Choosing the Future: Economic Preferences for Higher Education Using Discrete Choice Experiment Method

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Received: 9 November 2017 / Published online: 28 August 2019
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Abstract

This study illustrates how respondents' stated choices (the discrete choice experiment method) combined with the random utility framework can be used to model preferences for higher education. The flexibility offered by stated preference data circumvents limitations of other approaches, and allows quantifying young people's preferences for selected attributes of higher education programs that are typically highly correlated in revealed preference data. The empirical study presented here is based on a survey of 20,000 Polish respondents aged 18–30, who stated their preferences for higher education programs in carefully prepared hypothetical choice situations. The attributes considered include tuition fee, expected salary after graduation, quality of institution, interest in the field of study, distance from home, and mode of study. Using random parameters and latent class mixed multinomial logit models, young peoples' preferences are formally described, and the financial trade-offs they are willing to make are identified (willingness to pay for specific attribute levels in terms of increased tuition fees or expected salary after graduation). Accounting for respondents' observed and unobserved preference heterogeneity addresses a few research questions related to, for example, distinct preferences of students with parents who never attained tertiary education, students from lower socio-economic groups, or students of a particular gender. Overall, the usefulness of stated preference methods as a tool for exploring economic preferences is demonstrated, allowing for better understanding the determinants of choices, forecasting, and designing the services offered by higher education institutions in an optimal way.

Keywords Higher education institution choice · Random utility model · Stated preferences · Discrete choice experiment

JEL Codes I23 · D12 · H52

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Introduction

Educational decisions have significant economic consequences, both for individual career paths and for the economy as a whole (Sianesi and Reenen 2003; Moretti 2004). They determine the size and the structure of human capital resources, and thus, the size of potential output and welfare, both in economic and social dimensions (Blundell et al. 1999; Fukuyama 2001; Psacharopoulos and Patrinos 2004). The quality of the accumulated human capital determines the rate of technological progress, and the ability to absorb new technologies (Nelson and Phelps 1966; Romer 1990; Benhabib and Spiegel 2005). An economy with high quality human capital resources is more shock-resistant, flexible, and adaptive. This is particularly important in the era of globalization with dynamically changing economic conditions. The consequences of human capital accumulation go well beyond economic dimension. There is evidence of the link between the level of educational attainment and health status (Winkleby et al. 1992; Lleras-Muney 2005), quality of political life (Dee 2004; Milligan et al. 2004), and public safety or incidence of crime (Chiras and Crea 2004; Lochner 2004; Machin et al. 2011). For all these reasons, effective shaping of higher education programs is a key component of public welfare.

The past few decades have witnessed a boom in university education worldwide. A growing share of secondary school graduates continue their education at the tertiary level hoping for higher future wages and better career prospects.¹ In economic terms, the decision to continue education, particularly at the tertiary level, may be seen as an investment decision. A rational consumer decides to incur outlays (direct and indirect (alternative), including financial and time inputs) in anticipation of future benefits, which include income generated from paid work and non-material benefits (e.g., the prestige that comes with the education, the occupation, and the sense of self-accomplishment). On the other hand, the growing market for university education resulted in an increasing heterogeneity of the service offered by higher education institutions (HEIs). Students may choose between different fields of study, more or less prestigious HEI, different modes of study, and more. The alternatives also differ with respect to tuition fees and expected salaries upon completion of a degree. Higher education candidates' decisions allow an insight into their preferences for education, and hence, identifying trade-offs they are or are not willing to make with respect to attributes of the education programs they choose. Modeling their preferences for these attributes is, therefore, crucial for better understanding of determinants of choices, forecasting, and designing the services offered by HEIs in an optimal way.

In what follows, we present the results of a large-scale stated preference study devoted to investigating young peoples' preferences for tertiary education in Poland. Using a sample of 20,000 respondents aged 18–30, we collected information about their preferred HEI choices, allowing us to quantify the influence of such attributes as tuition fees, expected salaries upon completion, quality of HEI, interest in the field of study, distance from home, and mode of study. These attributes were selected because they were most often spontaneously brought up by respondents to our preliminary (qualitative) pretesting when asked about factors influencing their choice of HEIs. They were also commonly used in existing empirical studies, offering an opportunity for comparisons and qualitative evaluation of their relative importance.

¹ For example, in the EU-15 countries the average share of persons aged 25–64 with tertiary attainment in education grew from 17.7% in 1995 to 30.8% in 2014 [Eurostat 2015]. In many countries, college degree has become the most common level of education in this age group.

Our study demonstrates the potential of the discrete choice experiment method to model consumer preferences and investigate the isolated effects of the attributes identified in the literature as significant determinants of choices. By applying random utility framework (McFadden 1974), we are able to identify the financial trade-offs young people are willing to make, that is, estimate their willingness to pay (WTP) for specific attribute levels. In addition, accounting for respondents' observed and unobserved preference heterogeneity, we are able to address a few research questions present in the literature, related to distinct preferences of male versus female students, preferences of students whose neither parent attained tertiary education, and students from lower socio-economic groups (e.g., Dunnett et al. 2012), among others. Our empirical results may be useful for higher education institutions for tailoring their offer to young peoples' preferences, and for political decision-makers in the process of changing how the higher education system is organized, regulated, and funded.

Modeling Educational Preferences

Economic Models of Choice

Economic models of university choice process are based on the assumption that the choice is a rational process, and that students do what is best for them.² This provides the basis for utilizing the random utility framework (McFadden 1974, 2001), and utilizing discrete choice data for quantitative modeling of their utility functions. Prospective students are often found to short list and evaluate the attributes (such as tuition fee, distance or institutional quality) they consider important when choosing a university (Hossler and Gallagher 1987). Representing the available alternatives (i.e., colleges) as bundles of attributes allows us to investigate how choices change as one or more of a good's attributes are varied in either a continuous or discrete manner (Lancaster 1966). For example, we are able to estimate the extent to which the attributes such as expected earnings after graduation, distance from home or compliance of the program with personal interests influence respondents' probability to enroll. In addition, if one of the choice attributes is monetary (e.g., tuition fee or expected earnings), random utility framework allows for expressing preferences as trade-offs³ with respect to these attributes (estimating prospective students' WTP).

The data used for modeling consumers' preferences may come from two main sources—revealed or stated preferences. The former refers to the situation in which individuals' actual choices are observed, whereas the latter utilizes information on choices made in experimentally controlled hypothetical settings (Carson and Czajkowski 2014). In each case, the choice alternatives are synthetically described using their characteristics (attributes). Observing the attribute levels of the available alternatives and individuals' choices allows for inference with respect to the importance of the attribute levels, that is, to formally model consumers' utility functions (Lancaster 1966).

Nearly all available empirical studies utilizing a random utility framework are based on revealed preferences. The problem with this approach is that many of the attribute-level

² C.f. status attainment models, which are based on social theory and focus on processes such as socialization, the role of the family, social networks and academic conditions (Hossler et al. 1999).

³ Marginal rates of substitution.

combinations are never observed in the market, and the ones that are observed are often highly correlated or even collinear (e.g., tuition fees in prestigious HEIs are usually higher). Conversely, the ability to exogenously vary attributes of alternatives from which the respondent chooses in stated preference studies serves the joint purpose of allowing for clean identification (e.g., allaying endogeneity and collinearity concerns associated with market-observed attribute level combinations; Angrist and Pischke 2010; Freeman et al. 2014; Phaneuf and Requate 2016); and increasing the efficiency of preference parameter estimation (Scarpa and Rose 2008).⁴ In addition, individuals may not have perfect knowledge, that is, their choices are driven by subjectively expected, rather than objectively observed, attribute levels (Goeree 2008), possibly because acquiring and processing product information is costly (Hauser and Wernerfelt 1990). They may also include exogenous constraints on choices resulting in not including all possible alternatives in their consideration set—for example, exclude universities in a different region or state (Roberts and Lattin 1991; Gilbride and Allenby 2004). As a result, the estimates resulting from revealed preference data may be biased.

Stated preference data is usually free of these limitations, and hence, it is increasingly used for policy-relevant analysis in many fields of applied microeconomics, such as economics of public goods (environmental, health, transport) or marketing (see e.g., Hanley and Czajkowski 2019). Surprisingly, with the notable exception of Sutherland (2012), to the best of our knowledge, there have been no random utility-based stated preference studies of tertiary education choices. Our study aims at demonstrating the potential of this approach for such applications. Considering the flexibility of random utility-based stated preference methods, we believe that they can greatly contribute to filling many of the research gaps in this field.⁵

Literature Review: Modeling Consumers' Preferences for Education

Manski and Wise (1983) were among the first to demonstrate the power of the random utility framework for understanding higher education choices. The framework assumes that students enroll in the university/college that yields the highest utility. The choice data are analyzed with the use of discrete choice models, which are rooted in the economic choice theory (McFadden 2001). Since then, many other applications followed, which investigated how institutional characteristics, such as cost, size, distance, the quality of academic programs, and the availability of financial aid, influence college decision-making.

The literature devoted to factors influencing college choice is extensive and its full review is outside the scope of this paper. Instead, in what follows we list the main attributes of HEIs that were investigated by the studies that applied random utility framework. An extensive review of the most commonly studied institutional factors that students weighed

⁴ Note that stated preference choices do not usually include implausible combinations of attribute levels. Instead, choice situations are prepared in a way that reveals the most information from an individual choice. This is not the case with revealed preference data.

⁵ Admittedly, stated preferences or intentions have sometimes been observed to differ from peoples' actual choices, but the growing evidence on the importance of constructing the stated choice settings the right way gives hope for alleviating these concerns (see the incentive compatibility and consequentiality literature, for example, Carson and Groves (2011), Vossler et al. (2012) and Zawojcka and Czajkowski (2017)).

when selecting tertiary education is provided by Bergerson (2009) and Hemsley-Brown (2015).⁶

Among the most commonly studied (and the most important for respondents) factors in prospective students' choices are economic incentives, such as the cost of attendance (e.g., Fuller et al. 1982; Leslie and Brinkman 1987; Kane 1996; Heller 1997; Avery and Hoxby 2004; Long 2004b; Bergerson 2009; Flaster 2018); entry requirements (e.g., Brown et al. 2009); facilities, such as computer and library equipment; and quality of university accommodation and price of university-owned accommodation (e.g., Fleming and Storr 1999; Price et al. 2003; Maringe et al. 2009). Finally, graduate employment, and salary are also important economic incentives taken into account by prospective students (e.g., Soutar and Turner 2002; Maringe 2006).

Other attributes studied in the literature include distance from home (e.g., Hooley and Lynch 1981; Moogan et al. 1999; Price et al. 2003; Drewes and Michael 2006)⁷ and the location of the university within a country (e.g., Wright and Kriewall 1980; Welki and Navratil 1987; Moogan et al. 2001; Foskett et al. 2006).

Quality of teaching, in terms of the amount of contact time and qualifications of teaching staff (James et al. 1999; Foskett and Hemsley-Brown 2001), and academic reputation, such as the university brand (Stephenson et al. 2016) or position in league tables or national rankings (Brooks 2002; Pasternak 2005; Clarke 2007; Hazelkorn 2015), have been found to have a significant impact too. Other proxies for institutional quality that were used in empirical studies include selectivity, rejection rate, retention rate, tuition fees, faculty salary and student-to-faculty ratio (Eide et al. 1998; Black and Smith 2004, 2006; Long 2010).⁸

Another line of research focused on how students aspiring to post-secondary education develop a choice set, decide where to apply, and, conditional on admission, make their enrolment decisions (Zemsky and Oedel 1983; Hearn 1984; Hossler et al. 1989; Paulsen 1990; McDonough 1997; Hossler et al. 1999; Shamsuddin 2016; Skinner 2018). An important insight from these studies is that better students and those from high socio-economic status families apply to many schools, more selective schools, and more costly schools. In addition, evidence shows that students may self-select out of potentially better college matches due to lack of information about actual costs or limited geographic opportunity (Koricich et al. 2018; Skinner 2018).

Although most empirical researchers concerned with investigating educational choices using revealed preference data employ the random utility framework, studies differ in how university choice sets are specified. While some analysts presume that students consider every possible postsecondary institution (e.g., Long 2004a, c), others define subsets of institutions that granted respondents' admission (Avery and Hoxby 2004; Niu et al. 2006). Niu and Tienda (2008) showed that how choice sets are specified has significant impact on obtained preference estimates. The ambiguity related to the alternatives that

⁶ In addition, several studies examine preferences for course enrollment. For example, Meginnis and Campbell (2017) focus on postgraduate economics modules while Skinner (2019) investigates the importance of broadband access for online course enrollment. Wiswall and Zafar (2014) study the belief-led determinants of college major choice and observe that beliefs with respect to expected earnings and perceived ability are significant determinants of major choice, with substantial contribution of heterogeneous tastes.

⁷ Among others, Doyle and Skinner (2016, 2017), Baker and Doyle (2017), Ovink et al. (2018) and White and Lee (2019) used college proximity to predict the likelihood of enrollment.

⁸ Another stream of research aims at identifying students' characteristics that influence college choice (e.g., their personality, Weisser 2019).

constitute choice sets of individuals' observed decisions may be an important shortcoming of revealed preference studies, potentially resulting in biased estimates (Roberts and Lattin 1991; Gilbride and Allenby 2004).

Finally, it is worth noting that there are several empirical studies that investigated educational choices using conjoint analysis (e.g., Dunnett et al. 2012; Shtudiner et al. 2017; Huntington-Klein 2018). Conjoint analysis originated in mathematical psychology (Krantz and Tversky 1971), and has been mostly used in applied marketing (Green and Rao 1971; Wittink and Cattin 1989). It refers to several ways of eliciting preferences, wherein respondents rate “packages” of attributes or provide subjective attribute importance measures, and are, therefore, not consistent with the neoclassical economic theory (Louviere and Woodworth 1983; Friedman and Amoo 1999). However, classical conjoint measurement models are not associated with any error theory, and hence, they cannot be statistically interpreted or tested. Overall, while conjoint analysis are useful, for example, for marketing studies, they are not discrete choice experiments and cannot be used for obtaining valid measures of economic value (Louviere et al. 2010).

Choice Experiment of Higher Education Institutions in Poland

Case Study: Higher Education Market in Poland

The Polish higher education market evolved substantially during the 30 years that passed since the beginning of the transition from centrally planned to market economy in 1989. On the supply side, the number of HEIs grew considerably.⁹ A major part of the newly established HEIs were private entities, usually relatively small and offering education in the fields, wherein the demand was high and the costs of delivery were relatively low, like social sciences, business and law, humanities, pedagogy, etc. (Białek-Jaworska 2017; Grotkowska 2018; GUS 2018).

Another important feature of the Polish higher education market is the growth of atypical form of studies, including part-time studies (realized on weekends or in the form of evening classes) or distance learning.¹⁰ Such forms were attractive for both universities and students, since they lowered the costs of education for both sides (Sztanderska 2015; Sztanderska and Grotkowska 2017). However, the issue of the quality of education quickly became one of the major concerns of the higher education system in Poland (Thieme 2009; EY & IBnGR 2010). Despite some effort undertaken by both the state and by some HEIs themselves, the quality remains diverse, with low quality of education offered, in general, by private institutions, particularly offering studies on part-time basis (Liwiński 2017).

It should be noted that, in parallel to the development of private HEIs, public universities in Poland had begun to offer paid studies. Students who did not qualify for the free

⁹ In the academic year 1990/91, there were 112 HEIs in Poland (GUS 2005). Until 2010 their number increased by more than 4 times, up to 460 (GUS 2017). In the later years, some consolidation of HEIs was observed and their number fell to 397 in 2017 (GUS 2018).

¹⁰ At the beginning of social and economic transition, in the academic year 1990/91, only 22.8% of students were part-time students (usually with classes on weekends) (GUS, 2005). In the record academic year 2005/2006 (when total number of students reached almost 2 million), the share of part-time students increased up to 51.4% (GUS 2006). In the next years the share of part-time students fell down to 34.0% in the academic year 2017/2018 (GUS 2018).

programs could still enroll in them (or their part-time equivalents), if they were prepared to pay tuition fees.

In the 1990s, at the beginning of the transition process, Poland experienced a growing interest for tertiary education. It was partly related to the increased share of the population in college age (children of the baby boom generation of the 1950s), relatively high wage premium resulting from obtaining a university diploma, and partly as a way to avoid problems with entering the labor market (Bedi 1998; Newell and Reilly 1999; Hanushek and Zang 2006; Strawiński 2006; Newell and Socha 2007; Morawski et al. 2009; Gajderowicz et al. 2012). The net enrolment rate for individuals aged 19–24 grew from 9.8% in 1990 to 40.8% in 2010, and fell slightly in the following years (GUS 2018).

With such a dynamic growth of demand, and an increase of supply of higher education from newly formed schools and colleges, the number of students in Poland went rapidly up—from 403,000 in 1990 to 1,953,000 in 2005 (GUS, 2018). Since then, due to demographic changes and a fall of enrolment rate, the number of students fell by more than 600,000 (Grotkowska 2018; GUS 2018). Moreover, the share of privately-financed students (paying study fee) has been on the decline—from 58.6% (1.14 million) in 2006 (Kwiek 2016) to 40.8% (0.53 million) in 2017 (GUS 2018).

The structure of students by fields of study changed considerably. In the 1990s (the first decade of transition), social sciences, business and law, humanities, and pedagogy were particularly popular and, being relatively cheap to offer, these programs often did not limit admissions. In the later years, the popularity of engineering, construction, IT, medicine, among others, grew (Grotkowska 2018). Since 2008, there have been government-sponsored programs aimed at encouraging candidates to choose particular disciplines of study. These programs have involved 16 fields that were considered of strategic importance for the country, such as materials science, civil engineering, automatic control, robotics, environmental protection, mechanical engineering, or industrial design. The goal of the program was to increase the demand for studying these selected fields and “restore balance” between technical and social focus of higher education. Despite the lack of tuition fees and relatively high stipends offered to students, the programs have not been very popular, possibly because of a technical focus and the lack of an obvious link with employment after graduation. In addition, low entry requirements lead to relatively high dropout rates among students (Wincenciak et al. 2017).¹¹ In 2017/18 still almost 1/3 of students undertaken studies in business, law and social studies (GUS 2018).

Currently, the system of higher education in Poland is strongly affected by the relatively rapid decline in the number of students, resulting mainly from demographic developments. One of the consequences of this is the changing ownership structure of the higher education sector. In the 1990s, higher education was regarded as a relatively profitable business. As a result, Poland moved from a 100% public system of higher education to a dual, public–private system. In 2005, private institutions constituted 71% of all HEIs in Poland, with 32% of all students (GUS 2006). Starting from 2006, the role of the private HEIs has been decreasing. With falling demand, private HEIs could not withstand the competition

¹¹ In addition to the fee-free and government-sponsored programs, the state supports students from low-income families with a system of social stipends. It also offers scholarships for students with the best academic results. They are available to all students, whether their study is free or paid, in public or private HEIs. These stipends are typically much lower and offered to not more than a few students.

from their public counterparts, partly offering fee-free programs,¹² and usually associated with higher prestige and quality. Consequently, the Polish system of higher education is currently moving towards a nationalized system again, with a decreasing role of the private sector, and a dominant role of public funding. Between 2009 and 2017, the number of private HEIs decreased from 330 to 267, with the number of students falling from 633,000 (33% of all students) to 330,000 (25% of all students) (GUS 2016b, 2018).

Finally, it is worth noting that the quality of HEIs and career prospects of the graduates of different programs are not commonly known. It was only in 2016 when the first results of the public tracer studies were published. As a result, students' educational decisions are made with incomplete information (Hoxby and Turner 2013; Skinner 2018), which also influences their higher education preferences.

Design and Implementation of the Survey

Our survey was aimed at investigating young people's preferences regarding the choice of higher education. The main component of the survey consisted of a choice experiment wherein respondents were asked to choose from hypothetical alternatives, representing different hypothetical studies. The attributes that were used to describe the alternatives were selected based on the literature review, experts' opinions, and qualitative research, wherein young people (future, current, and past students) were asked about the main characteristics that drove their HEI choices. From the extensive list of attributes, we included six attributes: tuition fee (cost of the studies per semester),¹³ expected average net salary 5 years after graduation from a given program, compliance with personal interests (the extent to which a given program of studies subjectively matches student's personal interests),¹⁴ distance from home (when graduating from secondary school), prestige of the HEI in a particular field, representing the position of the HEI in the national rankings for a given field of studies, and the mode of studies, which represented full-time or part-time studies. These attributes were also used in past works devoted to studying determinants of educational choices (see "[Economic Models of Choice](#)" section for details). The attributes and attribute levels are summarized in Table 1.

The attributes and their levels were carefully explained to respondents in the survey. They were asked to assume that the alternatives were the same with respect to any characteristics not explicitly listed in the choice situations.¹⁵

Each respondent was presented with 12 choice situations, each consisting of three alternatives. For each choice situation, a respondent was asked to select the preferred

¹² The fee-free programs are warranted by the law and available to best ranked enrolling students. Currently, approximately 59.2% of students are enrolled in the fee-free programs (GUS 2018). General description of the Polish system of tertiary education may be found in FRSE (2018).

¹³ One of the goals of our study was to examine the extent to which a system of stipends can be used to influence students' educational choices. The Polish Ministry of Science and Higher Education has currently proposed such a system. The negative tuition fee levels represent the case of being offered a stipend for studying in one of the sponsored departments.

¹⁴ To familiarize respondents with these levels, before the stated choice part, respondents were presented with a list of main fields of studies, and were asked to assess how adequately their interests match a given field (using the same levels).

¹⁵ To ensure the discrete choice experiment was understandable and credible to respondents, the development of the questionnaire was conducted according to the state-of-the-art recommendations for stated preference studies, including thorough qualitative pre-testing (e.g., Champ et al. 2017; Johnston et al. 2017).

alternative. The combinations of the attribute levels presented in each of the choice tasks (i.e., the experimental design) were selected following state-of-the-art recommendations (Ferrini and Scarpa 2007; Scarpa and Rose 2008).¹⁶ An example of a choice card is given in Table 2.

The main survey was administered in the form of computer-assisted personal interviews (CAPI) to a random sample¹⁷ of 20,000 young people in Poland. The interviews were conducted by a professional public opinion polling agency in August–December 2014. All respondents were asked about their education history (especially, with respect to post-middle school education), current economic activity, and family situation at the age of 17.

The questionnaire was module-based—the interview script for a specific respondent matched that person’s level of schooling:

- Graduates of post-middle schools who have not gone to university, and do not intend to do so within the next 12 months ($n = 10,936$);
- Students or graduates of post-middle schools before enrolment, who declared that they intend to go to university within the next 12 months ($n = 1167$);
- First degree students, second degree or third degree students ($n = 3501$)¹⁸; and
- University graduates who are no longer studying ($n = 4396$).

The choice experiment setting was tailored to each group’s education path—the choices were framed as if participants were to enroll in tertiary education or could choose their course and university again (instead of what they actually chose). Even though the choices were hypothetical, they reveal our respondents’ preferences. In what follows, we analyze the preferences of each of the four groups of respondents separately, as they differ in their previous educational path and experience.

Results

Data on respondents’ choices provide an information about their preferences for choice attributes. These preferences are represented by the estimated utility function coefficients:

¹⁶ Additional information about the experimental design is available from the authors upon request.

¹⁷ The respondents were drawn from a PESEL database (Universal Electronic System for Registration of the Population). Nineteen thousand respondents were drawn from people born between 1 January 1984 and 31 December 1995 (aged 20–30), excluding students of basic vocational schools, middle and primary schools, and graduates of these schools who did not continue their education (which rules them out from going to university). In addition, 1000 respondents were drawn from people born between 1 January 1995 and 31 December 1996 (aged 18–19, with the same exclusions). The purpose of dividing the sample into two parts was to ensure adequate representation of people who are yet to decide whether to go to a university or who were making that decision at the time of the study. The final sample only includes respondents who successfully completed the survey (the response rate was 47%).

¹⁸ The group of first, second or third degree students are people who currently are enrolled in programs that end with this degree. We have decided to use this classification (and separate current students from university graduates who are no longer studying), as we believe (and confirmed in qualitative pretesting of our study), people who are currently enrolled in university programs have much better knowledge and more precise preferences for the programs than other groups. In addition, our survey included treatments, which depending on whether someone was currently a student of whatever degree program or was a graduate (who is no longer a student) asked about their hypothetical choices regarding current or past studies, respectively.

Table 1 The attributes and attribute levels used in the stated choice

Attributes	Attribute levels ^a
Tuition fee per semester	– 750 EUR (stipend) – 250 EUR (stipend) 0 EUR 750 EUR 1250 EUR 1750 EUR
Mean net monthly salary 4 years after graduation ^b	500 EUR 750 EUR 1000 EUR 1500 EUR 2000 EUR
Compliance with personal interests	Low Medium High
Distance from home	0–30 km 31–100 km 101–250 km 251 km or more
Prestige of the HEI	1–3 position in the national ranking 4–10 position in the national ranking 11–30 position in the national ranking
Mode of study	Full-time: students spend the full amount of hours per week on their program of study Part-time: courses offered at week-ends to accommodate students who want to work full-time

^aAll monetary attributes in the survey were presented in PLN. To facilitate interpretation, we present their equivalents in EUR. At the time of the study, 1 PLN $\approx$ 0.25 EUR $\approx$ 0.33 USD

^bIn 2014, average monthly salary in the national economy in Poland was 3783 PLN (approximately 900 EUR)

Table 2 Example of a choice card (translated)

Situation 1	Alternative A	Alternative B	Alternative C
Tuition fee per semester	–1000 PLN (stipend)	5000 PLN	7000 PLN
Mean salary five years after graduation	2000 PLN	6000 PLN	3000 PLN
Compliance with personal interests	Low	Medium	High
Distance from home	31–100 km	251 km or more	0–30 km
Prestige of the HEI (ranking place)	1–3	11–30	4–10
Mode of study:	Part-time (week-ends)	Full-time (week-days)	Part-time (weekends)
Your choice:	☐	☐	☐

$$\begin{aligned}
 U_j = & \beta_1 \text{Salary}_j + \beta_2 \text{Stipend}_j^{250} + \beta_3 \text{Stipend}_j^{750} + \beta_4 \text{Compliance}_j^{\text{medium}} \\
 & + \beta_5 \text{Compliance}_j^{\text{high}} + \dots + \beta_6 \text{Prestige}_j^{\text{medium}} + \beta_7 \text{Prestige}_j^{\text{high}} \\
 & + \beta_8 \text{Distance}_j + \beta_9 \text{Mode}_j^{\text{fulltime}} + \beta_{10} \text{Tuition}_j + \varepsilon_j
 \end{aligned} \quad (1)$$

where U_j represents utility associated with choosing a program j , variable names correspond to attributes used to characterize the programs (see Table 1 for details), β s are the parameters to be estimated and ε_j represents an error term, accounting for all other unobserved factors.

Utility function is by definition used to describe ordinal dependence (preference relation) and hence the estimated coefficients do not have an absolute interpretation. However, their signs represent whether a given attribute is seen as good (positive coefficient) or bad (negative coefficient). Increase of a desired attribute in an alternative would increase the utility associated with this alternative and hence the probability that it would be selected by respondents. In addition, the relative values of coefficients indicate whether one attribute is more important than other.¹⁹

In our model (the random-parameters mixed logit model, RP-MXL—see “Appendix 1” for technical description) the parameters are assumed to be random variables following a priori defined probability distributions. All distributions are normal, except for salary after graduation, for which lognormal distribution provided a better fit (and is consistent with theoretically expected strictly positive preferences for higher salary). The results present the estimated means and standard deviations of parameter distributions, which represent heterogeneity of individual preferences in the population. The model allows for correlations between random parameters—the estimated correlations are presented in the online supplement.

Note that the increase in one attribute could be offset by a decrease in another attribute, leaving the utility level unchanged. This trade-off is measured by the ratio of coefficients. The ratio of the coefficient of some attribute to the coefficient of the monetary attribute represents the trade-off respondents would be willing to make with respect to money. Following the procedure described by Eq. (4), we rescale the utility function with respect to tuition fee (i.e., divide each coefficient by β_{10}) so that the resulting ratios of coefficients represent marginal rates of substitution.²⁰ For example, β_1 / β_{10} represents the trade-off respondents are willing to make in terms of exchanging higher tuition fee for higher expected salary after graduation. In effect, the estimated coefficients can readily be interpreted as (means and standard deviations of) the marginal WTP for respective attribute levels.^{21,22}

¹⁹ Note that in the RP-MXL model the parameters are assumed random and therefore in the results we present the estimated means and standard deviations of their distributions, which represent heterogeneity of individual preferences in the population. All distributions are normal, except for salary after graduation, for which lognormal distribution provided a better fit (and is consistent with theoretically expected strictly positive preferences for higher salary). The model allows for correlations between random parameters—the estimated correlations are presented in the online supplement.

²⁰ In other words, we use money-metric utility function (aka WTP-space estimation) (Scarpa et al. 2008) wherein the marginal utility of tuition fee (in 1000 EUR per semester) is set to 1 (and hence not reported), providing a reference for other coefficients.

²¹ The models presented here were estimated using a DCE package developed in Matlab and available at <https://github.com/czaj/DCE>. The code and data for estimating the specific models presented in this study, as well as supplementary results, are available from <http://czaj.org/research/supplementary-materials>.

²² In simulation of the log-likelihood function, we used 10,000 Sobol draws with a random linear scramble.

Table 3 Respondents' marginal willingness to pay (WTP) for attribute levels—the results of the random parameters conditional mixed logit model in WTP-space (relative to tuition fee in 1000 EUR per semester)

Utility function of those who: Attributes	Never went to university			Currently consider university			Students			Graduates		
	Parameters											
	Means	SD		Means	SD		Means	SD		Means	SD	
Mean salary 5 years after graduation (1000 EUR)	0.8971*** (0.0257)	1.2799*** (0.1007)		0.8700*** (0.0574)	1.0738*** (0.1442)		0.9797*** (0.0426)	1.3137*** (0.1327)		0.8886*** (0.0298)	1.0344*** (0.0763)	
Stipend (250 EUR)	−0.1556*** (0.0142)	0.3309*** (0.0105)		−0.1458*** (0.0430)	0.4048*** (0.0367)		−0.2416*** (0.0271)	0.3727*** (0.0246)		−0.2490*** (0.0223)	0.3535*** (0.0201)	
Stipend (750 EUR)	0.0321* (0.0186)	0.5571*** (0.0139)		0.0827 (0.0547)	0.6894*** (0.0425)		0.0442 (0.0351)	0.6134*** (0.0310)		0.0487* (0.0275)	0.5677*** (0.0253)	
Compliance with personal interests (medium vs. low)	0.4000*** (0.0120)	0.4295*** (0.0112)		0.5776*** (0.0321)	0.5264*** (0.0374)		0.7398*** (0.0276)	0.7239*** (0.0284)		0.6355*** (0.0210)	0.6569*** (0.0221)	
Compliance with personal interests (high vs. low)	0.5154*** (0.0150)	0.6980*** (0.0139)		0.7582*** (0.0426)	0.8907*** (0.0453)		0.9208*** (0.0360)	1.2265*** (0.0355)		0.8026*** (0.0256)	1.0323*** (0.0263)	
Prestige of the HEI (program ranked 4–0 vs. 11–30)	0.0366*** (0.0082)	0.0679*** (0.0109)		0.1819*** (0.0309)	0.2223*** (0.0316)		0.0939*** (0.0201)	0.0792*** (0.0234)		0.0615*** (0.0141)	0.0544*** (0.0202)	
Prestige of the HEI (program ranked 1–3 vs. 11–30)	0.0444*** (0.0084)	0.0426*** (0.0093)		0.1435*** (0.0311)	0.2337*** (0.0298)		0.0969*** (0.0212)	0.1961*** (0.0345)		0.0808*** (0.0150)	0.1061*** (0.0184)	

Table 3 (continued)

Utility function of those who: Attributes	Never went to university		Currently consider university		Students		Graduates	
	Parameters		Parameters		Parameters		Parameters	
	Means	SD	Means	SD	Means	SD	Means	SD
Distance from home (100 km)	–0.2087*** (0.0069)	0.2753*** (0.0056)	–0.1984*** (0.0188)	0.2589*** (0.0180)	–0.2150*** (0.0126)	0.3239*** (0.0119)	–0.2169*** (0.0101)	0.2799*** (0.0102)
Mode of study (full time vs. part time)	–0.3527*** (0.0128)	0.5167*** (0.0117)	–0.2359*** (0.0475)	0.8916*** (0.0431)	–0.0826*** (0.0290)	0.9468*** (0.0271)	–0.2554*** (0.0221)	0.8009*** (0.0203)
Model diagnostics								
LL at convergence	–113,094.39		–12,268.60		–37,215.64		–46,444.05	
LL at constant(s) only	–144,150.54		–15,384.29		–46,143.71		–57,941.94	
McFadden's pseudo-R ²	0.2154		0.2025		0.1935		0.1984	
Ben-Akiva-Lerman's pseudo-R ²	0.4380		0.4289		0.4242		0.4266	
AIC/n	1.7246		1.7614		1.7748		1.7633	
BIC/n	1.7294		1.7965		1.7881		1.7742	
n (observations)	131,232		14,004		42,012		52,752	
r (respondents)	10,936		1167		3501		4396	
k (parameters)	65		65		65		65	

*, **, *** indicate significance at 10%, 5%, and 1% level, respectively. Standard errors given in parentheses

The results of the RP-MXL model are presented in Table 3. First, we note that all groups of respondents are quite similar with respect to their preferences for expected salary after graduation. Their choices show that, on average, they are willing to trade approximately 1000 EUR in a tuition fee per semester for 889 EUR (graduates) to 978 EUR (students) in expected salary per month. All groups of respondents are also quite similar with respect to their preferences for programs offering stipends.²³ While programs offering low stipends are perceived as less preferred on average (negative coefficients representing mean WTP for programs that offer a stipend of 250 EUR), the estimated coefficients for programs with higher level of stipends become positive, although in most cases not statistically different from zero. This result may seem unexpected, since being offered a stipend is expected to be beneficial compared to no tuition fee or even having to pay. However, as revealed by the qualitative analysis that preceded the survey, respondents associated programs that offered stipends with a requirement to meet certain criteria (e.g., choosing a particular program or excellent academic results). Consequently, our results show that the current stipend program is not viewed as particularly attractive, on average. A stipend of 750 EUR is barely able to compensate students for the disutility associated with other perceived characteristics of the programs offering stipends. However, we note the presence of substantial preference heterogeneity in the population with respect to this attribute, as indicated by relatively high estimates of standard deviations around the means.

Next, we observe preferences for programs that are more in line with one's personal interests. This effect is the weakest for young people who never went to university (they would be willing to pay, on average, 400 EUR or 515 EUR per semester more for studies that can be characterized with medium- or high-compliance levels, respectively) and the highest for current students (740 EUR and 921 EUR, respectively). Note that similar calculations can be made for trade-offs between compliance with personal interests and expected salary. The online supplement to our paper presents estimation results of a model wherein WTP for attribute levels is expressed in terms of expected mean salaries after graduation. We find that respondents who are willing to enroll in programs moderately or below in line with their interests require an increase of expected monthly salary of 659 EUR to 1428 EUR.

Although respondents display significant preferences for better HEIs, their mean WTP for higher-ranked programs is relatively low. This time, there are also larger differences between distinct groups of respondents, with those who never went to university willing to pay at least 44 EUR or 37 EUR per semester more for programs ranked as the top three or top 10 in the country, respectively. This is followed by graduates (80 EUR or 62 EUR), current students (around 97 EUR or 94 EUR), and those currently considering going to a university (144 EUR or 182 EUR). There are a few potential interpretations of this finding. It is possible that consumers do not have extensive knowledge about the differences in quality between HEIs in Poland. They are perceived as quite similar with respect to offered quality (students care about a degree, not necessarily the quality of the institution that issues it) or simply that the job market does not recognize the differences resulting

²³ Preliminary analysis indicated that marginal utility of increased tuition fees was significantly different (with respect to its absolute value) than marginal utility of stipends offered in funded programs. For this reason, we model the two parameters separately—while mean marginal utility of tuition fee is normalized to 1, and represents a reference in our WTP-space model, the marginal utility of stipends (effectively, negative tuition fees) is allowed to differ. Such an asymmetry of marginal preferences with respect to 0 can be related to i.a. prospect theory (Kahneman and Tversky 1979) and it is often observed in empirical studies (e.g., Bartczak et al. 2017).

from the quality of programs and HEIs. Another possible explanation of this finding is that the rankings are a proxy for quality that does not hold salience as a measure of quality for the students. It could be that students do not find the rankings to be a valid measure of the actual quality of a program or to be a measure that would be recognized by the labor market. Alternatively, because the best HEIs in Poland are public, and approximately 60% of enrolments are free (no tuition fee), it is possible that respondents would rather choose a different program that is free, than be required to pay for one that may be on top. Finally, since the estimates presented here correspond to the mean, it is possible that on average, respondents do not necessarily want to enroll in top universities, expecting higher requirements, expected effort, and cost in terms of time devoted to studying, and thus, associating them with higher probability of non-completion. In what follows, we shed more light on this issue by exploring what socio-demographic groups of respondents care about the quality of the course the most.

The last two attributes represent respondents' preferences for HEIs that are relatively closely located to their hometowns and average preferences for full-time (i.e., regular weekday programs) versus part-time programs. The former may be related to the Polish real estate market, with its relatively low availability of apartments for rent. As a result, educational choices may be significantly affected by the costly requirement of long-distance transfer. Regarding the latter, we find that respondents on average prefer part-time programs that can be combined with working part- or full-time during one's studies (particularly high for respondents who never went to university and already started their careers). This finding is in line with average respondents' relatively low preferences for highly ranked HEIs, possibly expecting a requirement of higher inputs of students' time. Once again, however, high standard deviations around this effect indicate the existence of substantial preference heterogeneity, with many respondents likely preferring full-time weekday programs.

In addition to the general overview of respondents' preferences, provided by the results of the RP-MXL model (Table 3) we also estimated the latent class model, which allows to identify discrete latent classes of preferences (rather than assuming that the distribution of preferences in the population is continuous) and makes the probability of respondents' belonging to each class a function of their socio-demographic characteristics.²⁴ The results and the discussion of the results of the latent class model are presented in "Appendix 2".

The analysis of respondents' socio-demographics as determinants of their preferences addresses a few research questions that generate attention in the literature (e.g., Dunnett et al. 2012). The detailed results, presented in "Appendix 2", show that utility patterns differ significantly for students from "non-traditional" backgrounds (i.e., families where neither parent attended university) compared to students from families where at least one parent attended university (cf. Maringe 2006; Clarke 2007; Bergerson 2009). Controlling for all other observed differences, such as income or one's own experience with higher education to date, we find that the former are more likely to be more sensitive to tuition cost and prestige of HEI. Students are also more concerned with compliance of the program with their personal interests, while being more unlikely to enroll in full-time model of study, and less sensitive to salary upon graduation. Similarly, we find that students from higher socio-economic groups (cf. Leppel et al. 2001; Bergerson 2009; Dunnett et al. 2012) are more likely to care about compliance with their personal interests, and are not necessarily

²⁴ For a recent application of latent class analysis in higher education research see Denson and Ing (2014).

more sensitive to tuition fees and mean salary upon graduation. Finally, we do not observe systematic differences between male and female respondents.

Overall, our analysis illustrates the insights allowed by applying the discrete choice experiment method to study consumer's preferences for higher education. Basing the econometric approach in the random utility framework allows for providing the general outlook of respondents' preferences as well as calculating their WTP for the attributes of interest, while using modern microeconomic methods allows accounting for unobserved, as well as observed preference heterogeneity.

Discussion and Conclusions

Summary

Modeling preferences for higher education allows for better understanding of determinants of choices, forecasting demand, and designing the services offered by HEIs in an optimal way, all of which are important for social welfare. Although revealed preference data can also be used for this purpose, the availability of such data, along with its inherent limitations associated with reflecting only the attribute level combinations actually observed in markets and consumers' limited knowledge on the true attribute levels of the education alternatives, limit its applicability. In this paper, we show how respondents' stated choices (the discrete choice experiment method) combined with the random utility framework (McFadden 2001) can help this cause.

We use a sample of 20,000 Polish respondents aged 18–30 to infer about their preferences for higher education. We estimate the relative importance of selected attributes of higher education programs (tuition fees, expected salaries upon completion, quality of HEI, interest in the field of study, distance from home, and mode of study), and calculate respondents' WTP for them in terms of tuition fees and future earnings.

Overall, we find that young people's preferences are highly heterogeneous. Part of this heterogeneity can be associated to whether they currently consider higher education, are students, are graduates, or have never gone to college or university. Much heterogeneity remains unobserved, however, despite utilizing respondents' socio-demographic characteristics as explanatory variables.

Effects of Information and Labor Market Experience

Despite cross-sectional character of our data, our results allow us to draw some conclusions regarding the issue of information barriers as experienced by participants of the higher education market in Poland. One may expect that as respondents become older and more experienced, their preferences change. We find that this is not necessarily the case. With respect to characteristics directly related to the labor market success, preferences for salary after graduation are relatively similar across those who currently consider enrolling in tertiary education programs, students, and graduates. Current students predominantly appreciated compliance of the study program with one's personal interests. This is likely because they are the ones who actually experience the consequences of the lack of such compliance the most—secondary school graduates rely on their expectations, while graduates have an opportunity to readjust career paths to their interests.

Prestige is mostly important for tertiary school candidates, less important for students, and even less for graduates. This may suggest that the labor market, at least in the perception of young employees, does not differentiate employees based on the prestige of HEIs. However, it is also possible that respondents did not consider rankings of HEIs a valid measure of quality or labor market appreciation.

Most respondents, independently of their position in the educational and professional career, prefer to study on part-time basis. This may mean that they want to have the opportunity to combine their studies with work and/or that they know that part-time studies involve less time and effort. In general, one important conclusion that emerges is that respondents, on average, prefer the characteristics of the study programs related to low-effort intensity (even if this may mean lower quality).

Quality of Higher Education Institutions and Signaling Theory

Provided that rankings of HEIs were perceived as valid measure of the actual quality of offered programs, our results may indicate that—at least in the perception of our respondents, including those already active in the labor market—higher education may be more related to signaling than accumulation of human capital.²⁵ This is because on average students were not keen on enrolling in higher quality programs, preferring easier studies at less prestigious HEIs. In other words, content of the study program may seem generally less important than obtaining a diploma. This is a somewhat surprising result. It could be expected that the increase in the share of graduates of HEIs among younger cohorts has caused the diploma itself to lose its signaling character. At the same time, it should increase the strength of such signals as prestige of HEI, study mode, and field of study, among others. In the light of the results of our study, this does not seem to be the case, at least not for the averaged results for the whole population.

On the other hand, the data on the employment of individuals with tertiary education indicates that the demand for their work mainly comes from public services.²⁶ This part of the economy is dominated by the public sector with relatively rigid rules on promotions and remuneration, which may encourage the “diploma-is-important” attitude. This leads us to hypothesize that the characteristics of a diploma are relevant, but only for a smaller share of higher education graduates—potentially those who are focused on work in the private sector, particularly in highly skilled occupations, big companies, and the largest cities. This issue clearly requires further research.

²⁵ In theory, higher education may be seen as leading to higher competences and the accumulation of human capital (human capital theory). Alternatively, it may be considered to be merely a way to signal for the employer of the desirable, yet unobservable, characteristics of a job candidate (signaling theory) (Kjelland 2008).

²⁶ According to the Labor Force Survey data (GUS 2016a), public services (administration, defense, healthcare, and education) provided 42.3% of the demand for employees with tertiary education in Poland. For persons aged 35 or less, this share was smaller; however, it was still 30.1%. Other parts of economy generating demand for the highest qualifications were information, communication finance, professional, and scientific activity – 15.9% for all workers and 18.6% for workers aged 35 or less, respectively. Significant demand was also generated by trade (11.6% and 13.0%, respectively) and manufacturing (10.6% and 13.0%, respectively).

Limitations of the Study

Our study has limitations that need to be acknowledged. First, stated preference methods have been criticized for behavior thought to be potentially at odds with standard neoclassical economic theory describing consumer choice (Carson and Hanemann 2005). Many of these effects were later shown to be quite robust across a range of non-market and market situations (e.g., WTP versus willingness to accept disparity). The key criticism of stated preference methods that remains is related to the so-called hypothetical market bias. Simply put, this means people may over- or under-state their WTP values in a systematic fashion because no actual payment is made. The economics response was improving survey design methods and developing ex-ante/ex-post methods to reduce hypothetical bias, thus improving survey design methods. It is clear that poor survey design and administration could easily induce numerous anomalous behaviors, including a hypothetical bias. On the other hand, studies that invested considerable time and effort into understanding what people believed, and in preparing a credible choice scenario with a well-defined good, generally appear to produce results that are well-behaved (Johnston et al. 2017). In our case, our survey has undergone a rigorous process of qualitative and quantitative pretesting to ensure respondents' choices reflected their true preferences. Even though the WTP estimates are necessarily associated with considerable uncertainty, we believe the observed rankings of attribute levels and the preference structures reflect respondents' true preferences, and hence, provide useful empirical and policy information.

By relying on stated preference data, we avoided the problems associated with revealed preference data, such as respondents' imperfect knowledge, exogenous constraints on choices, and unobserved consideration sets, which may all contribute to biased estimates. However, a potential limitation of this approach is reliance on respondents' perceptions of the presented attributes. For example, if rankings of HEIs are not considered valid measures of the quality of the offered programs, our conclusions based on observed preferences for higher ranked universities may be misleading. Similarly, it is possible that respondents associated other characteristics with presented attributes—for example, stipends or higher prestige of HEIs can be associated by respondents with additional requirements, and hence be observed to less preferred, overall.

Finally, another limitation of the results presented here is associated with our modeling choices. Stated preference data estimation involves trade-offs between the use of parsimonious and more-complex models. In this paper, we demonstrated the possibilities offered by random parameters and latent class mixed logit models, particularly with respect to estimating WTP, and accounting for unobservable and observable preference heterogeneity. We note, however, that other model specifications are possible—they should always be tailored to specific research questions and informed by fit to data.

Conclusions

In terms of policy relevance, our results provide Poland's first comprehensive description of what determines people's higher education choices. What makes it interesting is that the findings can be interpreted in light of the Polish institutional framework for two different higher education systems, with the coexistence of public and private universities. Knowledge of preferences towards higher education is crucial for higher education stakeholders in order to improve the effectiveness of the education system. On the other hand, our study

provides valuable inputs to political decision-makers, who have the power to change the ways in which the Polish higher education system is organized, regulated, and funded. For example, our study offers insights with respect to the public perception of government-sponsored programs, and surprisingly low appreciation for the prestige of the HEI programs. The educational reform is currently one of the most vivid areas of public debate in Poland. If supported by quantitatively described insights about public preferences for higher education, such as those contributed by this study, the currently designed reform can be more evidence-based and avoid populism.

In conclusion, our study demonstrates how stated preference studies, and the discrete choice experiment method in particular, can be used to explore economic preferences for higher education. Combining the flexibility offered by stated preference approach with random utility-based data analysis allows avoiding limitations of other approaches, particularly, relying on revealed preference data. Our empirical results help in better understanding of determinants of choices, can be used for forecasting students' decisions in new situations, and for designing the services offered by HEIs in an optimal way. We also demonstrated how stated preference studies could be used to address more general research questions, such as distinct preferences of students with neither parent experienced in tertiary education, from lower socio-economic groups, or of a specific gender. Overall, our study demonstrates that the discrete choice experiment method can be a valuable tool for exploring economic preferences, and thus, for more effective shaping of higher education programs and increasing public welfare.

Acknowledgements This study was part of the project “Social and economic determinants of tertiary education choices of people aged 19–30” conducted at the University of Warsaw, and funded by the European Social Fund within the Priority III framework of the “Operational Programme Human Capital”—“Quality of the education system” and “Creating tools and the environment for monitoring, evaluation and research in the education system.” Mikołaj Czajkowski gratefully acknowledges the support of the Polish Ministry of Science and Higher Education and the National Science Centre of Poland (Sonata, 2015/19/D/HS4/01972).

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Appendix 1: Econometric Framework

Modeling consumers' preferences using discrete choice data draws on theories of economic value (Lancaster 1966) and the random utility theory (McFadden 1974, 2001). It assumes that the utility an individual receives from an alternative chosen depends on observed characteristics (attributes) and unobserved idiosyncrasies, which are represented by a stochastic component. The utility of individual, i , resulting from choosing alternative, j , in situation, t , can be expressed as:

$$U_{ijt} = \mathbf{X}_{ijt}\boldsymbol{\beta} + e_{ijt} \quad (2)$$

The utility expression is separable in the observed choice attributes, $\mathbf{X}_{ijt}$, with the corresponding vector of parameters, $\boldsymbol{\beta}$, and the stochastic component, e_{ijt} , accounting for factors other than those observed by an econometrician. Assuming that the stochastic component

(e_{ijt}) follows an independent and identical extreme value (type I) distribution,²⁷ it leads to familiar logit probability specification, used in simple conditional logistic regressions:

$$P(j|J) = \frac{\exp(\mathbf{X}_{ijt}\boldsymbol{\beta})}{\sum_{k=1}^J \exp(\mathbf{X}_{ikt}\boldsymbol{\beta})} \quad (3)$$

which can be used for deriving the maximum likelihood estimator of the utility function parameters, conditional on individuals' observed choices and attribute levels associated with choice alternatives.

Given that we are interested in marginal rates of substitution with respect to the monetary attribute p , it is convenient to introduce the following modification of (2), which is equivalent to using a money-metric utility function (also called estimating the parameters in WTP space) (Train and Weeks 2005):

$$U_{ijt} = \alpha(p_{ijt} + \mathbf{Y}_{ijt}\mathbf{b}/\alpha) + e_{ijt} = \alpha(p_{ijt} + \mathbf{Y}_{ijt}\boldsymbol{\beta}) + e_{ijt} \quad (4)$$

In this specification (rescaling of the utility function), the vector of parameters, $\boldsymbol{\beta} = \mathbf{b}/\alpha$, can be directly interpreted as a vector of implicit prices (marginal WTPs) for the non-monetary attributes, $\mathbf{Y}_{ijt}$, facilitating an interpretation of the results.

Finally, note that in the above formulations, consumers' preferences are assumed homogenous across the entire sample (the parameters, $\boldsymbol{\beta}$, are the same for all respondents). This results in a multinomial logit model (MNL). One way of relaxing this assumption—that is, allowing for some level of (unobserved) preference heterogeneity and, possibly, correlations between the alternatives and choice tasks—is to include consumer-specific parameters, $\boldsymbol{\beta}_i$, which leads to a mixed logit model.

Two commonly used approaches are to make mixing distributions continuous or discrete. If individual parameters are assumed continuously distributed following a parametric distribution specified a priori by a modeler, $\boldsymbol{\beta}_i \sim f(\mathbf{b}, \boldsymbol{\Sigma})$, with means, $\mathbf{b}$, and variance–covariance matrix, $\boldsymbol{\Sigma}$, the random parameters mixed logit model is formed (RP-MXL, McFadden and Train 2000; Hensher and Greene 2003). If, on the other hand, individual parameters are assumed to follow a discrete distribution (belong to one of C sets of parameters), the so-called latent class mixed logit model is formed (LC-MXL, Greene and Hensher 2003). This specification assumes there is a finite set of classes of respondents of particular preferences, so that $\boldsymbol{\beta}_c$ is the vector of parameters describing the preference of class, c , from among C possible classes. Inside the classes, the probability of choosing a given alternative is described in the same way as for the MNL model. The respondent's belonging to a given class is not observable, and it is probabilistically described using a logit formula:

$$P(\text{class} = c) = \frac{\exp(\mathbf{z}_i\boldsymbol{\theta}_c)}{1 + \sum_{n=1}^{C-1} \exp(\mathbf{z}_i\boldsymbol{\theta}_n)}, \quad (5)$$

²⁷ Note that normalizing variance does not change the ordering provided by the utility function—it still represents the same preferences.

Table 4 Respondents' preferences classified into latent classes—the results of the latent class conditional logit model

	Latent class 1	Latent class 2	Latent class 3	Latent class 4
Utility function				
Mean salary 5 years after graduation (1000 EUR)	2.2541*** (0.0409)	1.0617*** (0.0157)	0.5593*** (0.0259)	0.3020*** (0.0084)
Tuition fee per semester (1000 EUR)	−0.7515*** (0.0347)	−2.5945*** (0.0321)	−0.9503*** (0.0328)	−0.5105*** (0.0098)
Stipend (250 EUR)	−0.1008** (0.0478)	−0.0863*** (0.0190)	−0.3203*** (0.0407)	−0.0839*** (0.0131)
Stipend (750 EUR)	0.2773*** (0.0461)	0.0691*** (0.0230)	−0.0715 (0.0445)	−0.0004 (0.0141)
Compliance with personal interests (medium vs. low)	0.5041*** (0.0338)	0.4597*** (0.0183)	0.6313*** (0.0359)	0.4638*** (0.0113)
Compliance with personal interests (high vs. low)	0.1260*** (0.0460)	0.4154*** (0.0204)	0.9378*** (0.0445)	0.7460*** (0.0119)
Prestige of the HEI (program ranked 4–10 vs. 11–30)	−0.0311 (0.0311)	0.1162*** (0.0176)	0.1303*** (0.0328)	0.0411*** (0.0096)
Prestige of the HEI (program ranked 1–3 vs. 11–30)	−0.0530* (0.0305)	0.1552*** (0.0188)	0.0329 (0.0313)	0.0800*** (0.0099)
Distance from home (100 km)	−0.0869*** (0.0162)	−0.1592*** (0.0086)	−0.3351*** (0.0172)	−0.2242*** (0.0051)
Mode of study (full time vs. part time)	−0.2649*** (0.0279)	−0.3234*** (0.0162)	−2.5780*** (0.0689)	0.0900*** (0.0104)
Class probability				
Constant	−1.5074*** (0.1537)	−0.8736*** (0.1059)	−3.2311*** (0.1731)	0.0000 (fixed)
Never went to university (vs. graduates)	0.1385* (0.0774)	0.1921*** (0.0538)	0.1393* (0.0845)	0.0000 (fixed)
Currently consider university (vs. graduates)	−0.3146** (0.1541)	0.1159 (0.0950)	0.5694*** (0.1411)	0.0000 (fixed)
Students (vs. graduates)	−0.0305 (0.0950)	−0.1769*** (0.0684)	0.0651 (0.1077)	0.0000 (fixed)
Works (dummy)	−0.1150 (0.0982)	0.0261 (0.0695)	0.4729*** (0.1095)	0.0000 (fixed)
Hours per week worked	0.0070*** (0.0022)	0.0004 (0.0016)	0.0088*** (0.0024)	0.0000 (fixed)
Age (years)	0.1684** (0.0830)	0.2336*** (0.0582)	0.2704*** (0.0926)	0.0000 (fixed)
City 10–100 k (vs. < 10 k)	0.0325 (0.0859)	0.2044*** (0.0594)	0.2785*** (0.0940)	0.0000 (fixed)
City > 500 k (vs. < 10 k)	0.1681 (0.1119)	0.0911 (0.0817)	−0.3222** (0.1542)	0.0000 (fixed)
City > 2 M (vs. < 10 k)	0.0632 (0.1406)	0.4284*** (0.0937)	−0.6057*** (0.2285)	0.0000 (fixed)
Parents with primary education (vs. middle)	0.0185 (0.0679)	0.2805*** (0.0444)	0.3733*** (0.0698)	0.0000 (fixed)
Parents with higher education (vs. middle)	0.4867*** (0.0824)	−0.0585 (0.0669)	−0.1173 (0.1142)	0.0000 (fixed)
Financial situation of parents' household (1–5)	−0.1008** (0.0431)	−0.0832*** (0.0298)	−0.0323 (0.0482)	0.0000 (fixed)

Table 4 (continued)

	Latent class 1	Latent class 2	Latent class 3	Latent class 4
Household size	−0.0445 (0.0286)	0.0169 (0.0193)	0.1655*** (0.0289)	0.0000 (fixed)
Female	−0.1985*** (0.0677)	−0.0180 (0.0464)	0.1218 (0.0752)	0.0000 (fixed)
Personal interests—engineering (vs. economics)	0.0270 (0.0314)	−0.0870*** (0.0226)	−0.0689* (0.0366)	0.0000 (fixed)
Personal interests—history (vs. economics)	−0.1148*** (0.0394)	−0.0572*** (0.0260)	−0.0325 (0.0414)	0.0000 (fixed)
Personal interests—law (vs. economics)	−0.0403 (0.0343)	−0.0668*** (0.0232)	0.0268 (0.0359)	0.0000 (fixed)
Personal interests—philology (vs. economics)	0.0511 (0.0384)	−0.0161 (0.0263)	−0.0706* (0.0424)	0.0000 (fixed)
Personal interests—sociology (vs. economics)	0.0016 (0.0381)	−0.0342 (0.0259)	−0.0294 (0.0408)	0.0000 (fixed)
Personal interests—psychology (vs. economics)	−0.0648* (0.0360)	−0.0676*** (0.0238)	0.0829*** (0.0369)	0.0000 (fixed)
Personal interests—mathematics (vs. economics)	0.0621** (0.0308)	−0.0290 (0.0220)	0.0341 (0.0350)	0.0000 (fixed)
Personal interests—physics (vs. economics)	−0.0358 (0.0404)	−0.1335*** (0.0299)	−0.2386*** (0.0510)	0.0000 (fixed)
Personal interests—environment (vs. economics)	−0.0235 (0.0364)	−0.0330 (0.0251)	−0.0697* (0.0406)	0.0000 (fixed)
Personal interests—agriculture (vs. economics)	0.0210 (0.0347)	−0.0131 (0.0239)	−0.0277 (0.0381)	0.0000 (fixed)
Personal interests—medicine (vs. economics)	−0.0705* (0.0403)	−0.0713*** (0.0272)	−0.0947** (0.0448)	0.0000 (fixed)
Personal interests—physical (vs. economics)	−0.0170 (0.0328)	0.0180 (0.0223)	0.0389 (0.0350)	0.0000 (fixed)
Personal interests—art (vs. economics)	−0.1352*** (0.0402)	−0.0738*** (0.0262)	−0.0752* (0.0429)	0.0000 (fixed)
Average class probabilities				
	0.1140*** (0.0040)	0.3120*** (0.0052)	0.0976*** (0.0036)	0.4763*** (0.0058)
Model diagnostics				
LL at convergence	−201,532.51			
LL at constant(s) only	−249,109.35			
McFadden's pseudo-R ²	0.1910			
Ben-Akiva-Lerman's pseudo-R ²	0.4249			
AIC/n	1.7784			
BIC/n	1.7840			

Table 4 (continued)

	Latent class 1	Latent class 2	Latent class 3	Latent class 4
<i>n</i> (observations)	226,788			
<i>r</i> (respondents)	18,899			
<i>k</i> (parameters)	124			

*, **, *** indicate significance at 10%, 5%, and 1% level, respectively. Standard errors given in parentheses

where $\mathbf{z}_i$ is the vector of $C - 1$ constants and individual-specific characteristics, which may have an impact on the probability of his or her belonging to a given class, and θ is the corresponding vector of parameters.

Appendix 2: Socio-demographic Explanatory Variables of Respondents' Latent Preference Classes—The Latent Class Conditional Logit (LC) Model

The latent class model allows to identify discrete latent classes of preferences, rather than assuming that the distribution of preferences in the population is continuous. The model also makes the probability of respondents' belonging to these classes a function of their socio-demographic variables. The number of latent classes is always a trade-off of explanatory power, the number of additional parameters, and the possibility of interpretation. In what follows, we present the model with four latent classes, which we found the most insightful, yet manageable. The results are presented in Table 4.²⁸

The latent classes differ with respect to preference parameters of each class. The first class is characterized by the strongest preferences for mean salary upon graduation and programs offering a stipend. Interestingly, students are not concerned with the prestige of the institution offering the program and its compliance with their personal interests. An average respondent has a probability of belonging to this class estimated at 0.11. Latent class 2 members (probability 0.31) are the most sensitive to tuition cost and prestige of HEI. Parameters of class 3 (probability 0.10) indicate that respondents with high probability of belonging to this class are the most concerned with compliance of the program with their personal interests. These respondents appreciate prestige of the institution, although do not necessarily aim for the very best universities. They are also the most unlikely to enroll in the full-time model of study, and are most sensitive to distance from home. The last class (probability 0.48) comprises of individuals who prefer full-time mode of study, care about compliance with their personal interests, and are the least sensitive to mean salary upon graduation.

The class probability models allow to identify socio-demographic characteristics that predict which class the individual respondents are more or less likely to belong to, in comparison with the reference class 4. We find that those who never went to university have preferences most similar to class 2; those who currently consider enrolling in higher education are less likely to belong to class 1, and more likely to belong to class 3; and current students are less likely to belong to class 2. Respondents who currently work are more likely to have preferences similar to those described by class 3. Older respondents are less likely to belong to class 4, so they are less concerned with compliance with personal interests, care about their salary more, and are less likely to prefer full-time studies.

Respondents from small cities are more likely to belong to class 2, and less likely to belong to class 3—they are, therefore, more sensitive to tuition costs, care about the prestige of the HEIs more, and are less sensitive to the distance from home, possibly because they have the most substitutes available nearby. Interestingly, we find that respondents whose parents are less educated are more likely to belong to class 2 or 3, while those

²⁸ The model is not estimated in WTP-space, because this time we are interested in the distribution of preferences, including marginal sensitivity to tuition fees, which was otherwise confounded with WTP expressed as an equivalent of their increase.

whose parents have higher education are more likely to belong to class 1. It may be surprising at first to see that having parents with higher education is correlated with caring less about the prestige of the HEI. It should be noted, however, that the quality of higher education of the older population, obtained before transition, was not necessarily concerned with today's standards. In addition, we observe that respondents whose households were financially better off are more likely to belong to class 3 and 4, those from larger households prefer class 3, and female respondents are less likely to belong to class 1.

Finally, the model includes a set of variables representing self-declared personal interests of respondents. They show that, relative to economics, people interested in engineering are less likely to belong to class 2 or 3, those interested in history are less likely to belong to class 1 or 2, law students are less likely to belong to class 2, and being interested in psychology is correlated with preferences for class 3. Mathematics students are more likely to have similar preferences of class 1, physics and medicine students are less likely to be in class 2 or 3, while those interested in art are more likely to have preferences described by the parameters of class 4.

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