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A SIDE EFFECT OF A UNIVERSITY BOOM: RISING INCIDENCE OF OVEREDUCATION AMONG TERTIARY-EDUCATED WORKERS IN POLAND

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A side effect of a university boom: rising incidence of overeducation among tertiary-educated workers in Poland

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Abstract

This paper analyses changes in overeducation incidence in Poland in 2006-2014. We find that a rise in number of tertiary educated workers outpaced an increase in number of jobs requiring tertiary education, in result the share of overeducated workers in total employment almost doubled. Overeducation increase is driven mainly by mild overeducation rather than severe overeducation. We find that overeducated workers are usually young with little job experience. Women are found at lower risk of severe overeducation compared to men, but relatively more at risk of mild overeducation. Low risk of overeducation is associated with having studied technical and health programmes. Working part-time, in small firms, in private sector, and living outside big cities in less developed regions are associated with higher risk of overeducation.

Keywords:

overeducation, education mismatch, tertiary education

JEL:

I21, J21, J24

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1. Introduction

Poland experienced a substantial increase in number of tertiary educated workers. Between 1992-2014 the share of tertiary educated workers rose from 10.0% to 32.5%. The change was even more pronounced for workers aged 25-34: from 9.8% in 1992 to 47.2% in 2014. This immense expansion of tertiary education raises question whether it was accommodated by the labour market. There is a lot of anecdotal evidence suggesting that graduates increasingly take up jobs that do not require tertiary education. Though, the scientific evidence remains scarce in this matter. This article aims at filling this gap.

In the article we report incidence of overeducation among tertiary educated workers in Poland in 2006-2014. To identify overeducated workers we use rather rare approach based on employers' declarations what education level is required to perform jobs. This information is obtained from Balance of Human Capital (BKL) survey. To our knowledge it is the first time that BKL data are used in the analysis of overeducation. Moreover, we identify and discuss characteristics of overeducated individuals.

The structure of the paper is as it follows. Part 2 briefly reviews the literature on overeducation. Part 3 presents our approach to identify overeducation. In part 4 we report changes in incidence of overeducation in working population in Poland. In part 5 we build an econometric model identifying characteristics of overeducated versus properly-matched tertiary educated workers. Finally, the summary concludes main findings of our analysis.

2. Literature review

The overeducation has been attracting researchers' attention since 1976 with publication by Freeman (1976) who presented the evidence for the US that rising number of university graduates was followed by deterioration of tertiary education wage premium. Since then, analysis of overeducation has evolved into a separate branch of economic research that aims at answering questions about extent of overeducation, wage returns to overeducation and the persistence of overeducation. McGuinness (2006), Quintini (2011), Leuven and Oosterbeek (2011) provide excellent literature reviews in this matter. Although overeducation is a well-established notion in the economic literature, studies directly addressing overeducation in Poland are still scarce.

Strategies to identify overeducation constitute a distinct issue in the literature on overeducation. They are usually grouped into four approaches: direct subjective approach, indirect subjective approach, job analysis approach and realized matches approach. The direct subjective method is based on individuals' self-assessment whether they think they are mismatched in respect of their education level. In indirect subjective method individuals are asked about the education level that is needed in a given occupation and then this information is compared with education actually possessed by workers. In job analysis approach occupations are assigned with certain education level based on experts' assessments. Finally, according to realised matches approach, individuals are overeducated if their educational level is above modal / mean educational level calculated for their occupation. However, this listing is not exclusive. For instance, approaches proposed by Chevalier (2003), who combines objective and subjective information to identify what he calls 'apparent overeducation', or Gottschalk and Hansen (2003), who use combined information on share of college graduates within occupations and college wage premia, fail to suit well in this four-approach taxonomy.

Choice of approach might affect results. Groot and Maassen van den Brink (2000) and Verhaest and Omey (2006) show that a realised matches approach gives significantly lower estimates of incidence of overeducation compared to other approaches. Even if the numbers of overeducated individuals are similar, approaches might very differently indicate who is overeducated. Verhaest and Omey (2006) report that correlation between different approaches varies from 4% to 72%.

Each overeducation identification method faces either conceptual or practical limitations. Approaches based on subjective assessments are vulnerable to a bias resulting from workers' misperception. The realised matches method is associated with severe endogeneity problem. A rapid increase in graduates in a non-graduate occupation might make this occupation to turn into a graduate occupation. Hence it would imply lowering overeducation incidence instead of, what we would expect, increasing overeducation rates. The job analysis method, although apparently offering the least of conceptual limitations, requires specialist-made education requirement assessments. Such studies are rather scarce.

The dynamics of overeducation is well-analysed from individuals' perspective. A debate on whether overeducation is transitory or long-lasting phenomenon builds on a paper by Sicherman and Galor (1990) which provides a theoretical model suggesting that overeducation is transitory state at beginning of worker's job career. A large body of subsequent empirical research gives mixed results. There are numerous papers proving implications of Sicherman-Galor model (Sicherman 1991, Robst 1995, Dekker et al. 2002, Wasmer et al. 2007, McGuinness and Wooden 2009, Frei and Sousa-Poza 2012) as well as opposing them (Dolton and Vignoles 2000, Rubb 2003, Frenette 2004, Lindley and McIntosh 2010, Mavromaras and McGuinness 2012).

However, few studies look at dynamics of overeducation from macroeconomic perspective. Based on meta-analysis of previous research, Groot and Maassen van den Brink (2000) find no evidence of changing incidence of overeducation over the 1970s, 1980s and 1990s. More recently, in the document prepared for European Commission, Pouliakas (2013) reports that the incidence of overeducation in the European Union was stable over 2001-2009. However they explain that this finding results from 'credentialism', i.e. changing the education requirements across occupations in response to increasing number of tertiary educated workers. Keeping the education requirements fixed would result in an increase in extent of overeducation. McGuinness et al. (2015) reports rising incidence of overeducation in most of European economies including Poland.

There are a few studies focusing exclusively on a phenomenon of overeducation in Poland. Kucel and Vilalta-Bufi (2012) base on data from HEGESCO study that covered tertiary graduates. The advantage of their study is that they analyse three types of mismatch: vertical education mismatch (referring to *levels* of education), horizontal education mismatch (referring to *fields* of education), and skill mismatch. They solely base on subjective approach. They find, when referring to vertical mismatch, that overeducation is negatively associated with being a women, possessing executive skills, working in big companies, having a social sciences degree (compared to an engineering degree as a baseline), and having studied prestigious study programmes. Since the study covers individuals of one graduation cohort interviewed at the same moment of time, Kucel and Vilalta-Bufi cannot address dynamic aspects of overeducation.

Kiersztyn (2011, 2013) uses data from POLPAN study covering years 1988-2008. The advantage of POLPAN is that it is a panel study that is conducted every five years. Kiersztyn (2011) reports descriptive results, whilst Kiersztyn (2013) presents results of an econometric analysis of determinants of overeducation. According to Kiersztyn (2011) incidence of overeducation rose in the analysed period of time. She finds that overeducation incidence among workers was 7.5% in 1988 whilst 19.1% in 2008. Subjective overeducation is found higher among young workers, aged 21-25, than those aged 26 or more (30% and 18% respectively). Similar numbers are reported for an objective measure of overeducation. Moreover, she demonstrates that overeducation in Poland is a persistent phenomenon. About 50%-68% respondents (depending on panel wave) who were overeducated remain overeducated after 5 years' time.

Kiersztyn (2013) confirms persistence of overeducation using econometric method. Overeducated workers are found about four times more likely to be again in overeducation after five years compared to initially not overeducated workers. What is more, Kiersztyn shows that younger cohorts

experience higher risk of persistent overeducation compared to older cohorts. This finding suggests that more recent cohorts struggle more to leave early-career overeducation than older cohorts did.

3. Identification of overeducation

In this part we discuss our strategy of identification of overeducation. We start our analysis with assigning occupations into one of two categories: university jobs and non-university jobs, based on data from Balance of Human Capital survey. Once each occupation is assigned, we apply this classification to Polish Labour Force Survey (LFS) data. From comparing workers' actual education level with education level that is required to perform their jobs we obtain four match-mismatch categories. There are two match categories: tertiary educated workers who work in jobs requiring tertiary education, and not tertiary educated workers who work in jobs not requiring tertiary education, and two mismatch categories: overeducated individuals, i.e. tertiary educated workers who work in jobs not requiring tertiary education, and undereducated individuals, i.e. workers without tertiary education who work in jobs requiring tertiary education.

Balance of Human Capital (Bilans Kapitału Ludzkiego, BKL) has been conducted each year since 2010. Up to now, there has been five editions of the survey. BKL consists of seven modules. One of them is a study on employers. In BKL, the employer is asked, *inter alia*, which level of education is required for candidates for recently vacating positions. For most of occupations, described with 2-digit ISCO codes, we obtain frequency of employers' declarations that tertiary education is required. Altogether there are 14,586 observations in the BKL sample (we pool data of five editions into one dataset). However, the number of observations per occupation is unevenly distributed. For some occupations number of observations is over one thousand, but there are occupations for which the number of observations is less than 100 or even less than 20. Those differences come from the fact that number of observations reflects number of recent vacancies. The results of responses whether tertiary education is required are presented in table A.1 in the appendix. The same information is depicted graphically in Figure 1.

The highest frequency of declared tertiary education requirement is found in professional and managerial jobs, belonging to major groups 1 and 2 of ISCO classification. Teaching and health professionals are at the top of the ranking with scores of 97% and 91% respectively. The occupations that are least frequently claimed to require tertiary education belong to the following ISCO major groups: 5 service and sales workers, 7 craft and related trade workers, and 9 elementary occupations.

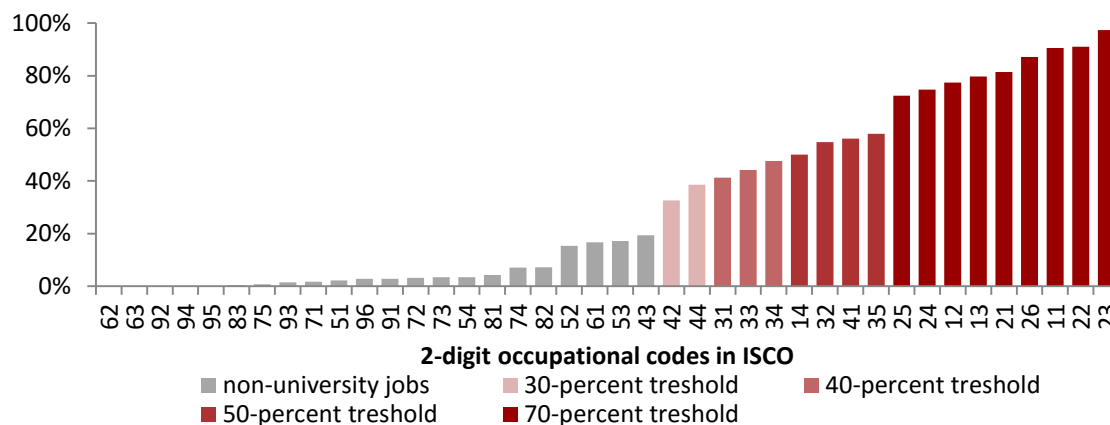
Having scores of tertiary education requirements across occupations, we assign occupations with low scores to non-university jobs category, and occupations with high scores to university jobs category. Obviously, we need to set some threshold value separating low and high score. Unfortunately, data give no hint where the demarcation line between the two categories should be. Hence, we try different threshold values: 70%, 50%, 40%, and 30%.¹ High and low thresholds identify slightly different overeducation. For low thresholds, 40% and 30%, we detect *severe* overeducation, i.e. tertiary educated individuals who work in occupations with very low tertiary education requirements. For high thresholds, the overeducation encompasses *mild and severe* overeducation. Furthermore, use of different thresholds works as a robustness check for our results.

For 70-percent threshold we get nine university jobs: all but one codes in managers and professionals ISCO sub-major groups (the exception is 14 hospitality, retail and other services managers). For 50-percent threshold we get four more university jobs. Now, university jobs consist of all occupations of 1 and 2 major groups as well as 32 health associate professionals, 35 information and communications technicians and 41 general and keyboard clerks. For 40-percent threshold we add further three occupations of 3 technicians and associate professionals major group. For the lowest

¹ Eight occupations with the lowest number of observations are assigned authoritatively to either university or non-university category.

threshold value, which is 30%, there are 18 occupations assigned to university jobs out of 43 in ISCO classification. The additional two are: 42 customer services clerks and 44 other clerical support workers.

Figure 1. The share of employers' responses that tertiary education is required (BKL, 2010-2014 pooled)



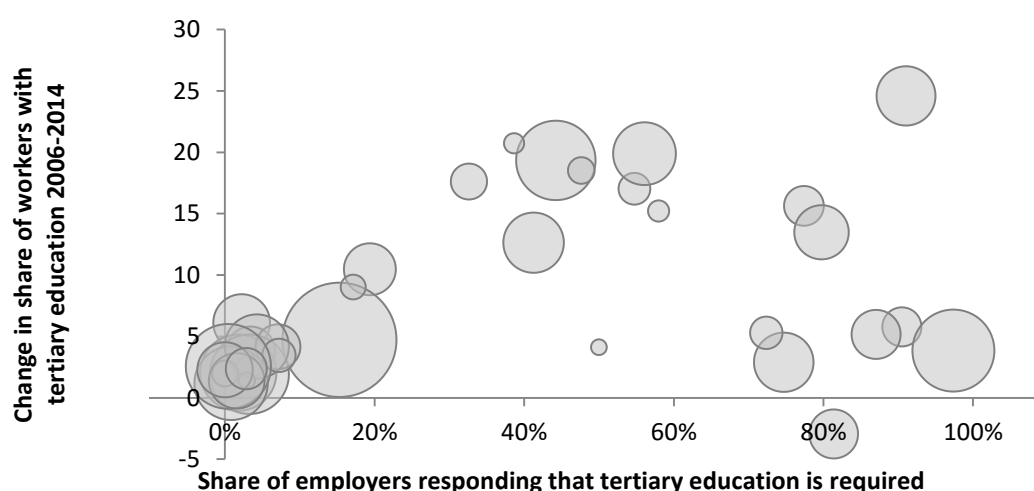
university jobs expanded by between 880 thousand and 1,430 thousand. In each case an increase in number of university jobs was smaller than expansion of tertiary educated workers.

In result number of overeducated workers steadily increased in the analysed period of time. Table 2 in the appendix reports structure of working population broken into four categories: matched non-graduates, undereducated, overeducated and matched graduates. Data show a substantial increase in share of overeducated workers. For 70-percent threshold, the share of overeducated workers in total employment rose from 6.7% in 2006 to 11.9% in 2014. For 50-percent threshold, the change was from 5.5% to 9.8%, respectively. For 40-percent it was 3.3% and 5.4%, respectively. Finally for 30-percent threshold, we report change in share of overeducated workers from 3.1% in 2006 to 4.8% in 2014. In other words, share of overeducated individuals in working population almost doubled in eight years, especially for higher threshold definitions of university jobs. The finding of rising overeducation incidence prevails irrespectively of a threshold value used to define university jobs.

Because of immense expansion of tertiary education, number of overeducated workers could significantly increase even with constant risk of being overeducated among tertiary educated workers. This is not the case. If we limit our analysis to tertiary educated workers only, the incidence of overeducation is rising. For 70-percent threshold, the share of overeducated individuals to all graduate workers rose from 30.0% in 2006 to 36.7% in 2014. For 50-percent threshold, the change is from 24.7% in 2006 to 30.3% in 2014. For 40-percent and 30-percent threshold, changes are much smaller: from 14.9% to 16.5% in the case of the former, and from 13.9% to 14.7%, in the case of the latter. Hence, rising number of overeducated workers is driven by two factors: expansion of tertiary education and increasing risk of being overeducated among tertiary educated workers.

Larger expansion of overeducation is observed in case of higher thresholds than lower ones. It suggests that *mild* overeducation is rising much faster than *severe* overeducation. This observation is consistent with the finding that occupations that have experienced the greatest increase in a share of tertiary educated workers are those from the middle of tertiary education requirement distribution according to employers' responses. There is only little increase in the share of tertiary educated workers in jobs of the bottom of education requirement distribution (cf. Figure 2).

Figure 2. Change in share of tertiary educated workers in 2006-2014 (LFS) versus the share of employers responding that tertiary education is required (BKL, 2010-2014)



Note: The size of the bubble represents number of workers in a given occupation in 2006.

However, two reservations about our analysis should be made. Firstly, there is apparent time discrepancy between LFS and BKL data we use. Education requirements are calculated on data for 2010-2014, whilst Labour Force Survey data cover 2006-2014. As education requirements might change over time, time discrepancy of the two datasets might cause some bias in identification of

overeducation. However, we expect that the bias due to not allowing for changing education requirements is rather small as the analysed period of time is relatively short.

Secondly, there is a problem due to changing occupation classification used in Labour Force Survey. Although we overcome this problem with using correspondence tables, the perfect correspondence is not achieved.³ It results in a break in series for overeducation numbers between 2010 and 2011. However, the break is apparently small for total working population (cf. Table A.2) and it tends to downsize overeducation incidence. Moreover, steady increase in overeducation incidence is shown for both subperiods: before classification change, 2006-2010, and after the change, 2011-2014. It means that occupation classification does not affect our findings.

5. Econometric analysis

In this part we verify econometrically findings presented in the previous part. We present results of logistic regression identifying factors associated with being overeducated among all tertiary educated workers. We limit our sample to tertiary educated workers. The dependent variable is a dummy variable that takes value 1 for overeducated workers and value 0 for properly matched tertiary educated workers. The analysis is conducted for each threshold value discussed in part 3 and 4. Explanatory variables include characteristics of worker and work as well as year dummies. Worker's characteristics are: age or cohort, gender, whether person is foreign born, whether person is disabled, whether there is a child aged 3 or less in worker's household, whether there is other worker in worker's household, field of study, degree of urbanization of place of living, and voivodship. Variables related to work and workplace characteristics are: individual's tenure in the current workplace, whether individual works part-time, sector of economic activity according to NACE classification, size of firm, whether firm is private or public owned. Moreover, we include year dummies to verify rising trend of overeducation risk among tertiary educated workers. For each threshold value we present three estimations: basic model, full model, and full model with cohort dummies instead of age. We use data from LFS study covering years 2006-2014. The results are presented in table A.3 in the appendix. Altogether there are twelve estimations. Values reported in the table are odds ratios.

Estimation results show that age is negatively associated with overeducation. This finding holds for basic and full model specifications. One additional year of age decreases probability of being in overeducation by 2.6% - 4.0%. We identify also statistically significant effect of tenure. One additional year of tenure in current workplace decreases probability of being in overeducation by 1.3% - 2.7%. Both results mean that overeducated individuals are usually young workers at the beginning of their jobs careers. This finding is consistent with implications of Sicherman-Galor model.

A gender is statistically significant variable explaining probability of being overeducated. However, the sign of this effect depends on the definition of overeducation. For the 70-percent threshold definition, full variable models indicate that women are at higher risk of being overeducated. It turns opposite for 50-percent and lower threshold definitions, meaning that women are at lower risk of overeducation when lower thresholds are applied. Moreover, we observe that the lower threshold, the lower the risk of overeducation associated with being a woman. It means that women are relatively more likely to be mildly overeducated but less likely to be severely overeducated. Other studies for Poland find also that females are at lower risk of being overeducated than men (Kucel and Vilalta-Bufi 2012, Kiersztyn 2013).

Results for a field of study indicate that individuals who studied computer science, engineering, manufacturing and health are at lower risk of being overeducated than those who studied social sciences, business and law, which is a baseline, according to all estimations presented in table A.3. This result stands in contrast to a finding by Kucel and Vilalta-Bufi (2012) who report that studying

³ In Table A.1 we indicate which occupations are affected with this problem.

social sciences is associated with lower risk of overeducation than studying engineering.⁴ Moreover, our analysis demonstrates that having studied services is always associated with higher than baseline risk of being overeducated. It is interesting that when we control for sector of economic activity, studying education becomes positively associated with severe overeducation (cf. columns 7-12). It suggests that graduates of this field, if working outside education sector, are likely to fall into severe overeducation.

Now we look at estimates for sectors of economic activity. Manufacturing is a baseline. The highest risk of overeducation is identified in case of two sectors: food services and accommodation, and trade and repairs. Those who work in trade and repairs are 2.2-2.8 times more at risk of being overeducated than those who work in manufacturing. Working in food services and accommodation is associated with 1.6-3.0 times higher risk of overeducation than working in manufacturing. Significantly lower than baseline risk of overeducation is found for education, health care, and financial services. Construction, real estate, professional and administrative activities are also associated with lower risk of overeducation.

Working part time is associated with higher risk of overeducation. Those who work part-time are 50% - 93% at higher risk of overeducation than those who work full-time. Individuals who work in bigger firms, employing eleven workers or more, have lower risk of overeducation. The same applies to individuals working in public-owned firms.

The effect of other worker in the household is insignificant. We added this variable to the model expecting that workers who are sole earners in their households are more likely to accept jobs that are below their education level. However, this intuition is rejected as coefficients for other worker in the household are not statistically significant in all estimations presented in table A.3.

Individuals who are in households with young children, aged 3 or less, are at lower risk of being overeducated. Our intuition behind this variable was similar as previously: those who have young children are expected to accept any job, even if it is below their education level. Estimation results suggest the opposite, though. An explanation of this finding might be reversed causality, that is those individuals who are in well-matched jobs are more likely to decide to have children.

The last two individuals' characteristics are being foreign born and being disabled. The effect of being foreign born is not statistically significant. Hence, the econometric analysis shows that immigrants working in Poland are not more endangered with overeducation than natives. This is contradictory to findings of other studies (cf. Quintini 2011). Disability is found to be associated with higher risk of overeducation. Disabled workers, even possessing the same other characteristics as workers without disabilities, are more at risk of overeducation by 40%-54%. Only one estimation presents statistically insignificant effect of disability.

Now we move to results for degree of urbanization. All estimations show consistently that overeducation is more prevalent among workers who live in small towns and in rural areas. Living in a city of 100 thousand inhabitants or more, which is a baseline level for this variable, is associated with the lowest risk of overeducation. This finding suggests that big cities offer better job-education match. Overeducation risk is the highest in rural areas.

The next spatial variable included in the model is voivodship. Dolnośląskie voivodship serves as a baseline. According to all estimations presented in table A.3, Lubelskie, Świętokrzyskie, Zachodniopomorskie are associated with significantly higher risk of overeducation than Dolnośląskie voivodship. Also Podlaskie, Warmińsko-Mazurskie and Kujawsko-Pomorskie are found to experience higher overeducation risk in majority of presented estimations. Those voivodships have in common that they are relatively less developed with still sizeable employment in agricultural sector.

⁴ Kucel and Vilalta-Bufi look at individuals who graduated in 2003. This was the time of economic slowdown characterised with depression of employment in manufacturing and construction. Hence, engineering graduates faced limited prospects of finding properly matched job compared to social sciences graduates.

The last variables included in the model are year dummies and cohort dummies. Year dummies are crucial variables to verify whether there has been rising trend of overeducation in Poland as it is suggested in part 4. Results differ significantly when only year dummies are included, and when both year and cohort dummies are added. Firstly, we discuss the former case. The year dummies are statistically significant for higher threshold definitions. For 70-percent and 50-percent thresholds the year dummies reveal that risk of overeducation is rising over time even if we control for other worker's and workplace's characteristics. This finding is in line with observations from previous part of the paper. However it is not proven when we analyse risk of overeducation for 40-percent and 30-percent definitions. Altogether, it suggests that overeducation is rising in the middle of education-requirement distribution of occupations but we find no evidence of university graduates taking more jobs in the bottom of education requirement distribution.

Lastly we report estimates for cohort dummies. Adding them into the model requires exclusion of age. It is because of that year of survey, age and year of birth are linearly dependent, hence it is impossible to have them all three in the model. Instead of reporting numbers in the table, odds ratios for cohort dummies with 95% confidence intervals are presented graphically in Figure A.1 in the appendix. We find that the risk of overeducation is associated with younger cohorts. For instance individuals born in 1980 are on average 36%-62% more risk of overeducation that workers born in 1970. When we use cohort dummies the year dummies turn decreasing over time. This is because now year dummies embrace the effect of cohort's ageing, that was previously controlled with variable *age*.

Summary

A university boom has triggered a substantial increase in a number of tertiary educated workers in Poland. It raises a question whether this surge has been properly utilised by the Polish labour market. There is a lot of anecdotal evidence suggesting that a rising number of workers with university diploma face obstacles to find a job that would match their education. However, there is scarcity of scientific research addressing this issue. This article contributes to filling this gap.

In the paper we analyse changes of overeducation of tertiary educated workers in Poland in 2006-2014. To identify overeducation we combine information extracted from Balance of Human Capital survey with Labour Force Survey. To our knowledge it is the first time that Balance of Human Capital survey is used to analyse overeducation. The survey provides us with intensities of tertiary education requirements based on employers' declarations for each occupation. Based on that we separate occupations into university jobs and non-university jobs and compare them with workers' actual education levels. The results demonstrate that number of tertiary educated workers expanded by 1,890 thousand whilst university jobs expanded by between 880 thousand and 1,430 thousand, depending on definition of university jobs. Hence, the number of tertiary educated workers grew at greater pace than the number of jobs requiring tertiary education. In result the share of overeducated workers in total employment almost doubled in just eight years. The finding of rising overeducation incidence prevails irrespective of different university job definitions. We show that overeducation is rising due to more workers taking jobs in the middle of education requirement distribution of occupations. We find less evidence of university graduates taking more jobs in the bottom of education requirement distribution. It means that rise in overeducation is driven by *mild* overeducation rather than *severe* overeducation.

We complement our investigation with econometric model. It proves that overeducation has been rising over time even if we control for other factors that might influence risk of overeducation. We find that rising overeducation risk can be also explained by cohort effects. However, our analysis does not allow to answer which explanation, cohort or year effects, is more accurate. We leave this issue as an agenda for future research. Furthermore, the econometric model finds that overeducated individuals are usually young and with little job experience. Women are found less likely to be in severe overeducation, whilst relatively more likely to experience mild overeducation. The least risk of

overeducation is found in case of graduates who studied computer science, engineering, manufacturing and health programmes. Having studied services is always associated with higher risk of overeducation. The highest risk of overeducation is identified in case of workers who work in food services, accommodation, trade and repairs. What is more, working part-time, working in small firms, working in private sector, living in small towns and rural areas or in less developed voivodships are all these factors associated with higher risk of being overeducated.

To summarise, our analysis confirms that university boom fueled the rise of overeducation incidence in Poland and the pace of this change is substantial. Hence, the issue of overeducation should attract more attention of researchers and policy makers. There is a need for further research to investigate the impact of expanding overeducation on workers' situation: career mobility and earnings.

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Appendix

Table A.1. Detailed results of employers' responses on education requirements compared to actual share of tertiary educated workers

code	occupation name	share employers' responses that of tertiary education is required for candidates, BKL 2010-2014	number of observations in BKL	share of tertiary educated workers within occupation, 2006, LFS	2014 share of tertiary educated workers within occupation, 2014, LFS	note
01	Commissioned armed forces officers	-	0			*
02	Non-commissioned armed forces officers	-	0			*
03	Armed forces occupations, other ranks	-	0	34%	17%	*
11	Chief executives, senior officials and legislators	90%	63	73%	79%	*
12	Administrative and commercial managers	77%	199	57%	73%	
13	Production and specialised services managers	80%	237	43%	56%	
14	Hospitality, retail and other services managers	50%	42	44%	48%	*
21	Science and engineering professionals	81%	623	100%	97%	*
22	Health professionals	91%	882	46%	70%	
23	Teaching professionals	97%	838	94%	98%	
24	Business and administration professionals	75%	810	85%	88%	*
25	Information and communications technology professionals	72%	304	86%	91%	
26	Legal, social and cultural professionals	87%	170	90%	95%	*
31	Science and engineering associate professionals	41%	366	11%	23%	
32	Health associate professionals	55%	106	13%	30%	*
33	Business and administration associate professionals	44%	988	35%	54%	*
34	Legal, social, cultural and related associate professionals	48%	170	26%	45%	*
35	Information and communications technicians	58%	69	19%	34%	
41	General and keyboard clerks	56%	255	28%	48%	*
42	Customer services clerks	33%	230	19%	37%	
43	Numerical and material recording clerks	19%	315	10%	20%	*
44	Other clerical support workers	39%	44	7%	28%	*
51	Personal service workers	2%	584	4%	10%	
52	Sales workers	15%	1156	14%	19%	*
53	Personal care workers	17%	70	4%	13%	
54	Protective services workers	3%	146	15%	19%	
61	Market-oriented skilled agricultural workers	17%	18	3%	6%	
62	Market-oriented skilled forestry, fishery and hunting workers	0%	2	1%	6%	
63	Subsistence farmers, fishers, hunters and gatherers	0%	5	1%	3%	
71	Building and related trades workers, excluding electricians	2%	1017	1%	4%	
72	Metal, machinery and related trades workers	3%	1230	2%	4%	
73	Handicraft and printing workers	3%	117	6%	8%	
74	Electrical and electronic trades workers	7%	437	4%	8%	
75	Food processing, wood working, garment and other craft and related trades workers	1%	858	1%	2%	
81	Stationary plant and machine operators	4%	353	2%	6%	*
82	Assemblers	7%	83	3%	7%	
83	Drivers and mobile plant operators	0%	1101	2%	4%	*
91	Cleaners and helpers	3%	207	0%	1%	
92	Agricultural, forestry and fishery labourers	0%	19	0%	2%	
93	Labourers in mining, construction, manufacturing	2%	320	2%	3%	

	and transport					
94	Food preparation assistants	0%	78	0%	3%	*
95	Street and related sales and service workers	0%	4	0%	17%	*
96	Refuse workers and other elementary workers	3%	70	1%	4%	*

Note: stars denote more than 10-percent change in 2010-2011, probably due to change in occupation classification.

Table. A.2. Structure of working population in Poland, 2006-2014

	70-percent				50-percent			
	matched non- graduate	under educated	over educated	matched graduate	matched non- graduate	under educated	over educated	matched graduate
2006	72.9%	4.8%	6.7%	15.6%	69.5%	8.2%	5.5%	16.8%
2007	72.5%	4.8%	7.2%	15.5%	69.1%	8.1%	5.9%	16.8%
2008	71.9%	4.7%	7.9%	15.5%	68.8%	7.9%	6.5%	16.9%
2009	69.8%	4.7%	8.7%	16.8%	66.7%	7.8%	7.1%	18.4%
2010	67.8%	4.6%	9.9%	17.7%	64.8%	7.6%	8.1%	19.5%
2011	67.6%	3.8%	10.0%	18.6%	64.4%	7.0%	8.2%	20.4%
2012	66.7%	3.7%	10.1%	19.4%	63.6%	6.8%	8.3%	21.3%
2013	65.1%	3.8%	11.1%	20.0%	62.2%	6.7%	9.1%	22.0%
2014	63.8%	3.7%	11.9%	20.6%	61.0%	6.5%	9.8%	22.7%
	40-percent				30-percent			
	matched non- graduate	under educated	over educated	matched graduate	matched non- graduate	under educated	over educated	matched graduate
2006	63.2%	14.5%	3.3%	19.0%	62.0%	15.7%	3.1%	19.2%
2007	63.1%	14.2%	3.6%	19.2%	61.9%	15.4%	3.3%	19.4%
2008	62.9%	13.7%	3.9%	19.5%	61.8%	14.8%	3.6%	19.7%
2009	61.2%	13.3%	4.2%	21.3%	60.1%	14.4%	3.9%	21.6%
2010	59.5%	12.9%	4.9%	22.8%	58.4%	14.0%	4.5%	23.1%
2011	58.4%	13.0%	4.5%	24.1%	57.0%	14.4%	3.9%	24.7%
2012	57.7%	12.7%	4.6%	24.9%	56.4%	14.1%	4.1%	25.5%
2013	56.4%	12.5%	5.1%	26.0%	55.1%	13.8%	4.5%	26.6%
2014	55.3%	12.3%	5.4%	27.1%	54.1%	13.4%	4.8%	27.7%

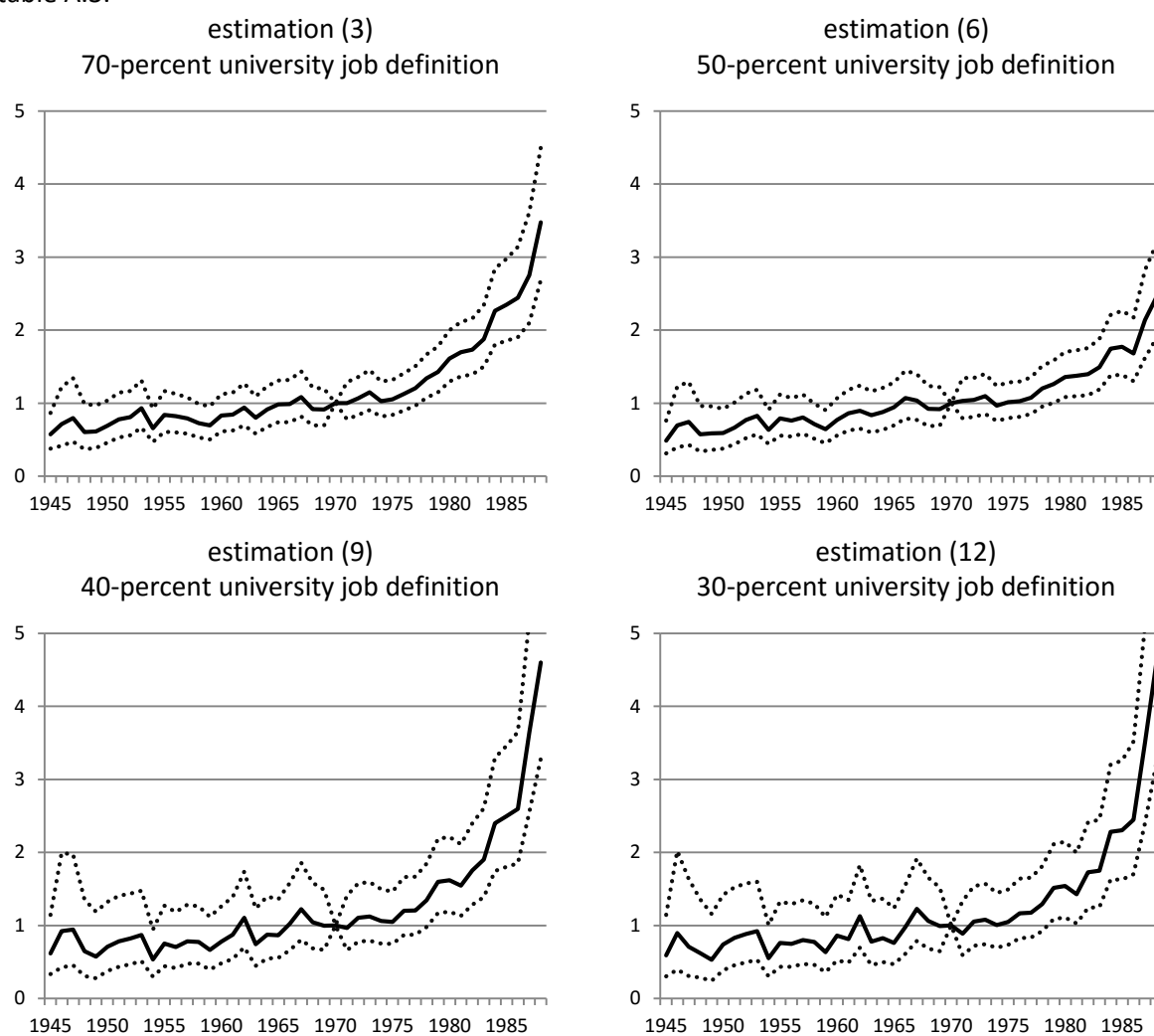
Table A.3. Results of logistic regressions (odds ratios reported)

	70- percent	70- percent	70- percent	50- percent	50- percent	50- percent	40- percent	40- percent	40- percent	30- percent	30- percent	30- percent
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
age	0.970***	0.966***		0.974***	0.972***		0.965***	0.960***		0.967***	0.962***	
tenure in current workplace	0.973***	0.980***	0.982***	0.976***	0.986***	0.987***	0.974***	0.980***	0.983***	0.975***	0.981***	0.983***
gender (woman)	0.938*	1.191***	1.187***	0.761***	0.899***	0.896***	0.517***	0.530***	0.525***	0.444***	0.415***	0.410***
field of study: ref. = social sciences, business and law												
education	0.425***	0.883*	0.874**	0.479***	1.061	1.051	0.794***	1.814***	1.795***	0.877**	2.062***	2.042***
humanities	0.380***	0.644***	0.637***	0.388***	0.653***	0.647***	0.540***	0.895	0.887	0.552***	0.892	0.883
science, mathematics and computing	0.406***	0.512**	0.516**	0.440***	0.534**	0.538**	0.525**	0.581	0.584	0.547**	0.664	0.662
life science	0.699***	0.731***	0.731***	0.677***	0.701***	0.705***	0.903	0.897	0.911	0.967	0.925	0.944
physical sciences	0.515***	0.635***	0.624***	0.524***	0.643***	0.638***	0.712***	0.813	0.800	0.726**	0.803	0.790
mathematics and statistics	0.243***	0.463***	0.450***	0.273***	0.533***	0.526***	0.393***	0.695	0.679	0.421***	0.818	0.802
computer science	0.373***	0.375***	0.370***	0.375***	0.373***	0.372***	0.530***	0.499***	0.499***	0.554***	0.542***	0.543***
engineering, manufacturing	0.523***	0.505***	0.492***	0.556***	0.532***	0.524***	0.682***	0.588***	0.570***	0.719***	0.589***	0.571***
agriculture and veterinary	1.303***	0.830*	0.815*	1.358***	0.813*	0.804*	2.201***	1.141	1.114	2.354***	1.145	1.115
health and welfare	0.227***	0.226***	0.219***	0.180***	0.214***	0.210***	0.337***	0.491***	0.471***	0.364***	0.564***	0.544***
services	1.647***	1.592***	1.544***	1.465***	1.428***	1.401***	2.083***	2.095***	2.036***	2.006***	2.038***	1.978***
sector of economic activity: ref. = C - manufacturing												
A - agriculture		0.778	0.767		0.789	0.780		0.552**	0.540**		0.647	0.632*
B - mining		1.062	1.064		1.081	1.081		1.252	1.270		1.385	1.410*
D E - electricity, water supply		0.866	0.873		0.640***	0.643***		0.528***	0.528***		0.470***	0.470***
F - construction		0.713***	0.707***		0.697***	0.695***		0.679***	0.675***		0.649***	0.645***
G - trade and repairs		2.375***	2.399***		2.153***	2.161***		2.772***	2.802***		2.863***	2.895***
H J - transportation and communication		0.875*	0.869*		0.828**	0.824**		0.980	0.973		0.595***	0.588***
I - food services and accomodation		2.962***	2.894***		1.636***	1.600***		2.915***	2.811***		1.495**	1.409*
K - financial services		0.462***	0.462***		0.552***	0.553***		0.378***	0.377***		0.091***	0.090***
L M N - real estate, prof. and adm. activities		0.656***	0.644***		0.607***	0.601***		0.369***	0.359***		0.293***	0.285***
O - public administration		1.406***	1.411***		1.169*	1.171*		0.896	0.899		1.122	1.126
P - education		0.100***	0.100***		0.072***	0.072***		0.051***	0.051***		0.058***	0.058***
Q - health care		0.713***	0.712***		0.504***	0.504***		0.271***	0.270***		0.192***	0.190***
R S T U - entertainment and other		1.079	1.057		0.839*	0.829*		0.444***	0.429***		0.384***	0.370***

part-time		1.629***	1.501***		1.660***	1.586***		1.926***	1.724***		1.880***	1.679***
firm employing 11 workers or more		0.629***	0.639***		0.632***	0.638***		0.537***	0.544***		0.508***	0.515***
public owned firm		0.826***	0.834***		0.833***	0.836***		0.737***	0.739***		0.556***	0.558***
other worker in HH		1.029	1.029		0.991	0.988		1.003	1.004		1.000	0.998
child aged 3 or less		0.860***	0.925*		0.899**	0.950		0.829***	0.919		0.844***	0.938
foreign born		0.641	0.635*		0.625	0.623		0.826	0.816		0.904	0.891
disabled		1.539***	1.487***		1.511***	1.492***		1.529**	1.469*		1.402*	1.351
urbanisation: ref. = town of more than 100k inhabitants												
town, 20k - 100k		1.475***	1.480***		1.414***	1.416***		1.348***	1.352***		1.343***	1.346***
town, less than 20k		1.489***	1.492***		1.493***	1.494***		1.600***	1.598***		1.596***	1.590***
rural area		1.650***	1.626***		1.615***	1.596***		1.680***	1.640***		1.670***	1.627***
voivodship: ref. = dolnośląskie												
kujawsko-pomorskie		1.403***	1.405***		1.300**	1.299**		1.298*	1.293*		1.175	1.166
lubelskie		1.469***	1.485***		1.453***	1.463***		1.454***	1.482***		1.404**	1.433**
lubuskie		1.213	1.222		1.233	1.237*		1.303	1.312*		1.228	1.233
łódzkie		0.951	0.957		0.852*	0.856*		1.079	1.091		1.023	1.033
małopolskie		0.856*	0.861*		0.812**	0.815**		0.982	0.989		0.969	0.977
mazowieckie		0.943	0.956		0.895	0.903		0.950	0.966		0.953	0.968
opolskie		1.187	1.197		1.093	1.099		1.081	1.090		1.035	1.040
podkarpackie		1.239**	1.248**		1.218*	1.225*		1.299*	1.315*		1.209	1.223
podlaskie		1.528***	1.546***		1.480***	1.490***		1.306*	1.320*		1.294	1.307*
pomorskie		1.196*	1.212*		1.147	1.157		1.028	1.039		1.017	1.027
śląskie		1.070	1.083		1.007	1.015		1.021	1.036		1.017	1.031
świętokrzyskie		1.581***	1.604***		1.315**	1.326**		1.696***	1.729***		1.630***	1.659***
warmińsko-mazurskie		1.381***	1.388***		1.390***	1.394***		1.316*	1.328*		1.266	1.276
wielkopolskie		0.949	0.947		0.903	0.901		1.119	1.118		1.035	1.033
zachodniopomorskie		1.328**	1.350***		1.340***	1.354***		1.326*	1.352**		1.355*	1.383**
year dummies: ref. = 2006												
2007	1.041	1.051	0.994	1.024	1.006	0.966	1.024	1.046	0.980	1.030	1.049	0.984
2008	1.124*	1.136	1.028	1.114	1.092	1.013	1.083	1.062	0.944	1.094	1.073	0.958
2009	1.150**	1.156*	1.000	1.128*	1.098	0.985	1.068	1.035	0.874	1.076	1.049	0.891
2010	1.255***	1.237***	1.016	1.214***	1.157*	0.998	1.172*	1.123	0.887	1.178*	1.137	0.905
2011	1.198***	1.115	0.870*	1.163**	1.098	0.911	1.011	0.921	0.679***	0.935	0.806*	0.598***
2012	1.181**	1.082	0.803***	1.154**	1.075	0.857*	1.032	0.943	0.646***	0.965	0.849	0.586***

2013	1.277***	1.181**	0.835**	1.246***	1.160*	0.889	1.104	1.018	0.650***	1.036	0.922	0.591***
2014	1.357***	1.268***	0.852*	1.327***	1.232**	0.907	1.132	1.025	0.606***	1.069	0.936	0.555***
cohort dummies	no	no	yes	no	no	yes	no	no	yes	no	no	yes
_cons	2.696***	3.234***	0.862	1.889***	2.376***	0.874	1.325***	2.083***	0.451***	1.148	2.343***	0.562**
obs.	272 985	233 626	233 626	272 985	233 626	233 626	272 985	233 626	233 626	272 985	233 626	233 626
pseudo R^2	0.0872	0.2140	0.2175	0.0759	0.1950	0.1967	0.0747	0.2392	0.2441	0.0751	0.2681	0.2732

Figure A.1. The odds ratios associated with cohort dummies from logistic regression presented in table A.3.



Note: Odds ratios and 95-percent confidence intervals are presented. 1970 is a baseline year. 1945 is assigned to all workers born in 1945 and earlier. 1988 is assigned to all workers born in 1988 or later.



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