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Efficiency of higher education institutions management and the labour market situation of graduates - an assessment of relations based on structural equation modelling (SEM)

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1. Introduction

The institutions of the education system are organised forms of activity that respond to people's needs and aspirations for the development of intellectual abilities and competences, according to their own predispositions and the opportunities provided by the environment. In other words, they build human capital, increasing the productivity of students, later graduates, and the beneficiaries of this system are both the state, society and the graduates themselves. There are, however, complex interrelationships between the actors in the system due to the expectations of the education process itself and the added value it creates (Benabou, 2008; Knight, 1952). With economic and social progress, changing norms and regulations, and the accumulation of new knowledge, the aims and foundations of educational institutions are constantly

being modified. This raises the question of how to describe the efficiency of a higher education institution in this process of change and what objectives to assign to it. The government's outsourcing of the task of higher education to public institutions draws attention to the problem of verifying the results obtained, i.e. the translation of the costs associated with teaching and research activities into the results achieved. The latter can have different dimensions, and one of the more practical approaches is to assess the performance of graduates feeding into the labour market. Obtaining such hard measures is the basis for reliable evaluation and verification of the implementation of the contract between the government, the university and society. The evaluation system described is common in, among others, the new institutional economics, which examines the effectiveness of the system through the lens of transaction costs (cf. North, 1993; Williamson, 1999).

Students, later graduates, teaching staff, administrative staff, the Rector, Senate, University Council, etc. are all directly involved in education. The principle of the limited rationality of human choices and their opportunism represented in the new institutional economics can lead to the assumption of increasing transaction costs. Institutions are supposed to minimise them; however, their inertia and resistance to change can lead to the opposite effect (Simon, 1991; Kahneman, 2003). In this sense, the public higher education system may no longer be competitive with private education providers, including corporations.

In their research, the authors compared two gaps in a still unexplored area of determining the efficiency of the higher education, hindered by the absence of comprehensive data for quantitative analysis. The concept of efficiency has been previously defined in terms of labour market efficiency. Research on education has extensively discussed its determinants concerning graduates' labour market outcomes, such as wage levels and their growth (Machin & McNally, 2007), selection by employers, and unemployment risks (Brzezicki, 2020), as well as the so-called "distribution of rewards" (Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, 2017). The phenomenon of overqualification can also occur (The Impact of Education on Wages and Labour Productivity, 2023), potentially leading to lower wages despite increased educational investments, thereby resulting in lower rewards. This, in turn, increases the flexibility requirement in employing individuals with higher education and the market's ability to adapt and absorb them (Obadić & Viljevac, 2023).

On the other hand, due to the methodology in literature, the concept of efficiency is often associated with the increasingly used Data Envelopment Analysis (DEA) methodology (see Tavares et al., 2021; Brzezicki, 2020; Zhang et al., 2020, among others). These studies focus on resolving linear problems with specified weights. "As Moreno et al. (2015) pointed out, in a classical DEA approach, efficiency is calculated by dividing the weighted sum of the outputs produced by the evaluated unit by the weighted sum of the resources consumed by it. The weights are determined by solving a linear programming problem (LPP) in the most benevolent way possible for each Decision Making Unit (DMU)". Tavares et al. (2021) present a systematic review of the use of DEA methods but note a distinctive approach focusing on areas like teaching or research. Most studies focus only on certain activities, such as budget expenditures (the only financial component in Tavares' study), the number of students, the number of defended doctoral theses, graduates, patents, and the number of publications indexed in Scopus. However, they point out problems in obtaining data on employment metrics (wages or unemployment rates). While Brzezicki (2020) suggests the possibility of examining relationships using DEA, despite incorporating the labour market aspect, he does not detail parameters related to the potential of universities (such as expenditures on education, research, publications, etc.).

Therefore, the authors propose examining efficiency as a correlation between a latent variable describing the collective potential of universities (understood comprehensively based on the presented determinants) and the returns to education. These returns are assessed through factors such as salary growth and job-finding outcomes, including the threat associated with unemployment and the time taken to secure employment (Review of Education Policies - Education GPS - OECD: Labour Market Outcomes, 2023; Fényes, 2020; Elamir & Mousa, 2022). Ideally, these latent variables should complement each other, a notion underscored by Plavgo (2023), emphasizing the importance of considering complementarity. Hence, correlating these two elements, depicted as latent variables, is deemed appropriate. In this context, leveraging Structural Equation Modeling (SEM) alongside efficiency considerations presents an alternative approach to framing the issue, allowing for a comprehensive integration of hard-to-access information and providing an alternative to DEA.

In view of this, the aim of this research is to assess the relationship between the efficiency of higher education institutions management and the graduate's position in the labour market. Learning about such a relationship may be necessary to diagnose transaction costs and attempt to reduce them, in order

to increase the positive effects of higher education institutions (Hodgson, 2006; Ashford and Biswas, 2010). At the same time, an attempt is made to define the determinants of the university's potential and the graduate's situation looking for a job. The subject scope of the research consists of higher education institutions included in the evaluation questionnaire and monitoring system (135 units), and the spatial scope refers to Poland as a whole. The research covers the period 2013-2017.

According to the authors, the presented problem is still insufficiently described in the literature, in particular there is a lack of analyses based on measurable values linking the position of a graduate in the labour market with the determinants of efficiency of HEIs. One of the reasons for the lack of in-depth research may be the unavailability of source data on a detailed description of university staff, administration and management, funding sphere, research activities, etc., as well as data on the fate of graduates (Ćwiąkała-Małys, 2010; Kwiek, 2016; Wolszczak-Derlacz, 2019). In the study, the authors have used a unique set of data, often unpublished, which fills an information gap in the area studied. This constitutes an added value of the publication.. The introduction of a quantitative method for determining efficiency and its valuation can significantly assist the management of universities, by removing frictions and reducing transaction costs. Thus, it is potentially possible to identify specific places where performance can be improved or where certain solutions should be abandoned. The applied nature of the publication is related to the development of a practical rationale for changing the management policy of higher education institutions both at the central level and at the level of higher education units. The article is structured as follows: the next two sections present the data set and methods, followed by the results and discussion, and finally the conclusions.

2. Data set

In order to measure the efficiency of HEIs in relation to the graduate labour market, it was decided to analyse the possibility of obtaining the necessary data that would cover the largest area of the country. The information had to meet important assumptions - first and foremost, to allow for the aforementioned identification of a measurable relationship between two latent variables (university's potential and labour market) and to enable analysis at the general level of the higher education system. It was determined that the higher education institutions in Poland in 2017 were covered by the unit evaluation survey together with the so-called System for the Evaluation of Academic Achievement (SEAA).

These data were obtained from the Information Resources Department of the Information Processing Centre - National Research Institute. These collections, mostly unpublished, consisted mainly of individual questionnaires for the years 2013-2016 collected within the SEAA and the Integrated Information System for Science and Higher Education (POLON, 2020). The information obtained related to the following areas: 1) employees engaged in research or development (5,443 observations); 2) publications (1,975 observations); 3) students (10,755 observations); 4) expenditures and financial result of the scientific unit (427 observations); 5) costs of teaching activities (137 observations); 6) costs of research activities (137 observations); 7) list of organised scientific conferences (47. 379 observations); 8) list of scientific projects (84,178 observations); 9) list of patents and protection rights (22,670 observations); 10) list of awards and distinctions (39,316 observations).

Data on graduates, on the other hand, concerned the national system for monitoring the Economic Career of Graduates of higher education institutions. These are data based on statistics from the Social Insurance Institution and the SEAA system and relate to the national and county coverage. The data used in the analysis come from 2017 and concern those students, who graduated in 2016 (ELA, 2018). They refer to the average monthly salary from all sources in relation to the salary in the county and within the sector, the relative unemployment rate in the first year after graduation (where they did not undertake any other studies after graduation), the average time spent looking for contract employment. All variables covered a total of 9,609 observations for graduates of Bachelor's and Master's degree programmes, as well as for graduates of uniform Master's degree programmes from 365 universities in Poland. In turn, the Bank of Local Data, which is an integral part of public statistics, was selected to obtain data on labour market conditions. A given field of study was linked to the section of the economy using the ISCED-F 2013 grouping ((International Standard Classification of Education) and previous research (e.g. Polcyn and Gawrysiak, 2018a).

3. Methods

The efficiency of a HEI can be defined by a set of indicators comprising the achievement of the statutory objectives of a higher education institution. In our study, it was defined as the relationship between the parameters describing the management of a higher education institution's resources and its teaching and research potential and the functioning of the graduate

in the labour market. Thus, a hypothesis is posited: the efficiency of higher education institutions is expressed through a positive correlation between the university's potential and the graduate's situation looking for a job. The sub-hypotheses are presented later in this subsection (table 1) as a set of assumptions about the direction of influence of observable variables (determinants) on unobservable variables, i.e. university's potential and labour market. As the issues presented are complex phenomena, many variables need to be collected for their analysis and synthetic measures need to be constructed. Groups of variables refer to specific concepts, such as the potential of a university or the potential of a student in the labour market, but these cannot be observed directly. Therefore, it is necessary to build appropriate constructs that are a combination of several variables.

Due to the above reasons, it was decided to use structural equation modelling (SEM), which perfectly links observable variables with variables that are difficult to measure, with a particular application of confirmatory factor analysis (CFA).

Confirmatory factor analysis (CFA) is a statistical technique used to verify the factor structure of a set of observed variables. CFA allows the researcher to test the hypothesis that a relationship between observed variables and their underlying latent constructs exists. The researcher uses knowledge of the theory, empirical research, or both, postulates the relationship pattern a priori and then tests the hypothesis statistically (Suhr, 2006). This paper uses a model with two unobservable variables related by correlation and in which there is a shared observable variable. These models belong to the group of non-standard models with complex indicators (Kline, 2011).

SEM is not considered a specific statistical technique, but rather provides a framework for modelling carried out in this area. Therefore, it integrates many different and multidimensional techniques into one adapted pattern, drawing on the achievements of various fields of science - starting from psychology and the related measurement theory, through factor analysis (Anderson and Rubin, 1965; Spearman, 1904; Thurstone, 1934), path analysis taken from biology (Duncan, 1966; Koopmans, 1945; Wright, 1918), regression modeling, ending with simultaneous equations, known in econometrics (Joreskog, 1971; Morgan, 1990; NCRMUK, 2016). SEM is also referred to as a combination of covariance structure analysis, analysis of moment structures, analysis of linear structural relationships, and casual modelling. Together, these methods create an environment known as structural equation modelling. The implementation of SEM is therefore justified in the

case of systemic problems that require the analysis of relationships between individual elements instead of looking for a single relationship between the explained variable and the explanatory variables. This method works particularly well in research on the indirect influence of one factor on another (Gunzler et al., 2013; Pearl, 2010). This is a situation in which a given variable X does not necessarily directly affect variable Y, but may affect variable Z, which in turn directly affects Y. This phenomenon often occurs in the social sciences.

SEM can be viewed as path analysis using so-called latent variables (also called theoretical or hidden variables), which are the cause of observable variables, i.e. contained in data sets (Hoyle, 2012). They are not directly measured, but are a kind of approximation of other indicators that are considered part of a given construct (Rabe-Hesketh et al., 2007). They can only be determined using observable values of other variables (indicators) describing them, although resulting from an unobservable, i.e. latent, construct. The use of path analysis allows for the graphical representation of theoretical models using standardized notations replacing sets of equations. At the same time, this method illustrates equations between measured values, i.e. systems of their mutual connections, both at the direct, indirect and general levels. While the ellipse identifies the latent variable and the rectangle identifies the observed value, the small circles represent a measure of disturbance, i.e., variance. The diagram also shows covariance (or a path without direction) as an arc with arrows pointing in both directions. Straight lines with one arrow represent a directional path, or regression (Bollen, 1989b). An example of a graphical representation of the SEM model is figure 1, in which there is a certain relationship between the latent variables (L1) and (L2) measured on the basis of three observable variables (Y1, Y2 and Y3 and Y4, Y5 and Y6, respectively), but its relationship has not been determined (arrows in two directions). Parameters (ε) in turn represent error measures for observable variables (Y). Endogenous variables in the equations, i.e. those to which at least one arrow leads, are the result of the action of variables located in the system and are determined by the system of equations, while exogenous variables, to which no arrows lead, result from variables outside the system.

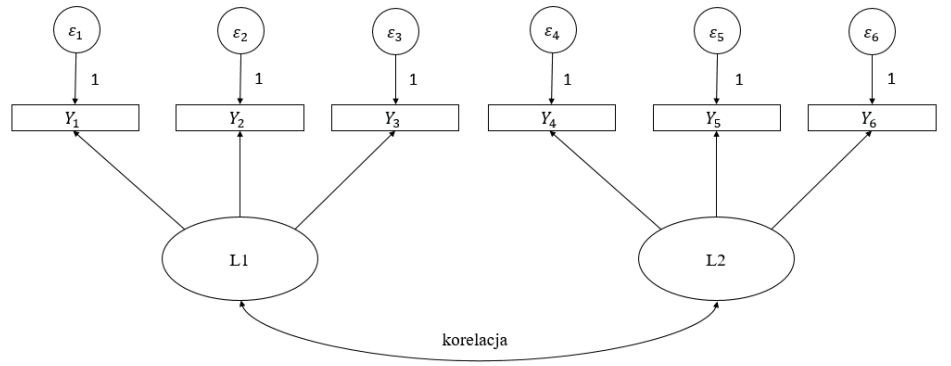

Figure 1. Schematic of the SEM model for two latent variables

Source: authors' elaboration based on (Brown and Moore, 2012)

The aim of SEM modelling in our research is to assess the efficiency of the university, and in particular to find a statistically significant correlation between two latent variables: the school's potential and the graduate's situation in the labour market. The construction of variables was guided by the general principles for creating indicators for higher education institutions presented in the recommendations of the UNESCO Institute of Statistics (Martin et al., 2011). The latent variable "university potential" (PU) is described by the set of data presented in table 1.

Table 1. Elements of latent variables: potential of the university and expected direction of influence

Name of the element	Characteristics/justification	Direction of influence
1. The ratio of students to full-time teaching staff at the university's primary workplace (S_T)	a generally accepted measure describing not only the teaching load, but also the possibility of inferring the size of teaching groups, the quality of the classes taught or the distribution of the costs of teaching activities	-

2. The ratio of students to full-time teaching staff at the university, regardless of whether the university is the primary place of work (S_TN)	analogous to element 1, but due to a change in the allocation algorithm (i.e. inclusion of persons who do not declare university as their primary place of work) it was decided to include it as a separate variable	-
3. The ratio of teaching to research staff FTEs set at university level (T_R)	due to the complexity of the concepts of research or teaching or teaching/research staff, it was decided to include this indicator separately as well. It defines, in a sense, the profile of the university and the way it is managed, which can be related, for example, to the level of teaching and research workload of academic staff (Geschwind and Broström, 2014; Wolszczak-Derlacz, 2019)	+
4. Teaching activity costs (inputs) per student set at university level (CD_S)	these include, but are not limited to, the costs of maintaining the teaching process, staff training and maintenance of the university, including renovation costs (Brzezicki and Wolszczak-Derlacz, 2015; EAC, 2018; Johnes et al., 2009)	+
5. Teaching activity costs (inputs) per academic staff (CD_T)	analogous to indicator 4, a new conversion variable was proposed - attempts to make correct SEM models were unfortunately not successful in this case	+
6. The ratio of the number of students (still studying) to the number of graduates in a given year at the university (S_G)	often referred to as an outcome of the university's activities, but its high level can also inform the degree of effort expended without 'producing' a graduate outcome (Johnes et al., 2009; Powell et al., 2012; Loukkola et al., 2020)	-
7. The ratio of the total number of teaching staff with professorial or postdoctoral degrees to the total number of teaching staff (PH_A)	it determines both the distribution of funds according to the aforementioned algorithm, which assumes greater funding for professors and post-doctoral fellows, and the share of the most highly qualified staff in view of the commonly applied reduction in teaching hours based on academic rank. This is a kind of measure of the professionalism of the teaching sphere (Brzezicki et al., Wolszczak-Derlacz, 2015; Newlyn, 2015; Piper, 1994; Loukkola et al., 2020)	+

8. Research activity costs per point from scientific publications at faculty level (CR_PP)	although bibliographic indicators are a subject of controversy, it is recognised that stimulating a publication with additional funding increases its impact known as impact factor (Stern i in., 2014; Wang and Shapira, 2015). At the same time, the points from the publication are a basic evaluation criterion of the institution on the part of government bodies	+
9. Number of projects per researcher (NP_R)	the implementation of projects is also subject to evaluation by both university authorities and staff, while also determining the level of workload of research staff in the implementation of projects (Abramo and D'Angelo, 2014; Bloch and Sørensen, 2015)	+
10. Total publication credits (points) per researcher (PP_R)	the number of publication credits is an important part in the evaluation of both academics and research staff, and is intended to reflect their productivity (Carpenter et al., 2014)	+
11. Total publication credits from the ministerial list per researcher (PA_R)	the rationale for the introduction of this measure is analogous to the previous one, but it is limited to the so-called A-list (highest scoring) and is thus applicable to the measurement of publications with a far greater impact	+
12. Research funding from university's revenue divided by total research funding including grants (COR_CAR)	this variable communicates the degree of independence of research from state grants and is often used in the literature, while also determining the level of autonomy of institutions (Santiago et al., 2008; Hicks, 2012; OECD, 2018; Loukkola et al. 2020).	+
13. Research activity costs per researcher at university level (CR_R)	this includes labour costs as a measure of the productivity of research staff and an incentive for effort (Abramo and D'Angelo, 2014; Bloch and Sørensen, 2015; Hicks, 2012)	+
14. Number of projects per faculty (PJ_F)	it can be a measure of both scientific development and researcher productivity, as well as internal cooperation in the implementation of projects at the university in consultation with other units, including administration (OECD, 2019)	+

Source: authors' elaboration

The latent variable "graduate's labour market situation" (RP) was described through items collected from the ELA database and related to the county of residence (along with the expected impact on the graduate's situation):

- the relative unemployment rate of graduates in the first year after graduation (variable designation: P1_34) - negative impact on the graduate's situation in the labour market;
- unemployment risk of graduates in the first year after obtaining the diploma, if they did not study in another field or degree after obtaining the diploma (variable designation: P1_26) - negative impact;
- average time (in months) from graduation to first contract job after graduation (variable designation: P1_19) - positive impact;
- relative earnings ratio of graduates in the first year after obtaining a diploma (variable designation: P1_164) - positive impact.

These observation variables were used by the Ministry of Science and Higher Education until the end of 2020. They also appear as a criterion in the competition for the Didactic Excellence Initiative, where the evaluation of universities is based on the results of labour market monitoring. In the literature, we can find a similar approach in publications by Bożykowski et al. (2014), Jasinski et al. (2017), Wolszczak-Derlacz (2019), Navracsics (2019), Guerrero and Urbano (2012), Oreopoulos et al. (2012), Tomlinson, 2008.

The model also delineated separate relationships between individual parameters describing the potential of universities and the labour market. At the same time, a common variable labelled D_S, difference in salary, was introduced for both unobservable variables. It identifies the difference between the average salary of graduates of a given field of study at a given university in a specific discipline and the average salary in the corresponding section of economic activity at the level of a given province. For comparison, previous analyses used salary in relation to the national average (Rocki, 2018).

STATA software version 15.1 was used for the calculations.

4. Results and discussion

In accordance with the procedure established in the literature, in the first step independent models describing each latent variable were constructed in order to determine whether, based on the collected observations, it is possible to determine a model that meets the goodness-of-fit conditions separately for each latent variable (the so-called two-steps analysis). Both latent variables were analysed using as many variables as possible with the greatest possible data

availability. The final result was a set containing 2,318 observations, on the basis of which models were determined to describe the situation of the graduate in the labour market (designation RP), the potential of the university PU and the combined SEM model. Measures of goodness of each model are included in table 2.

Table 2. Statistics for the SEM model – goodness-of-fit

Measure tested	Results – PU	Results – RP	Results – SEM
(X2) (chi-square): the 0 hypothesis indicates that the estimated model is equal to the saturated model	Chi2(2)=0.961 p >chi2=0.618	Chi2(3)=18.99 p >chi2=0.618	Chi2(2)=155 p >chi2=0
Tucker Lewis Index (TLI)*	1.000	0.978	0.934
Comparative Fit Index (CFI)**	1	0.993	0.964
Root Mean Square Error of Approximation (RMSEA)***	0	0.048	0.056
Standardized Root Mean Square Residual (SRMR)****	0.005	0.022	0.039
Coefficient of Determination (CD)	0.737	0.808	0.959

* Tucker-Lewis index (TLI) - in structural equation modelling, this is one of the indicators of model fit. This index takes values from 0 to 1, where 1 indicates a perfectly fit model.

** The Comparative Fit Index (CFI) is equal to the discrepancy function adjusted for sample size. CFI ranges from 0 to 1 with a larger value indicating better model fit. Acceptable model fit is indicated by a CFI value of 0.90 or greater (Hu & Bentler, 1999).

*** Root Mean Square Error of Approximation (RMSEA) is related to residual in the model. RMSEA values range from 0 to 1 with a smaller RMSEA value indicating better model fit. Acceptable model fit is indicated by an RMSEA value of 0.06 or less (Hu & Bentler, 1999).

**** The SRMR is defined as the difference between the observed correlation and the model implied correlation matrix. Thus, it allows assessing the average magnitude of the discrepancies between observed and expected correlations as an absolute measure of (model) fit criterion. A value less than 0.10 or of 0.08 (in a more conservative version) are considered a good fit (Pavlov et al., 2020)

Source: authors' calculations

The university's potential model is shown in figure 2. It was very well fitted in terms of all the variables analysed. This is the result of successive

estimations with the elimination of those elements that had almost zero impact on the latent variable and did not provide additional information about the relationships under study. Their elimination in subsequent stages made it possible to obtain better goodness-of-fit parameters for the remaining factors. From the obtained models, the one with the highest coefficient of determination (CD) was selected, and at the same time for which the observed variables did not exceed the critical value of $p>0.1$ (the values of the CFI, TLI, chi-square parameters were also satisfactory). Finally, 5 observed variables were left, which, according to the model, most significantly shape the potential of universities, i.e. CD_S - the cost of teaching activities (inputs) per student, PH_A - the ratio between the sum of the number of teaching staff with a professorial or postdoctoral degree to the total sum of teaching staff (positively related to the university's potential, according to the authors' assumptions), S_T - the number of students per full-time teaching position, PP_R - the sum of publication credits per research staff member, COR_CAR - research funding per research staff member (negative relationship with potential, directions of influence of the last two variables contrary to assumptions).

For the first four, the factor loadings obtained satisfactory values (>0.3). The positive direction of the impact for the variable 'volume of inputs' should not come as a surprise. Similar findings can be found, for example, in a study by the Economic Policy Committee and Directorate-General for Economic and Financial Affairs of the European Commission (2010), Wolszczak-Derlacz (2019) or European Commission/EACEA/Eurydice (2018). Also in the case of teacher quality, the literature confirms a positive effect on university capacity (see: OECD, 2012; Newlyn, 2015; Loukkola et al., 2020). This may be due to the scholar's authority and years of professional experience gained (Maciejewska and Sajdak-Burska, 2018). Although one can also find studies challenging the above assumption (Johnson and Crews, 2013). The negative impact of excessive student enrolment on the quality of higher education institutions was written about by Lynch (2021) and Meador (2019), among others. In turn, the negative sign of the relationship between the variable 'research funds' and the university's potential in shaping the graduate's position on the labour market can be explained by the fact that for research centres, teaching activities become a secondary issue. Research centres relatively rarely educate graduates directly for the labour market, because the results of scientific work are most often publications and degrees or scientific titles (doctorates, habilitations), and less often patents and discoveries (Smith, 2020).

However, the negative sign for the loading at the variable 'total points from publications' requires explanation. This may indicate a common tendency to 'chase points' that do not translate into the quality of education and, consequently, the potential of the school. This problem is pointed out, for example, by Altbach and de Wit (2018); Rawat and Meena (2014). Palali et al. (2018) prove that being taught by teachers with high quality publications does not lead to higher quality of education. While assessing the didactic process, master students do not give higher scores to teachers with high quality of publications, bachelor students give even lower scores. Significant in this context is the decision of the prestigious journal The Review of Higher Education to suspend acceptance of articles for review due to the excessive number of papers received by the editors.

In the Polish reality, in the last few years we have seen a change in the rules of assigning points for publications, which may indicate that despite numerous corrections related to the evaluation of scientific activity, the system is still imperfect. The "publish or perish" principle has long been known in academia, which encourages publication, even of little creative achievement (Bowman, 2020), at the expense of neglect in other areas. The role of agencies overseeing the teaching process in higher education should be to direct the evaluation process of scholarly activity in such a way that the results achieved measurably contribute to raising both the scientific and teaching levels of the university. Besides, the amount of points allocated for publications per teaching staff may depend on the structure of the scientific staff. This finding is supported by some scientific studies indicating that the publication activity of academic employees decreases with the attainment of more academic degrees, especially after the highest title of professor (Macri and Sinha, 2010). This may suggest that young employees, not yet experienced in teaching, publish the most, which translates into lower quality of student education.

Also interesting is the negative correlation between the parameters S_T and PP_R, indicating that a higher number of students per teaching staff member is associated with a lower number of publication credits per researcher. This picture of didactic overload is a typical phenomenon for the Polish higher education system. Information on the promotion structure of academic teachers could be useful in explaining this phenomenon, which could prove that a significant portion of teaching is carried out by employees who are less active in publishing. Such a relationship was previously confirmed by Macri and Sinha (2010). In turn, the findings by Li and Xie (2016) indicate that professors involved in publishing are less burdened by teaching.

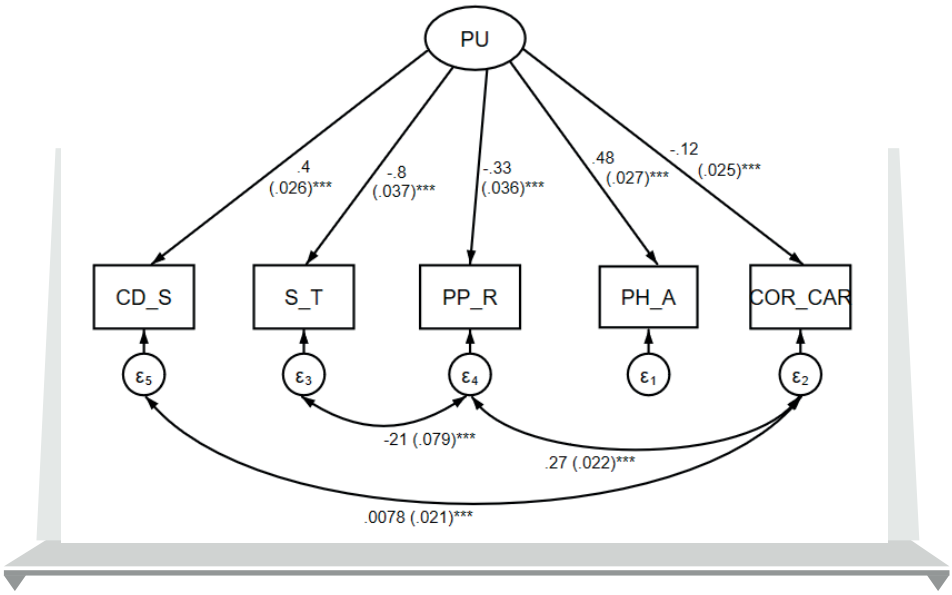

Figure 2. SEM-CFA model for the latent variable: potential of the university (PU)

Standard errors are shown in parentheses; asterisks indicate the level of statistical significance of the p-value, respectively: *** p <0.01, ** p <0.05, * p <0.1

Source: authors' calculations

The model for the graduate's labour market situation (RP, figure 3) was very well fitted for all variables included in the study, i.e. P1_26 - unemployment risk, P1_34 - relative unemployment, P1_19 - time to find a job, P1_164 - relative salary value, D_S - difference between the average salary of a graduate and the average salary in the sector. It has a high coefficient of fit (CD>0.8) and satisfactory values of the CFI, TLI and chi-square parameters, which proves the validity of using the selected parameters in the analysis. Therefore, in this case, it was not necessary to eliminate the data by the method of successive steps. Three of the observed variables obtained factor loadings above 0.3, with the highest and negative one for the 'relative salary

value' variable (the D_S variable can be interpreted similarly). This negative direction of the relationship contradicts the authors' assumptions. In an attempt to explain this phenomenon, it can be assumed that high wage rates are an obstacle to finding a job and improving the situation of graduates. In industries where wages are lower, it is easier to find employment and earn an income. Schnabel (2016) points out that getting a lower salary at the beginning of one's career can be a good strategy for finding a job, if the job serves as a 'springboard' for higher earnings in the future. Gabe et al. (2018) take the same view, but with the caveat that this applies to workers with higher levels of education. Young, educated, urban workers quickly move to better paid jobs (Richardson and Miller-Lewis, 2002). Durán and Biletta (2016) use the term 'tool to combat unemployment' on low wages. It may be worth considering the issue of graduates' inflated expectations of their earnings immediately after graduation.

On the other hand, the positive signs of the loadings for the variables 'risk of unemployment' and 'relative unemployment' (also opposite to the assumptions, although the values of the loadings below 0.3) may be due to the fact that the occurrence of these phenomena in the labour market may provide the impetus for a more intensive job search and thus improve the situation of the graduate. This aspect is pointed out by Altmann et al. (2015) and Abraham et al. (2017). On the other hand, the positive sign for the variable describing time to find a job can be explained by the fact that those graduates who took longer to find employment were in a better position in the market. Findings from the analysis of van Hooft et al. (2021) confirm the role of job search intensity in achieving success in obtaining satisfactory employment. The support of mentors can be an additional asset for earlier success in the labour market among graduates. Research conducted in this regard confirms that the assistance of such individuals shortens the job search time, allows to obtain satisfactory and well-paid employment, with fewer interviews (Antonelli et al., 2018).

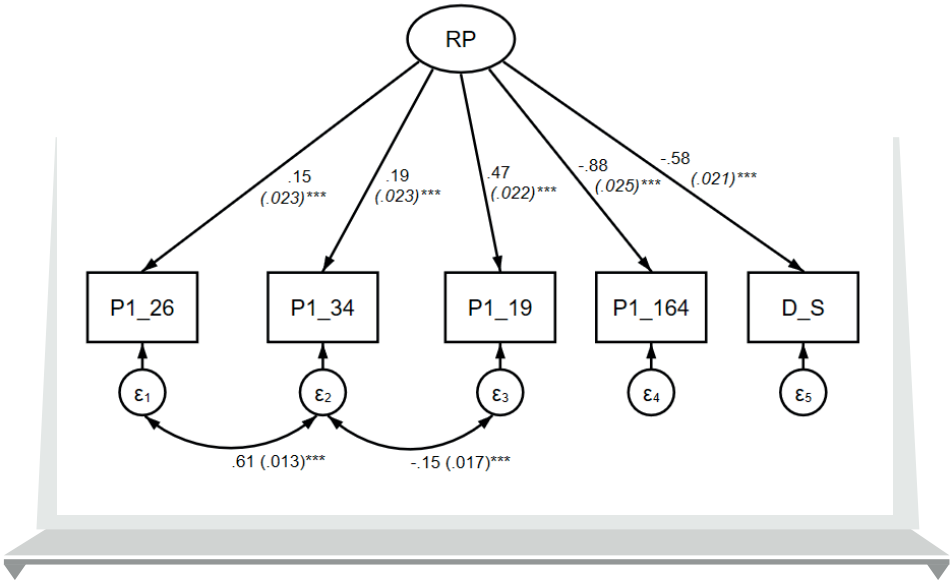

Figure 3. SEM-CFA model for the latent variable: situation of the university graduate in the labour market (RP)

Standard errors are shown in parentheses; asterisks indicate the level of statistical significance of the p-value, respectively: *** p <0,01, ** p <0,05, * p <0,1.

Source: authors' calculations

After constructing two statistically valid models for each latent variable, a SEM model was constructed combining parameters describing the graduate's situation in the labour market and the potential of the university. The final model used 2,318 observations. The diagram of the model is as follows:

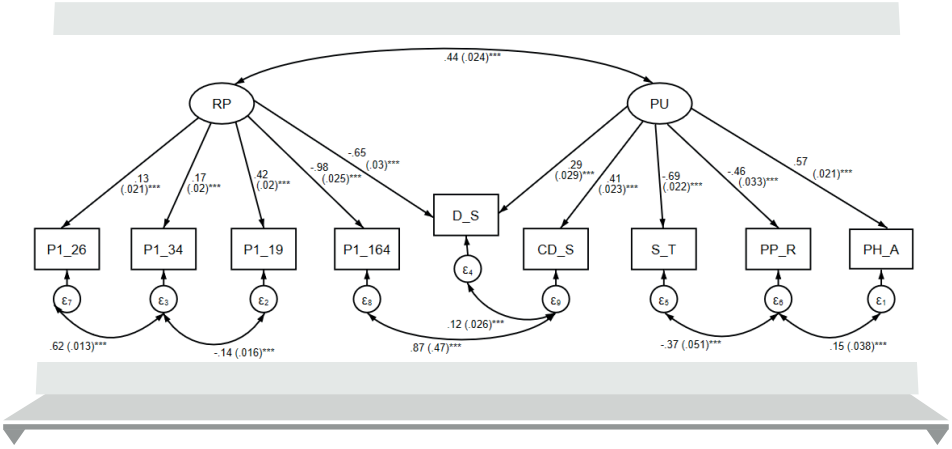

Figure 4. Combined SEM-CFA model for the efficiency of higher education institutions

Standard errors are shown in parentheses; asterisks indicate the level of statistical significance of the p-value, respectively: *** p <0,01, ** p <0,05, * p <0,1

Source: authors' calculations

The model presented here distinguishes two unobservable variables related by correlation, for which there is a shared observable variable - here the D_S indicator. In the process of building the model, measures describing the ratio of teaching teachers to research staff and the ratio of students to graduates were rejected. They turned out to be statistically insignificant for models that achieved convergence (convergence), or their introduction disturbed the models so much that the numerical algorithm was unable to determine the optimal parameters. The final model has a very high goodness of fit, with a coefficient of determination of almost 96%, a rare occurrence in the social sciences. In an interpretive sense, the correlation between the PU and RP latent variables is important. Its positive and higher than 0.3 value confirms the hypothesis that there is a positive relationship between the university's potential and the labour market situation of graduates. This is an important argument in favour of shaping the university's potential, in particular, increasing spending on improving the quality of teaching, improving the qualifications of university teachers (through academic promotions), lowering the ratio of students per teacher, reducing the pressure to earn points for publications (according to the

rule, fewer publications are better, but more valuable). It is noteworthy that satisfactory values of loadings greater than 0.3 were obtained for all these variables. As in the single model, the combined SEM confirms the assumptions made earlier about the direction of the relationship. From the correlations between the observed variables, one can point to a negative relationship between the number of students per teaching FTE (full-time teaching position) and the number of publication points, which seems understandable - an increase in teaching load reduces the number of publications. In turn, an increase in the proportion of employees with higher degrees increases the number of publications (although here the factor loading is below 0.3). The link between the D_S variable and the latent variables is also interesting. On the one hand, an increase in a school's potential is associated with a higher graduate's salary compared to the average salary in a given sector of the economy (which was also proved by, inter alia, Navracsics, 2019; European Commission - Joint Research Centre, 2019 and Agencia Ejecutiva en el Ámbito Educativo, 2020). On the other hand, a high gap between these salaries worsens the graduate's situation in the labour market (as written about earlier). There is also a positive relationship between teaching expenditures (which shape a school's potential) and a graduate's relative earnings in the first year after graduation, although too high a salary expected by graduates can worsen their situation on the labour market.

The model results can be compared to the work of other authors. Thus, Elamir (2020) indicates a positive relationship between the quality of education and management of universities and the efficiency of the labour market. The potential of higher education depends, among others, on the scope of staff training, and the effectiveness of the labour market is a result of the ability to attract talent, salaries, cooperation in employee-employer relations and professional management. Machin and McNelly (2007) proved more than 15 years ago that there is a positive correlation between education and the level of graduates' earnings and the ability to find a job. According to the authors, in most of the countries studied there was a wage premium associated with tertiary education, despite an increase in the supply of graduates. At the same time, they emphasize that the amount of the salary premium may result from the quality of the educational institution, although it is difficult to separate the impact of the university's potential from the fact that students with very different characteristics may choose different types of institutions. Later studies (e.g. Baum et al., 2013; Autor, 2014) confirmed the existence of a positive relationship between higher education and wage rates and obtaining a more attractive job

position, although they also pointed to the growing difficulties of employers in finding graduates with appropriate skills in certain areas (Holzer, 2013; Salzman, 2013). Lauder and Mayhew (2020) point out the imperfections of the labour market in offering a sufficient number of jobs in the conditions of a growing supply of graduates. They indicate that this situation is not only the result of an imbalance in demand and supply, but also of higher education institutions themselves, which have lost their original mission and have become more and more a "factory" of students, with low quality courses and teaching. For many graduates, higher education converts into a wasted investment, and the costs of this waste can be reduced by increasing the potential of universities, financially supported by state policy. As Kinash et al. (2017) noted in their research, during studies most students are pessimistic about their career outcomes and feel largely unsupported in identifying suitable career goals. On the other hand, the failure of the labour market to provide appropriate employment conditions (pay, flexibility) may result in an outflow of highly qualified candidates, e.g. towards countries with more attractive labour markets, which was observed in the post-socialist European countries (Milovanovitch et al., 2023; Ostoj, 2015). Therefore, as emphasized in the report of the International Labour Organization (2016), the government's strategy in creating high-quality education and an effective labour market is of key importance. In addition to the positive effects at the individual level (easier access to employment, better working conditions and remuneration, other benefits), higher education capacity combined with sufficient opportunities for productive employment can have a positive impact at the national level, promoting inclusive economic growth and helping to reduce income inequality. Increasing the employment of highly educated people also has a positive impact on the GDP growth rate and the level of expenditure on research and development (R&D sector), as proven by Krajnakova et al. (2020). Moreover, education has spill-over effects: human capital is at the heart of innovation, and a more educated workforce fosters innovative ideas leading to more and better jobs (OECD, 2023). Promoting higher levels of education should remain a priority in countries where a large proportion of the workforce is unskilled and where there is a mismatch between the supply and demand for skilled labour. Although a high level of education does not completely protect against unemployment, it generally reduces the time needed to look for a job and facilitates access to professions that are not available to low-educated people. In this context, the attitudes of educated people are also important as they shape their expectations regarding potential work and the tendency to compromise.

5. Conclusions

The results of the analysis indicate that there is a positive relationship between the potential of the university and the situation of the graduate in the labour market. A better functioning higher education model should provide university graduates with more attractive employment conditions in terms of salaries, contract flexibility and time to look for a job. The conclusions from the modelling are basically consistent with the authors' expectations and the results of previous work by other authors, as demonstrated in the discussion part. As the publication puts the main emphasis on the quality of higher education institutions (the topic of labour market efficiency is not the subject of the analysis), a set of recommendations can be created to improve the potential of these entities. They include the implementation of the following objectives: increasing the unit expenditure on student teaching, increasing the share of employees with academic titles in the educational process, reducing the number of students per lecturer, reducing the burden of the number of publications (reducing the so-called pursuit of credits). Achieving these goals necessitates both a revision of the state-level higher education development strategy and reforms in university management. Unfortunately, reports from the Supreme Audit Office (an organ of the Polish state) highlight widespread inertia in both areas (NIK 2015, 2016, 2021). Issues include delay in the implementation of the state's science policy, implementation of new funding rules, inconsistencies in the awarding of government grants, shortcomings of universities in the system in the area of legislation (development strategies that are not adapted to economic reality, constantly changing reporting regulations), adaptation of educational programs to the labour market, implementation of information systems and documentation workflow. Intra-university dynamics and emerging tensions among academic, administrative, and student spheres warrant further investigation in this area.

The model presented here proves that it is possible to use quantitative methods to comprehensively address the effectiveness of state-funded higher education, which is the value added of this publication. Such modelling should complement the qualitative description of the education system's functioning. It provides an opportunity to build scenarios for improving this system, thus making it more competitive with private education, as well as corporate forms of education and qualification. Additionally, it is useful in adapting the functioning of higher education units to meet the requirements of the economy, specifically the labour market. Improving the institutional efficiency of higher education institutions is

key to developing human capital and fulfilling the social functions of education. The advantage of SEM modelling used in the article is that, in addition to examining the relationship between the university's potential and the graduate's situation on the labour market, it provides an answer to the question about the variables shaping this potential and the labour market. Such a comprehensive approach has not been common in the researched topic so far, hence the work fills a gap in the area of education quality management and labour market efficiency.

Two limitations can be pointed out in the current work. The first relates to the static nature of the research. The data relates to the selected period for which the evaluation was conducted. Updating this information to illustrate process dynamics would be advisable but requires awaiting the availability of more recent data, which typically lags behind by several years. The second limitation relates to the holistic view of the higher education system, without dividing it into types of universities. A classification based on university types (e.g., technical universities, medical universities, economic universities) could reveal variations in outcomes. While not feasible within the scope of this publication due to space constraints, such classification is planned for future research by the authors.

Abstract:

The aim of this publication is to assess the relationship between the effectiveness of university management and the graduate's position on the labor market. The implementation of the goal serves to verify the following hypothesis: the higher the effectiveness of educational institutions, the better the graduate's position on the labor market. Additionally, two specific goals were adopted: 1) identification of variables important for shaping the university's potential and the direction of their influence; 2) identification of variables important for shaping the graduate's position on the labor market and the direction of their impact.

The study used a structural equation modeling (SEM) approach, which perfectly relates observable variables to difficult-to-measure variables. The data concerns Poland and comes from the Scientific Achievement Assessment System and the Graduates' Economic Career Monitoring System. As a result of the analyses, it was confirmed that there is a positive relationship between the university's potential and the situation of graduates on the labor market. It was also shown that the factors influencing the

improvement of the university's potential, which should be taken into account in the management process, are the following variables: expenditure on teaching activities and the share of the number of teachers with academic degrees in the total number of teachers. In turn, the improvement of the situation of graduates on the labor market is determined primarily by the extension of the average time of looking for a job.

Keywords: *labour market, higher education institutions, relations, management efficiency, SEM modelling.*

JEL Codes: H0, H4, H6, I2, J5.

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