doi.org/10.26398/IJAS.0032-003

APPLYING CONJOINT ANALYSIS TO THE LABOUR MARKET: ANALYSING THE POSITION OF ICT ASSISTANT IN THE ITALIAN ELECTUS PROJECT

Paolo Mariani, Andrea Marletta[1]

Department of Economics, Management and Statistics, University of Milano-Bicocca, Milan, Italy

Mariangela Zenga

Department of Statistics and Quantitative Methods, University of Milano-Bicocca, Milan, Italy

Abstract. *This paper discusses the utilisation of conjoint analysis in the labour market by investigating the case of companies hiring new graduates. Specifically, the analysis is based on the Education-for-Labour Elicitation from Companies' Attitudes towards University Studies (ELECTUS) project, involving 471 enterprises with 15 or more employees operating in Lombardy. The paper investigates the decision process for selecting candidates with the best skill sets. The conjoint analysis is able to examine the companies' preferences using the part-worth utilities and an index of economic re-evaluation for the position of information and communications technology assistant.*

Keywords: *Conjoint Analysis, Economic re-evaluation, ELECTUS, Job Market, New Graduates*

1. INTRODUCTION

In the last two decades, policymakers have paid attention to human capital considering it one of the driving forces of economic development. In particular, the importance of investing in education and training is seen as a way of improving skills of employees. In fact, an interest in such skills remains a focal point of the European Union's (EU) 2020 strategy (EC, 2010). This strategy is aimed at increasing higher education attainment, raising employment levels, increasing investment in research and development and innovation, reducing greenhouse emissions, reducing school dropout rates, and reducing the risk of poverty (Hamburg et al. 2013). Moreover, the initiative of 'New Skills and Jobs' under the 2020

[1] Andrea Marletta email:andrea.marletta@unimib.it

strategy should lead to changes in views of the future skills considered necessary to match employee skills with those required in the labour market. Matching educational institutions and company needs should also focus on bridging the gap between demand and supply in the labour market. In general, the match between required and provided skills plays a crucial role in economic growth. For example, Allen and van der Velden (2001) find four different types of skill mismatch: wrong skills (the simultaneous presence of skill deficits and skill overutilisation), skill shortage (skill deficit and no skill overutilisation), skill match (no skill deficit and skill underutilisation) and skill surplus (no skill deficit or skill overutilisation).

Desjardins and Rubenson (2011) analyse the phenomenon of skill mismatch from several points of view; the authors suggest that a variety of complex mechanisms that generate mismatch exist. Some approaches consider mismatch a phenomenon driven by supply-side conditions: in this case, the mismatch is due to the inadequacies of the education and training system. In contrast, other approaches consider the mismatch as a phenomenon driven by demand-side conditions, where the mismatch tends to be attributed to the inadequacies of labour market practices, and employers have to identify and correct the mismatch. The authors underscore that skill mismatch and skill deficit can be perceived as the result of continual technical changes in the economy, as in the case, for example, of the introduction of new technologies.

This paper identifies the requirements of enterprises in terms of the labour market for new graduates. Moreover, a monetary valuation requires a monetary evaluation of the competencies required by the entrepreneurs as well. The study is based on the multi-centre ELECTUS research project, an acronym for Education-for-Labour Elicitation from Companies' Attitudes towards University Studies, a research project involving several Italian universities (Fabbris and Scioni, 2015). The project was aimed at measuring job offers through a company survey. Specifically, entrepreneurs were asked to choose the best profiles suitable for five different job vacancies (administration clerk, human resources assistant, marketing assistant, information and communications technology assistant, and Customer Relationship Management). Here, we analyse the profile for the information and communications technology (ICT) assistant.

The rest of the paper is structured as follows: Section 2 presents an overview of the Italian labour market and the ICT position. Section 3 describes the

conjoint analysis (CA) methodology in the presence of stratification factors. Section 4 shows the results from the ELECTUS research and Section 5 concludes the paper.

2. THE ICT ASSISTANT IN ITALY

Defining professional positions in Italy are sometimes tricky due to the evolutionary path of the labour market. The classification of professions is complicated by the emergence of new roles in current business organisations. Often, professional positions have characteristics of traditional positions, but have been hybridised through skill sets in light of the transformations in the labour market; namely, professional positions evolve in light of innovations. In this paper, the definitions of professional positions are from ISFOL[2] (ISFOL, 2017), which is in charge of creating a national system of permanent observations of professions and related needs. All existing professions in Italy are housed in about 800 professional units and each of these is described in light of over 300 variables. This situation is also reflected in the company classification model based on the declarations of the national collective labour agreements defined, shared, and stipulated by employee and employer representatives. Within these agreements, there are remuneration profiles too. The process of enterprises hiring a new graduate is regulated by these agreements (CNEL, 2016). The current professional classification system has been updated and reviewed in relation to changes in organisational factors which have occurred over the last several years. In particular, the redefinitions may be concerned with the updated declarations related to the evaluation of professionalism, hierarchical-functional responsibility, technical competence specifics; transversal competencies; and the factors of polyvalence, multi-functionality, continuous improvement and innovation linked to new integrated systems of operational management, safety, and work organisations.

The professional assistants classified under ICT help software designers and analysts by translating instructions and specifications for controls, procedures, and problem solutions in logic flow diagrams used for programming in computer languages; and by developing and writing programs to store, search, and process information and data. The activities carried out include mainly creating prototypes, conducting feasibility studies, drafting reports or technical documents, setting technical specifications for the implementation of ICT applications (e.g. creating programs and procedures, designing interfaces), developing software and other applications, and conducting routine or extraordinary maintenance on systems or programs. These activities require the knowledge of electronic circuits, processors, electronic equipment chips, and computer hardware and software, including

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[2] From the Italian 'Istituto per lo sviluppo della formazione professionale dei lavoratori', (Institute for the development of vocational training for workers).

knowledge of application packages and programming languages, knowledge of the structure and content of a foreign language or of the meaning and the pronunciation of the words, of the rules of composition and of the grammar, and in part, of math, algebra, geometry, calculus, statistics, and their applications. Compared with others, this profession is more technical and specialised, so the skills required are more specialised and, therefore, less generic. An ICT assistant is able to identify complex problems and gather useful information to evaluate possible options and find solutions, produce or adapt equipment and technologies to meet the needs of users, determine the causes of malfunctions and decide what to do to solve them, and conduct tests and inspections of products, services, or processes to evaluate their quality and performance. In terms of the skills required, attention to detail, cooperation, innovation, and analytical thinking are certainly needed. In such work, the three personality characteristics that are most commonly found are conventional, investigative, and realistic.

3. THE INDEX OF MONETARY EVALUATION

To identify the most common features among new graduates which influence the entrepreneurs' choices and to evaluate the monetary variation associated with these attributes required by the entrepreneurs, we follow the proposal of Mariani et al. (2018). Using CA (Lancaster, 1966; Green and Srinivasan, 1978), the authors derived the utility from the properties of each single characteristic of a job application. The authors proposed a new formulation to find the relative importance among the attributes; moreover, they computed the monetary variation associated with any change in the combination of the attributes of a job as introduced by Mariani and Mussini (2013).

Let J indicate the number of attributes, where each attribute has l_j (j = *1, 2…, J*) levels.

Let

$$u_k = \sum_{j=1}^{J} \sum_{h=1}^{l_j} \beta_{jh} x_{jh}$$

where u_k is the overall utility assigned by respondents to the k-th alternative of all K alternatives in the experiment. Moreover, β_{jh} is the part-worth utility associated with the h-th level of the j-th attribute, and x_{jh} denotes the presence (x_{jh}=1) or absence (x_{jh}=0) of the h-th level of the j-

th attribute. As a result, the overall utility u_k is obtained by summing the terms $\boldsymbol{\beta_{jh}x_{jh}}$ over all attribute levels. Here, this piece-wise linear function is a part-worth function model that gives a specific utility value for each level of the considered attributes, the part-worth utility $\boldsymbol{\beta_{jh}}$.

Let $\boldsymbol{\beta_{jt}} = \left[\boldsymbol{\beta_{jt1}}, \boldsymbol{\beta_{jt2}}, \ldots \boldsymbol{\beta_{jtl_j}}\right]$ indicate the vector of the part-worth utilities; referring to the various levels of the *j*-th attribute of the *t*-th respondent, the $\max(\boldsymbol{\beta_{jt}})$ and $\min(\boldsymbol{\beta_{jt}})$ are, respectively, the highest and lowest values of the vector. The range from the highest to lowest utility value for each attribute is an indicator of how important the attribute is compared with the others. The relative importance of the *j*-th attribute with l_j levels is defined as:

$$I_{jt}^{*} = \frac{\frac{\max(\boldsymbol{\beta_{jt}}) - \min(\boldsymbol{\beta_{jt}})}{l_j}}{\sum_{j=1}^{J} \frac{\max(\boldsymbol{\beta_{jt}}) - \min(\boldsymbol{\beta_{jt}})}{l_j}} \quad (1)$$

The sample distribution enables the derivation of quantiles of order *p*, $I_{(p),j}^{*}$. Moreover, it is possible determine a coefficient based on part-worth utilities. This coefficient allows computing the monetary variation associated with any change in the combination of the attributes of a job with respect to the actual revenue generated by that job.

Total utility variation is computed by replacing one attribute level of *status quo b*, where *b* is the current profile of the job, with attribute level *h* (with $h = 1, \ldots, l_j$).

Let

$$V_{(p),j} = M_j \cdot I_{(p),j}^{*} \cdot GAS \quad (2)$$

where $V_{(p),j}$ denotes the vector which represents the amount of salary variation for the *j*-th attribute for the l_j levels. In formula (2):

- $M_j = \left[M_{j1}, M_{j2}, \ldots, M_{jh}, \ldots M_{jl_j}\right]$ is the vector related to the *j*-th attribute and the *h*-th element is given by $M_{jh} = \frac{u_h^j - u_b}{u_b}$. The element u_b (assumed to be different from 0) denotes the sum of the utility scores of the *status quo b* of the job, while u_h^j denotes the sum of the part-worth utilities associated with the specific combination of

the *j*-th attribute. The element M_{jh} indicates whether the *status quo b* modification creates a loss or a gain. If $M_{jh} = 0$, there is no loss or gain in terms of total utility. However, the change in utility from an attribute-level modification can be considered more or less important by respondents. Accordingly, this change can have a more important economic impact than a utility modification, which has a similar intensity while involving a less relevant attribute. As a solution, we weigh the relative importance of the modified attribute (Mariani et al. 2018);

- GAS is the gross annual salary associated with the *status quo b* profile; here, we use an average monetary evaluation as a benchmark value.

4. APPLICATION AND RESULTS

4.1 THE QUESTIONNAIRE

The survey based on the ELECTUS project was conducted in 2015 using a CAWI (Computer Assisted Web Interviewing) technique. Data were collected using the software program Sawtooth (Sawtooth, 2017). Data manipulation and CA were obtained using *R* software and the *Conjoint* package (Bak and Bartlomowicz, 2012). The questionnaire contained two sections: the first covered the conjoint experiment for the five job positions and the second covered general information about the company (demographic questions).

The candidates' profiles were characterised by six attributes: *Field of Study* with 10 levels (philosophy and literature, educational sciences, political sciences/ sociology, economics, law, statistics, industrial engineering, mathematics/computer science, psychology, foreign languages); *Degree Mark* with 3 levels (low, medium, high); *Degree Level* with 2 levels (Bachelor, Master); *English Knowledge* with 2 levels (suitable for communication with foreigners, inadequate for communication with foreigners); *Relevant Work Experience* with 4 levels (no experience at all, internship during or after completion of university studies, discontinuous or occasional work during university studies, one year or more of regular work); *Willingness to Travel for Business* with 3 levels (unwilling to travel for business, willing to travel for business only for short periods, willing to travel for business for even long periods).

4.2 THE SAMPLE

The respondents were companies registered on the Portal of Almalaurea for recruitment and linkage, limited to the University of Milano-Bicocca. The population

at the companies consisted of 4,183 potential recruiters. The total of final respondents was 471. The majority (52%) of the companies had 15-49 employees, followed by the second largest group of companies (25.6%) with 50-249 employees, and 22.4% of the companies had at least 250 employees (22.4%). The most common business sectors were services to industry (62.1%), services to consumers (16.2%), and manufacturing (14.9%). The majority of the companies (89.4%) operated fully or partially in the Italian domestic market; moreover, most companies were directly managed by entrepreneurs (64.2%). The first two characteristics of the companies, company size and business sector, are layering factors for a stratified CA (see Table 1). The source for all the tables is our analysis of the ELECTUS survey (University of Milano-Bicocca unit) data.

4.3 RESULTS

The ICT assistant is the most specialised among the five positions taken into consideration in the survey. Table 1 reports the median of the relative importance of the attributes for the five work positions.

Tab. 1: Median of relative importance for the five work positions.

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Attributes	**Administrative clerk**	**Marketing assistant**	**Human Resource assistant**	**CRM**	**ICT**
Field of Study	14%(4)	11%(4)	20%(3)	8%(5)	37%(1)
Degree Level	4%(6)	1%(6)	3%(6)	7%(6)	8%(6)
Degree Mark	18%(2)	13%(3)	14%(4)	14%(3)	14%(3)
English Knowledge	41%(1)	48%(1)	29%(1)	35%(1)	18%(2)
Relevant Work Experience	16%(3)	18%(2)	12%(5)	11%(4)	9%(5)
Willingness to Travel	5%(5)	7%(5)	22%(2)	25%(2)	11%(4)

As defined in UNESCO (2014), the skills represented by the attributes can be divided into specialised and transversal skills. Specialised skills include the specific ‘know-how’ needed for employment. Workers often acquire such skills through their participation in post-basic education, including technical and vocational education and training, or extracurricular activities. These skills may relate to a specific job, task, academic discipline (e.g. teacher, geographer, doctor, or journalist), or area of particular knowledge and skills (e.g. hobby). In terms of this analysis, specialised skills are represented by the field of study, qualification level, and Degree Mark. Transversal skills are defined as skills not specifically related to a particular job, task, academic discipline, or area of knowledge, but which can be

used in a wide variety of situations and work settings. Moreover, these skills can be acquired at school and then transferred to areas in different paths of life. In this analysis, English knowledge, relevant work experience, and willingness to travel are considered transversal skills.

Table 1 shows that, except for the ICT position, transversal skills are more important than specialised skills; in particular, English knowledge is the most important requirement for new graduates according to the entrepreneurs. In contrast, for the ICT position, the influence of the study area is clearly the highest (37%); the knowledge of English is the second-most relevant competence, with a relative index of importance equal to 18%, while degree mark, willingness to travel, work experience, and degree level represent 14%, 11%, 9%, and 8%, respectively.

It is reasonable to expect greater differences among the study areas identified. In fact, as can be seen in Table 2, the area of study preferred by respondents is computer science, and its associated utility appears as the highest in absolute terms, even considering other open positions. Positive values are obtained for engineering, statistics, and economics in descending order. Further, there is a lack of a significant difference between first- and second-level graduates. However, a high degree mark is definitely required for the ICT assistant position. Knowledge of English and having regular work experience appear as fundamental requirements. Finally, the willingness to travel is valued by the respondents, especially for long periods.

In terms of monetary requirements, the GAS corresponding to the best profile[3] is €23,500. This value is the average of the wages provided by the sector for the ICT assistant position. The estimate of the interval for a graduate with the best profile, net of a first degree, is between € 11.75 and €37.60. With regard to the degree mark, after applying the new weighting technique for the importance indices, this difference varies between €32.90 and €176.25 for a candidate with the best profile, but with a low grade at the degree level. The difference in GAS between the best and identical profiles, with a lack of English knowledge, is between €49.35 and €148.05.

As for previous work experience, a graduate with all the best attributes but only limited work experience sees his/her GAS drop by between €16.45 and €124.55. Finally, with regard to the availability for business trips, the changes are not large and reach a maximum of €91.65 in the case of unavailable candidates. Notably, in the coefficients in Table 2, only some estimates related to the field of

[3] The best profile (or status quo) is represented by a new graduate in Computer Science, with a master degree, with a high degree mark, Suitable for communication with foreigners, with One year or more of regular work, and Willing to travel on business even for long periods.

study are significantly different from zero; this means that differences in monetary terms are reliable only when concerned with that attribute.

Tab. 2: Part-worth utilities for the ICT assistant and the coefficients of economic valuation (p=0.025; p=0.5; p=0.975)

Levels and attributes	Part-worth utilities	$V_{(0.025),ij}$ (€)	$V_{(0.5),ij}$ (€)	$V_{(0.975),ij}$ (€)
Field of Study				
Philosophy and Literature	-0.6792**	-2780.05	-4284.05	-8215.60
Educational Sciences	-0.0759	-2321.80	-3579.05	-6864.35
Political Sciences/Sociology	-0.7714***	-2848.20	-4392.15	-8422.40
Economics	0.2981	-2037.45	-3141.95	-6025.40
Law	-0.8958***	-2944.55	-4537.85	-8702.05
Statistics	0.3956	-1964.60	-3026.80	-5806.85
Industrial Engineering	0.8889***	-1588.60	-2451.05	-4700.00
Computer Science	2.9842***	0.00	0.00	0.00
Psychology	-1.0325***	-3047.95	-4697.65	-9009.90
Foreign Languages	-1.1121	-3106.70	-4791.65	-9188.50
Degree Level				
Bachelor	-0,0483	-11.75	-28.20	-37.60
Master	0,0483	0.00	0.00	0.00
Degree Mark				
Low	-0,1047	-32.90	-112.80	-176.25
Medium	-0,0431	-23.50	-84.60	-131.60
High	0,1478	0.00	0.00	0.00
English Knowledge				
Suitable	0,0969	0.00	0.00	0.00
Inadequate	-0,0969	-49.35	-110.45	-148.05
Relevant Work Experience				
No experience at all	0,0303	-4.70	-25.85	-44.65
Internship	-0,0182	-9.40	-37.60	-68.15
Discontinuous or occasional	-0,13	-16.45	-70.50	-124.55
Regular work experience	0,1179	0.00	0.00	0.00
Willingness to Travel				
Unwilling to travel	-0,0768	-23.50	-58.75	-91.65
Willing only for short periods	-0,0295	-16.45	-42.30	-68.15
Willing even for long periods	0,1063	0.00	0.00	0.00

5. CONCLUSIONS

The match between required and provided skills in the job market plays a crucial role in economic growth, and is thus considered a key target in the EU's 2020 strategy. This study aimed to reconcile the two sides of the policy, trying to identify the requirements by the enterprises in terms of the labour market for new graduates. In general, this study offers a starting point for students and families to address their choices in terms of fields of study and extracurricular skills. Knowing what the most required characteristics are for access to the job market can help students understand what job positions will be most suitable for them. Meanwhile, universities can be encouraged to compare their educational offerings with what entrepreneurs are looking for in new recruits.

Specifically, we analysed evidence from the ELECTUS project on 471 enterprises in the Lombardy region (Northern Italy). We evaluated the requirements of the ICT assistant position for new graduates using the CA, which is used extensively in market research. The ICT assistant position is a very technical and specialised position for a new hire so the required skills are not generic but rather specifically qualified (compared with other new hire professional positions). In fact, the results of the analysis show that being a computer science graduate is the main requirement for job recruitment in ICT. The monetary requirements show that a lack of qualification in computer science negatively affects wages from 70% (for an Economics graduate) to 137% (for a foreign language graduate), theoretically. The monetary evaluation amount shows a very unbalanced scenario with respect to the other professional positions.

As future research, it would be beneficial to compare our results with analogous research to improve the alignment among what universities offer, the labour market, and what companies are looking for.

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