Locational choices and the costs of distance: empirical evidence for Dutch graduates

Carree, Martin and Kronenberg, Kristin

Maastricht University, Open University of the Netherlands, Statistics Netherlands

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Martin Carree[1]
Maastricht University, Maastricht, The Netherlands

Kristin Kronenberg[2]
Open University of the Netherlands, Heerlen, The Netherlands
Maastricht University, Maastricht, The Netherlands
Statistics Netherlands (CBS), Heerlen, The Netherlands

Abstract

This study identifies and analyzes the effects of university/college graduates' personal, household and employment characteristics as well as the attributes of their study, work and home locations on their college-to-work, college-to-residence, and commuting distances. The results illustrate that graduates are drawn to prospering regions with ample job opportunities, supposedly in order to advance their careers. They choose their places of residence so as to balance their commuting distances and the distances to their previous places of study. Residential amenities have a comparatively small effect on graduates' locational choices, whereas they appear to value accessibility of the place of residence.

JEL classifications: R23, R41
Keywords: distance, migration, locational choice, commuting, college-to-work, college-to-residence

[1] Department of Organization and Strategy, School of Business and Economics, Maastricht University, Maastricht, The Netherlands. E-mail: M.Carree@maastrichtuniversity.nl
[2] Faculty of Management Sciences, Open University of the Netherlands, Heerlen, The Netherlands. E-mail: Kristin.Kronenberg@ou.nl

1 INTRODUCTION

The locational choices of graduates can be expected to have a substantial impact on the economic performance of regions experiencing the in- and/or outflow of highly educated individuals (e.g. Venhorst et al., 2010). Yet, while a vast body of literature exists on the migratory decisions of individuals in general, comparatively little is known about the locational preferences of recent university/college graduates, both regarding their choices of workplace and place of residence, and how these decisions depend on their location of study.

Recent university and college graduates, being young and highly educated, can be expected to display comparatively high levels of spatial mobility (Clark and Cosgrove, 1991; Kodrzycki, 2001; Ritsilä and Ovaskainen, 2001) as well as a high commuting tolerance (Schwanen et al., 2002). Yet, while the locational choices of these graduates may profit those areas which experience the inflow of qualified and affluent individuals, they might harm those regions which are confronted with the loss of a talented workforce, or have to bear the consequences of excessive commuting and the congestion associated with it.

This study contributes to the existing literature on individuals' spatial behavior by analyzing the determinants of graduates' college-to-work, college-to-residence and commuting distances. It takes into account the influence of graduates' personal, household and employment characteristics, the attributes of the regions of origin and destination, and the distances between the regions of origin and destination and other locations of interest, thereby illustrating the trade-offs individuals have to make between locational benefits and the costs associated with the distances between relevant localities. The study makes a valuable addition to the literature on individuals' locational choices which often distinguishes between areas considerably larger than the average Dutch municipality, and commonly assumes one's locations of work and residence to be identical.

The dataset used in the empirical analysis was provided by Statistics Netherlands. It is based on register data covering virtually all Dutch university/college graduates in 2003,

and consists of information regarding graduates' personal, household and employment characteristics, their study, home and work locations, and the attributes of these localities. The Netherlands are a comparatively small country with a surface area of only 41.528 km², and with the maximum distance between two municipalities amounting to just slightly more than 300 kilometers. Thus, a person living and working in the Netherlands can easily reach any location of interest within a reasonable period of time, and may virtually commute between any given workplace and place of residence. Yet, as the Netherlands are also a densely inhabited country with a population density of more than 490 inhabitants/km², congestion is a critical issue (e.g. Camstra, 1996; Kronenberg & Carree, 2010; Rouwendal and Meijer, 2001), asking for the understanding of the determinants of long-distance journeys and commutes.

Results illustrate that graduates appear to be drawn to prospering regions with ample job opportunities, supposedly in order to advance their careers, yet try to balance their commuting distances and the distances to their previous place of study by locating their place of residence accordingly. Residential amenities have a negligible effect on graduates' locational choices, whereas they appear to value accessibility of the place of residence, possibly in order to be prepared for future job changes.

The study is organized as follows: Section 2 provides an overview regarding the theoretical background of the research, and section 3 outlines the characteristics of the data used in the study. Section 4 introduces the theoretical model employed in the analysis as well as the empirical specification, and defines the variables which are used. Section 5 presents and discusses the results, and section 6 concludes. In the Appendix, all tables are provided.

2 THEORETICAL FRAMEWORK AND HYPOTHESES

A Model of Graduates' Locational Choices

For each graduate, we discuss three locations of interest, namely the place of study, which is assumed to also constitute the place of residence until graduation, and both the place of work and the place of residence in the year following graduation, and determine the respective distances (Figure 1).

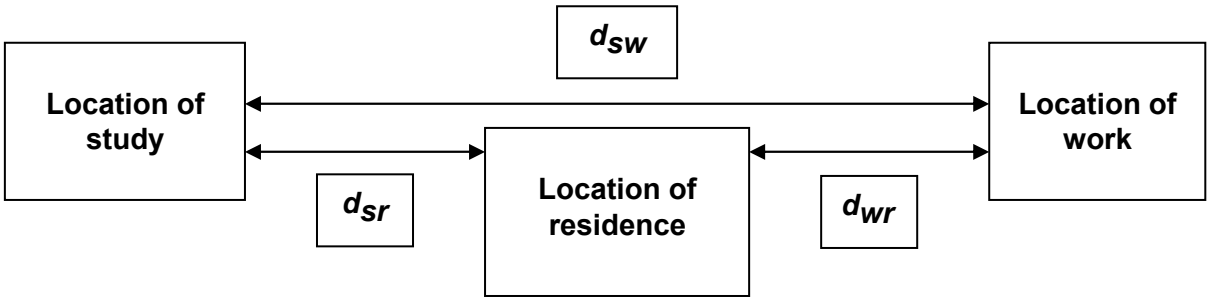

FIGURE 1: Graduates' locations of study, residence and work and the respective distances.

It is assumed that graduates first decide on a workplace, and then choose a place of residence by taking into consideration the distances to the locations of study and work. This model is supported by our Dutch data showing that the average college-to-work distance between a graduate's place of study and place of work amounts to 42.58 km, while the average distances between the place of residence and the place of study and that of work equal 34.02 km and 25.13 km, respectively (see Table 1). This suggests that graduates attempt to locate their place of residence in close proximity to both their workplace and place of study, so as to minimize the distances traveled when commuting and realizing return visits.

The Determinants of the Distances between Graduates' Places of Interest

We assume the distances between a graduate's place of study, workplace and place of residence to be influenced by the individual's personal, household and employment characteristics, career opportunities and residential amenities at the locations of interest, and their accessibility. One's commuting distance is also expected to be affected by the distances between the place of study and the place of residence respectively work, as is the distance between the place of study and the place of residence assumed to be influenced by the commuting distance as well as the distance between the place of study and the workplace.

The costs of moving can be assumed to increase with age (Sandell, 1977), as older individuals can be expected to have developed stronger ties with their environment, and might thus be less willing to leave their familiar surroundings (Kronenberg and Carree, 2010; Pekkala, 2003; Ritsilä and Ovaskainen, 2001). At the same time, the commuting distances of older individuals are generally shorter than those of younger persons (Manaugh et al., 2010; Plaut, 2006; Schwanen et al., 2004; Susilo and Maat, 2007), supposedly since younger workers are more likely to have the energy required to realize lengthy, time-consuming commutes (So et al., 2001).

Since accepting a job at a large distance from one's place of study and current residence entails either simultaneous relocation, or the realization of long commutes, we hypothesize the distance between a graduate's place of study and workplace to decrease with the age of the graduate, resulting in both shorter commutes, and shorter distances between the place of study and the place of residence

Female graduates have been found to be more migratory than males, as they may aim to counterbalance gender bias in the labor market by extending their search radius when looking for employment (Faggian et al., 2007). Correspondingly, Venhorst et al. (2011) established that female college graduates are more likely than their male equivalents to cover large college-to-work distances when starting their first job after graduation. At the same time, females generally have shorter commutes than males (Crane, 2007; Manaugh et

al., 2010; Plaut, 2006; Sang et al., 2011; Shuttleworth and Gould, 2010; Susilo and Maat, 2007), possibly due to the gender-specific allocation of domestic responsibilities (Rouwendal and Nijkamp, 2004; Schwanen et al., 2002; Schwanen et al., 2004), or because women tend to attach a larger value on the disutility of commuting than men (So et al., 2001). We thus hypothesize that the distance between a graduate's place of study and workplace will be larger for female graduates and, since we expect women to have shorter commutes, we assume their college-to-residence distances to be longer than those of men.

Family ties have been found to discourage residential mobility (Mincer, 1978), as other members of the household might be unwilling to leave their familiar surroundings, or might even suffer from a residential move, since relocation might entail losing nearby friends, giving up one's job, or accepting a longer daily commute. Hence, it follows that multi-person households will be less inclined to move than those consisting of only one person (Becker, 1981; Eliasson et al., 2003; Kan, 2003; Kronenberg and Carree, 2010; Linneman and Graves, 1983; Pekkala, 2003). Accordingly, Clark and Cosgrove (1991) found that singles migrate across larger distances than individuals having a partner. Furthermore, commuting distances have been found to decrease with the number of persons in a worker's household (Manaugh et al., 2010; Schwanen et al., 2002), and are lower for employees with dependent children (Manaugh et al., 2010; Susilo and Maat, 2007), supposedly since the coordination of domestic and professional responsibilities becomes more difficult with distance (So et al., 2001). We therefore hypothesize the distance between a graduate's place of study and workplace to be smaller for married graduates, and for those having children, bringing about shorter commutes as well as a shorter distances between the place of study and the place of residence.

Hensen et al. (2008) find that the probability of finding a full-time job increases with the distance covered between one's location of study and location of work, and graduates who are geographically mobile also have an increased propensity to find jobs which generate above-average pay. Correspondingly, employees working part-time have been found to have shorter commutes than those in full-time positions (Camstra, 1996; Kwan, 1999; Manaugh et

al., 2010; Sang et al., 2011), presumably since their commuting costs relative to the total salary earned are comparatively high. Furthermore, commuting distances were found to be larger for individuals with higher incomes (Kim et al., 2005; Manaugh et al., 2010; Mulalic et al., 2010; Plaut, 2006; Schwanen et al., 2004; So et al., 2001; and Susilo and Maat, 2007). There are two related explanations for this phenomenon. Workers might bargain for higher wages in order to compensate for longer commutes (Mulalic et al., 2010), or those being offered high salaries might attach a comparatively lower importance to commuting distance and the associated costs (Kim et al., 2005), especially if they can realize living in their preferred location. We thus hypothesize that both the distance between a graduate's place of study and workplace, and the commuting distance between the place of residence and the workplace increase with the salary earned, and with the part-time factor of the job.

Career opportunities have been found to have a considerable impact on the spatial behavior of individuals. Employees have been found to be generally drawn to high-wage regions (e.g. Davies et al., 2001; Greenwood and Hunt, 1989; Kodrzycki, 2001; Molho, 1984; Pekkala, 2003), to locations which had been subject to employment growth (e.g. Clark and Hunter, 1992; Greenwood and Hunt, 1989; Davies et al., 2001; Gottlieb and Joseph, 2006), or to highly populated areas with generally favorable economic circumstances (e.g. Berry and Glaeser, 2005; Davies et al., 2001; Gottlieb and Joseph, 2006; Kodrzycki, 2001; Pekkala, 2003). Conversely, being located in a sparsely populated, low-wage area with unfavorable employment conditions can be expected to push individuals towards seeking employment elsewhere (e.g. Hansen et al., 2003; Nakosteen and Zimmer, 1982; Pekkala, 2003; Ritsilä and Ovaskainen, 2001; Venhorst et al., 2011; Whisler et al., 2008; Yousefi and Rives, 1987). We thus assume that the distance between a graduate's place of study and workplace decreases with the career opportunities present at the location of study, and increases with the job opportunities present at the location of work. Career opportunities are proxied by population, employment growth, the average salary earned, the share of highly educated workers, and the degree of specialization in the graduate's sector of employment.

While the career opportunities present in an area attract workers seeking employment (e.g. Berry and Glaeser, 2005; Clark and Hunter, 1992; Davies et al., 2001; Gottlieb and Joseph, 2006; Greenwood and Hunt, 1989; Kodrzycki, 2001; Molho, 1984; Pekkala, 2003), individuals may not be able to find (or afford) their preferred type of accomodation in these areas. When selecting the location of residence, individuals may therefore face a trade-off between housing attributes (e.g. size of the dwelling and the surrounding premises, qualities of the building, availability of a garden) and commuting distance (Clark and Burt, 1980; Kain, 1962; Kim et al., 2005; Rouwendal and Meijer, 2001; So et al., 2001), possibly encouraging workers to live and work in different locations. We therefore hypothesize that the distance between a graduate's place of residence and workplace increases with the career opportunities present at the location of work, and decreases with the career opportunities present at the location of residence.

The choice of one's residential location can be expected to be influenced by the presence of residential amenities such as favorable climatic conditions, low crime rates, and good educational and recreational facilities. Amenity-rich locations have been found to experience larger inflows of migrants than those lacking characteristics which appeal to individuals (e.g. Clark and Hunter, 1992; Davies et al., 2001; Graves, 1983; Rappaport, 2007). Conversely, regions which are perceived as unattractive are more likely to be subject to the outmigration of residents (e.g. Clark et al., 1996; Herzog and Schlottmann, 1986). In case the location of work is not endowed with the desired locational attributes, individuals may decide to locate elsewhere, thus trading off residential amenities and commuting distance. We thus expect that the distance between a graduate's place of residence and workplace increases with the amenities present at the location of residence, and decreases with the amenities present at the location of work. Amenities are proxied by dummy variables indicating whether the municipalities of residence and work have been ranked as one of the 50 most attractive Dutch municipalities for individuals to live in. Correspondingly, as illustrated by Clark and Cosgrove (1991), the distance moved by migrants increases with the differences in amenity levels between the region of origin and the region of destination. In

case the location of study provides the desired locational attributes, graduates may decide to remain in their place of study, whereas knowledge about alternative residential locations which appeal to individuals might induce them to relocate. We thus expect that the distance between a graduate's place of study and place of residence increases with the amenities present at the location of residence, and decreases with the amenities present at the location of study.

The better one's place of study and workplace can be reached, the larger the distance between those two locations can be without necessarily requiring concurrent relocation, as access to good transport infrastructure at both the locations of residence and work enables employees to realize longer commutes (Manaugh et al., 2010). Alternatively, better accessibility of the place of study implies that in the case of a residential move, it will be easier to return for visits and short-term stays, the psychic and actual costs of which will be diminished by the presence of good transportation facilities connecting the locations of origin and destination (Clark and Cosgrove, 1991). We therefore hypothesize that the distance between a graduate's place of study and workplace increases with the accessibility of both locations, as both longer commutes, and longer college-to-residence distances are facilitated.

Individuals can be expected to keep the distances between all locations of interest as short as possible, e.g. by relocating to a place which is located between the place of study and the workplace. The decision of where to relocate thus entails a trade-off between remaining located in close proximity to the place of study, and minimizing the commuting distance between the place of residence and the workplace. Naturally, however, the larger the college-to-work distance, the larger the combined college-to-residence and commuting distances will be. We thus hypothesize that the commuting distance between a graduate's place of residence and workplace increases with the distance between the place of study and the workplace, and decreases with the distance between the place of residence and the place of study. Likewise, we expect the distance between a graduate's place of residence and place of study to increase with the distance between the place of study and the

workplace, and to decrease with the commuting distance between the place of residence and the workplace.

3 DATA

Data Sources

The data used in this study were provided by Statistics Netherlands (CBS). Data on graduates, universities, households, firms and municipalities originate from various sources and were merged for the purpose of this study.

Education-related information on graduates (year of graduation, institution of higher education, field of study) stems from the Dutch central student register (CRIHO), which is based on information derived from the Informatie Beheer Groep, a Dutch governmental institution. For 57 institutions (13 universities and 44 colleges) of higher education, the location (municipality) could be determined.

Personal, household- and job-related information on graduates originates from the Social Statistical Database (SSB) which is compiled on the basis of register and survey data from two main sources. Personal and household-related data (e.g. date of birth, gender, partner, children, residential location on the municipal level) stem from the municipal registration system, while information regarding a person's job (e.g. employer, duration of employment, salary, part-time factor) is provided by the Fibase, a database delivered by the Dutch Tax Administration. As each graduate is identified by a unique identification number, personal-, employment- and household-related information from these different sources could be merged.

Data regarding firms (e.g. industrial sector, location on the municipal level) are available on the level of the 'business unit'. The information originates from the SSB, the Dutch business register (ABR), the Survey on Employment and Wages (EWL), the Survey Production Statistics (SBS and STS), and data provided by the Dutch Tax Administration. As

each employee can be linked to the respective employer, identified by a unique identification number, employer-related information is available for each employed graduate.

Basic information regarding the Dutch municipalities (e.g. population) originates from Statline, a publicly available database provided by Statistics Netherlands which supplies aggregate regional information on the municipal level. Further data regarding the characteristics of the workforce, firms and sectors present in each municipality were established on the basis of the microdata on employees and firms at hand. Information regarding the attractiveness of the Dutch municipalities for individuals was obtained from www.elsevier.nl, where all Dutch municipalities are evaluated each year. Apart from a general ranking (regarding e.g. economic position, health, education, infrastructure, and accessibility) of the municipalities, separate rankings are also available with regard to specific topics such as 'accessibility by car'. Since the locations of the university/college, workplace, and place of residence are known for each graduate, municipal-level characteristics of all three locations are available.

As the exact location of each municipality (its center) is known, the distances between municipalities/locations can be calculated. For each graduate, the respective distances between their place of study, workplace, and place of residence could be determined on the municipal level.

Data Description

The dataset consists of 5,665 individuals who graduated from a Dutch university or college in 2003, held a job (at least 0.6 FTE[1]) at a single-site[2] firm on March 24, 2004 which did not start before January 1, 2003[3], and had a registered place of residence at the reference date[4] (September 24) in 2004. For these 5,665 graduates, the respective distances between the university/college they graduated from in 2003, their workplace in 2004, and their place of residence in 2004 were calculated.

The dataset further consists of information regarding graduates' personal characteristics (e.g. age, gender, field of study), household composition (e.g. partner, children), employment (e.g. salary, part-time factor), and the characteristics of the municipalities in which their university/college, workplace and place of residence were situated.

These characteristics were determined for the year 2004 for the 475 Dutch municipalities for which information was complete[5]. They include general municipal features (population), employment-related characteristics (previous employment growth, average salary, share of employees aged 22-40 with degree in higher education, sectoral specialization[6]), and indicators of regional attractiveness and accessibility.

4 METHODOLOGY

Theoretical Model

There are 475 potential locations (w = 1, ..., 475) where graduates may enter employment, and they can choose between the same 475 locations (r = 1, ..., 475) when selecting their place of residence. Since individuals will aim to maximize utility, they can be expected to select the locations at which they expect to obtain the highest net benefits, e.g. by choosing their job in a region with ample career opportunities, and selecting their residence in an area where residential amenities are abundant. At the same time, individuals derive disutility from the distances between locations of interest, as daily commutes and frequent return visits become increasingly costly and time-consuming with distance. The utility function of graduate i selecting a job at w and a place to live at r can thus be written as

$$U = U(B, T) \qquad (1)$$

with *B* signifying the benefits of choosing locations *w* and *r*, and *T* denoting the (travel) costs associated with these decisions. More specifically, we assume that

$$U_{iwr} = \alpha_i X_{iwr} - \beta_i (d_{iwr})^2 - \gamma_i (d_{isr})^2 \qquad (2)$$

where X_{iwr} is a vector of the benefits which graduate *i* selecting a job at *w* and a place to live at *r* attains, and d_{iwr} and d_{isr} refer to the costs associated with the commuting distance between the place of residence and the workplace, and with the distance between the place of residence and the place of study[7].

As graduates will aim to minimize the distances between all locations of interest, we assume that their place of residence is located on a straight line between their places of study and work, so that the college-to-work distance $d_{sw} = d_{wr} + d_{sr}$, hence $d_{sr} = d_{sw} - d_{wr}$. A graduate, having chosen a job at a specific location, will attempt to solve the following optimization problem:

$$\text{Min } T = \beta (d_{wr})^2 + \gamma (d_{sw} - d_{wr})^2 \text{ with respect to } d_{wr} \qquad (3)$$

The first order condition is:

$$2\beta d_{wr} - 2\gamma (d_{sw} - d_{wr}) = 0 \qquad (4)$$

Solving this for d_{wr} yields:

$$d_{wr} = [\gamma/(\beta+\gamma)] d_{sw} \qquad (5)$$

It thus follows that:

$$d_{sr} = [\beta/(\beta+\gamma)] d_{sw} \qquad (6)$$

Hence:

$$U_{wr} = \alpha X_{wr} - \beta(\gamma/(\beta+\gamma)d_{sw})^2 - \gamma(\beta/(\beta+\gamma)d_{sw})^2 \quad (7)$$

In case two jobs, J_1 and J_2, offer the same benefits X_{wr}, but are located at dissimilar distances from the place of study, the graduate will prefer the job which is located closer to the place of study so as to minimize d_{sw} and the associated costs T. Only if the benefits offered by J_2, located at a greater distance to the place of study than J_1, are sufficiently large to compensate for the greater distance, the graduate will prefer J_2 to J_1. Graduates will only be tempted to move away from their place of study in case X_{wr} is a (locally) increasing function of d_{sw}, say δd_{sw}. If δ was equal to zero, then graduates would always remain at their place of study. A reason for δ to be positive is that the number of alternative jobs increases with distance.

Thus:

$$U_{wr} = \alpha\delta d_{sw} - \beta(\gamma/(\beta+\gamma)d_{sw})^2 - \gamma(\beta/(\beta+\gamma)d_{sw})^2 \quad (8)$$

A graduate will attempt to solve the following optimization problem:

$$\text{Max } U_{wr} = \alpha\delta d_{sw} - \beta(\gamma/(\beta+\gamma)d_{sw})^2 - \gamma(\beta/(\beta+\gamma)d_{sw})^2 \text{ with respect to } d_{sw} \quad (9)$$

The first order condition is:

$$\alpha\delta - 2\beta\{[\gamma/(\beta+\gamma)]^2 d_{sw}\} - 2\gamma\{[\beta/(\beta+\gamma)]^2 d_{sw}\} = 0 \quad (10)$$

Solving this for d_{SW} yields:

$$d_{SW} = \alpha\delta / \{2\beta[\gamma/(\beta+\gamma)]^2 + 2\gamma[\beta/(\beta+\gamma)]^2\} \quad (11)$$

If a job located at a specific distance offers high benefits (e.g. a high wage), the positive effect of choosing this distance (which allows the graduate to accept the job) is large, thus δ is large. If it offers low benefits, the opposite is true. Thus, the size of δ depends on the benefits which a job has to offer. Hence, (*11*) illustrates that a graduate's college-to-work distance increases as the benefits (δ) of employment offered at a larger distance increase, but decreases with the unpleasantness (β and γ) the graduate associates with the distances between relevant localities.

Empirical Specification

We assume that a graduate chooses his or her first post-graduation job by taking into account personal, household and employment characteristics, attributes of the locations of study and work, and the distance between the location of study and the location of the workplace. The distance between a graduate's place of study and workplace will thus be determined by the graduate's personal features, characteristics of the household, qualities of the job obtained after graduation, and attributes of the municipalities of study and work.

Having decided on a specific job in a particular location, the graduate selects a place of residence. The distance between a graduate's place of residence and place of study is expected to depend upon the graduate's personal features, characteristics of the household, attributes of the municipalities of study and residence, the distance between the place of study and the workplace, and the commuting distance between the graduate's place of residence and workplace. At the same time, the commuting distance between a graduate's place of residence and workplace will be determined by the graduate's personal features, characteristics of the household, qualities of the job obtained after graduation, attributes of

the municipalities of work and residence, the distance between the place of study and the workplace, and the distance between the graduate's place of residence and place of study.

Since the dependent variables – the distances between the locations of interest – are naturally left-censored at zero[8], Tobit regression models are used to examine the influence of personal, household, employment and locational characteristics as well as distances between locations of interest on graduates' college-to-work, college-to-residence and commuting distances. The Tobit model is based on the unobserved continuous dependent variable y_i^* for which the dependent variable (distance) $y_i = y_i^*$ if $y_i^* > c$ and $y_i = c$ if $y_i^* \leq c$, with $c = 0$ being the threshold for censoring.

Variables

Table 2 displays the variables employed in the analysis. (Note: for all dummy variables, the value '1' signifies 'yes', and the value '0' denotes 'no'.) The variables D_SW, D_WR and D_SR measure the respective distances (in km) between the municipalities a graduate's place of study, workplace and place of residence are located in. All variables are measured in 2004 (or, in the case of D_SW, D_SR and GROWTH_REL, between 2003 and 2004).

AGE is the age of the graduate (in years), and FEMALE indicates whether a graduate is female. PARTNER denotes whether a graduate is married[9], and CHILDREN indicates the presence of at least one child in the graduate's household. SALARY is the daily salary (in €) earned by the graduate, and PTF is the part-time factor of the job (the values of this variable range between 6000, indicating a 0.6-FTE-job, and 10000, denoting a full-time position).

All municipal-level variables are available for each graduate's place of study, workplace and place of residence, distinguished by the suffixes _S, _W and _R. POP indicates the population of a municipality (in 1,000 inhabitants), and GROWTH_REL is the relative change in employment in comparison to the previous year. SALARY denotes the average daily salary (in €) in a municipality, and HIGH_EDUC indicates its share of highly educated employees (aged 22-40). SPEC denotes the sectoral specialization (or location

quotient) of a municipality, referring to the sector the graduate is employed in. This variable measures the share of employees in the graduate's sector (2-digit level) in the municipality relative to the share of employees in the graduate's sector in the Netherlands. A value of 1 indicates that in the municipality, the graduate's industry is as present as in the rest of the Netherlands, a value smaller than 1 indicates that in the municipality, the industry is underrepresented, and a value greater than 1 indicates that in the municipality, the industry is overrepresented. TOP_50 denotes whether a municipality has been ranked as one of the 50 most attractive Dutch municipalities for individuals, and CAR indicates the accessibility of a municipality by car (on a Likert-scale with values ranging from 1 to 5, with 1 indicating very poor accessibility, and 5 indicating excellent accessibility).

Furthermore, dummy variables in order to control for the graduates' fields of study are included, classifying the following nine subject areas: education (1), agricultural and life sciences (2), natural sciences (3), engineering sciences (4), healthcare (5), economics and business sciences (6), law (7), social sciences (8), and linguistics and cultural sciences (9), with the latter being the reference category.

Descriptive statistics for the explanatory and control variables are presented in Table 3. Graduates were on average 24.97 years old, with 50.4% being female. Slightly more than one third of the graduates had at least one child, and 31% were living in a registered partnership. The average daily salary earned in the year following graduation amounted to € 60.09, and the average part-time factor (for jobs between 0.6 and 1.0 FTE) was 0.89.

The average population (in 1000 inhabitants) of a graduate's place of study was 273.8, and the average relative employment growth in the municipality in which a graduate's university/college was located in was -1.2%. The average daily salary in a graduate's place of study amounted to € 99.56, the average share of employees with a degree in higher education in the municipality in which a graduate's university/college was located in was 31.8%, and the average sectoral specialization (in the graduate's sector) was 1.29. Some 57.5% of the graduates had studied in a city which had been ranked as one of the 50 most

attractive places in the Netherlands, and the average accessibility (by car) of a graduate's place of study was 2.8 (on a 5-point Likert-scale).

The average population (in 1000 inhabitants) in the municipality in which a graduate's workplace was located in was 211.7, and the average relative employment growth in the municipality was -0.5%. The average daily salary in the municipality in which a graduate's workplace was located in amounted to € 96.85, the average share of employees with a degree in higher education was 26.4%, and the average sectoral specialization (in the graduate's sector) was 2.24. Some 37.5% of the graduates worked in a municipality which had been ranked as one of the 50 most attractive places in the Netherlands, and the average accessibility (by car) of the municipality in which a graduate's workplace was located in was 2.7 (on a 5-point Likert-scale).

The average population (in 1000 inhabitants) in the municipality in which a graduate's place of residence was located in was 194.5, and the average relative employment growth in the municipality was -1.1%. The average daily salary in the municipality in which a graduate's workplace was located in amounted to € 94.99, the average share of employees with a degree in higher education was 26.1%, and the average sectoral specialization (in the graduate's sector) was 1.29. Some 36.8% of the graduates worked in a municipality which had been ranked as one of the 50 most attractive places in the Netherlands, and the average accessibility (by car) of the municipality in which a graduate's workplace was located in was 2.7 (on a 5-point Likert-scale).

5 RESULTS AND DISCUSSION

Determinants of the Distance between Place of Study and Workplace

Results are presented in Table 4. They show that graduates living in a registered partnership, and those having children indeed cover shorter distances between their place of study and workplace. Female and male graduates do not differ in their behavior regarding

the choice of their workplace location, but, somewhat surprisingly, one's college-to-work distance increases with age. This finding may be attributed to the fact that older graduates, due to knowledge and experience, may be more proficient in locating suitable employment elsewhere, or may have to accept work in remote locations due to the fact that nearby jobs are taken by younger graduates.

As expected, the distance covered increases with the salary earned in the accepted position, and also with the part-time factor of the job. These findings are in line with Hensen et al. (2008), suggesting that one's willingness to look for employment within a larger radius increases the chances of fulltime employment as well as a competitive salary. Equally, it may also be the case that graduates secure adequate compensation for the commuting efforts, relocation costs or the general uprooting which may accompany the acceptance of a job in a distant location.

The better the career opportunities at the location of study, the shorter the distance between the locations of study and work. These findings confirm our expectations, and illustrate that favorable economic conditions, also with respect to a graduate's sector of specialty, can retain graduates in the region. The results also point at the significance of a 'good match' between the education provided at an institution of higher education, and related employment in local industries, as adjacent career opportunities may prevent the 'brain drain' of a capable workforce, and help to retain graduates in the region in which they obtained their degree. Correspondingly, the college-to-work distance generally increases with the career prospects at the selected location of work, indicating that graduates indeed cover large distances in order to work in an area which offers favorable conditions such as high salaries, employment growth, and a specialization in the graduate's area of work.

The better the accessibility of the place of study, the larger the college-to-work distances of graduates. This finding indicates that graduates may indeed be willing to accept job offers at a larger distance in case their place of study can be easily reached, as daily commutes or return visits are facilitated by the ease of access.

Furthermore, the attractiveness of one's place of work also increases the college-to-work distance, possibly suggesting that graduates who are willing to cover large distances between their place of study and place of work prefer to live and work in close proximity, and are therefore drawn to municipalities offering residential amenities.

Determinants of the Commuting Distance between Place of Residence and Workplace

Results are presented in Table 5. Graduates' commuting distances are not influenced by personal and household characteristics, indicating that recent graduates may form a rather homogeneous group for which the length of the daily commute is determined by other factors. As expected, the commuting distance increases with the salary earned, suggesting that persons with higher incomes may indeed bargain for higher wages in order to compensate for the costs and efforts associated with a longer commute, or simply have the financial means to realize living and working in different locations.

The commuting distance increases with certain career opportunities (salary, sectoral specialization) at the location of work, and decreases with those career opportunities at the location of residence. Especially since the local wage level may also capture rents and land prices, these findings also suggest that workers may indeed trade off housing attributes (e.g. size and quality of the dwelling and the surrounding premises) and commuting distance. At the same time, however, commuting distances are lower for those living and working in municipalities which are highly populated. This may indicate that recent graduates, being young and highly educated, may find it appealing to reside and work in large urban areas (Clark and Hunter, 1992; Kim et al., 2005), also since these locations may be expected to offer superior 'marriage markets' for this demographic group (Adamson et al., 2004; Costa and Kahn, 2000).

Somewhat surprisingly, residential amenities do not have the expected effect on commuting distance. Yet, as established by Chen and Rosenthal (2008) as well as Whisler et al. (2008), the locational decisions of recent graduates may be predominantly motivated by

career considerations, and comparatively less by the appeal of a location regarding the residential amenities it may offer. Furthermore, attractive municipalities may also be characterized by higher costs of living which young graduates at the beginning of their professional careers may not be able to afford.

As hypothesized, one's commuting distance increases with the accessibility of the residential location, albeit not with the accessibility of the work location. These findings may indicate that young professionals expect to repeatedly change jobs in the near future, and aim to secure residential locations which are easily accessible in order to avoid further residential moves.

One's commuting distance, as expected, decreases with the college-to-residence distance, and increases with the distance between the place of study and the workplace. These findings illustrate that graduates indeed face a trade-off between minimizing their daily commute, and diminishing the distance to the location they may still feel emotionally attached to.

Determinants of the Distance between Place of Study and Place of Residence

Results are presented in Table 6. We find that female graduates indeed move further away from their place of study, presumably in order to reduce the commuting distance between their workplace and place of residence, as gender bias in the labor market may have required them to accept a position in a distant location (Faggian et al., 2007). Age does not have an effect on the migration distance, yet the presence of additional household members has a positive impact. These findings may indicate that graduates already having a family may attach comparatively less importance to the social network they may have established at their place of study, or, already having a family, may even have abstained from moving to their university town while studying.

Residential amenities do not have the expected effect on one's college-to-residence distance, again suggesting that the spatial decisions of young professionals are not primarily

driven by the attractiveness of regions (Chen and Rosenthal, 2008; Whisler et al., 2008). Surprisingly, the effect of the accessibility of the locations of study and residence on the distance between the two locations is absent, or even negative.

As hypothesized, graduates with longer college-to-work distances also face longer distances between their places of study and residence, yet they appear to be confronted with a trade-off between longer commuting distances and a greater separation between their places of study and residence.

6 CONCLUSIONS

The results of this study illustrate the challenges graduates face when selecting the locations of their first post-study workplaces and places of residence. Graduates in the Netherlands – a comparatively small country – do not insist on living and working in the same locality, but apparently select their location of residence with the intention that both their place of work and place of study - which they may still feel emotionally attached to - can be easily reached.

Several of the empirical findings merit further attention. We find that recent graduates appear to attach considerable importance to career prospects and choose their location of work correspondingly, thereby accepting residential relocation and/or long daily commutes. Yet, results suggest that they strive to balance their commuting distances and the distances to their previous place of study by locating their place of residence accordingly.

Furthermore, graduates may decide to live and work in different regions for reasons which may be (also) related to the availability of adequate and affordable housing, whereas residential amenities have a comparatively small impact on their locational choices. In addition, they apparently value residential locations which are easily accessible, supposedly as they expect to frequently change jobs in the near future, yet may want to avoid additional residential moves.

The results of this study contribute to explaining the increasing congestion which can be observed for the Netherlands, as individuals apparently do not feel compelled to colocate

their workplace and place of residence, but trade-off the desired qualities of their workplace and place of residence with longer commutes and travel distances between relevant locations. These findings may be distinctive for a country with a comparatively small surface area, thus allowing for commutes between the majority of possible home and work locations, and for frequent (return) visits to any place of interest. The provision of better means of public transportation which are able to compete with the automobile in terms of speed and usability may be one measure to be taken. Furthermore, supplying attractive and affordable housing for young professionals located in urban areas respectively centers of economic growth may also be an instrument to be considered.

[1] Many Dutch students work parttime while studying, often even having more than one 'small' job, all of which may be unrelated to one's field of study. By only selecting graduates who work in the same job at least three days per week, we expect to limit the dataset to those with degree-related post-graduation jobs.

[2] More than 95% of the firms are single-site firms. Since the exact location of a person's workplace cannot be determined for those working in firms with subsidiaries in various locations, the latter had to be excluded from the analysis.

[3] Again, by imposing this restriction, we expect to exclude pre-graduation student jobs.

[4] In the dataset at hand, a person's place of residence as well as all other personal and household characteristics are only established once a year (last Friday in September).

[5] In 2004, the Netherlands consisted of 483 municipalities. Since information on employment growth and accessibility was not available for all municipalities, eight municipalities had to be excluded from the analysis. Graduates who were working and/or living in one of these municipalities were consequently excluded as well.

[6] The values for sectoral specialization depend on the sector (2-digit NACE level) the graduate is employed in.

[7] We assume utility to be a negative quadratic function of distance, as the travel time between two locations will be subject to higher variance. Counterbalancing efforts (e.g. leaving earlier to be at work on time) thus generate a convex loss function (Juster and Stafford, 1991). For convenience, the subscript *i* will be omitted throughout the remainder of the text.

[8] Theoretically, the dependent variables would also have to be right-censored, since the maximum distance between two Dutch municipalities is 314.48 km. Yet, as values of this magnitude are exceptionally rare, we abstained from right-censoring.

[9] With the available data, it is only possible to determine whether or not an individual is living in a registered partnership. While in most cases, registered partners are indeed married, the variable also captures those who registered their partnership without getting married.

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TABLE 1: Graduates' college-to-work (D_SW), college-to-residence (D_WR) and commuting (D_SR) distances (in km)

	Mean	SD	Minimum	Maximum
D_SW	42.584	47.31	0.00	314.48
D_WR	25.134	36.06	0.00	314.47
D_SR	34.018	43.69	0.00	275.55

TABLE 2: Definitions of variables

Variable	Definition
D_SW	Graduate's college-to-work distance (in km)
D_WR	Graduate's commuting distance (in km)
D_SR	Graduate's college-to-residence distance (in km)
AGE	Age of the graduate (in years)
FEMALE	1 = female, 0 = male
PARTNER	1 = graduate lives in registered partnership, 0 = otherwise
CHILDREN	1 = at least one child is living in the graduate's household, 0 = otherwise
SALARY	Graduate's daily salary (in €)
FTE	Part-time factor of graduate's job
POP_S	Population of municipality of study (in 1,000 inhabitants)
GROWTH_REL_S	Relative change in employment in municipality of study
SALARY_S	Average daily salary (in €) in municipality of study
HIGH_EDUC_S	Share of highly educated employees in municipality of study
SPEC_S	Sectoral specialization in graduate's sector of employment in municipality of study
TOP_50_S	1 = municipality of study has been ranked as one of the 50 most attractive Dutch municipalities for individuals, 0 = otherwise
CAR_S	Accessibility of municipality of study by car, 1 = poor accessibility, 5 = excellent accessibility
POP_W	Population of municipality of work (in 1000 inhabitants)
GROWTH_REL_W	Relative change in employment in municipality of work
SALARY_W	Average daily salary (in €) in municipality of work
HIGH_EDUC_W	Share of highly educated employees in municipality of work
SPEC_W	Sectoral specialization in graduate's sector of employment in municipality of work
TOP_50_W	1 = municipality of work has been ranked as one of the 50 most attractive Dutch municipalities for individuals, 0 = otherwise
CAR_W	Accessibility of municipality of work by car, 1 = poor accessibility, 5 = excellent accessibility
POP_R	Population of municipality of residence (in 1000 inhabitants)
GROWTH_REL_R	Relative change in employment in municipality of residence
SALARY_R	Average daily salary (in €) in municipality of residence
HIGH_EDUC_R	Share of highly educated employees in municipality of residence
SPEC_R	Sectoral specialization in graduate's sector of employment in municipality of residence
TOP_50_R	1 = municipality of residence has been ranked as one of the 50 most attractive Dutch municipalities for individuals, 0 = otherwise
CAR_R	Accessibility of municipality of residence by car, 1 = poor accessibility, 5 = excellent accessibility

TABLE 3: Descriptive statistics

	Mean	SD	Minimum	Maximum
AGE	24.967	2.883	20.00	56.00
FEMALE	0.504	0.500	0.00	1.00
PARTNER	0.310	0.463	0.00	1.00
CHILDREN	0.353	0.478	0.00	1.00
SALARY	60.088	25.825	17.95	601.00
FTE	8,869.319	1,404.244	6,000.00	10,000.00
POP_S	273.817	207.461	24.05	739.10
GROWTH_REL_S	-0.012	0.045	-0.09	0.11
SALARY_S	99.564	11.826	76.56	129.56
HIGH_EDUC_S	0.318	0.064	0.14	0.41
SPEC_S	1.289	1.574	0.00	70.87
TOP_50_S	0.575	0.494	0.00	1.00
CAR_S	2.750	1.337	1.00	5.00
POP_W	211.675	239.195	1.16	739.10
GROWTH_REL_W	-0.005	0.059	-0.34	0.64
SALARY_W	96.854	14.537	64.57	179.10
HIGH_EDUC_W	0.264	0.084	0.06	0.41
SPEC_W	2.240	6.213	0.03	123.54
TOP_50_W	0.375	0.484	0.00	1.00
CAR_W	2.710	1.317	1.00	5.00
POP_R	194.494	224.059	2.53	739.10
GROWTH_REL_R	-0.011	0.057	-0.34	0.64
SALARY_R	94.993	14.918	63.81	179.10
HIGH_EDUC_R	0.261	0.091	0.08	0.41
SPEC_RE	1.292	2.170	0.00	70.87
TOP_50_R	0.368	0.482	0.00	1.00
CAR_R	2.729	1.321	1.00	5.00

TABLE 4: Tobit regression, distance between place of study and place of work (D_SW)

	Coefficient	*SE*	*t*	*P>|t|*
AGE	0.891	0.292	3.05	0.002
FEMALE	-2.013	1.700	-1.18	0.237
PARTNER	-2.970	1.761	-1.69	0.092
CHILDREN	-3.916	1.762	-2.22	0.026
SALARY	0.147	0.032	4.59	0.000
FTE	0.002	0.001	4.23	0.000
POP_S	-0.024	0.008	-3.16	0.002
GROWTH_REL_S	-109.125	20.959	-5.21	0.000
SALARY_S	-0.384	0.127	-3.03	0.002
HIGH_EDUC_S	-51.709	19.469	-2.66	0.008
SPEC_S	-6.339	0.918	-6.91	0.000
TOP_50_S	-2.166	2.147	-1.01	0.313
CAR_S	9.459	0.829	11.41	0.000
POP_W	-0.019	0.005	-4.06	0.000
GROWTH_REL_W	40.750	13.012	3.13	0.002
SALARY_W	0.444	0.076	5.81	0.000
HIGH_EDUC_W	-129.927	14.526	-8.94	0.000
SPEC_W	0.672	0.118	5.70	0.000
TOP_50_W	3.959	2.032	1.95	0.051
CAR_W	-3.247	0.658	-4.93	0.000
Dummies for 'field of study'	*Yes*			

Pseudo R^2: 0.0217
Number of observations: 5,665

TABLE 5: Tobit regression, distance between place of work and place of residence (D_WR)

	Coefficient	*SE*	*t*	*P>|t|*
AGE	0.251	0.226	1.11	0.267
FEMALE	-1.381	1.325	-1.04	0.297
PARTNER	-0.730	1.399	-0.52	0.602
CHILDREN	0.855	1.508	0.57	0.571
SALARY	0.051	0.025	2.05	0.041
FTE	-0.000	0.000	-0.46	0.645
POP_W	-0.021	0.004	-5.69	0.000
GROWTH_REL_W	16.069	10.179	1.58	0.114
SALARY_W	0.316	0.061	5.21	0.000
HIGH_EDUC_W	22.279	11.667	1.91	0.056
SPEC_W	0.525	0.092	5.72	0.000
TOP_50_W	-1.668	1.630	-1.02	0.306
CAR_W	-0.870	0.525	-1.66	0.097
POP_R	-0.020	0.004	-4.85	0.000
GROWTH_REL_R	-15.879	10.436	-1.52	0.128
SALARY_R	-0.098	0.059	-1.67	0.096
HIGH_EDUC_R	-18.500	11.420	-1.62	0.105
SPEC_R	-3.755	0.503	-7.47	0.000
TOP_50_R	-1.738	1.703	-1.02	0.307
CAR_R	1.250	0.509	2.46	0.014
D_SW	0.641	0.016	39.61	0.000
D_SR	-0.347	0.017	-19.89	0.000
Dummies for 'field of study'	*Yes*			

Pseudo R^2: 0.0451
Number of observations: 5,665

TABLE 6: Tobit regression, distance between place of study and place of residence (D_SR)

	Coefficient	*SE*	*t*	*P>|t|*
AGE	0.082	0.220	0.37	0.710
FEMALE	3.828	1.278	3.00	0.003
PARTNER	3.351	1.360	2.46	0.014
CHILDREN	5.232	1.439	3.64	0.000
SALARY	0.026	0.024	1.06	0.287
FTE	0.001	0.000	1.76	0.079
POP_S	-0.009	0.006	-1.62	0.106
GROWTH_REL_S	12.643	15.736	0.80	0.422
SALARY_S	-0.241	0.094	-2.55	0.011
HIGH_EDUC_S	48.878	14.751	3.31	0.001
SPEC_S	0.617	0.334	1.85	0.065
TOP_50_S	-2.598	1.620	-1.60	0.109
CAR_S	0.436	0.624	0.70	0.485
POP_R	-0.016	0.004	-4.07	0.000
GROWTH_REL_R	21.194	9.925	2.14	0.033
SALARY_R	0.302	0.055	5.44	0.000
HIGH_EDUC_R	-166.000	10.748	-15.44	0.000
SPEC_R	-0.101	0.239	-0.42	0.672
TOP_50_R	2.327	1.610	1.45	0.148
CAR_R	-1.419	0.474	-2.99	0.003
D_SW	0.842	0.014	62.07	0.000
D_WR	-0.333	0.017	-20.09	0.000
Dummies for 'field of study'	*Yes*			

Pseudo R^2: 0.0875
Number of observations: 5,665