EDUCATIONAL EFFECTS ON THE LABOR MARKET
IN POLAND: DATA ANALYSIS AND MODELLING

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Although a higher student enrollment in Poland is a pro-growth factor, it is not ruled out that it contributes to a higher unemployment through one of three channels such as: (i) negative productivity effects, (ii) excessive administrative regulations, (iii) educational mismatches. In turn, educational mismatches could be a result of the "wrong" field of study choice, lack of proper competences (skills) or over-education. Our study reveals that the expansion of students on humanities, economics/business and engineering fields of study could be one of the reasons behind higher unemployment rate, but this is not the case for science/mathematics studies. The most important aspects of modeling of labor market educational effects are discussed in the context of the graduates career path monitoring project.

Keywords: unemployment, higher education, educational mismatch, 2SLS and VAR estimates, career path monitoring

1. Introduction

Since the beginning of 1990s there had been a significant increase in the number of students and university graduates in Poland, especially in the field of economics and business. Both outcomes have been given a predominantly positive assessment [9, p. 70; 23], though critical views on the situation in the national tertiary education system are not lacking too [13, pp. 34−41; 19]. As higher education institutions (HEIs) in Poland are often referred to as „unemployment factories"

[11] or „straight roads to unemployment” [12], it does not necessarily imply an excessive supply of university graduates or worsening of the quality of education, as suggested as early as in 2001 [23, p. 65]. An unpleasant direct link between the number of students and unemployment could be justified on many grounds such as (i) the choice of „wrong” field of study, (ii) overeducation (graduates take positions which do not require all of their qualifications), or (iii) the lack of proper competences (skills). All kinds of educational mismatches mentioned above potentially blur an expected positive relationship between higher education and labor market outcomes, leading to significantly lower gains from education as the most important component of human capital. Although there is a vast literature on labor market returns to different *levels* of education, the labor market effects of different fields of study are given much less attention in international studies [2, p. 423; 20], not to mention Poland's ones.

In this article, unemployment effects of student enrollment across fields of study are estimated for Poland with the use of 2SLS and VAR methods. Our main result is that only graduating from the science/mathematics field of study is associated with a decrease in the unemployment rate. The structure of the paper is as follows. Section 2 provides a brief survey of the relevant academic literature. Section 3 describes the data and statistical model. Section 4 provides the empirical results of unemployment effects across several fields of study, namely humanities, economics/business, engineering and science/mathematics. Based on the empirical results, Section 5 puts forward arguments in favor of a computer-based platform for graduates' career path monitoring as a useful tool for elimination of educational mismatches. Section 6 summarizes the main findings and concludes.

2. Literature survey

As highlighted in the *Report of education 2010* [20, pp. 19─34], it is not clear whether a higher student enrollment has been affecting quality of education, personal income, labor market and social integrity. The United Nations Development Programme (UNDP) experts claim that the supply of university graduates since the beginning of 1990s has been well in excess of the demand for high-skilled labor, resulting in relatively high unemployment among university graduates [6]. Foldvari and van Leeuwen [7, pp. 5─20] remark that a steep increase in the student enrollment in the Central and East European countries has not always been met with stronger demand for labor and higher effectiveness of HEIs. However, it is reported by the World Bank experts that even during the recession university graduates used to be in a better position compared with persons with lower level of education due to higher flexibility and ability to continue education [24, pp. 12─13]. Assuming high unemployment rate and rather low labor market participation rate, it was assumed that in line with an increase of knowledge-related employment opportunities

in Poland, as it was the case in industrial countries, the share of low-skilled labor was likely to decrease.

As argued by Jarecki [9, pp. 69─82], a higher student enrollment not only brings about a stronger competition on the labor market, but it contributes to higher productivity as well. Other potential benefits include higher levels of labor market participation, culture, democracy etc. Orczykowska [18, pp. 49─64] claims that it is not the number of university graduates that matters but a match between education standards and labor market demand. Being an unemployed person for quite a long time could be an indicator that competences acquired during higher education studies do not match the structure of labor market demand; consequently, the unemployment rate reflects not only aggregate demand for labor, but its structural components as well [20, pp. 244─246].

Assuming that that general education is always demanded before specific education [8, p. 391], it is possible to conclude that humanities have an advantage in the economy which is on a transition path, being characterized with a lower demand for labor in the industry. Bertocchi and Spagat [3, pp. 559─582] similarly argue that the fraction of the population in vocational secondary education has declined steadily in most of the post-war Europe. However, an excess supply of students in the humanities and economics fields could be a source of structural mismatch, being responsible for either lower individual returns on education, or disappointing relationship between student enrolment and output growth. Using data of 22 European countries, Reimer and Noelke [21, pp. 233–256] establish that relative differences in the employment effects between different fields of study increase with educational expansion at the university level, with degree-holders from humanities having higher risk of unemployment.

Lin [14, pp. 355─371] obtained that an increase in the number of students on humanities, literature and art fields of study has a negative impact on real earnings, suggesting a less favorable relationship with the unemployment rate, but all coefficients are not statistically significant at the 10% level. On the other hand, a percentage point increase in the number of graduates from economics/social, agricultural and engineering/science fields contributes to economic growth by 0.04, 0.07 and 0.09%, respectively. Klein [10] found for Germany that the lack of occupational specificity is partly responsible for difficulties in labor market entry of graduates from "soft fields" such as humanities or social sciences, which are considered as less academically challenging as well.

Nunez and Livanos [17, pp. 475–487] established for EU15 countries that graduates from such fields of study as education, engineering, health/welfare and services/tourism are likely to avoid the short-term unemployment. Sciences, biology/environment, computer sciences and health/ welfare provide with best opportunities to stay employed in the long-run. For the graduates of engineering, a higher probability of the long-term unemployment may be explained by (i) strong geo-

graphical dispersion of the industrial sector or (ii) expansion of the tertiary sector combined with the globalization of manufacturing. It is found by Livanos [15, pp. 473─489] that graduates from polytechnics and computer science are better off in the Greek labor market, while graduates of social sciences face poor employment prospects. For Italy, Buonanno and Pozzoli [5, pp. 559─588] and Ballarino and Bratti [2, pp. 421─457] established that employment probability and earnings are better for graduates from such "quantitative" fields, as sciences, engineering and economics. Böckerman *et al.* [4] found that wage and employment levels for Finnish graduates are higher in the field of business and administration, while being much smaller and usually insignificant in other fields of study.

As similar empirical studies on relationship between number of students across fields of study and unemployment are lacking for transformation economies, this study is supposed to fill this gap at least to some extent for Poland.

3. Data and statistical model

Our regression model is a standard unemployment rate equation (in first differences), in the fashion of the familiar Okun's law specification:

$$\Delta UN_t = \beta_0 + \beta_1 \Delta UN_{t-1} + \beta_2 \Delta Y_t + \beta_3 \log EF_t + \varepsilon_t, \tag{1}$$

where UN_t is the unemployment rate (% of GDP), Y_t is the output, EF_t is the number of students on the particular field of study, ε_t is the stochastic factor, and Δ is the first difference operator.

Based on the ISCED-97 classification, the *field of study* is coded into four categories: humanities, economics/business, engineering and science/mathematics. The humanities field includes students studying journalism, welfare services, social sciences and education. Besides technical studies, the engineering field includes biology, food processing, architecture and construction, environmental studies, transport and security services. The science/mathematics field includes students studying mathematics, physics and computer sciences.

Changes in the unemployment rate are supposed to be inertial ($\beta_1 > 0$), and inversely related to the GDP growth rate ($\beta_2 > 0$), as it is implied by the well-known Okun's law. Changes in the unemployment rate effects of the field of study choice are likely to be predominantly positive ($\beta_3 < 0$), but either neutral ($\beta_3 = 0$) or even negative effects ($\beta_3 > 0$) are not ruled out as well.

Visual inspection of the GDP growth and unemployment rates time series does not contradict the inverse relationship in the fashion of the Okun's law (Fig. 1), as it is established by Shevchuk [22, pp. 75─90], though the implied asymmetry is not straightforward. For example, a recovery in GDP growth over the 2002─2004 period had coincided with an increase in the unemployment rate. Similar develop-

ments are observed in 2010 and 2011, providing ground for the jobless growth hypothesis, as it was common in the analysis of the 2001—2003 period.

Number of students in the humanities field had been increasing till 2006, but since then it is on a decline (Fig. 2). Economics and business is the second largest group of students, witnessing a steep increase since the middle of 1990s till the end of decade. However, the number of students in this field of study has been decreasing over last ten years. Engineering has been attracting more students over last few years, probably reflecting important shifts in the demand for labor, though supply considerations should not be downplayed as well. The science/mathematics field of study is characterized by a steady downward enrollment trend since 2005.
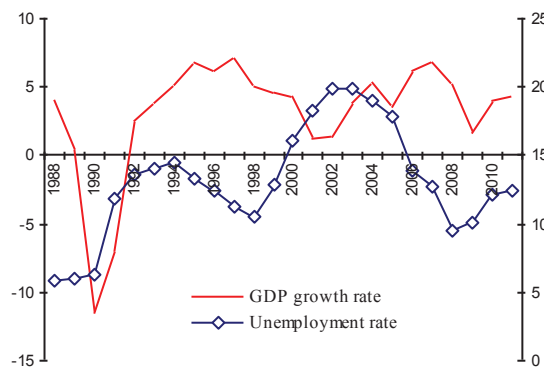
Figure 1. Poland: the GDP growth and unemployment rates (%), 1988—2010.
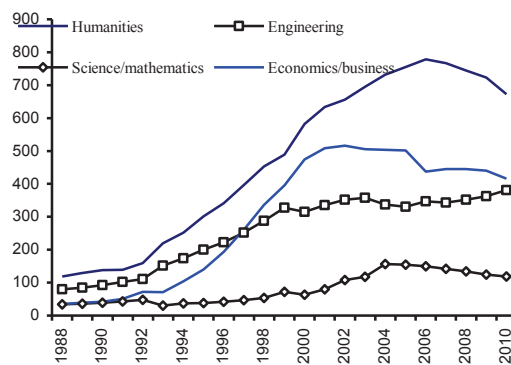Source: IMF International Financial Statistics

Figure 2. Poland: number of students across fields of study, 1988—2010.
Source: the Poland's Central Statistical Office (GUS)

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4. Empirical results

As presented on Fig. 1 and 2, annual data for the 1988–2010 period used in this paper is from the Poland's Central Statistical Office *Statistical Yearbooks of the Republic of Poland* for various years and from the IMF *International Financial Statistics* online database.

Our 2SLS estimates for individual fields of study effects on the unemployment rate are as follows:

a) humanities

$$\Delta U_t = \underset{(-2.44^{**})}{-0.218\Delta Y_t} \quad \underset{(-2.56^{**})}{+0.443\Delta U_{t-1}} \quad \underset{(1.81^{***})}{+0.356\,SH_t},$$
$$R^2 = 0.33 \quad DW = 2.09 \quad ADF = -5.12^* \tag{2}$$

b) economics/business

$$\Delta U_t = \underset{(-2.87^{**})}{-0.358\Delta Y_t} \quad \underset{(2.64^{**})}{+0.499\Delta U_{t-1}} \quad \underset{(2.37^{**})}{+0.649\,SE_t},$$
$$R^2 = 0.45 \quad DW = 1.41 \quad ADF = -3.26^{**} \tag{3}$$

c) engineering

$$\Delta U_t = \underset{(-2.57^{**})}{-0.231\Delta Y_t} \quad \underset{(2.43^{**})}{+0.419\Delta U_{t-1}} \quad \underset{(1.70^{***})}{+0.450\,ST_t},$$
$$R^2 = 0.35 \quad DW = 2.19 \quad ADF = -5.36^* \tag{4}$$

d) science/mathematics

$$\Delta U_t = \underset{(4.53^*)}{2.506} \quad \underset{(-4.90^*)}{-0.470\Delta Y_t} \quad \underset{(1.18)}{+0.182\Delta U_{t-1}} \quad \underset{(-1.53)}{-0.857\,SS_t},$$
$$R^2 = 0.60 \quad DW = 1.74 \quad ADF = -3.56^{**} \tag{5a}$$

$$\Delta U_t = \underset{(5.50^*)}{2.805} \quad \underset{(-5.18^*)}{-0.498\Delta Y_t} \quad \underset{(-2.24^{**})}{-1.159\,SS_{t-3}}.$$
$$R^2 = 0.60 \quad DW = 1.57 \quad ADF = -3.22^{**} \tag{5b}$$

All regression models have a coefficient of determination R^2 ranging from 0.33 to 0.60, which is high enough by the standards of the typical first differences specification. The ADF test allows to reject the hypothesis that there is a unit root in the residuals at the 5% level of statistical significance.

It is apparent from equations (2)–(4) that an increase in the number of students in the fields of humanities, economics/business and engineering is associated with a higher unemployment rate. Only higher enrollment in the science / mathematics field has a favorable effect on unemployment. Such an outcome is more

eloquent in the specification (5b) where an autoregressive term ΔUN_{t-1} is dropped. Our results could mean that there is an excess demand for graduates from fields with a strict „quantitative" content. Also, it is possible to argue that graduates from the science/mathematics field could induce a self-sustaining demand for labor, which becomes a main cause of the favorable education-unemployment relationship. In a wider analytical context, a higher student enrollment could bring about an increase in the unemployment rate through negative productivity effects, for example due to prestige considerations or exaggerated expectations of future earnings, or excessive administrative regulations on the labor market, which prevent university graduates in the "soft" fields of study from obtaining jobs which are relevant to their academic credentials. Though a detailed analysis of these issues is beyond the scope of this study, recent government initiative to deregulate as many as 91 professions is a clear sign that the problem has been noticed.

For all regression models, it is confirmed that a higher GDP growth rate is a key factor of a decrease in the unemployment rate. Coefficients on ΔY_t range from -0.218 to -0.438, suggesting that strength of the growth–unemployment causal link could be dependent upon educational variables, as university graduates used to represent a human capital input in the production function.

As the level of unemployment rate and educational variables are not cointegrating, the VAR model is used for the purpose of checking out for the robustness of our results:

$$Y_{i,t} = \Gamma_1 Y_{i,t-1} + \dots + \Gamma_k Y_{i,t-k+1} + \Psi X_t + \varepsilon_t, \qquad (6)$$

where Y_t is the vector of dependent variables, X_t is the vector of independent variables, and ε_t is the stochastic factor. The VAR model allows for the two-way causality between dependent variables, with no need for elaborate theory-based simultaneous equations models. We use a simple VAR model with the field of study-specific number of students and unemployment rate as dependent variables.

Impulse-response functions (responses of the dependent variable to one standard deviation structural shocks) and the variance decomposition (contributions of each structural shock to the real output conditional variance) are shown in Fig. 3. It is confirmed that higher enrollment in the humanities and economics/business fields of study contributes to unemployment. Similar causal link is observed for engineering, but in this case it is likely to expect a gradual phasing out of the initial shock in six years. Only studying at the science/mathematics field brings about a favorable decrease in the unemployment rate, with the share the decomposition of residuals of the unemployment rate approaching 40% over six years time span. Similar pattern is observed for humanities and economics/business fields of study. Higher share of engineering students in the residuals of unemployment is rather disturbing as it could be a sign of insufficient demand for this kind of labor force.
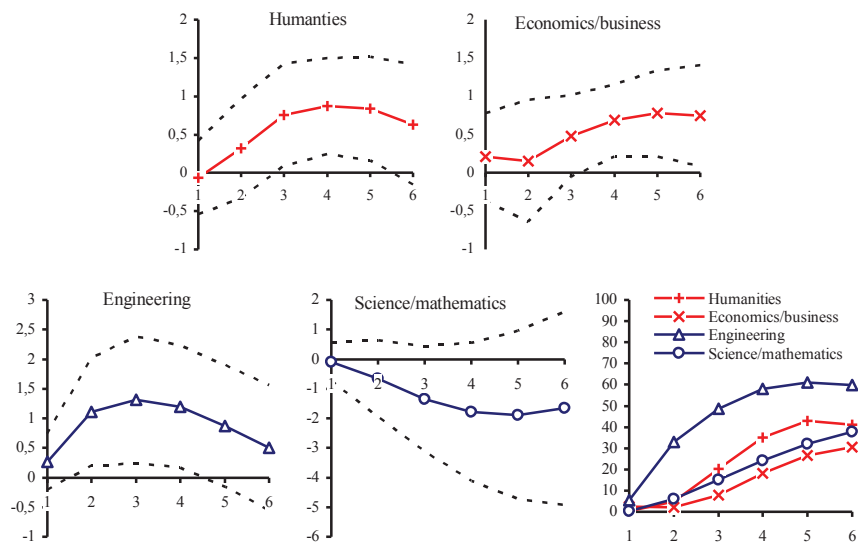
a) number of students effects on the unemployment rate
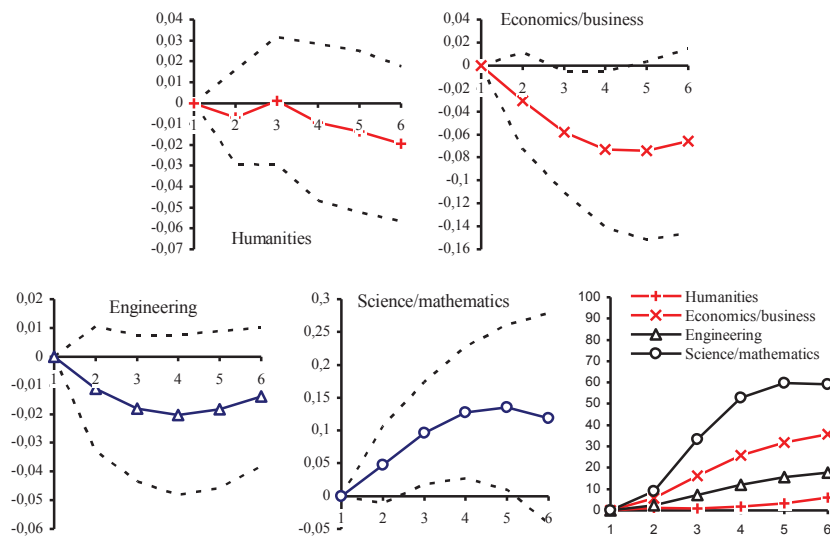
b) unemployment rate effects on the number of students

Figure 3. Impulse responses of the unemployment rate and number of students (VAR)
Note: the solid line is the point estimate, while the dotted lines represent a one-standard error confidence band around this point estimate

The unemployment rate does not affect the number of students in the humanities field, but it causes a decline in the number of students in the economics/business and engineering fields of study. At the same time, higher unemployment contributes to an increase of students in the science/mathematics field. Thus periods of high unemployment are associated with a higher enrollment   in the science/mathematics field, while in turn it contributes to a decrease in the unemployment rate. Two-way causality is different for economics/business and engineering studies, as an increase in the unemployment rate results in a decline in the number of students on both fields of study, which is a factor behind lower unemployment. As indicated by the decomposition of variance, the share of unemployment rate in the demand for studying science/mathematics is very high at 60% in the long run. This indicator is much lower for economics/business and engineering fields of study.

5. Potential effects of the graduates' career path monitoring

Our study indicates that concerns about a possible negative relationship between expansion of the educational system and unemployment are justified. As three out of four fields of study are associated with an increase in the unemployment rate, it could be viewed as a sign of serious educational mismatches. Such a situation strengthen motivation in favor of monitoring of the graduates' career path as an instrumental tool for adjustment of demand and supply of university graduates on the labor market.

Monitoring of graduates' career paths should be helpful in identification of the root causes of educational mismatches such as: (i) the choice of the „wrong" field of study, (ii) insufficient level of acquired competences, and (iii) over- or undereducation. As for Poland, an excessive enrollment in the humanities and economic/business fields of study can be considered as one of the reasons behind high unemployment rate. However, a similar negative unemployment effect of the engineering field of study is likely to indicate the mismatch of competences (skills). Even having chosen the „correct" field of study (science/ mathematics) and obtaining all necessary competences at the proper university, unemployment of the university graduate could result from overeducation. Similar effects of undereducation are easier for analytical interpretation, but even in this case it is difficult to distinguish between two different causes of unemployment, i.e. a high demand for specific high-skilled labor or low quality of higher education.

Graduates' career path surveys have proved their efficiency in Italy, having been practiced since 1994. Such surveys are aimed not only at monitoring of the labor market entering for university graduates, but at other activities in a wider context as easier access to working places, studying of labor market requirements for labor force, verification of study programs, providing necessary information

during the choice of the field of study according to the situation on the labor market, enhancing of the cooperation between universities and business, monitoring of educational and labor market reforms [16, pp. 168−178]. One of the most important latest results is that the labor market requires not so much field-specific knowledge, but skills of retraining and lifelong education.

One of the biggest obstacles in conducting surveys of graduates career path is the lack of proper understanding of potential benefits by university graduates. Another challenge is the need of creating a unified system of career path surveys for all HEIs. Existing system of data collection about university graduates in Poland does not provide necessary information on the match between acquired education and workplace requirements, being fragmented and episodical if compared with other European countries [1]. It is not possible to assess the structure and scale of the mismatch between university-thought competences and those ones expected by the employers. GUS Report *Economic Activities of Population* presents data on the scale and types of on-the-job training. As of the beginning of 2011, male university graduates formed 16% of those who took various types of professional training, with the relevant number for female graduates stood at 21%. However, the report does not include any explanations for specific reasons leading to on-the-job training decisions by university graduates, which may include retraining (acquisition of new competences not related to the previous field of study) or improvement of acquired competences. Pilot survey of university graduates with five years after graduation under auspices of HEGESCO (Higher Education as a Generator of Strategic Competences) 2009 project (this project had been coordinated in Poland by the Institute of Economics, Sociology and Philosophy at the Cracow Technical University over the 2008−2010 period) supports the assumption that on-the-job training aimed at improvement of the level of acquired competences had been expanding. Up to 69% of respondents reported that they had participated in various on-the-job training programs during a few months before the survey was conducted (an average for the UE is 62%), and 44% of graduates claimed that their job positions required different competences than those acquired during the university studies.

Obtaining proper knowledge about labor market evaluation of university graduates' competences across different fields of study is of strategic importance for the Poland's HEIs. As it is stipulated by the Law 2011/84/455 of March 18, 2011, all universities and other HEIs are obliged to monitor their graduates' career developments. Although there is a legal requirement of conducting at least two surveys on the same sample of graduates for 3 and 5 years after graduation in order to *achieve a better match between student enrollment across fields of study and university majors and labor market requirements*, neither methodology nor applied procedures for such monitoring of graduates are specified.

Based on the precise identification of existing and potential educational mismatches (regardless of whether they are caused by over- or under-education), HEIs

are able to introduce necessary amendments to study programs, being aimed at reorganization of academic activities. Identification of actual strong and weak points of academic teaching at a particular HEI, which are crucial in determination of success at the labor market, is a necessary step in the process of achieving higher quality of education and better match with the labor market requirements. A necessary pre-condition for effectiveness of graduates' career path surveys is an active involvement of employers into the process of a detailed definition of required (specialized) competences, which are instrumental for implementation of enterprise development strategies. Only a modern computer-based decision-support system that includes automated sending of survey questionnaires and data processing of the replies from university graduates over different spans of time can provide with a convenient opportunity to introduce necessary (and timely) modifications of the teaching programs and procedures so that they can meet labor market requirements of the modern knowledge-based economy.

All said, it is a very timely decision by NCBiR to start in 2012 an innovative research project „Monitoring of graduates' career path as the road to success of the XXI century higher education institution" POKL 04.01.01-00-246/11, which is co-financed by the EU Cohesion Fund within the 4.1.2 Human Capital Operational Program. The Electronic Platform for Competence Analysis (EPCA) is supposed to be the final product of the project, with a potential to create the truly „early warning" system for existing and potential educational mismatches on the Poland's labor market and in the higher education system. Project has been prepared and will be realized by the Institute of Economics, Sociology and Philosophy and the Institute of Informatics at the Department of Physics, Mathematics and Informatics at the Cracow University of Technology.

6. Conclusion

Based on the annual 1988–2010 dataset, it is established that educational expansion could be responsible for a higher unemployment rate in Poland. Either 2SLS or VAR estimates report that an increase in the number of students on humanities, economics/business and technical fields of study is responsible for a higher unemployment rate. Only studying science/mathematics is associated with a favorable decrease in the unemployment rate. A clear pro-unemployment bias of Poland's higher education could be explained not so much by an excessive supply of university graduates, as by educational mismatches of several types referring to the choice of the field of study or acquired skills. In order to identify the causes of a negative relationship between the number of students and unemployment across the majority of the fields of study, wide-scale university graduates' career path surveys are needed in Poland. A convenient computer-based platform for monitoring of career paths is being developed at the Cracow University of Technology as a

joint research project by the Institute of Economics, Sociology and Philosophy and the Institute of Informatics.

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