Differences in salaries and employment security between tertiary education graduates and their determinants: Evidence from Poland

Michał Pietrzak, Warsaw University of Life Sciences, Poland, michal_pietrzak@sggw.pl

Piotr Pietrzak, Warsaw University of Life Sciences, Poland, piotr_pietrzak1@sggw.pl

Abstract

This article verifies empirically differences in salaries and employment security across 140 thousand graduates of 231 Higher Education Institutions (HEIs) in Poland. HEIs according to the clustering procedure, results were grouped into four clusters: "Underdogs", "Middlers", "Aspirants", and "Winners". Then, a contingency analysis was done, which proved dependence between belongingness to cluster and: localization (weak dependence), profile of HEIs' graduate curricula (medium), as well as ownership type (strong). Discussion of the results and conclusions are presented.

Keywords: Higher education, private monetary benefits of education, salary, and employment security.

Introduction

Since the year 1998, when the Sorbonne Declaration was signed and European Higher Education Area was establish, the modernization of the tertiary education system has been one of the most essential aims of the European Union (Targaszewska, 2014). High quality education plays an important role in the economic growth. The literature provides strong evidence of the benefits of education to individuals and societies (Potelienė & Tamašauskienė, 2014). The educational attainment is a key determinant of earnings and has a significant effect on labor market outcomes. Higher education is also associated with longer life expectancy, improved health, and reduced participation in crime.

Private benefits of higher education (which we note in this paper as lucrativeness and employment security) are expected to be primal incentives for individuals' decisions on whether to attend university. They could be also useful for understanding overall trends in participation in tertiary education. So, one could ask: Is it a good investment decision to start tertiary education? As it is shown by de la Fuente (2003), in Europe, investment in education is more attractive than financial investment, because the former is supported by the government. Thus, the aim of this research was to explore the determinants of the differences of private economic benefits (gainfulness or lucrativeness and employment security) among Higher Education Institutions (HEIs) in Poland. We conjecture the following hypotheses:

H1: Localization of HEIs influences on lucrativeness and employment security

H2: Ownership type of HEIs influences on lucrativeness and employment security

H3: Profile of HEIs influences on lucrativeness and employment security

H4: Graduated curricula influences on lucrativeness and employment security

Theoretical Background

Higher education meets limited aspects of pure public goods, namely non-rivalry and non-exclusion of the good (Moşteanu & Creţan, 2011). For example, certain individuals cannot access higher education because of the practice of quite high tuition fees, or because they are partially excluded from the consumption of this good as a consequence of the reduction of the time allotted by the teacher to the second or third student (Creţan & Lacrois, 2008). Therefore, higher education is not a pure public good. Perspective offered by Musgrave (1959), places higher education in the field of so called merit goods. This is due to the fact that the benefits of education have a positive impact on society, thus, justifying the need for government intervention in the financing of this activity (Pietrzak, 2016). Higher education generates not only personal but also social benefits, called positive externalities (Daviet, 2016). For example, education reduces the need for training and retraining when new technologies are incorporated. The higher productivity of more educated people, especially those having the abilities and skills that transmit higher education, is spilled out to other workers having an important effect on the whole productivity of the enterprise (Dziechciarz, 2015).

Classification of benefits of higher education covers the following types (Dziechciarz, 2015): (1) the private monetary benefits, (2) the social monetary benefits, (3) the private non-monetary benefits, and (4) the social non-monetary benefits. Related classification is also proposed in other works (Hermannsonn et al., 2017; McMahon, 2006; Psacharopoulos, 2007). Broadly speaking, private monetary (or economic) benefits are the individual earnings after taxes and employment security (Bugaj & Rybkowski, 2015), while social monetary gains are the incomes that a country generates from the extra taxes from its citizens, who earn more as a result of their higher education. In turn, the non-monetary benefits to higher education McMahon and Wagner (1979) describe as "those accruing later to the student following the investment made during the college years and consumption benefits enjoyed while attending college" (p. 5). To the individual, these may include a longer life, or greater use of leisure time. For society, these benefits include lower health care costs, lower crime rates, and bigger welfare. So higher education is a prominent factor in the new global knowledge-driven economy (Russ, 2017). In the rest of this paper, we will focus only on private monetary (economic) return.

Several economic surveys find a positive relationship between an educational degree and the received salary; – higher levels of education usually translate into better employment opportunities and higher earnings (García-Suaza, Guataquí, Guerra, & Maldonado, 2009). Labor market research indicates that for the United States each additional year of education increases average wage/salary by 7.5% (Acemoglu & Angrist 1999). Caponi and Plesca (2007) showed that people with a university degree earn 30-40% more than secondary school graduates. In similar article Blundell, Dearden, and Sianesi (2001) showed that having a university diploma in the United Kingdom raises the average salary by 25%.

Similar results have been obtained in studies concerning other European countries that have a "continental" system of higher education. Strawiński (2007) examined the Polish labor market data and showed that the average yearly rate of return to university education is about 9.5%. Similar results were achieved in the earlier work of Strawiński (2006). To provide strong evidences to the result with valid robustness, several models were estimated. In all models, the estimated return rates ranged from 5 to 10% depending on the wage equation used. These values are comparable to the other European countries, placing Poland among the countries with the highest return to education rates. This result is in compliance with expectations noted by Psacharopulos and Patrinos (2002), along with the support of Strawiński (2007) that a "country with a comparatively low [Gross Domestic Product] GDP level in comparison with the other European countries and a faster rate of economic growth is characterised by a high demand for skilled workers" (p. vii-xii). However, the studies presented previously do not take into account the differences in the benefits achieved by graduates of various universities and of various curricula. The question arises then, whether all graduates are characterized by the same level of gainfulness and employment security? Our research intended to fill the gap in this area.

Methodology

Our study is based on the data available at the Polish Graduates Tracking System (GTS). GTS started according to the new law about tertiary education introduced in Poland in 2014. GTS allows tracking economic careers of graduates. GTS collects administrative data from two reliable sources: ZUS – the Social Insurance Institution and POL-on – central Information Technology (IT) system on higher education institutions supporting the Ministry of Science and Higher Education (Polish Graduates Tracking System, 2018). GTS has important advantages in comparison to the traditional opinion surveys:

- It is based on objective facts instead of subjective opinions, therefore, it is not biased by speculative interpretations, memory failures etc.;
- It is organized as an entire population research instead of sample research, therefore, it gives the more relevant picture, not biased by sampling procedures or errors;
- It is based on secondary administrative data, therefore, there is no need for direct contact with graduates. As such:
  - The study is relatively easy and cheap
  - The study does not violate the privacy, while anonymity of respondents is guaranteed.

Similar studies that track careers of graduates are used in many European countries, among others: Spain, Austria, Scandinavian countries, Hungary, Lithuania (Polish Graduates Tracking System, 2018). In Poland, a significant number of HEIs usually offer curricula divided into bachelor degree and master degree. Most bachelor degree graduates directly continue their education on to a master degree. Therefore, we focused in our analysis on the final stage of tertiary education, namely people who graduate with a master degree. There were 139,777 of such individuals in 2014 (first year of data availability) in Poland and they graduated from 231 HEIs. These 231 HEIs with an average number of 605 graduates at the master degree level

created our basic data set. In practice, our study was the entire population, given that the data from GTS covers around 95% of all graduates.

Bugaj and Rybkowski (2015) identified two basic parameters that illustrate the economic career of graduate, namely: gainfulness or lucrativeness and employment security. We draw three variables to proxy each of these parameters:

- Average monthly gross salary in the first year of work after graduation, average monthly gross salary in the second year of work after graduation and increment of average monthly gross salary between the second and the first year of work after graduation – as indicators of gainfulness. Gross salary is the term used to describe all of the money graduates have made while working at their job, figured before any deductions are taken for state and federal taxes;
- Percentage of months that graduates have been employed (i.e. months without unemployment period) during the first year of work after graduation, percentage of months that graduates have been employed during the second year of work after graduation and increment of percentage of months without unemployment period between the second and the first year of work after graduation – as indicators of employment security.

One should note, that there are data only for two years, 2014 and 2015, available in GTS at the moment this research study began. This explains why data for the first and second year of employment after graduation was used.

Six variables mentioned above to conduct cluster analysis. A two-stage approach was followed in our clustering. The first, exploratory stage, was based on Ward's method that utilizes an analysis of variance approach. It attempts to minimize the Sum of Squares (SS) of any two (hypothetical) clusters that can be formed at each step (Hair, Black, Babin, & Anderson, 2009). Ward's method is popular, nevertheless, the k-means method is treated as one of the best clustering methods, even better than Ward (Äyrämö, & Kärkkäinen, 2006). The k-means method, however, requires as an input the number of clusters. This number could be given *ad hoc*. Defining the number of clusters *ad hoc* is rather artificial. So, we prefer the procedure based on two stages. First, we used Ward's method as an exploratory method to detect the reliable number of clusters. Second, we used this number as an input in the k-means method to define the ultimate clusters. Then, grouping was used to verify the possible determinants of differences in salaries and employment security across graduates of 231 HEIs in Poland, according to the conjectured hypotheses. The hypotheses were tested by conducting a contingency analysis, including Chi-square and standardized contingency coefficient C. Because this study included practically the entire population, the statistical significance was not calculated. In calculations, we used popular software packages: STATISTICA 7.0 and MS Excel 2013.

Results

The first stage of the clustering procedure is given in Figure 1. Figure 1a illustrates amalgamation schedule (Ward's method). One could observe that at 226th step Euclidean distance rise sharply at value 25 (indicated by red dotted line). Determining 25 as a cutoff point

(as suggested by the amalgamation schedule in Figure 1a) results in four distinct clusters of HEIs (Figure 1b). We used this number as an input in the k-means method. The basic statistics describing ultimate clusters, which we obtain during the second stage of grouping procedure one could find in Table 1.
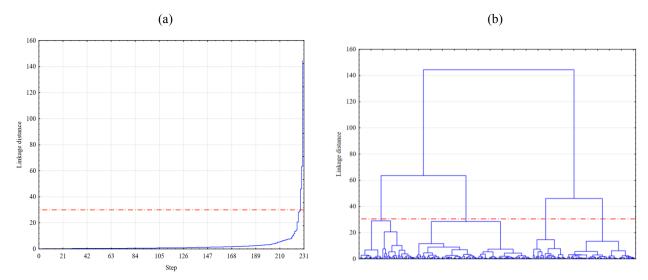

Figure 1. Exploratory Stage of Clustering: (a) Graph of Amalgamation Schedule and (b) The Tree Diagram (N=139,777)

Table 1. Characteristics of Clusters (N=139,777)

Items		"Underdogs"	"Middlers"	"Aspirants"	"Winners"
General	Number of HEIs	29	78	101	23
	Number of graduates (master degree only)	18465	65376	25745	30191
	Average size of HEI [# graduates at master degree]	637	838	255	1313
Gainfulness	Av. monthly salary in the 1. y.a.g. [PLN]	1736	2251	2871	3844
	Av. monthly salary in the 2. y.a.g. [PLN]	2236	2715	3146	4590
	Increment of av. salary between 1. and 2. y.a.g. [PLN]	501	464	276	747
Employment security	% of months without unemployment period – 1 y.a.g.	64	79	90	86
	% of months without unemployment period – 2 y.a.g.	79	89	93	93
	Increment of % of months without unemployment period between 2. and 1. y.a.g.	15	10	3	7

Note: PLN – Polish zloty (1 USD = 3.33 PLN; 1 EUR = 4.14 PLN at 19-02-2018); y.a.g. – year after graduation.

We named the clusters according to the main features of the individuals falling in those categories. "Underdogs" consist of 29 HEIs, graduated by approximately 18.5K people in 2014. Those graduates received, on average, the worst salary in comparison to others graduates in Poland. For example, in the first year after graduation (y.a.g.), they earned barely 45% of salary received by the top-earning graduates of HEIs named "Winners". People leaving "Underdogs" HEIs also faced the highest risk to be unemployed. On average, 36% of their time during the first year after graduation (y.a.g.) was spent without any employment. Nevertheless, starting from the relatively low level, there is a noticeable substantial progress between the first and second y.a.g.: the highest one in employment safety and the second highest in salary (Table 1).

There were 78 HEIs members of "Middlers". This group accounts for 65.4K of graduates, therefore, this was the biggest cluster. "Middlers" earned on average 30% more than graduates from "Underdogs" in the first y.a.g., but still much less than from the best group. Graduates leaving "Middlers" faced the medium risk to be unemployed. They spent, on average, 21% of their time during the first y.a.g. without employment. They experienced noticeable progress between the first and second y.a.g. in both employment safety as well as in salary (Table 1).

"Aspirants" were identified as the group, which could be positioned between "Middlers" and "Winners." In other words, if we imagine "Middlers" as peloton and "Winners" as a leader of bicycle racing, "Aspirants" could be also called ahead of the pack. A specific feature of this cluster is the lowest progress done between the first and second y.a.g. in employment safety as well as salary. However, one could notice that graduates of this group are second best paid and the best in the employment safety during the first y.a.g. The second characteristic feature of "Aspirants" was the cluster consists of the smallest HEIs (on average 255 graduates on master degree), while the biggest HEIs were members of Winners (1313 graduates) – Table 1.

"Winners" consist of 23 HEIs, graduated by nearly 30.2K people. Those graduates received on average the best salary in comparison to other graduates in Poland. In the first y.a.g., they earned 34% more than graduates of "Aspirants", 71% more than people leaving "Middlers", and as much as 121% more than graduates of "Underdogs". Individuals after studying in HEIs from this group faced relatively low risk to be without any job. On average, they spent 14% of their time during the first y.a.g. unemployed and still noticed some progress in employment safety during the second y.a.g. Moreover, they experienced the highest increment of average salary (Table 1).

After the clustering procedure, in the next step of this study, we have tested the hypotheses. In order to know if localization of HEIs does or does not determine the lucrativeness and employment security according to the belongingness to the particular cluster (H1), three types of localization were first differentiated: the small cities (below 0.5m inhabitants), big cities (0.5m inhabitants or more) and capital city (Warsaw). According to contingency analysis on the general level, standardized contingency coefficient C equals 0.37, therefore, the dependence between localization and cluster membership could be assessed as rather weak. However, partial analysis shows that one could observe rather weak dependence in the case of small and big cities, but in the case of capital dependence is much more clear-cut (Table 2). Localization in Warsaw substantially increases the possibility to be a member of "Winners" and lowers the possibility to be a member of "Underdogs" or "Middlers". In short, studying in the capital of Poland increases the chance to be employed and to earn relatively high salary.

Table 2. Localization of HEIs vs. Clusters' Membership – Contingency Analysis (N=139,777)

Items		"Underdogs"	"Middlers"	"Aspirants"	"Winners"
Capital	Observed frequency (O)	3	8	19	11
	Expected frequency (E)	5.14719	13.84416	17.92641	4.08225
	O – E	-2.14719	-5.84416	1.07359	6.91775
	$(O-E)^2/E$	0.89571	2.46705	0.06430	11.72276
	χ^2	15.14982			
Cities > 0,5 mln people	Observed frequency (O)	14	31	35	10
	Expected frequency (E)	11.2987	30.38961	39.35065	8.96104
	O – E	2.7013	0.61039	-4.35065	1.03896
	$(O-E)^2/E$	0.645828	0.01226	0.481012	0.120459
	χ^2	1.259559			
Cities < 0,5 mln people	Observed frequency (O)	12	39	47	2
	Expected frequency (E)	12.5541	33.7662	43.7229	9.9567
	O – E	-0.55411	5.23377	3.27706	-7.95671
	$(O-E)^2/E$	0.024457	0.811234	0.245617	6.358449
	χ^2	7.439757			
Total χ^2		**23.849136**			
Standardized contingency coefficient		**0.37**			

Second, the ownership type influence on the gainfulness and employment security according to the membership of given cluster was verified (H2). There were three types of HEIs in Poland: public owned, private owned (usually small in number of students & graduates), and very limited number of church owned (3 HEIs). On the general level, the dependence between ownership type and cluster membership could be assessed as rather strong (standardized C = 0.66). However, one could be aware of the very small number of objects in the case of the church owned HEI, which in fact weakens the reliability of coefficient. According to the directions of identified relations, one could find that graduating public HEIs mostly decreases possibility of belonging to the "Aspirants", then increases possibility of being a member of "Middlers" or "Underdogs" and finally in a limited scale it increases the possibility to belong to "Winners". Generally speaking, to graduate from public school rather decreases the attractive perspectives of high salary and employment security, but the relation is not straightforward and ambiguous. On the other hand, to graduate from private HEI it increases the possibility to be a member of "Aspirants", while decreasing the possibility of belonging to "Middlers", "Underdogs" and in limited scale – to "Winners". In short, graduates of private HEIs have rather better perspectives than those of public, but repeatedly, the relation is ambiguous (Table 3).

The results obtained are striking. A very common opinion in Poland is that a much higher quality of education offered by public HEIs in comparison to private ones. However, one assertion made at this point, that a high number of private HEIs in Poland offer only the bachelor degree. Those private HEIs, which offer also master degree, could be assessed as a *crème de la crème*. In this case, the widespread opinion about private HEIs, could be not justified at least, based on our results as they appear to suggest such possibility. Moreover, one could note, that in public HEIs in Poland, there is a larger diversity of curricula offered. Many disciplines are relatively less gainful (see Table 5). In opposite, private HEIs focus usually on relatively more lucrative (but not on the most gainful) disciplines.

Table 3. Ownership Type of HEIs vs. Clusters' Membership – Contingency Analysis (N=139,777)

Items		"Underdogs"	"Middlers"	"Aspirants"	"Winners"
Public	Observed frequency (O)	21	56	11	13
	Expected frequency (E)	12.6797	34.1039	44.1602	10.0563
	O – E	8.3203	21.8961	-33.1602	2.9437
	$(O-E)^2/E$	5.45978	14.0582	24.90020	0.8617
	χ^2	45.27988			
Private	Observed frequency (O)	6	21	90	10
	Expected frequency (E)	15.9437	42.8831	55.5281	12.645
	O – E	-9.9437	-21.8831	34.4719	-2.645
	$(O-E)^2/E$	6.20166	11.16688	21.40013	0.55327
	χ^2	39.32195			
Church owned	Observed frequency (O)	2	1	0	0
	Expected frequency (E)	0.376623	1.012987	1.311688	0.298701
	O – E	1.62338	-0.01299	-1.31169	-0.2987
	$(O-E)^2/E$	6.997313	0.000167	1.311688	0.298701
	χ^2	8.607869			
Total χ^2		**93.209699**			
Standardized contingency coefficient		**0.66**			

Third, a HEIs' profile influence on the salaries and employment security according to the belongingness to the given cluster was investigated (H3). There are many categories of HEIs in Poland according to their specialization, which were differentiated into three categories: general university, university of technology (polytechnic), and the rest (others). According to the contingency analysis on the general level, standardized contingency coefficient C equals 0.51, therefore, the dependence between profile of HEIs and cluster membership could be assessed as medium. However, partial analysis shows that one could observe practically independence in the

case of "others" HEIs, which is not surprising, taken into account the huge diversity of this category. In the case of general universities, the dependence is rather strong. Graduating from such universities substantially increases the possibility to be a member of "Middlers" and substantially lowers the possibility to be a member of "Aspirants". In a much lower scale, it also increases the possibility of belongingness to "Underdogs" and decreases the possibility of belongingness to "Winners". On the other side, graduates from polytechnics are highly possible to be a member of "Winners". They, similarly to general universities, are less prone to belong to "Aspirants". In a much lower scale to be a graduate of polytechnic increases the possibility to be a member of "Middlers" and decreases the possibility to be a member of "Underdogs". Those dependencies are quite visible. In summary, to study at university of technology gives a graduate much higher probability to find highly paid and secure job than in the case of general university (Table 4).

Table 4. Profile of HEIs vs. Clusters' Membership – Contingency Analysis (N=139,777)

Items		"Underdogs"	"Middlers"	"Aspirants"	"Winners"
General University	Observed frequency (O)	4	13	0	1
	Expected frequency (E)	2.25974	6.07792	7.87013	1.79221
	O – E	1.74026	6.92208	-7.87013	-0.79221
	$(O - E)^2/E$	1.3402	7.88348	7.87013	0.35018
	χ^2	17.44399			
University of Technology	Observed frequency (O)	1	10	0	7
	Expected frequency (E)	2.25974	6.07792	7.87013	1.79221
	O – E	-1.25974	3.92208	-7.87013	5.20779
	$(O - E)^2/E$	0.70227	2.53091	7.87013	15.13279
	χ^2	26.23610			
Others HEIs	Observed frequency (O)	24	55	101	15
	Expected frequency (E)	24.4805	65.8442	85.2597	19.4156
	O – E	-0.4805	-10.8442	15.7403	-4.4156
	$(O - E)^2/E$	0.009432	1.78597	2.905894	1.004213
	χ^2	5.705510			
Total χ^2		**49.3856**			
Standardized contingency coefficient		**0.51**			

Fourth, support of the H4 regarding graduated curricula (we used the disciplines of science that the individuals graduated from as a proxy for the curricula) influence on the gainfulness and employment security according to the membership of particular cluster was assessed. There are eight disciplines of science classified in Poland: Humanities (e.g. History, Philosophy,

Theology), Social sciences (e.g. Psychology, Economics, Law); Science (e.g. Mathematics, Computer sciences, Chemical sciences); Natural sciences (e.g. Earth sciences, Biological sciences), Engineering and Technology (e.g. Civil engineering, Electrical engineering); Agricultural sciences (e.g. Agriculture, Forestry, Veterinary sciences); Medical and Health sciences (e.g. Basic Medicine, Sport and fitness sciences); Arts (e.g. Art history, Studies on Film, Radio and Television).

To verify this hypothesis (H4) a contingency table with frequency of occurrence of graduates in any given cluster (Table 5) was used. On the general level, the dependence between graduated science disciplines and cluster membership could be assessed as medium (standardized C = 0.58). In particular, for example, the strongest dependence was observed in the cases of Agricultural sciences, Art, and most of all – Engineering and Technology. Graduates of Agricultural sciences and Arts face relatively high risk of lower salary and difficulties with finding job. However, people graduating from Engineering and Technology have high possibility to take most lucrative and secure jobs. About 60% of the Engineering and Technology graduates were grouped into "Winners" cluster.

Table 5. Discipline of Sciences Graduated vs. Clusters' Membership – Contingency Analysis (N=139,777)

Items		"Underdogs"	"Middlers"	"Aspirants"	"Winners"
Humanities	Observed frequency (O)	2491	11090	1827	1402
	Expected frequency (E)	2220.66	7862.31	3096.17	3630.86
	O – E	270.34	3227.69	-1269.17	-2228.86
	$(O - E)^2/E$	32.912	1325.05	520.254	1368.22
	χ^2	3246.436			
Social sciences	Observed frequency (O)	9041	26633	20486	10459
	Expected frequency (E)	8800.59	31158.8	12270.3	14389.31
	O – E	240.41	-4525.8	8215.7	-3930.31
	$(O - E)^2/E$	6.567	657.37	5500.897	1073.527
	χ^2	7238.363			
Science	Observed frequency (O)	690	2119	0	855
	Expected frequency (E)	484.026	1713.713	674.858	791.402
	O – E	205.974	405.287	-674.858	63.598
	$(O - E)^2/E$	87.6504	95.8489	674.8584	5.1108
	χ^2	863.4685			

Table 5. Discipline of Sciences Graduated vs. Clusters' Membership – Contingency Analysis (N=139,777) (Cont.)

Items		"Underdogs"	"Middlers"	"Aspirants"	"Winners"
Natural sciences	Observed frequency (O)	1291	3987	20	607
	Expected frequency (E)	780.07	2761.866	1087.62	1275.445
	O – E	510.93	1225.13	-1067.62	-668.44
	$(O-E)^2/E$	334.649	543.457	1047.988	350.324
	χ^2	2276.417			
Engineering and Technology	Observed frequency (O)	974	9482	675	16668
	Expected frequency (E)	3672.34	13002.05	5120.19	6004.42
	O – E	-2698.34	-3520.05	-4445.19	10663.58
	$(O-E)^2/E$	1982.67	952.98	3859.18	18938.05
	χ^2	25732.88			
Agricultural sciences	Observed frequency (O)	1103	3550	21	41
	Expected frequency (E)	622.867	2205.283	868.438	1018.412
	O – E	480.133	1344.717	-847.438	-977.412
	$(O-E)^2/E$	370.108	819.969	826.946	938.063
	χ^2	2955.085			
Medical and Health sciences	Observed frequency (O)	1974	7297	2501	60
	Expected frequency (E)	1563.05	5534.02	2179.29	2555.64
	O – E	410.95	1762.98	321.71	-2495.64
	$(O-E)^2/E$	108.047	561.634	47.491	2437.05
	χ^2	3154.223			
Arts	Observed frequency (O)	901	1218	215	99
	Expected frequency (E)	321.407	1137.954	448.125	525.514
	O – E	579.593	80.046	-233.125	-426.514
	$(O-E)^2/E$	1045.178	5.631	121.277	346.164
	χ^2	1518.249			
Total χ^2		**46985.122**			
Standardized contingency coefficient		**0.58**			

Conclusions

This study shows the differences in the private monetary benefits between graduates from 231 Polish HEIs. The cluster analysis including gainfulness and employment security showed four groups of graduates: "Underdogs", "Middlers", "Aspirants", and "Winners". According to the contingency analysis, dependence between cluster belongingness and localization is weak, in the case of profile of HEIs and disciplines of science graduated from – it is medium, and in the case of ownership type – it is strong. However, as with all research, this study has its limitations. First, the selection of criteria of differentiating the situation of graduates in the labor market was difficult. This study presented two main private monetary benefits: gainfulness and employment security. Second, only data for the first and for the second y.a.g (in GTS there are data only for two years: 2014 & 2015) were utilized. Thus, this study did not give a full picture of graduates in the labor market. Last, the private monetary benefits of tertiary education at the university level, not at the faculty level. This former appears to be a better level of aggregation, however, it is not directly available from GTS. Thus, future studies that make comparisons between graduates' gainfulness and employment security from different countries are warranted. Additionally, investigating the correlations between the faculty level and economic benefits of learning could offer fruitful results as well.

References

Acemoglu, D., & Angrist, J. (1999). How large are the social returns to education? Evidence from compulsory schooling laws. *NBER Working Paper*, *7444*, vii-xii.

Äyrämö, S., & Kärkkäinen, T. (2006). *Introduction to partitioning-based clustering methods with a robust example*, Jyväskylä: University of Jyväskylä.

Blundell, R., Dearden, L., & Sianesi, B. (2001). Estimating the return to education: Models. methods and results. *IFS Working Paper*, *19*, vii-xii.

Bugaj, J. M., & Rybkowski, R. (2015). Prywatne korzyści z wyższego wykształcenia – analiza finansowa [Private benefits from higher education – financial analysis], *Zeszyty Naukowe Uniwersytetu Szczecińskiego nr 855. Finanse, Rynki Finansowe, Ubezpieczenia [Finance, Financial Markets, Insurance]*, *74*(1), 687-696.

Caponi, V., & Plesca, M. (2007). Can ability bias explain the earnings gap between college and university graduates? *IZA Discussion Paper*, *2784*, vii-xii.

Creţan, G. C., & Lacrois, Y. L. (2008). Considerations on the implementation of cost-benefit analysis in evaluating the efficiency of investing in higher education. *Theoretical and Applied Economics*, *12*(517), 127-134.

Daviet, B. (2016). Revisiting the principle of education as a public good. *Education Research and Foresight Series*, *17*, vii-xii.

De la Fuente, A. (2003*). Human capital in a global and knowledge-based economy. Part 2: assesment at the EU country level*, European Commission Report.

Dziechciarz, J. (2015). Measurement of rate of return in education. Research Directions, [in:] Velencei, J. (ed.). *Proceedings of FIKUSZ '15*, Budapest: Óbuda University, 39-56.

García-Suaza, A. F, Guataquí, J. C., Guerra, J. A., & Maldonado, D. (2009). Beyond the mincer equation: The internal rate of return to higher education in Colombia. *Serie Documentos de Trabajo*, vii-xii.

Hair, J. F, Black, W. C., Babin B. J., & Anderson, R. E. (2009). *Multivariate data analysis: A global perspective*. London, UK: Pearson Publications.

Hermannsonn, K., Lisenkova, K., Lecca, P., McGregor, P. G., & Swales, J. K. (2017). The external benefits of higher education. *Regional Studies*, *51*(7), 1077-1088.

Moşteanu, T., & Creţan G. C. (2011). Education and the characteristics of public goods. overlaps and differences. *Theoretical and Applied Economics*, *9*(562), 33-40.

McMahon, W. W., & Wagner, A. P. (1979). The monetary returns to higher education: Are they worth the investment costs? *Faculty Working Paper*, *619*, vii-xii.

McMahon, W. W. (2006). Education finance policy: Financing the nonmarket and social benefits. *Journal of Education Finance*, *32*(2), 264–284.

Musgrave, R. A. (1959). *The theory of public finance*. New York, NY: McGraw-Hill Book Company.

OECD (2017). *Education at a glance 2017: OECD indicators*. Paris, France: OECD Publishing.

Pietrzak, P. (2016). *Efektywność funkcjonowania publicznych szkół wyższych w Polsce [Efficiency of functioning of public higher education institutions in Poland]*. Warszawa, Poland: Wydawnictwo SGGW.

Polish Graduate Tracking System (2nd ed.) (2018). Available via: http://ela.nauka.gov.pl/en/

Potelienė, S., & Tamašauskienė, Z. (2014). The rate of return to investment in education: A case study of Lithuania. *Wroclaw Review of Law, Administration & Economics*, *4*(2), 41-55.

Psacharopoulos, G., & Patrinos, H. A. (2002). Returns to investment in education. A further update. *Policy Research Working Paper*, *2281*, vii-xii.

Psacharopoulos, G. (2007). The returns to investment in higher education: Methods, data and policy implications, [in:] Mora, J. G, Vila, L., Psacharopoulos, G., Vossensteyn, J. J., Schmidt, E. K., Villarreal E. (ed.). *Report on rates of return and funding models in Europe*. Valencia: Centro de Estudios en Gestión de la Educación Superior, vii-xii.

Russ, M. (2017). The trifurcation of the labor markets in the networked, knowledge-driven, global economy. *Journal of the Knowledge Economy*, *8*(2), 672-703.

Strawiński, P. (2006). Zwrot z inwestowania w wyższe wykształcenie [Return to investment in higher education]. *Ekonomista [Economist]*, *6*, 805-821.

Strawiński, P. (2007). Changes in return to higher education in Poland 1998-2004. *MPRA Paper*, *5185*, vii-xii.

Targaszewska, M. (2014). An attempt at measuring the effectiveness of higher education in Poland. *Econometrics*, *1*(43), 50-59.

Authors' Biographies

Michał Pietrzak is a strategic management and performance measurement researcher and practitioner. He is an associate professor at Faculty of Economic Sciences at Warsaw University of Life Sciences – SGGW and a vice chairman of the committee responsible for the strategy of the university.

Piotr Pietrzak is a performance measurement researcher. He is an assistant professor at Faculty of Economic Sciences at Warsaw University of Life Sciences – SGGW.