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EVOLUTION OF PRIVATE RETURNS TO SCHOOLING OVER THE BUSINESS CYCLE IN A TRANSITION ECONOMY

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Evolution of private returns to schooling over the business cycle in a transition economy

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Abstract: The purpose of this study is twofold. First, it aims to provide the estimates of returns to schooling using consistent methodology and comparable set of data for a relatively long time horizon for a country undergoing economic transition and accession process into European Union, 1995-2017. Secondly, using the Mincer (1974) methodology of wage regressions it aims to verify if returns to schooling are pro-cyclical or counter-cyclical. Returns to schooling are linked to the evolution of unemployment rate on a regional level. Estimated earnings functions suggest that returns to schooling were increasing in Poland until 2006 and declining afterwards unveiling the supply side effects domination. The estimates show that an increase in unemployment rate by 1 percent leads to an increase of return to additional year of schooling roughly by 0.008 percentage points.

Keywords: returns to schooling, education, earnings equation, wage curve, business cycle, transition.

JEL codes: I26, J24, J31

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1. Introduction

Economic and political transformation in Poland brought significant changes to the economy and to the society as well. One of the striking effects was noticeable increase in the tertiary education enrollment rates and an increase in the value of tertiary education. Gross enrolment ratio for the academic year 1990/1991 was as low as 9.8% and reached its climax in 2010/2011 with a value of 53.8% (see Fig. 1.). During that period the number of students (see Fig. 2) increased five times: from nearly 400 thousand to a little under 2 million in the academic year 2005/2006 after which it started to decline gradually to 1.550 million in the academic year 2013/2014. The demographic projections for Poland indicate that this trend will continue for at least 10 years. It is therefore no surprise that the massive increase in the enrollment rates followed.

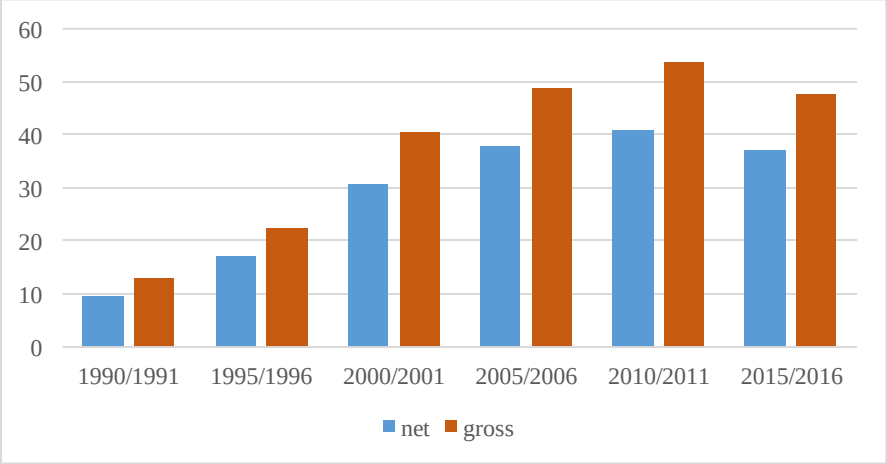

Figure 1. Enrollment rates into tertiary education in Poland (%).
Data source: Central Statistical Office of Poland.

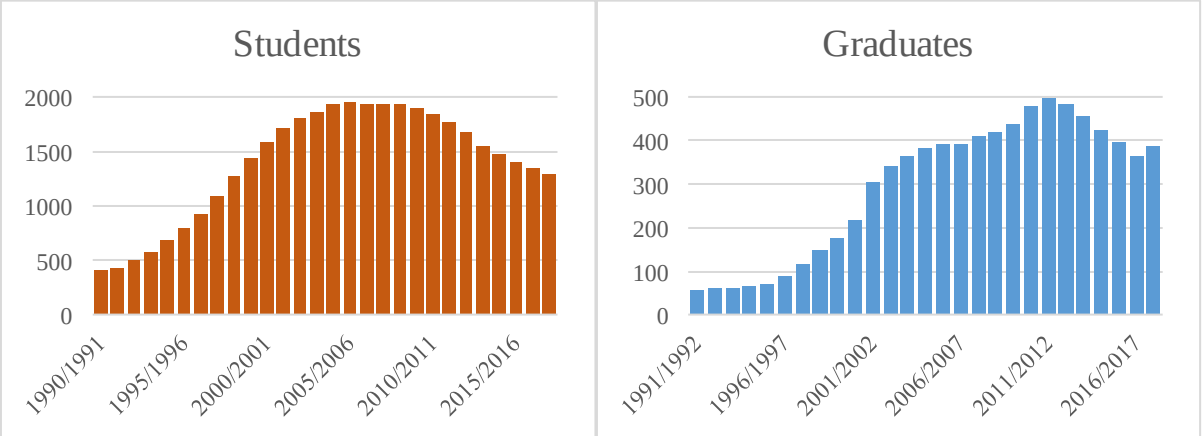

Figure 2. Massification of tertiary education: students and graduates in Poland, 1990-2017.
Data source: Central Statistical Office of Poland.

Figures 3 and 4 show employment rates and employment structure by years of schooling. Employment rates for people with at least 15 years of schooling were consistently significantly higher in relation to people with less schooling. On the other hand we observed a continuous trend of increasing share of employees with at least 15 years of schooling in total employment. In 1995 this share was as low as 10% reaching nearly 1/3 in recent years.

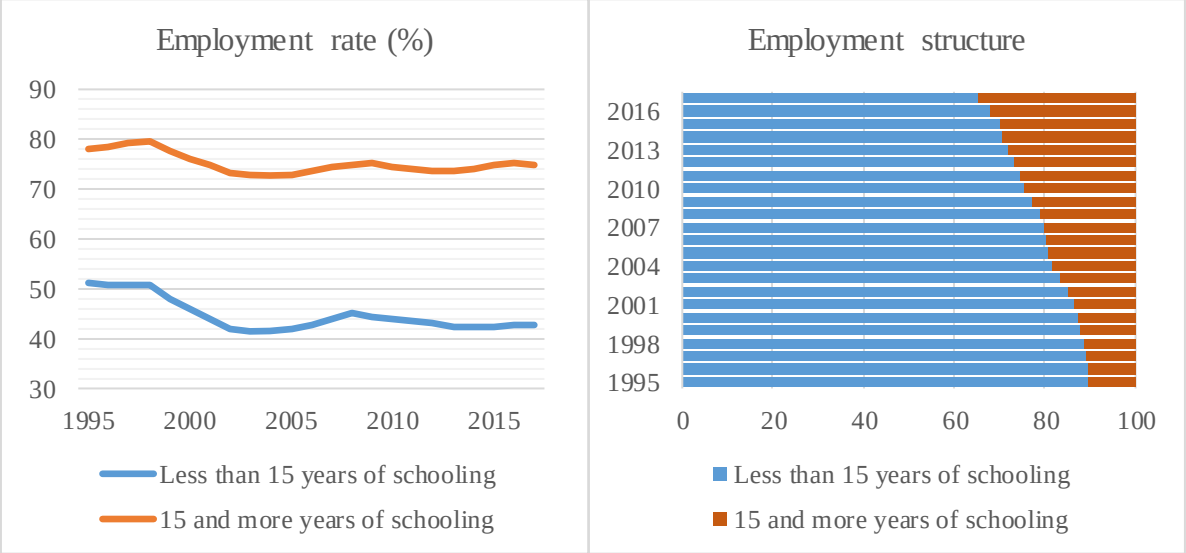

Figure 3. Employment rate and structure.
Data source: own calculations using LFS, 1995-2017.

The massive increase in the number of students can be easily explained by observed differentiation of the labour market opportunities. This was manifested by significantly lower unemployment rates for tertiary graduates (Fig. 4) as well as significantly higher wages (Fig. 5). However, the relative unemployment rate was continuously increasing until 2008 and stabilized onwards. Relative wages for graduates with at least 15 years of schooling completed began to fall after 2001. In 2006 the log difference of hourly net wages was as high as 0.6, while in 2017 it was only 0.37. This relative wage decline for tertiary graduates points to a phenomenon of *overeducation* as it is called in the literature, suggesting more graduates are taking up jobs which do not require tertiary education and do not provide appropriately high returns.

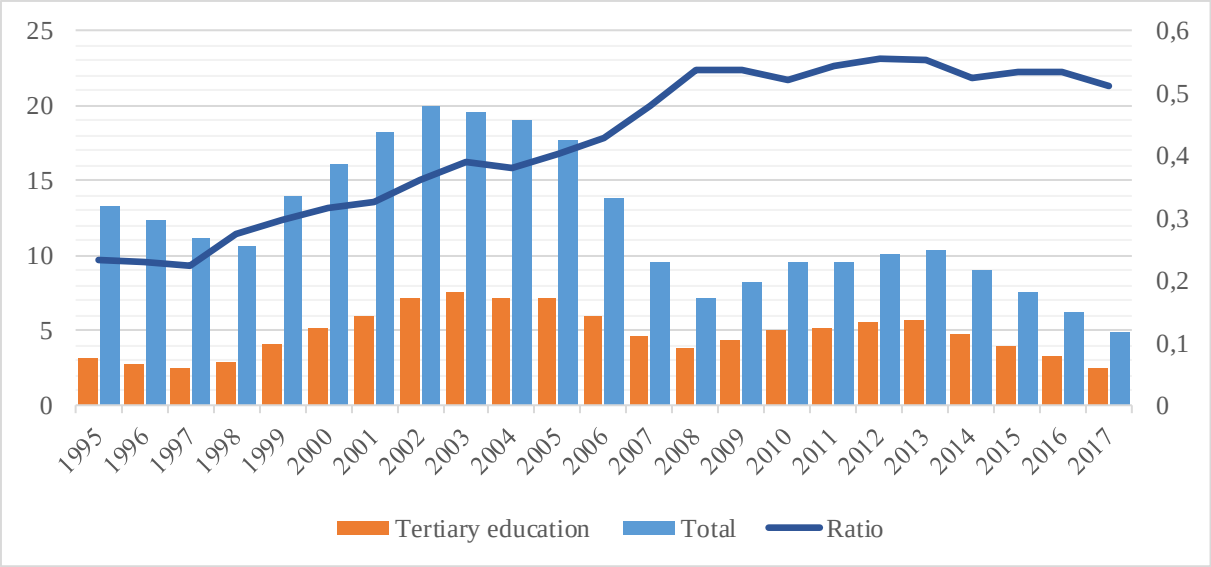

Figure 4. Relative unemployment (LFS definition).
Data source: Central Statistical Office of Poland.

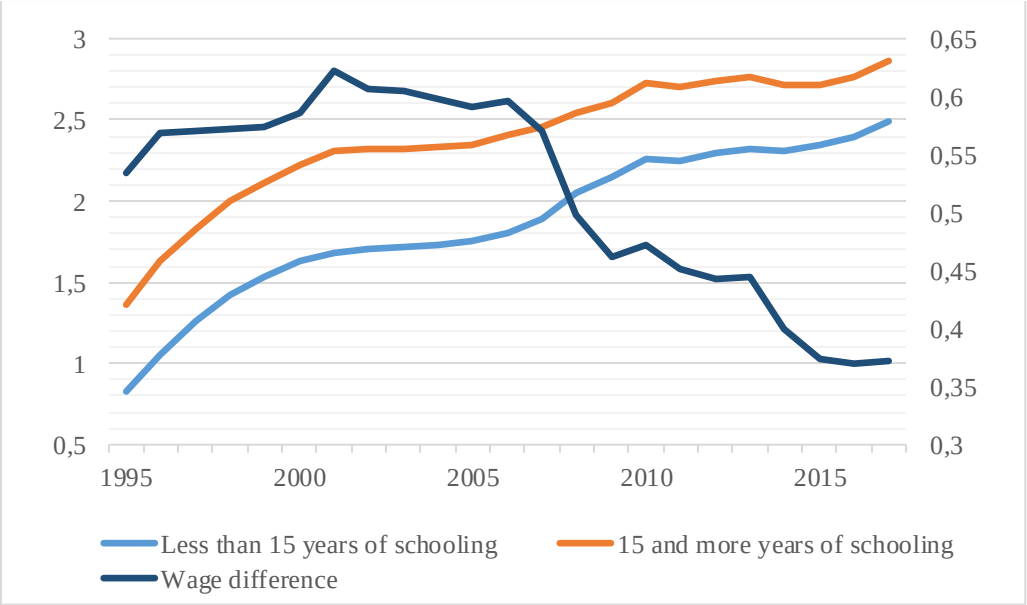

Figure 5. Logs of hourly net wages.
Data source: Central Statistical Office of Poland.

The aim of the study is to **document the evolution** of returns to education in Poland using comparable data for a long horizon of time, covering the transformation period and EU pre- and post-accession period, and to verify the link between the **business cycle** and returns to education in Poland. For this purpose a collection of individual LFS data for 1995 – 2017 is used. The paper is organized as follows. Section 2 presents the theoretical background for the research and describes the data used in empirical analysis. Section 3 describes the empirical strategy and

discusses the results. Section 4 discusses the robustness check for the reliability of results. The paper ends with conclusions and references.

2. Theoretical background and data

2.1. Theoretical setting

Individual returns to schooling are the premium to investment in education as perceived by the theory of human capital (Schultz, 1961; Becker, 1962; Mincer, 1974; Ben-Porath, 1967 and others).

Returns to schooling change in relation to supply and demand shifts over time. Tinbergen (1975) provides an excellent description of this phenomenon as the "race between technology and education", where expansion in education shifts the supply curve of highly educated people to the right, while at the same time the technological progress also shifts the demand curve for skilled persons in the same direction. Dominating supply side effects result in a decreasing trend of returns to schooling, while dominating demand side effects are pulling the returns upwards. Important aspect of those changes is the fact that education always lags behind demand due to time spent at school. Individual decisions formed with some expectations are realized few years later when demand for skills might not exactly be as expected before. The evolution of returns to schooling follows an alternating pattern of increases and decreases over time.

This paper aims to bridge the findings on individual returns to education and the results of well-established wage curve literature (Blanchflower and Oswald, 1994). Unemployment rate at the local level is additionally included into the Mincer wage regression together with its interaction term with years of schooling to capture the impact that unemployment exerts on the wages and on the premium to additional year of schooling. The literature findings on how unemployment rate influences the returns to schooling are ambiguous (Ammermueller et al., 2009). Returns to education would decrease with unemployment rate if wages of high skilled were less sensitive to unemployment rate than the wages of low skilled. On the other hand, higher unemployment rate would increase the returns to education if high skilled are better sheltered against the business cycle effects and their employment rates experience less variation along the business cycle than that of low skilled (Card, 1995). Which case is actually true remains an empirical question which is addressed here in the context of Poland. The hypothesis to be verified is that the returns to education are anti-cyclical in Poland due to significantly better employment opportunities for high skilled over the period of transition.

In the background, this paper also documents the evolution of returns to schooling in Poland for a long horizon of time and is yet another piece of evidence in discussing relative demand and supply shifts of high skilled employees. Gender differences in the evolution of returns might be explained by observed differences in labour force participation. It is empirically established fact, that the participation rates for women are more sensitive to business cycle effects (Killingsworth, 1983). On the other hand, in the Polish context, 60 percent of women are employed in a public sector, where business cycle effects are weaker in terms of employment and wages.

The evolution of returns to education was studied in a number of papers before. Psacharopoulos (1989) shows increasing returns to schooling in the USA for 1950s and 60s and which are attributed to increasing demand for skills. The subsequent period of 1960-1980 is characterized by falling returns where it were the supply side effects to have played more important role. He found similar effects for the 1970s in Canada, France and United Kingdom. Returns following business cycle pattern were also found in his later paper (Psacharopoulos et al., 1996) in Mexico for the period 1984-1992.

Sakellaris and Spilimbergo (2000) have studied the effects of economic fluctuations on investment in higher education for a number of countries. The scope of their study was the analysis of foreign students enrollment rates in the United States and the business cycle in the sending countries. They have found a strong relation between these two and more importantly they have claimed that the cyclical pattern of enrollment was different for two groups of countries. Enrollment was countercyclical for the OECD sending countries, while it was procyclical for non-OECD countries. Hartog et al. (2001) found a significant increase of returns to education for Portugal after joining the European Union in 1986 which was accompanied by an increase in the average level of education. They concluded that this effect was mostly demand driven. The findings of Dellas and Koubi (2003) support the hypothesis that changes in the opportunity costs of schooling along the business cycles play a major role in individual schooling decisions. Fersterer and Winter-Ebmer (2003) showed falling returns in Austria for the period 1981-1997 which were mainly driven by an increase of supply of highly educated workers during that time. On the other hand, Zhang et al. (2005) showed extraordinary increase in returns to education in urban China from only 4 percent in 1988 to 10.2 percent in 2001. They attributed this increase to institutional reforms of education system as well as substantial increase in demand for high skills. Findings by Zhu (2011) and Wang (2012) confirmed

increasing returns to schooling in urban China between 1995 and 2002 both for men and women, particularly in the upper quantiles of wage distributions.

Relationship between returns to schooling and unemployment rate was studied for Germany by Ammermueller et al. (2009). They found that an increase in regional unemployment by 1% decreased returns to education by 0.005 percentage points. Devereux and Fan (2011) studied the effects of the large expansion in British educational attainment for cohorts born between 1970 and 1975. Using the Quarterly Labour Force Survey, they found that the expansion caused men to increase education by about a year on average and gain about 8% higher wages; women obtained a slightly greater increase in education and a similar increase in wages.

Bartolj et al. (2013) analysed the evolution of returns to education during the period of transition from a socialist to a market economy in Slovenia, between 1994 and 2008. He documented that the initial period of transition (1994-2001) exhibited an increase in supply of higher skills but the demand side effects were much stronger which resulted in increasing returns. The following period (after 2001) exhibited continued increase in supply but was not matched by appropriate shifts in demand which reversed the trend of returns to schooling.

Corliss et al. (2013) showed important business cycle effects on the private returns to university degrees in Australia. At the top of the business cycle the private rate of return to a degree diminished as the pool of unskilled labour dried up along with decreasing unemployment rate putting pressure on wages to rise disproportionately faster for the least skilled. Another factor which contributed to reduction of the returns to schooling was huge increase in supply of university graduates after 1990.

The paper by Kyui (2016) analyzed the effects of an educational system expansion in the Russian Federation. It was found that higher education was offering higher returns in terms of employment opportunities and wages, but it decreased over time as a result of increased enrollment.

Returns to education for transition economies were studied in a number of papers. For an excellent study using comparable data see Tiongson et al. (2007). In the context of Poland the evolution of returns for the whole period of transition was however not yet documented and this paper aims to fulfil this gap. To my best knowledge there are no studies on cyclicality of returns to education in Poland and this paper aims to fulfil the gap also in this aspect.

2.2. Data description

The major data source comes from the individual data sets of LFS, quarterly waves for 1995 – 2017. Levels of education were transformed into typical years of schooling to construct the measure of the most important independent variable. Wages were calculated from declared monthly earnings in the main job and declared typical hours worked to give hourly net earnings in the main job. The self-employed are excluded from the analysis due to unreliable information on their income. Personal characteristics (age, sex, education, marital status, class of settlement unit, region) and job characteristics (experience, firm size, ownership sector) are all considered as independent variables in the earnings equation, as well as time dummies and various interaction terms. Overall database consisted of 970 thousand observations. Descriptive statistics are presented in table 1.

Table 1. Descriptive statistics

Year	Log net hourly wage	Years of schooling	Male (%)	Experience	Regional unemployment rate	N
1995	0.891 (0.439)	10.492 (2.874)	47.4	26.585 (19.036)	0.134 (0.028)	61471
1996	1.128 (0.437)	10.544 (2.861)	47.3	26.68 (19.092)	0.124 (0.028)	60171
1997	1.332 (0.438)	10.603 (2.845)	47.5	26.665 (19.121)	0.113 (0.027)	59903
1998	1.494 (0.430)	10.661 (2.849)	47.6	26.577 (19.141)	0.106 (0.024)	59340
1999	1.615 (0.444)	10.693 (2.856)	47.7	26.813 (19.229)	0.140 (0.033)	24414
2000	1.718 (0.454)	10.751 (2.834)	47.4	26.899 (19.336)	0.164 (0.032)	40573
2001	1.776 (0.493)	10.799 (2.884)	47.3	27.145 (19.392)	0.186 (0.034)	41173
2002	1.803 (0.498)	10.864 (2.945)	47.5	27.336 (19.466)	0.203 (0.036)	38479
2003	1.814 (0.504)	11.020 (2.967)	47.5	27.341 (19.475)	0.199 (0.033)	36142
2004	1.841 (0.505)	11.170 (2.982)	47.5	27.214 (19.497)	0.189 (0.030)	34745
2005	1.869 (0.510)	11.263 (2.989)	47.4	27.423 (19.487)	0.179 (0.028)	35877
2006	1.925 (0.524)	10.922 (3.364)	48.0	25.532 (20.028)	0.140 (0.024)	37143
2007	2.005 (0.522)	11.278 (3.066)	48.1	26.980 (19.874)	0.098 (0.019)	37568
2008	2.143 (0.481)	11.370 (3.077)	48.2	27.395 (19.996)	0.073 (0.016)	31893
2009	2.236 (0.467)	11.480 (3.113)	48.1	27.788 (20.106)	0.086 (0.017)	26819
2010	2.378 (0.480)	11.516 (3.072)	48.1	28.021 (20.027)	0.099 (0.016)	92667
2011	2.351 (0.464)	11.586 (3.059)	48.0	28.440 (20.028)	0.099 (0.016)	39560
2012	2.401 (0.472)	11.667 (3.060)	48.0	28.785 (20.059)	0.103 (0.017)	35938
2013	2.431 (0.472)	11.735 (3.069)	47.9	29.193 (20.069)	0.106 (0.019)	30270
2014	2.426 (0.437)	11.805 (3.079)	47.9	29.699 (20.09)	0.093 (0.021)	44208
2015	2.455 (0.431)	11.928 (3.010)	47.8	31.237 (19.931)	0.077 (0.018)	36952
2016	2.511 (0.436)	12.078 (3.022)	47.6	31.549 (19.910)	0.065 (0.018)	32951
2017	2.616 (0.430)	12.282 (3.037)	47.5	31.922 (19.904)	0.052 (0.018)	33636

Standard deviation in parentheses. Regional unemployment rates were calculated at the voivodeship level.

Source: Own elaboration using LFS data, 1995-2017.

3. Empirical evidence

3.1. Estimation strategy

In the first attempt I run several Mincer wage regressions to document the evolution of returns to schooling in Poland over the period of 1995-2017. All specifications include the log of hourly net wage in the main job as dependent variable. The explanatory variables include: years of schooling (s_{it} – typical years of education needed to obtain a particular education level), sex, labour market experience (additionally a squared term to capture non-linearity), ownership sector, firm size, region (voivodeship), class of settlement unit, yearly and quarterly dummies and several interaction terms to control for possible non-linearity over time in the returns to schooling, gender wage gap, ownership sector. The results are presented in a compact form in Table 1.

$$\log w_{it} = \beta_0 + region_i + time_t + \beta_1 s_{it} + \beta_2 X_{it} + e_{it}$$

Specifications (1) and (2) use simple OLS method, while (3) and (4) use the Heckman selection procedure, where the participation equation includes years of schooling, sex, age, marital status and the class of settlement unit as identification variables.

The second stage of empirical strategy is to include the regional unemployment rate (at the voivodeship level) into the Mincer wage regression together with an interaction term with the years of schooling. Typically, the expected sign for the log unemployment parameter is negative (in the spirit of wage curve estimates), while the sign of the interaction term remains uncertain. Under the null hypothesis of anti-cyclicality of returns it is expected to be positive. The interpretation is the following: in times of recessions the growth of GDP slows down or even becomes negative and the unemployment rate increases. High skilled employees are better sheltered against those unfavorable market conditions and their relative wages increase. This increases observed returns to schooling. In times of recovery however, increase in aggregate demand causes unemployment to fall and the employment opportunities improve relatively stronger for low skilled as their employment and wages increase. This reduces the wage premium for higher skills and reduces observed returns to schooling. There is however one econometric problem. The data used for estimation is gathered at the individual level, while the unemployment rate is calculated at the regional level, so for large groups of individuals we have the same value of unemployment rate at the particular point in time. To account for this inconsistency in the level of data aggregation I use the procedure of clustered standard errors over regional dummies. This might not fully solve the problem, therefore a robustness check is

proposed to see if those results hold when we aggregate the data at the regional level. This is discussed in more detail later in the text. The second robustness check involves using non-employment rate in place of unemployment. The idea for this comes from the fact that many commentators believe the evolution of non-employment might better represent the changes in the business cycle in the transition economies. The results of the second stage are presented in Table 2.

$$\log w_{it} = \beta_0 + region_i + time_t + \beta_1 s_{it} + \beta_2 \log u_{jt} + \beta_3 s_{it} * \log u_{jt} + \beta_4 X_{it} + e_{it}$$

Specifications (1) to (3) use OLS estimates, while specification (4) uses Heckman selection model with the same identification equation as in stage one. Specifications (1) to (3) differ in the set of explanatory variables. The first regression uses only the basic variables: years of schooling, sex, experience and log unemployment rate with interaction term with the years of schooling and some additional dummies (see the table for detailed description). Regression model (2) basically adds job characteristics, while regression (3) adds also the share of employment in the public sector. Regression (4) uses the same set of variables but the equation is estimated using two-step Heckman procedure with maximum likelihood.

3.2. Discussion of results

Table 2 summarizes the results of standard Mincer wage regression models for pooled data over the period 1995-2017. Basing on those results Figures 6 and 7 were generated to present the evolution of estimated returns to schooling over the years (yearly and quarterly estimates, respectively). These are the estimates of time dummies interacted with schooling variable (specification 3). Obviously more variation is seen when quarterly dummies are used, but generally these two graphs show the same pattern. The conclusions from the estimates are the following. The average yearly return to schooling in Poland was around 6.5 – 8 percent, depending on the model specification. Lower estimate was obtained when selection into employment was controlled for. There was consistently negative wage premium for women for the whole period, on average reaching 16-18 percent. The returns to experience were quite stable, representing 2.2 – 2.4 percent per additional year but significantly negative parameter for the squared term suggests concavity of wage profile to experience with wages reaching peak at around 30 years of labour market experience. Generally, the average wage premium for the public sector was positive, but the analysis of time dummies interacted with this variable shows substantial variation. This is however beyond the scope of this paper and will not be

analysed any further. There are considerable wage premia to firm size. The largest companies pay significantly more and this effect if fairly stable over time and across model specifications.

Table 2. Mincer wage regressions for Poland: 1995-2017.

	(1)	(2)	(3)	(4)
schooling	0.0812***	0.0719***	0.0740***	0.0645***
	[0.0007]	[0.0010]	[0.0007]	[0.0010]
woman	–0.1833***	–0.4190***	–0.1667***	–0.4050***
	[0.0030]	[0.0158]	[0.0030]	[0.0158]
experience	0.0235***	0.0236***	0.0220***	0.0221***
	[0.0001]	[0.0001]	[0.0002]	[0.0002]
experience^2	–0.0004***	–0.0004***	–0.0003***	–0.0003***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
public sector	0.0333***	0.0310***	0.0327***	0.0303***
	[0.0031]	[0.0031]	[0.0031]	[0.0031]
firm size: 10-50	0.0982***	0.0969***	0.0976***	0.0962***
	[0.0012]	[0.0012]	[0.0012]	[0.0012]
firm size: 50-100	0.1366***	0.1360***	0.1356***	0.1350***
	[0.0015]	[0.0015]	[0.0015]	[0.0015]
firm size: 100+	0.1939***	0.1957***	0.1924***	0.1941***
	[0.0013]	[0.0013]	[0.0013]	[0.0013]
inverse Mills ratio			–0.1140***	–0.1154***
			[0.0023]	[0.0023]
constant	–0.5106***	–0.4037***	–0.3061***	–0.1956***
	[0.0083]	[0.0115]	[0.0093]	[0.0122]
dummies				
yearly dummies	yes	yes	yes	yes
quarterly dummies	yes	yes	yes	yes
regional dummies	yes	yes	yes	yes
class of settlement dummies	yes	yes	yes	yes
interaction terms				
years and schooling	yes	yes	yes	yes
years and sex	yes	yes	yes	yes
years and public sector	yes	yes	yes	yes
years, sex and schooling	no	yes	no	yes
Adj. R2	0.6912	0.6923	0.6919	0.6931
N	964 279	964 279	964 279	964 279

Clustered standard errors at the regional level are reported in the parentheses.
Significance levels are denoted by * 5%, ** 1%, *** 0.1%.

The analysis of Figures 6 and 7 allows to draw more attention to the evolution of returns over time. Returns to additional year of schooling increase on average for the period 1995-2006, decline in the period 2006-2015 and increase only slightly again after 2015.

Using the framework of relative demand and supply shifts we might argue the following:

- the period 1995-2006 is characterized by dominating demand side effects. Increasing average number of years of schooling is accompanied by increasing return to additional year of schooling. Despite enormous increase in enrollment rates and the number of graduates, demand side effects seem to have prevailed. Although a significant increase in supply of high skills was observed, demand for high skills was increasing even faster;
- the period 2006-2015 is characterized by dominating supply side effects. The average number of years of schooling was still increasing, but this was accompanied by a fall in average return to schooling. Demand for high skills was not dynamic enough to follow the shifts in supply. The studies on overeducation show increasing shares of higher education graduates performing jobs which do not require tertiary education. The studies show also that the overeducation incidence intensified after 2006 in Poland.

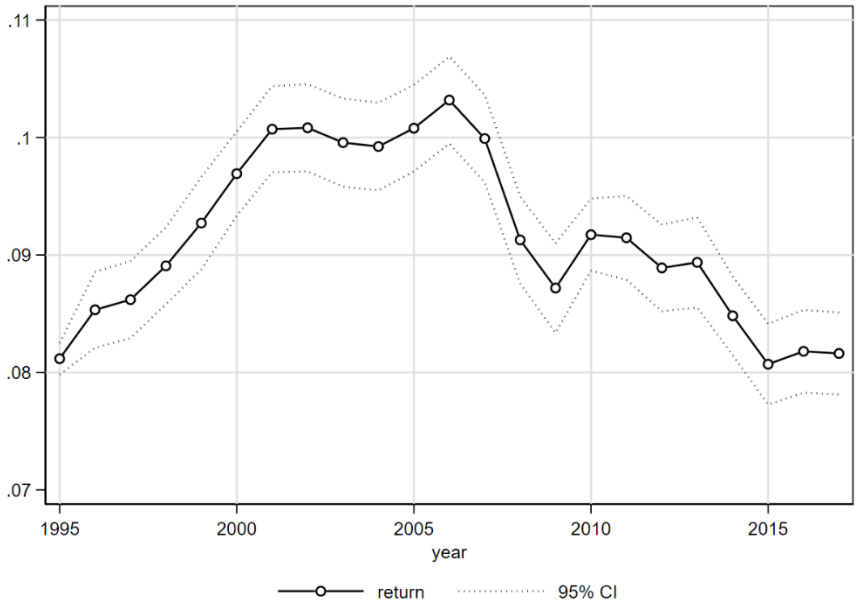

Figure 6. Returns to schooling 1995-2017: yearly time dummies.
Source: own estimations using LFS data

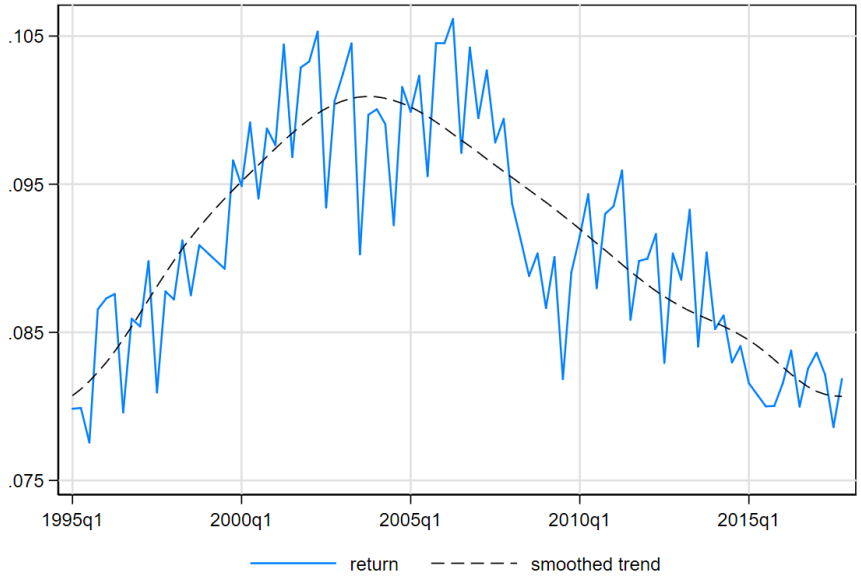

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Figure 7. Returns to schooling 1995-2017: quarterly dummies.
Source: own estimations using LFS data.

Figure 8 shows the evolution of returns to schooling for males and females for the period 1995-2017. The estimates used to construct this figure were obtained from specification (4), where I allow for the returns to vary by year differently for men and women, and sector of ownership (interaction terms of all these variables are included in the regression). This graphical illustration reveals a number of interesting facts. The returns to additional year of schooling were on average higher for women, but the last two years in the sample are exception to this rule. Returns for men have surpassed those for women and this poses an interesting question about the causes of this reversal to be investigated in future research. Generally, the returns were falling over time after 2006-2007, but it is clearly visible now, that they did in a different manner for men and women. Evolution of returns to schooling for men followed the general pattern more closely, while the returns for women were consistently falling since 2007, showing little variation in the initial period: 1995-2006. Returns for men were increasing in that period, closing the gender gap in this respect, but then they sharply fell in 2008 and did not manage to recover until 2016. The explanation of this phenomenon might be the economic crisis of 2008 which affected both sexes differently. Employment structure of men and women is quite different with respect to the ownership sector in Poland. The share of women in the public sector employment is round 60 percent. Significantly more women are employed in administration, education and health sectors, which are significantly less vulnerable to business cycle effects and adverse macroeconomic shocks. Males on the other hand are significantly more likely to be employed in sectors of greater exposure to economic cycle and various

demand shocks propagated by international channels. Another reason for falling returns to schooling for women after 2008 might be the government policy of freezing nominal wages in the public sector as a response to worldwide financial crisis.

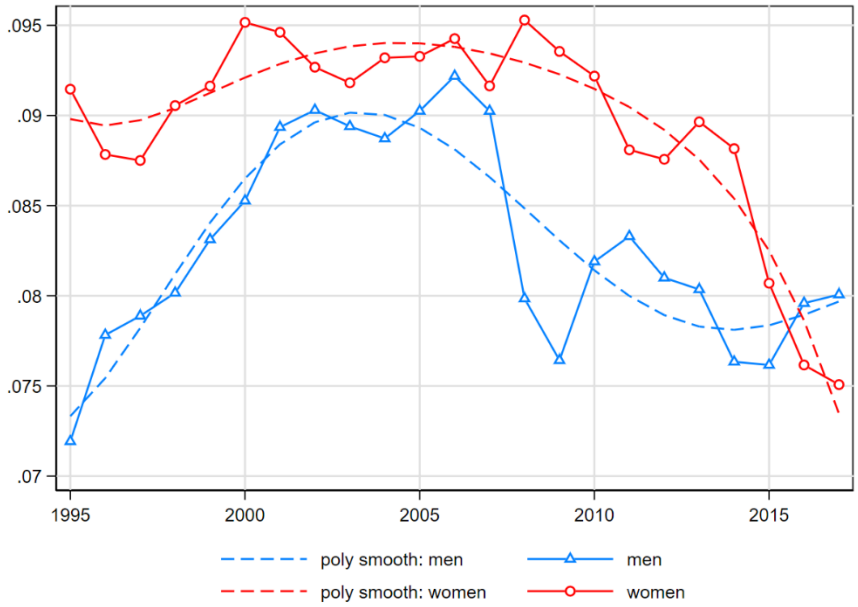

Figure 8. Returns to schooling by sex, 1995-2017.
Source: own estimations using LFS data.

The analysis for the second stage involving the local unemployment rate results in estimates gathered in Table 3. The parameters of primary interest here are those related to log unemployment rate. The impact of unemployment on wages was found negative and this is in line with estimates of wage curve literature. In general, the wages response to local unemployment rate in Poland is somewhat greater in absolute terms (–0.16) than it is found in other studies. Nijkamp and Poot (2005) find that the average effect of unemployment on wages is –0.07 across 208 studies. Blanchflower and Oswald (1994) found that relationship of –0.10 for most countries. The interaction term of log unemployment rate and the years of schooling turned out to be significantly positive in 3 out of 4 specifications. It was insignificant only in the first regression, where a number of covariates were not controlled for. The estimate was fairly robust and amounted to 0.008-0.009. It suggests that there are is no evidence against the null hypothesis of returns to schooling being counter-cyclical. The returns to schooling in Poland were higher in periods of higher local unemployment. The estimated value implies that an increase in unemployment rate by 1 percent leads to an increase of return to additional year of schooling roughly by 0.008 percentage points. To make these numbers more interpretable imagine a local unemployment rate increase from 10 percent to 11 percent followed by an increase in the return to schooling from 8 percent to 8.08 percent. This impact is not

quantitatively large but remains highly statistically significant. Other parameters exhibit similar values to those obtained in a standard Mincer wage regressions (compare Table 2).

Table 3. Mincer wage regressions including unemployment rate

	(1)	(2)	(3)	(4)
schooling	0.0801***	0.0709***	0.0708***	0.0622***
	[0.0117]	[0.0085]	[0.0085]	[0.0090]
ln_u	–0.2290***	–0.1542***	–0.1581***	–0.1633***
	[0.0336]	[0.0348]	[0.0357]	[0.0359]
schooling # ln_u	0.0085	0.0083*	0.0083*	0.0087*
	[0.0041]	[0.0030]	[0.0030]	[0.0030]
woman	–0.1947***	–0.1899***	–0.1899***	–0.1730***
	[0.0116]	[0.0246]	[0.0246]	[0.0238]
experience	0.0261***	0.0233***	0.0233***	0.0218***
	[0.0014]	[0.0010]	[0.0010]	[0.0009]
experience^2	–0.0004***	–0.0004***	–0.0004***	–0.0003***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
public sector		0.0243	0.0246	0.0242
		[0.0180]	[0.0179]	[0.0178]
firm size: 10-50		0.0986***	0.0986***	0.0979***
		[0.0035]	[0.0035]	[0.0035]
firm size: 50-100		0.1370***	0.1370***	0.1359***
		[0.0043]	[0.0043]	[0.0043]
firm size: 100+		0.1944***	0.1944***	0.1928***
		[0.0093]	[0.0093]	[0.0093]
public sector share			–0.1137	–0.1141
			[0.0775]	[0.0791]
inverse Mills ratio				–0.1141***
				[0.0106]
constant	–0.0041	–0.2224*	–0.1377	0.0864
	[0.0981]	[0.1009]	[0.1194]	[0.1326]
dummies				
yearly dummies	yes	yes	yes	yes
quarterly dummies	yes	yes	yes	yes
regional dummies	no	yes	yes	yes
class of settlement dummies	no	yes	yes	yes
interaction terms				
years and schooling	yes	yes	yes	yes
years and sex	no	yes	yes	yes
years and public sector	no	yes	yes	yes
Adj. R2	0.6712	0.6908	0.6908	0.6916
N	971 893	964 279	964 279	964 279

Clustered standard errors at the regional level are reported in the parentheses.
Significance levels are denoted by * 5%, ** 1%, *** 0.1%.

4. Robustness check

Here I use a two-step procedure (following Ammermueller et al., 2009) as a robustness check whether there exist any significant relationship between regional unemployment rate and regional return to years of schooling. First step estimation uses standard Mincer wage regression, controlling for regional dummies, time dummies and various personal and job characteristics of sampled population. The estimated equation becomes as follows:

$$\log w_{it} = \beta_0 + reg_j + time_t + R_{jt}s_{ijt} + \beta_1 X_{ijt} + e_{ijt}$$

Using the estimates of parameters of the equation above the values for returns to years of schooling on regional level are predicted. In the second step they are explained by the log of regional unemployment:

$$\hat{R}_{jt} = \alpha_0 + \alpha_1 \log u_{jt} + reg_j + time_t + \varepsilon_{jt}$$

The level of data aggregation – region – is the same for both explained and explanatory variable. Table 4 presents the estimates of the second step regression model with several specifications. First specification is the base one. The second one adds lagged dependent variable by four quarters (autoregressive model). The third specification uses in place of current log unemployment rate the lagged log of unemployment rate by four quarters and a difference in log unemployment rates over four quarters. Last specification uses IV technique for the second specification where log unemployment rate is instrumented by log unemployment rate lagged by four quarters.

Table 4. Results of the second step regression of returns on unemployment at the regional level

	(1)	(2)	(3)	(4)
Log u	0.0032**	0.0034***		0.0057***
	[0.0010]	[0.0010]		[0.0015]
Lagged log u			0.0045***	
			[0.0011]	
regional dummies	Yes	Yes	Yes	Yes
time dummies	Yes	Yes	Yes	Yes
lagged local return	No	Yes	Yes	Yes
difference in log unemployment	No	No	Yes	No
Adj. R2	0.850	0.871	0.872	0.871
N	1 440	1 344	1 344	1 344

Standard errors are reported in the parentheses.
Significance levels are denoted by * 5%, ** 1%, *** 0.1%.

Results indicate persistent significant effect of log unemployment rate on returns to years of schooling on regional level in all model specifications. The relationship between these two variables is positive which strengthens the conclusions from previous section. An increase in regional unemployment rate is associated with an increase in return to additional year of schooling. Quantitatively, the effect is not so strong – a 10% increase in local unemployment rate (from 10% to 11%) results in an increase of return to additional year of schooling by 0.03 – 0.06 percentage points (for example from 8% to 8.03-8.06). Relationship between the estimated returns to schooling and local unemployment rates are shown graphically for Polish voivodeships on the Figure 9. In all graphs we see a positive correlation between these two variables, suggesting there exists a counter-cyclical behavior of the returns to schooling.

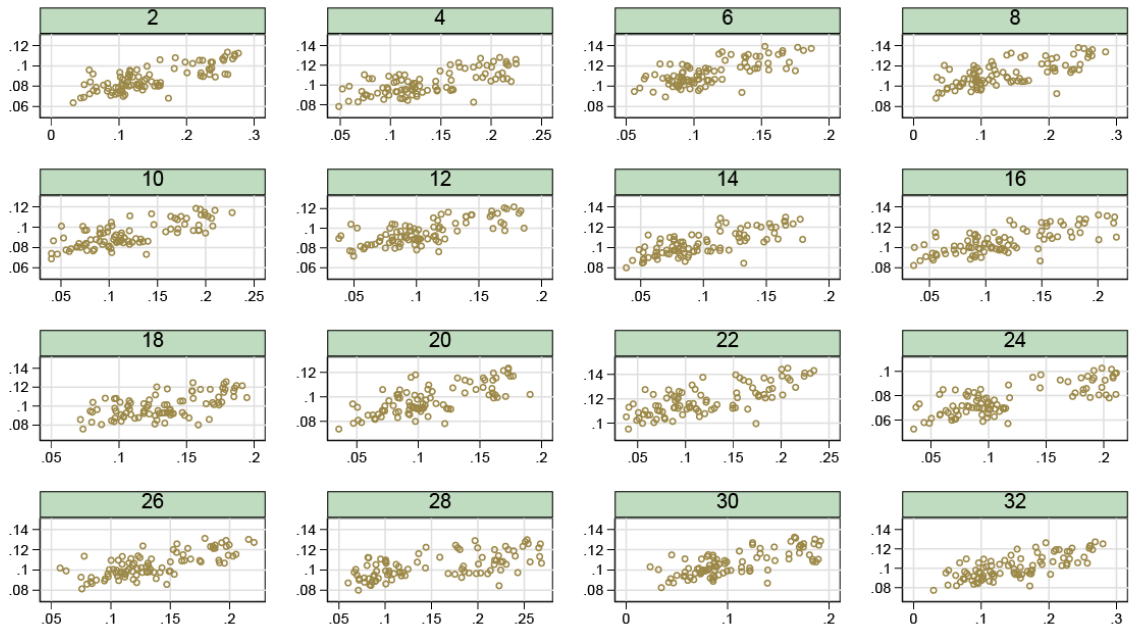

Figure 9. Returns to schooling and local unemployment rates by voivodeships, 1995-2017.
Source: own estimations using LFS data.

5. Conclusions

The aim of this paper was to document the evolution of returns to education in Poland during a long period of time to capture possible relation to the evolution of unemployment rate over the business cycle. For the purpose of empirical analysis individual LFS data was used covering the period of 1995-2017, resulting in more than 970 thousand observations. Estimated Mincer earnings equations indicated a dynamic upward trend of returns to schooling in Poland in

the initial period of transition, and continued until 2006. Despite significant increase in enrollment rates and the number of graduates, demand side effects seem to have been dominating in that period, as demand for skills was increasing faster than supply. On the other hand, the period after 2006 was characterized by dominating supply side effects with the average number of years of schooling still increasing, but falling returns to schooling. The evolution of returns over time for men and women followed to a high degree similar pattern, but the distinctive difference was observed in the period of world financial crisis of 2008-2009, where returns for men dropped significantly more than those for women. In the whole analysed period returns for women were however generally higher than returns for men.

Local unemployment rate included into Mincer earnings function in the spirit of the wage curve literature, revealed that the periods of increasing local unemployment rates were accompanied by increasing returns. This suggests that returns to schooling are counter-cyclical in Poland. In periods of recession high skilled are better isolated from macroeconomic shocks than low skilled. In periods of economic recovery increasing demand for low skills increases the relative wages in favour of low skilled, leading to diminished returns to an additional year of schooling. The periods of better economic activity are therefore offering ceteris paribus less incentives to continue education, while it is the adverse shocks that stimulate higher enrollment rates. Using LFS data made it impossible to control for ability bias therefore it is quite likely that the estimates are to some extent biased. However, it might be argued that using consistent methodology for the whole period of time gives still informative results in the aspect of returns evolution.

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