existence of social  
4  
5 interactions. We assume that an individual ordering of university alternatives relies on  
6  
7 what he thinks his schoolmates facing the same decision are doing. These are called  
8  
9 endogenous effects as their decisions are contemporaneous: an individual is influenced  
10  
11 by his colleagues' decisions, but he himself influences the others' choices. In our study,  
12  
13 social interactions result from peer choices, which are operationalized as the proportion  
14  
15 of students in the same high school who intended, over the last year of secondary  
16  
17 education, to choose one of the universities concerned, with the high school as the  
18  
19 reference group. The individual student is left out of the computations, and proportions  
20  
21 are computed based on intentions, rather than actual choices (Table 3).  
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28 GAVIRIA and RAPHAEL (2001), in their study of juvenile behaviour, provide some  
29  
30 arguments in favour of the choice of the school as the reference unit of analysis. The  
31  
32 school is a 'neighbourhood' where youths are forced to interact with a fixed, well-  
33  
34 defined (in terms of grade, track) set of peers. It could be argued that neighbourhoods  
35  
36 should be used instead. However, as schools offer a larger pool of potential friends for a  
37  
38 student than do neighbourhoods, students will establish, on average, more durable  
39  
40 friendships with schoolmates than with neighbours. Because students interact mainly  
41  
42 during school hours, estimated social interaction effects are more likely to reflect  
43  
44 endogenous effects than contextual effects, because they reflect the influence of the  
45  
46 behaviour of peers rather than the influence of peer background factors. Therefore, the  
47  
48 peers variable we use reflects endogenous interactions, while we assume that  
49  
50 contextual interactions do not exist. Following BROCK and DURLAUF (2003), we consider  
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3 that the group choice probabilities are not constant across schools, but each individual  
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5 within a group is modelled as possessing identical beliefs about the percentage of  
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7 choices within the group.  
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14  
15 *Individual characteristics determining living-arrangement choice.*  
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17  
18 As explained above, the nested logit model can be seen as a modification of the  
19  
20 stochastic specification in the conditional logit model, and, like the conditional logit  
21  
22 specification, it is the variation in college attributes that drives the estimates. In fact, the  
23  
24 student's own characteristics are the same regardless of the alternative he chooses, and  
25  
26 they cannot be a reason for choosing one university over another. However, individual  
27  
28 student attributes may affect the way he responds to a university or a match-specific  
29  
30 attribute. Thus, interactions of individual characteristics and a dummy for at-home  
31  
32 alternatives enter the utility specification. Variables referring to individual  
33  
34 characteristics included in the IBG data contain both demographic and family  
35  
36 background aspects (Table 4).  
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43 < Place Table 4 here >  
44

45 Our empirical specification considers individual demographic variables such as  
46  
47 gender, age, and parents' nationality (in line with previous studies on home leaving, as  
48  
49 for instance MULDER and CLARK, 2002). Although all students are similar in terms of  
50  
51 years of schooling, they differ in the human capital stock at university entrance that can  
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53 be measured by the GPA in high school final exams.  
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Several studies have explored the effect of family socio-economic background on young adults' co-residence decisions (ERMISCH and DI SALVO, 1997; ERMISCH, 1999; MULDER and CLARK, 2002). As pointed out by MULDER and HOOIMEIJER (2002), the relationship between parents' resources and the child's probability of leaving home is not clear. On the one hand, parents' resources may be important to help their adult children bearing the housing costs when deciding to live independently. On the other hand, rich parents usually live in bigger houses, where their children may have enough privacy, and then become less likely to leave parental home. This has been reflected in the conclusions of empirical studies. For instance, WHITTINGTON and PETERS (1996) conclude that the higher the family income, the lower the probability of becoming independent; that effect, however, declines with the child age. In turn, MULDER and HOOIMEIJER (2002) show that the decision of leaving home to live alone is encouraged by family resources. MULDER et al. (2002) found that the socio-economic status is relevant for home leaving decisions in the Netherlands, but only for males. In a study for the UK, CHRISTIE (2007) concludes that not leaving home is an economically rational decision for students from non-traditional backgrounds.

We test for the effect of family income on student decisions. Whether the student gets a supplementary grant, and the type of health insurance are controls for socio-economic background. As explained in Section 3.1, only low-income students can get a supplementary grant. We generate a dummy equal to 1 if the student gets a supplementary grant, and 0 otherwise, and use it as a proxy for family income. In principle, private insurance is indicative of better-off economic condition than public

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3 health insurance, as the government only takes care of those with low income or those  
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5 who are refused insurance by a private company. We then use a dummy variable equal  
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7 to 1 if the student is privately insured, and 0 otherwise, which acts as a crude measure  
8  
9 for economic background.  
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### 12 13 14 15 16 3.3 Modeling strategy 17

18  
19 Our empirical modeling strategy is as follows. We first perform some tests on the  
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21 IIA property and on the choice of a nested logit model against other available alternative  
22  
23 models.  
24  
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26  
27 We continue estimating the model specified in Section 2 with the explanatory  
28  
29 variables presented in Section 3.2. All results are obtained with the STATA package  
30  
31 NLOGITRUM prepared by HEISS (2002). As we report coefficients for  $\tau_m$ , not  $\rho_m$ ,  
32  
33 inclusive value parameters in the regression tables should be interpreted in the  
34  
35 following way:  $\tau_m < 1$  means that alternatives within nest  $m$  are perceived as more  
36  
37 *similar* than alternatives outside the nest;  $\tau_m > 1$  means that alternatives within nest  
38  
39  $m$  are perceived as more *dissimilar* than alternatives outside the nest, and suggests  
40  
41 that the nesting structure is not appropriate;  $\tau_m = 1$  means that alternatives are  
42  
43 independent, and the nested logit collapses into the conditional logit model.<sup>19</sup> Using  
44  
45 model estimates, we compute marginal effects and elasticities for some relevant  
46  
47 variables, and estimates of the probability of choosing each university-living  
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49 arrangement combination.  
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57 Finally, we perform some additional robustness tests on our model specification.  
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3 We estimate the model with alternative quality variables and under alternative tree  
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5 structures.  
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## 10 11 12 4 Results 13

### 14 15 16 4.1 Nested logit: the preferred model 17

18 At the start of the analysis, we perform the Hausman test of the IIA assumption.  
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20 Table 5(a) shows the results for the test when we take a university out of the choice set.  
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22 The results show that the null hypothesis is rejected at any ordinary significance level in  
23  
24 all tests.  
25  
26

27  
28 < Place Table 5 here >  
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31  
32 A similar test was performed by omitting each of the combinations one by one,  
33  
34 and the null hypothesis is rejected at the 1% significance level in all 26 tests. These tests  
35  
36 suggest that the IIA assumption between choices does not hold, suggesting that the  
37  
38 more complex nested logit model should be used.  
39

40  
41 In order to show the advantages of using the nested logit over its conditional  
42  
43 logit equivalent, we perform a likelihood ratio test on the null hypothesis that all  
44  
45 inclusive value parameters are equal to 1. As shown in Table 5(b), the null hypothesis is  
46  
47 rejected at any ordinary significance level, and so we reject the hypothesis of equal to  
48  
49 unit inclusive values. The test results indicate the appropriateness of the nested logit  
50  
51 model as compared to the conditional logit model.  
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## 4.2 Main results

We therefore concentrate on the estimation results of the nested logit model (Table 6, Model (1)). The inclusive value parameters are both within the unit interval, showing that the model is consistent with the RUM approach. Furthermore, this means that alternatives within a nest are perceived as more *similar* than alternatives outside the nest (as explained in the previous Section). The model includes two separate coefficients for distance and for rent, one for at-home options and the other for out-of-home alternatives. When we perform a likelihood ratio test on the equality of those coefficients, the null hypothesis is rejected. As it can be seen in Table 6, Model (1), university quality and diversity, and student's age, are not statistically different from zero. All the remaining parameter estimates are statistically different from zero, at a significance level of 5% or lower.

< Place Table 6 here >

We start with a discussion of the statistically non-significant coefficients. We found a correctly signed, but not significantly different from zero effect of institutional quality on the attractiveness of a university. The quality measure we have used does not discriminate between institutions, as it could be expected. Studies for the US higher education such as KOHN et al. (1976) and MANSKI and WISE (1983) show that institutional quality has a positive impact on college choice, which has become more and more relevant over time (LONG, 2004). The indication that investment motives might not be at work in the Dutch higher education context was already found by OOSTERBEEK et al. (1992). SÁ et al. (2004) argue that this might be an inevitable

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3 outcome of the egalitarian tradition in university funding, which has contributed to non-  
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5 discernible differences in quality between the Dutch universities. Results would  
6  
7 probably be different if the choice between professional colleges and universities was  
8  
9 included because there is a clear quality difference between those two types of  
10  
11 institutions. Nevertheless, explicit inclusion of the choice of university versus higher  
12  
13 vocational training would be beyond the scope of the present article.  
14  
15  
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17

18 The diversity of the study programmes appears not to be relevant in student  
19  
20 university choice. Age is unimportant for the home-leaving decision. This result probably  
21  
22 has to do with the fact that there is not very much variation in age among the  
23  
24 individuals in our sample (about 90% of the students are either 18 or 19 years old).  
25  
26  
27

28 As explained in Section 2, the magnitude of coefficient estimates is not directly  
29  
30 interpretable, and computation of marginal effects and elasticities is required. Table 7  
31  
32 shows the marginal effects on the probability of choosing a university conditional on  
33  
34 living at home and conditional on not living at home for the religious variable, in Model  
35  
36 (1). These are direct effects, computed as changes in the probability of choosing each  
37  
38 religious university if it was to change into a non-religious university. For ease of  
39  
40 interpretation we report elasticities for the remaining variables, but only for parameter  
41  
42 estimates that are statistically different from zero.  
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48 < Place Table 7 here >  
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51 Table 7 shows that all universities with a religious denomination would be  
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53 chosen less if they were to become not religious, and such impact would be stronger for  
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55 out-of-homer's choices than for at-homers' decisions. This scenario might seem a merely  
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3 academic exercise, but these results show that the religious denomination of some  
4  
5 universities might be a relevant attribute in student choice, although the marginal  
6  
7 effects are small. This has possibly to do with the central role of denomination within  
8  
9 the Dutch primary and secondary sectors of education. Although church attendance in  
10  
11 The Netherlands has decreased dramatically, "the denominational educational system  
12  
13 has remained largely intact" (DRIESSEN and VAN DER SLIK, 2001: 562). Denomination  
14  
15 has a central role within the Dutch primary and secondary sectors of education, which  
16  
17 probably reflects into higher education institution choices as well. Another potential  
18  
19 source of explanation is the one that establishes a link between religious denomination  
20  
21 and the ethnic mix of students. In this regard, our data do not provide very conclusive  
22  
23 insights. Although 25% of students with a non-Dutch background (that is, both parents  
24  
25 are non-Dutch) attend religious universities, the share of non-Dutch students in some  
26  
27 non-religious universities is still also quite high.

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36 The estimate for the coefficient of the centrality index is positive and statistically  
37  
38 significant, suggesting that more centrally-located universities (i.e. closer to a greater  
39  
40 number of large institutions) attract more students. Higher values for the centrality  
41  
42 index are found in the highly urbanized Randstad area, which has 6 out of the 13  
43  
44 universities, and where there are plenty of job opportunities for university graduates. It  
45  
46 is possible that students are forward-looking in that they take into account to what  
47  
48 extent a university has a central location in the country, so that after having finished  
49  
50 their studies it may be relatively easy to find a job within commuting distance. The  
51  
52 effect of this variable is, however, very small, as its marginal effect (Table 7) is very close  
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3 to zero; so virtually no hierarchical choice is at work in higher education students'  
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5 decisions.  
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8 As we anticipated above, rents play a major role in student university choice. The  
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10 probabilities of choosing a given university conditional on any of the living-arrangement  
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12 alternatives are negatively influenced by housing prices. The effect is, however, stronger  
13  
14 when students opt to live away from their parents' home, which is understandable as  
15  
16 for them rents mean an actual cost, while for at-homers rents are merely a potential  
17  
18 (future) cost.  
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23 Although investment motives do not seem to be at work in the Dutch higher  
24  
25 education market, there may be consumption reasons behind the decision to attend a  
26  
27 given university. Our finding of a positive effect of city attractiveness on students'  
28  
29 choices reinforces and extends what OOSTERBEEK et al. (1992) found for economics  
30  
31 students.  
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36 The effect of distance works in the same direction as that of rents, as distance  
37  
38 deters students from choosing a given university that is far from home. We confirm in  
39  
40 the present setting the results of OOSTERBEEK et al. (1992), using individual-level data,  
41  
42 and SÁ et al. (2004), employing aggregate-level data, that distance is associated with a  
43  
44 disutility and the probability of choosing any university decreases as distance increases.  
45  
46  
47 Another sensible result is that at-homers are more deterred by distance than out-of-  
48  
49 homers, as follows from a size comparison of both elasticities. The distance negative  
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51 effect on the likelihood of choosing a given college has already been found for other  
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53 higher education contexts, namely the American higher system (see for instance, KOHN  
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3 et al., 1976, and MANSKI and WISE, 1983), although it has been losing importance over  
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6 time (LONG, 2004).  
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9 The unemployment rate in the university city has a negative impact on university  
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11 choice, suggesting that labour market conditions are relevant for student decisions, and  
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13 out-of-homers are more affected by changes in the unemployment rate than at-homers.  
14  
15 At-homers have the option of working in the region where they live, which is often  
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17 different from the one where they attend the university. Conditions in the labour  
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19 market of the residence area may overcome potentially worse employment prospects at  
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21 the university location.  
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26 Unlike OOSTERBEEK et al. (1992), our results suggest that students copy their  
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28 high school peers' choice. Out-of-homers' decisions are more influenced by their peers  
29  
30 than the choices of those staying at the parental home.  
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34 Table 8 shows the (direct) marginal effects of individual characteristics on the  
35  
36 probability of staying at the parental home. Our model estimates reveal that women  
37  
38 leave home earlier than men, a finding consistent in all models of leaving home  
39  
40 throughout Europe and North America (HOLDSWORTH et al., 2002; MULDER and CLARK,  
41  
42 2002). The tendency to leave the parental home is less frequent among students with  
43  
44 very good high school performance as compared to their low-ability counterparts.<sup>20</sup>  
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47  
48 Having a Dutch background appears to make young adults more likely to leave home,  
49  
50 pointing to cultural differences as a possible explanation. We confirm the relevance of  
51  
52 socio-economic background found in previous studies and in other higher education  
53  
54 settings (for instance, WHITTINGTON and PETERS, 1996, for the US; MARTINEZ-  
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3 GRANADO and RUIZ-CASTILLO, 2002, for Spain), measured by the right to a  
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5 supplementary grant and the type of health insurance, on young peoples' decision to  
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7 live on their own. Such low residential mobility among poorer students limits their  
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9 university choice and should concern policymakers, usually engaged in assuring equal  
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11 opportunities to all individuals. Furthermore, helping poor students in moving out of the  
12  
13 parental home will have a direct impact on their university choices and potentially on  
14  
15 their performance.  
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21 < Place Table 8 here >  
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23 < Place Table 9 here >  
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28 Estimated probabilities of the choice of each and every alternative are computed  
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30 on the basis of the estimation results presented above. Table 9 shows the predicted  
31  
32 probabilities for elemental alternatives, based on estimation results for Model (1), in  
33  
34 Table 6. It emerges that about 55% of the first-year students stay at home. Utrecht  
35  
36 University, located in the geographical midpoint of The Netherlands, appears as the  
37  
38 most chosen institution by at-homers, whereas more out-of-homers are found among  
39  
40 the students at the University of Groningen.<sup>21</sup>  
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#### 48 4.3 Additional checks 49

50 To test the robustness of our results, we tried out several alternative  
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52 specifications. First, a popular alternative way of measuring institutional quality in the  
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54 student-choice literature is the student-teacher ratio. Estimation results for the model  
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3 with that variable instead of the quality index are in Table 6, Model (2), but no  
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5  
6 substantial differences are apparent when compared with those of Model (1) in the  
7  
8 same table.  
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10  
11 Second, similarly to what we did for other location-related variables like rent and  
12  
13 distance, we estimated the model with two coefficients for leisure, one for at-home  
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15 options and another one for out-of-home alternatives. In that case, however, one of the  
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17 inclusive values exceeds 1, suggesting that the model specification is not compatible  
18  
19 with a random utility maximization approach.  
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21

22  
23 Finally, we chose our 'preferred' tree structure after evaluating the results  
24  
25 obtained from a number of potential candidate trees. While searching for the  
26  
27 appropriate nested structure, we kept in mind that the main purpose of the nested logit  
28  
29 model is to accommodate the violation of the IIA assumption. "It has nothing to do with  
30  
31 any behavioural belief in the way that alternatives are assessed in the process of making  
32  
33 a choice" (HENSHER et al., 2005: 482). Thus, we were looking for a tree that is  
34  
35 compatible with global utility maximization, and that results in the lowest log-likelihood.  
36  
37 The necessary conditions for a nested structure to be consistent with global utility  
38  
39 maximization are inclusive values lying between 0 and 1, and scale parameters declining  
40  
41 in value as we move up the tree (HENSHER et al., 2005).  
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49 In a first attempt to look for the 'best' model, we re-estimate the nested logit  
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51 model based on a tree with 13 branches, for each and every university, and two-living  
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53 arrangement alternatives within each branch. Most coefficients show the same sign and  
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55 statistical significance as those in the model presented above. Among other tree  
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3 structures we tried, we would like to refer in particular to the tree structure that  
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5 explicitly incorporates the university city. The location coincidence of the University of  
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7 Amsterdam and the VU University, is accommodated by means of a three-level nested  
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9 structure with the two living-arrangement limbs on the top level, two city branches  
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11 within each limb (Amsterdam and non-Amsterdam location), and finally the universities  
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13 at the bottom level. Although the main results in terms of sign and significance are the  
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15 same as in the model presented earlier, again such a three-level nested logit model is  
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17 not compatible with a RUM formulation as 1 out of the 6 inclusive value parameter  
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19 estimates is above 1.  
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26 Our conclusion is therefore that our results are robust to the inclusion of  
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28 alternative quality variables and to the tree structure behind the nested logit model.  
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## 35 5 Conclusion

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37 University attendance is often associated with the decision on whether to move  
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39 out of the parental home. Data on individual student choices and characteristics were  
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41 combined with university attributes and matched high school-university features in  
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43 order to estimate a Random Utility Maximization Nested Logit model on the factors that  
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45 influence university choice and living-arrangement decisions.  
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50 We did not find evidence of a quality pattern of choosing a university, which  
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52 goes against human capital theory predictions. This result is in line with some previous  
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54 studies on the Netherlands, although studies for other countries (namely, the US) have  
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56 found the opposite result.  
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Leisure supply as measured by the proportion of higher education students to the total population in the university city influences students' university choice. It is very much in the interest of cities to attract and fix highly educated individuals, as they add to the city's human capital stock, which is highly relevant for local growth. Our results confirm that housing rent is the most important factor for both at-homers and out-of-homers, and that the high housing costs in some university cities are deterring students from going there. Universities and local authorities should work together on these issues, as active, integrated strategies of housing and leisure can attract students in the first place, and attach them to the city, in such a way that they take their residence there after the completion of their studies. As there are peer effects at work, these policies are expected to have a multiplier effect.

Distance is shown to have a negative impact on university choice. Such result is in line with the results found for the American setting. From an individual point of view, it is important to highlight that students from disadvantaged economic backgrounds appear to be more constrained in their choices than any other students.

There are, however, a number of weaknesses of our study that should be discussed. First, there may be a selectivity bias problem that does not allow us to generalize these results to all high-school leavers, as only students who can directly continue on to university education are in our sample. We cannot correct the problem using a selection equation due to data non-availability on all students (namely those in a professional track in high school) and on professional college choice determinants. We also do not have a variable that only explains the selection. Even if data were available,

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3 there were 54 professional colleges in 2003 which would enlarge the choice set to a  
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5 point that would make it very difficult to estimate the model. Furthermore, some  
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7 variables would be difficult to operationalize. For example, the multi-location of most  
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9 professional colleges would be a problem when computing distance between home  
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11 region and institutional location. Because we do not account for sample selectivity, our  
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13 estimates might suffer from sample selection bias, which is a limitation of our study.  
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15 Nevertheless, about two thirds of the students from the secondary education academic  
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17 track pursue a university education. This suggests that this study does not lose its  
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19 validity as a step towards understanding the university choice and how it relates to the  
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21 living arrangement decisions. Our conclusions, however, cannot be extrapolated to  
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23 students in secondary education tracks other than the academic track and to those  
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25 choosing professional college alternatives. Second, as mentioned before, the paper  
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27 would be enriched by also addressing the choice between professional colleges and  
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29 universities. In that case, we could check whether quality differences between the two  
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31 types of institutions are relevant for student choices, as well as whether there is equity  
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33 in access to both types of institutions for students from disadvantage backgrounds.  
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35 Third, some exogenous variables that are relevant for this decision process are missing.  
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37 The analysis of students' decisions concerning living-arrangement choice could be  
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39 improved if some information on parents' money transfers to their children was  
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41 available. Finally, the inclusion of the study programme in individual's choice set would  
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43 enrich the study, as study programme is an important dimension of the choice problem  
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45 that we did not explicitly deal with in the present study.  
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19 Netherlands).

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## Appendix: Computation of marginal effects

The derivative that describes the direct effect of a (quantitative) variable  $y_j$  on the probability of choosing university  $j$  given the living arrangement  $m$  is:

$$\frac{\partial \Pr(\omega = j | \omega \in B_m)}{\partial y_j} = \frac{\beta_{y,m}}{\tau_m} \Pr(\omega = j | \omega \in B_m) [1 - \Pr(\omega = j | \omega \in B_m)],$$

$$\forall j \in B_m, \quad m = 0,1, \quad (\text{A.1})$$

where  $\beta_{y,m}$  is the coefficient of variable  $y_j$  in branch  $m$ . For coefficients that do not vary with living arrangements,  $\beta_{y,1} = \beta_{y,0} = \beta_y$ , and  $\beta_y$  applies to both branches. The corresponding elasticity is obtained when multiplying the marginal effect in Eq. (A.1) by

the ratio  $\frac{y_j}{\Pr(\omega = j | \omega \in B_m)}$ .

Instead, if we are interested in estimating the direct impact of a variable ( $y_j$ ) on the probability of choosing a certain living arrangement type, then the expression is:

$$\frac{\partial \Pr(\omega \in B_m)}{\partial y_j} = \beta_{y,m} \Pr(\omega = j | \omega \in B_m) \Pr(\omega \in B_m) [1 - \Pr(\omega \in B_m)], \quad (\text{A.2})$$

where  $\beta_{y,m}$  is the coefficient for variable  $y_j$  associated with branch  $m$ . Once again, if the coefficient of a given variable is equal in both branches, then  $\beta_{y,1} = \beta_{y,0} = \beta_y$ . In order to obtain the elasticity, the marginal effect in Eq. (A.2) has to be multiplied by the

quotient  $\frac{y_j}{\Pr(\omega \in B_m)}$ .

For individual-level variables included as the cross-product with a dummy for one of the branches, marginal effects as given in Eq. (A.1) are 0. Marginal effects for dummy variables are computed as differences in predicted probabilities, that is, the value of the predicted probability at 1 minus its value at 0, rather than using Eq. (A.2).

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Table 1: Definitions of the explanatory variables

Variables	Definition
<i>University-specific and location attributes</i>	
Quality	University overall quality
Student-teacher	Student-teacher ratio
Diversity	Diversity of the study programmes offered
Religious (D)	= 1 if the university has a religious denomination
Centrality	Centrality index
Ho-Rent	Average housing price by $m^2$ for at-home options
Out-Rent	Average housing price by $m^2$ for out-of-home options
Leisure	% of higher education students in the municipality total population
Unemployment	Unemployment rate in the university municipality
<i>Matched high school-university characteristics determining university choice</i>	
Ho-Distance	Distance between HS and university for at-home options
Out-Distance	Distance between HS and university for out-of-home options
Peers	% of students from each high school choosing each university in the pre-application phase
<i>Individual characteristics determining living arrangement choice</i>	
Male (D)	= 1 if the student is male
Age	Student age (in years)
Dparent (D)	= 1 if at least one parent is Dutch
GPA	Student GPA in final exams
Supplem (D)	= 1 if the student gets supplementary grant
Priv-Insurance (D)	= 1 if the student is privately insured

Note: (D) stands for dummy variable; HS is the abbreviation for High School; and GPA means

Grade Point Average.

Table 2: University-specific and location attributes: summary statistics (N = 16,006)

Characteristics	Mean	St deviation
Quality	1.1507	0.6913
Student-teacher	12.6523	3.1808
Diversity	0.6189	0.2157
Religious (D)	0.2343	-
Centrality	2999.9270	1224.1580
Rent	19.1250	4.9225
Leisure	4.1171	2.2505
Unemployment	0.0527	0.0171

Sources: VSNU (2000), CFI (2005), LSVb (2003), and Elsevier (2003).

Table 3: Matched high school-university characteristics: summary statistics (N = 16,006)

	Mean	St deviation
Distance (in km)		
At-home	29.9727	24.0902
Out-home	82.6570	51.0197
Peers	21.2867	16.5085

Source: CBS (2005), IBG (2003).

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Table 4: Individual characteristics: summary statistics (N = 16,006)

Variable	Mean	St deviation
Male (D)	0.4960	-
Age	18.3109	0.6980
Dparent (D)	0.1266	-
GPA	6.9032	0.5414
Supplem (D)	0.2380	-
Priv-Insurance (D)	0.5512	-

Source: IBG (2003).

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Table 5: The preferred model: statistical tests

(a) Hausman test of the IIA assumption		
Removal of both at- and out-of-home	test statistic	(significance level)
Leiden U	250.93	(0.00)
U Groningen	431.53	(0.00)
Utrecht U	435.95	(0.00)
E U Rotterdam	660.25	(0.00)
T U Delft	365.23	(0.00)
T U Eindhoven	388.38	(0.00)
U Twente	247.02	(0.00)
Wageningen U	477.79	(0.00)
Maastricht U	148.59	(0.00)
U Amsterdam	171.80	(0.00)
VU Amsterdam	257.28	(0.00)
R U Nijmegen	324.64	(0.00)
U Tilburg	493.77	(0.00)

The hypothesis was tested that there is a non-systematic difference in coefficients between the model estimated for the full choice set and the model estimated for a subset of that choice set. The test was performed 13 times by removing each time the combination of a university and both living arrangements. The table shows the test statistic and the lowest level of significance (in parenthesis) at which the null hypothesis can be rejected. These results show that the null hypothesis is rejected at any ordinary significance level in all tests.

(b) Likelihood ratio test on nested logit versus conditional logit models		
Log-likelihood Nested logit model		-38,814.52
Log-likelihood Conditional logit		-38,852.78
LR test statistic	76.52	(0.00)

The hypothesis was tested that both IV parameters are equal to 1, and so the nested logit collapses into the conditional logit model. The log-likelihood at convergence for both models, the test statistic, and the lowest level of significance (in parenthesis) at which the null hypothesis can be rejected are given in the table. The null hypothesis is rejected at any ordinary level of significance.

Table 6: Nested logit model: estimation results

Variables	(1)		(2)	
	Coeff	St Error	Coeff	St Error
<i>University-specific and location attributes</i>				
Quality	0.0029	(0.0137)	-	-
Student-teacher	-	-	-0.0006	(0.0033)
Diversity	-0.0548	(0.0495)	-0.0448	(0.0584)
Religious (D)	0.0789***	(0.0237)	0.0780***	(0.0224)
Centrality	0.0001***	(0.0000)	0.0001***	(0.0000)
Ho-Rent	-0.0387***	(0.0038)	-0.0388***	(0.0038)
Out-Rent	-0.0610***	(0.0038)	-0.0611***	(0.0038)
Leisure	0.1575***	(0.0091)	0.1571***	(0.0091)
Unemployment	-1.3238**	(0.6026)	-1.4094***	(0.4787)
<i>Matched high school-university charact. determining univ. choice</i>				
Ho-Distance	-0.0314***	(0.0010)	-0.0315***	(0.0010)
Out-Distance	-0.0005**	(0.0002)	-0.0005**	(0.0002)
Peers	0.0326***	(0.0015)	0.0326***	(0.0015)
<i>Individual characteristics determining living-arrangement choice</i>				
Male (D)	0.4600***	(0.0335)	0.4600***	(0.0335)
Age	0.0141	(0.0104)	0.0141	(0.0104)
Dparent (D)	-0.2257***	(0.0515)	-0.2256***	(0.0515)
GPA	0.0997***	(0.0261)	0.0996***	(0.0261)
Supplem (D)	0.1934***	(0.0403)	0.1935***	(0.0403)
Priv-Insurance (D)	-0.3668***	(0.0339)	-0.3668***	(0.0339)
<i>Inclusive Values</i>				
At-home	0.8640***	(0.0295)	0.8641***	(0.0295)
Out-of-home	0.7137***	(0.0310)	0.7134***	(0.0311)
<i>Log-likelihood</i>	-38,814.52		-38,814.53	
<i>Nr Observations</i>	16,006			

Note: 1. Significance at the 1, 5 and 10% level is indicated with \*\*\*, \*\* and \*, respectively. 2. These are the estimation results for the nested logit model with either the composite index (Specification (1)) or the student-teacher ratio (Specification (2)) for the university quality.

Table 7: Selected (direct) marginal effects and elasticities on the probability of choosing a university, given the living arrangements

	Elasticities		Marginal effects	
	Prob univ j given at-home	Prob univ j given out-home	Prob univ j given at-home	Prob univ j given out-home
<i>University-specific and location attributes</i>				
Religious (D)				
Radboud Univ Nijmegen			-0.0048	-
Tilburg University			-0.0045	-0.0072
VU Univ Amsterdam			-0.0052	-0.0056
Centrality	0.0000	0.0000		
Rent	-0.6481	-1.1976		
Leisure	0.5716	0.6617		
Unemployment	-0.0617	-0.0711		
<i>Matched high school-university characteristics determining university choice</i>				
Distance	-0.8191	-0.0388		
Peers	0.6050	0.7109		

Note: Elasticities and marginal effects are computed using the expressions presented in the text.

Marginal effects for the religious universities' dummy are computed as the difference between the probability of choosing a given religious university if that university is no longer religious and that same probability if it continues to be religious. Both marginal effects and elasticities in this table refer to Model (1), in Table 6.

Table 8: (Direct) marginal effects on living-arrangement decision

Probability of living at home	
<i>Individual characteristics determining living arrangement choice</i>	
Male (D)	0.1041
Dparent (D)	-0.0509
GPA	0.0247
Supplem (D)	0.0432
Priv-Insurance (D)	-0.0826

Note: Marginal effects are computed using the expressions presented in the text, and refer to Model (1), in Table 6.

Table 9: Predicted choice probabilities

	University	At home	Out home	Total
LEI	Leiden University	0.0474	0.0366	0.0840
RUG	University of Groningen	0.0529	0.0766	0.1295
UU	Utrecht University	0.0962	0.0651	0.1613
EUR	Erasmus University Rotterdam	0.0534	0.0332	0.0866
TUD	Delft University of Technology	0.0300	0.0285	0.0585
TUE	Eindhoven University of Technology	0.0260	0.0252	0.0512
UT	University of Twente	0.0181	0.0239	0.0420
WU	Wageningen University	0.0137	0.0123	0.0260
UM	Maastricht University	0.0232	0.0250	0.0482
UvA	University of Amsterdam	0.0543	0.0274	0.0817
VU	VU University Amsterdam	0.0475	0.0257	0.0732
RUN	Radboud University Nijmegen	0.0464	0.0374	0.0838
UvT	Tilburg University	0.0386	0.0354	0.0740
Total		0.5477	0.4523	1.0000

Note: The probabilities in this table were computed based on the estimation results for

Model (1), in Table 6.

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<sup>1</sup>This parameterization is suggested by HEISS (2002). HENSHER and GREENE (2002) propose different, but equivalent parameterizations.

<sup>2</sup>Following HEISS (2002), we use the designation non-normalized nested logit (NNNL) model to refer to the nested logit formulation that might not be compatible with a RUM formulation. That formulation is the most frequently presented in the literature (GREENE, 2003), and the default in most econometric packages.

<sup>3</sup>See, for instance, HEISS (2002), HENSHER and GREENE (2002), KOPPELMAN and WEN (1998), for a detailed discussion on the RUM formulation of the nested logit model.

<sup>4</sup>BÖRSCH-SUPAN (1990) argues, however, that this condition, pointed out by McFadden, may be unnecessarily restrictive.

<sup>5</sup>The conditional logit model can be seen as a special case of the nested logit model, when  $\tau_m = 1$ ,  $\nu_m = 0,1$ . It can easily be tested against the nested logit model by means of a likelihood ratio test.

<sup>6</sup>An extra reason pointed out by HEISS (2002) has to do with the simplicity of command syntax.

<sup>7</sup>According to CBS (2005), there were 38,890 university applicants in the school year 2003/2004, of whom 22,770 had a VWO diploma.

<sup>8</sup>We use a composite overall index for educational quality of the university to combine the scores on those attributes in only one measure. The composite index has the advantage of positioning each study programme within the classification of each attribute, by comparing it with the mean classification. For each university and attribute

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4 we compute the average score over the different study programmes, weighted by the  
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6 number of students in that specific programme in the total number of students of the  
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8 programmes evaluated in the 2003 exercise at a specific university.  
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12<sup>9</sup>The quality index is strictly positive, and varies between 0.5 and 1.5 per attribute  
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14 (PORTELA, 2001).  
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18<sup>10</sup>However, we estimate the model with the student-teacher ratio, and in Section 4.3 we  
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20 discuss how those results compare with those for the model with the quality index.  
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23<sup>11</sup>Some authors would argue that the urbanization index would be a good proxy for  
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25 leisure. The Dutch context is a bit specific in this regard as it is possible to think of  
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27 several Dutch cities, with quite low values for the urbanization index, but still very  
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29 attractive for students because of their tradition as party cities.  
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33<sup>12</sup>The survey covers 253 offers in all 12 university cities in the Netherlands. Room  
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35 adverts were randomly picked from www.kamernet.nl. Specifically, the first ten  
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37 advertisements on a certain number of days were taken and both the rent and the  
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39 surface area of the room were registered.  
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43<sup>13</sup>This index is used in BROSE (2003), who took it from Magurran, in his work of 1988 on  
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45 ecological diversity measurement.  
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48<sup>14</sup>The Dutch Ministry of Education, Culture and Science groups all university study  
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50 programmes into nine main areas: namely, Behaviour and Society, Economics,  
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52 Education, Health Care, Land and Natural Environment, Language and Culture, Law,  
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54 Nature, Technical. For areas which are not present in a given university,  $p_m \log p_m = 0$ ,  
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56 which follows from the L'Hôpital rule.  
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$$C_j = \sum_{m=1, m \neq j}^M \frac{P_m}{d_{jm}^\delta}$$

<sup>15</sup>The general formulation for this measure is  $C_j = \sum_{m=1, m \neq j}^M \frac{P_m}{d_{jm}^\delta}$ . We use the special case when  $\delta = 1$ , which is standard in the literature of hierarchical destination choice (FOTHERINGHAM et al., 2001).

<sup>16</sup>In order to avoid scale problems, we define the intrazonal distance, which is relevant when a high school and a university location coincide in the same region, as  $d_i = \left(\frac{\pi - 1}{\pi}\right) \times \sqrt{\frac{S_i}{\pi}}$ , where  $S_i$  is the area of region  $i$  measured in square metres (see RIETVELD and BRUINSMA, 1998). The formula assumes that regions are circular, and all zones are equally intensively used.

<sup>17</sup>See SÁ et al. (2004: 381-382) for a discussion on the use of geographical distance as a spatial separation measure.

<sup>18</sup>In the particular case of Dutch students, the monetary costs of travelling are not relevant, as they are all entitled to a transportation permit, allowing them to travel for free.

<sup>19</sup>Each  $\rho_m$  can be obtained using the expression  $\rho_m = 1 - \tau_m^i$ .

<sup>20</sup>We believe there is no unique reason for this fact. It might have to do with personal preferences (e.g., better students want to concentrate on their study and give less priority to live independently); the fact that in the Netherlands there is no numerus clausus for most studies, and hence both low and high ability students have the same university opportunities; the parental residential location choice, which makes that better students are more likely to live close by the best schools, and they therefore do

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4 not need to move to attend university.  
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7 <sup>21</sup>In line with the remarks made in the Introduction, which are reinforced in Section 4.3,  
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9 this does not imply a causal relationship. It just represents the observed data.  
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