QUANTITATIVE METHODS IN ECONOMICS
Vol. XVI, No. 2, 2015, pp. 159 – 169

THE INFLUENCE OF PUBLIC AND PRIVATE HIGHER EDUCATION IN POLAND ON THE ECONOMIC GROWTH OF THE COUNTRY

Joanna Żyra
Institute of Economy, Sociology and Philosophy
Cracow University of Technology
e-mail: jzyra@pk.edu.pl

Abstract: This paper seeks to investigate empirically the relationship between the enrolment at public and private higher education institutions (HEIs) and regional growth in Poland. Based on the panel data of 16 voivodeships for the period of 2000-2011, it is established that an increase in the number of students at both types of HEIs has a positive effect on the regional growth. Regardless of the specifications of the regression model, our results demonstrate, supporting the Nelson–Phelps hypothesis, that accumulation of human capital is one of the factors behind economic growth, with no differences detected between public and private HEIs.

Keywords: higher education, the Nelson–Phelps hypothesis, regional growth, public and private higher education institutions

INTRODUCTION

As a source of human capital, higher education used to be viewed as an important source of economic growth [An and Iyigun 2004, Barro 2002, Daren 2007, Lee 2010, Miller 2007, Sianesi and Reenen 2003]. There are two main approaches to explanation of the macroeconomic relationship between education and output: (i) interpretation of economic growth as the result of an increase in the stock of human capital as a factor of production (it means that the rate of economic growth depends on the *changes* in the education variable) or (ii) looking at the stock of human capital as the most important source of innovation and implementation of new technologies (it means that the rate of economic growth depends on the *level* of the education variable). The former approach is based on

the proposals by Lucas [1988] and thus treats education in the similar way as physical capital. As a consequence, the rate of output growth is accelerated by an increase in the rate of student enrolment, which is viewed in the similar way as an investment in human capital. On the other hand, the Nelson–Phelps approach [1966] is based on the assumption that the R&D activities are stimulated by accumulation of immaterial factors of inventions and knowledge resulting from a larger number of educated workers, which in turn contributes to economic growth.

Despite numerous arguments in favour of the benefits of education, including external effects [Bredt and Sycz 2007, Karamalla-Gaiball 2006, Moretti 2004], an implied positive relationship between education and the long-term level of output or its rate of growth is lacking strong empirical support [Benhabib and Spiegel 1994, Islam 1995, Levine and Renelt 1992, Pritchett 2001]. Voices expressing concern regarding a remarkable increase in the number of students in Poland are not rare [Chałasińska-Macukow 2009, Kuciński 2009, Papuzińska 2009, Tomusk 2001], especially in the context of financing public and private HEIs or their location outside large and long-established academic centres. As mentioned by Minkiewicz [2007], quantitative and structural changes in higher education are stemming mainly from higher educational aspirations of the youth and higher returns on education, but low costs of higher education at public HEIs are very important as well.

As found by Żyra [2013] based on annual data on Poland's economy over the period of 1988 – 2010, an increase in the number of students in either dynamic (in first differences) or static form (in levels) leads to a slower output growth across all fields of study. However, a growth stimulating effect of the number of students has been confirmed for the estimates in levels for a shorter sample of regional data over the period of 2000 – 2010, yet a negative effect is still observed for estimates in first differences. A positive relationship between the number of students and regional growth in Poland has been demonstrated by Bronisz and Heijman [2010]. For Poland, various aspects of higher education and research sector growth effects are studied by Florczak [2006] and Welfe [2008]. Considering the ongoing discussion on higher education in Poland, it is of particular interest to estimate education effects across public and private HEIs.

THE ROLE OF EDUCATION IN ECONOMIC GROWTH

The influence of education on growth has been studied from many academic angles. Endogenous growth models imply increasing returns on human capital. Lucas [1988] demonstrated how investments in education could contribute to acceleration of economic growth. In a similar way, Romer [1990] identified human capital with research activities. As suggested by Psacharopoulos and Patrinos [2004 a], both Lukas and Romer growth models imply that (i) output is not constrained by the constant return to scale assumption, contrary to the neoclassical

Solow model, and (ii) ”knowledge” is considered a public good, with favourable educational externalities. Mueller [2007] suggests that such externalities should be viewed as an argument in favour of expansion of higher education, regardless of considerable expenses on HEIs.

There are numerous arguments that positive educational externalities are created in a situation of sharing knowledge and skills during formal and informal contacts or skill-based endogenous technological progress, which brings about non-monetary benefits as well [Moretti 2004]. Educational externalities could also be found in other forms, such as better health conditions, stronger social relationships, rational election choices etc., creativity or new approaches to professional activities [Bredt and Sycz 2007]. Education contributes to a wide range of social activities, which makes it easier to cooperate on the basis of positive interpersonal relationships [Karamalla-Gaiball 2006]. Based on the empirical findings for Poland, Bronisz and Heijman [2010] argue that both economic growth and regional competitiveness are positively correlated with the level of social capital.

Marattin [2007] established that economic growth is stimulated by accumulation of human capital, no matter how it is financed – with private or public funds:

$$y = \frac{\gamma}{(1+\beta+\gamma)(1+n)^2}\left(1+(1-\tau_k)r\right)(1-\tau_w)w_t E^{\eta} h_t^{1-\eta}, \tag{1}$$

where y is the rate of economic growth, γ is the share of expenditure on education by parents, β is a discount factor, n is the rate of population growth, τ_k and τ_w are tax rates on labour and capital, respectively, r is the interest rate, w_t is wage, E_t is the expenditure on education, h_t is the stock of human capital.

The model implies that private and public expenditure on education is complementary. Thus it is expedient to tax labour in order to increase the total expenditure on education. Taxation of capital promotes growth only if the share of households in the total expenditure on education, η, is high enough and the share of capital in the production function is between 0.3 and 0.4, which is relevant to the actual figures for industrial countries.

According to the Nelson–Phelps approach [1966], an increase in the level of education is almost immediately translated into a decrease in the distance between the levels of (1) technology in practice, which measures the best-practice level of technology or the average technology level “embodied” in the representative assortment of capital goods currently being purchased, and (2) theoretical technology, which is the best-practice level of technology that would prevail if technological diffusion were completely instantaneous (it is a measure of the stock of knowledge that is available to innovators). The rate of innovation growth is increased by the level of education and the gap between technology in practice and theoretical technology. As the equilibrium gap is a decreasing

function of educational attainment, a higher level of education increases the path of the technology in practice in the long run.

The Nelson–Phelps approach envisages that the rates of productivity growth and technological progress are higher in line with an increase in the number of educated persons, especially university graduates, as it increases the number of potential researchers/inventors in the economy. The payoff to increased educational attainment is greater, the more technologically advanced is the economy. This kind of regularity is supported by empirical findings, which indicate an inverse relationship between the demand for education and amortisation of the stock of physical capital. For technologically backward countries, education allows an import of technologies from advanced countries in attempts to achieve an appropriate rate of productivity growth.

A class of economic growth models relates the impact of education to a certain *threshold level*, which decides on whether a higher level of education leads to a higher output growth or to a stagnation trap [Aghion and Hewitt 1998]. As it is not expedient to invest in education while in the stagnation trap, the economy is stuck indefinitely in the equilibrium with a low output growth. Assuming complementarity between investments in physical and human capital, Bassetti [2009] provides evidence of the same education-motivated stagnation trap within the framework of the Solow model.

Education subsidies are among solutions for avoiding the stagnation trap, providing a possibility of attaining a higher path of economic growth. A positive impact of public educational expenditure on economic growth is found in empirical studies by Barro and Sala-i-Martin [1995] and Baldacci et al. [2008], though Blankenau and Simpson [2004], by calibration of the endogenous growth model, obtain a less optimistic result. A positive effect on growth of public expenditure on education is seriously weakened or even reversed if it is controlled by such factors as the level of government expenditure, composition of taxes and production technologies. Lin [1998] argues that an increase of public expenditure on education, for example in the form of educational subsidies, is useful for accumulation of human capital, though on condition that it does not lead to an increase in the long-term interest rate.

All said, educational expenditure is a necessary but not sufficient factor for achieving a higher output growth rate. The efficiency of education as a growth factor is dependent on such factors as: (i) openness of the economy, (ii) quality of institutions, or (iii) functioning of the labour market.

MODELS OF INTERACTIONS BETWEEN PUBLIC AND PRIVATE UNIVERSITIES

Geiger [1987] identifies three models of interactions between public and private HEIs:

1. *Monopolisation of educational services by several public universities* (usually with high academic credentials). In such a situation, public HEIs attract students on the basis of low tuition costs, being set up in response to a high demand for higher education. It is common that private HEIs are characterized by modest financial capabilities and employment of faculty on the part-time basis.
2. *Parallel coexistence of public and private universities*. Among necessary conditions for that kind of model are such factors as relevant group interests, a unified national educational standard for diplomas issued by HEIs and significant co-financing of private HEIs by the state.
3. *Peripheral status of private HEIs*. In this case private HEIs are marginalized, lacking public financial support and thus being not able to match academic standards of public universities.

As for now, a dynamic development of private HEIs is observed in Australia [Edwards and Ali Radloff 2013] and China [Zha 2006]. Expansion of the Chinese private HEIs is based upon the pillars of strong economic growth and decentralisation policies. However, there is considerable concern related to the equal access to higher education for all social groups.

The main arguments in favour of public education could be summarized as follows: (i) redistributional effects; (ii) using tax revenues for strengthening the foundations of the economic growth (in particular, it is important for developing new technologies, which is not possible outside strong HEIs and requires substantial public expenditure); (iii) complementarity with expenditure borne by households.

Using the *overlapping generations* model, Ayed Zambaa and Ben Hassen [2013] show that public HEIs can be more effective in attaining a higher rate of economic growth. Angelopoulos et al. [2007] present a model that implies favourable externalities in the case of higher expenditure on public education. For the USA, it has been demonstrated that such expenditure stimulates economic growth and the sense of well-being in the society. Although public expenditure is characterized by partial crowding out of private consumption, nevertheless it is expedient to modify the structure of public expenditure in favour of education.

In a slightly different setting, Arcalean and Schiopu [2007] suggest that an increase of public expenditure on education results in "crowding out" of private expenditure on higher education, while there is an increase of expenditure on education in schools. On the other hand, an increase of public expenditure on schooling induces higher expenditure on higher education by households.

Northern Cyprus, suffering from lack of international recognition since 1974, is a good example of using HEIs as a source of economic growth. In the absence of other alternatives, it had been decided to invest in the development of tourism and higher education [Katircioĝlu et al. 2010]. Since the beginning of the 1990s, local HEIs are oriented towards students from Turkey and African countries. Universities organize academic conferences, while being engaged in cultural events and sport competitions as well.

Two arguments in favour of private HEIs are as follows:

- General benefits from private ownership,
- An increase in accumulation of human capital.

As stated by Yamada [2005], in societies with a strong quest for social status privately financed education could improve the allocation of human resources, thus increasing the growth rate in the private finance regime compared with the public finance regime. The explanation is that private cost dissuades *wrong* agents from participating in growth enhancing activities. As a consequence, the allocation of human resources is improved. It is worth noting that under strong preferences for social status the growth rate declines in the public finance regime even though tax revenues are used for productivity augmenting expenditure.

DATA AND STATISTICAL MODEL

The annual data for 16 *voivodships* of Poland over the period of 2000─2011 are used. The panel dataset is balanced, and the number of observations depend on the lags for dependent and independent (explanatory) variables. Educational variable is the number of students at public and private HEIs, according to the information provided by the GUS (Central Statistical Office of Poland).

Our statistical model is as follows:

$$\Delta \log Y_{it} = a_1 \Delta \log S_{it} + a_2 \log S_{it} + a_3 \log I_{it} + a_4 \log W_{it} + \eta_i + \tau_t + \varepsilon_{it}, \qquad (1)$$

where Y_{it} is the regional output per capita (in PLN), S_{it} is the number of students per 1000 of population, I_{it} – is the level of investments per 1000 of population (in *PLN*), W_{it} is the nominal wage (in PLN), η_i and τ_t are variables for controlling regional and time effects, ε_{it} is the stochastic factor.

Microeconomic Mincer-style models of wages and some endogenous growth models, for example by Lucas [1988], imply positive returns on *changes* in educational attainment, not in the *level* of education. Such a relationship is not always supported by empirical studies. For example, Benhabib and Spiegel [1994] find that there are no positive effects of changes in educational attainment on economic growth, or that there is even an inverse relationship between education and economic growth, although there exists an expected positive link between the level of education and the rate of GDP growth. Krueger and Lindahl [2001] provide arguments that using *first differences* of educational variable is responsible for weakening of the signal and strengthening of the white noise, which could yield

biased estimates of the educational effects upon economic growth. In order to improve empirical assessment of educational effects, it is suggested to include into regression modes the educational variable in both first differences and levels.

Along the lines of endogenous growth models, it is possible to assume that an increase in the number of students, regardless of whether it is in the first differences or in the level of educational variable(the number of students), should contribute to a higher regional growth per capita $(a_1, a_2 > 0)$. However, numerous empirical studies suggest a possibility of negative coefficients, especially for a_1. For example, such results are obtained in the study of educational effects on economic growth in Poland by Żyra [2013]. Changes in educational attainment potentially reflect general equilibrium effects on the national level and eliminate all kinds of effects by permanent technological shocks [Kruger and Lindahl 2001], while the level of educational variable controls the effects of an increase in the stock of human capital.

Variable I_t captures the effects of an increase in the stock of physical capital, as one of the production function components. It is standard for neoclassical growth models (the Solow model) or endogenous growth models (the Lucas and Romer models) to claim that investments contribute to economic growth $(a_3 > 0)$. Kruger and Lindahl [2001] acknowledge that the probability of finding an inverse relationship between education and economic growth is higher in specifications, with investments in physical capital included. Controlling the growth effects by investments in physical capital, it is possible to obtain estimates of the impact of education upon economic growth that are not biased by the possible link between investments in education and physical capital.

The nominal wages W_{it} are for the labour market effects. The impact of wages on economic growth is dependent to a large extent on the interplay between supply and demand for labour. If the wage level is below equilibrium, it brings about an increase in the demand for labour, with a positive link between wages and economic growth to be implied $(a_4 > 0)$. Otherwise it is likely to expect the inverse relationship between wages and economic growth, as the lack of demand would inhibit employment $(a_4 < 0)$. Of course, all considerations of the sign on the coefficient on W_{it} are just the opposite for the supply-driven developments on the labour market.

ESTIMATION RESULTS

In order to estimate the magnitude of educational effects, fixed effects (FE) is used. Our results are presented in Table 1. The baseline regression model of specification I includes only investments in the physical capital, while the extended regression model of specification II corresponds to the full set of explanatory variables from equation (1). According to the R^2 statistics, the FE estimates explain from 29 to 35 percent of changes in regional growth in

specifications with the number of students at public HEIs, and from 19 to 33 percent in specification with the number of students and private HEIs. It is clear that the extended specification has a better explanatory power.

If control for investment in physical capital, there is a negative effect of the changes in the number of students (in *first differences*) at public HEIs on regional growth (coefficients are statistically significant at the 1 percent level). For private HEIs, there is a positive and statistically significant link between $\Delta \ln S_{it}$ and regional growth. Regardless of the type of HEIs — public or private, an increase in the number of students (in *levels*) has a positive effect on regional growth, which is compliant with the estimates for nationwide data [Żyra 2013]. The magnitude of the coefficient for the number of students is higher for public HEIs.

Table 1. Determinants of regional economic growth (baseline regression model)

Variables	Public HEIs		Private HEIs	
	I	II	I	II
$\Delta \ln S_{it}$	−0.373 (−6.45***)	−0.253 (−3.76*)	0.070 (2.20*)	0.070 (2.42**)
$\ln S_{it}$	0.108 (2.74***)	0.079 (2.04**)	0.072 (5.21***)	0.041 (2.92*)
$\ln I_{it}$	−0.021 (−2.01**)	−0.088 (−3.77*)	−0.016 (−2.76***)	−0.011 (−5.08*)
$\ln W_{it}$		0.068 (3.18*)		0.097 (5.01*)
Year dummies	Yes	Yes	Yes	Yes
R^2	0.29	0.35	0.19	0.33

Notes: t-statistics in parenthesis: ***, **, * significant at the 1, 5 and 10 percent levels respectively.

Source: Author's calculations

It is confirmed that there is a stronger positive impact on regional growth of the number of students at public HEIs (in levels), which could be indicative of a better position in respect to accumulation of human capital. In the context of the Nelson–Phelps approach, our results could be explained by the fact that study programmes in the fields of technology and natural sciences are predominantly the domain of public HEIs, while being hardly noticed at private HEIs due to substantially higher costs of studying. Estimates for the educational effect in the extended specification are similar to those of the baseline model (Table 1), as the coefficients on $\Delta \ln S_{it}$ favour private HEIs.

Our results can reflect the selection problem. To put it in the simplest way, students at private HEIs are those who otherwise would have been unemployed or employed as low-skilled labour being unable to enrol at public HEIs. A decrease in the number of such persons as they enrol at private HEIs may contribute to an increase in the stock of human capital, thus leading to a higher rate of economic growth. Another line of reasoning implies higher motivation of students at private

HEIs, as it is necessary to pay tuition fees. One more argument refers to a lower probability of educational mismatches in the case of choosing fields of study at private HEIs. It is quite often that the choice is made by persons who are already employed in a specific profession.

Among other results, investments in physical capital do not seem to stimulate regional growth, running counter to standard predictions of neoclassical and endogenous growth models. Our results provide evidence that investments in physical capital in Poland may not be effective or may be confined only to the long-term growth effects. An increase in the level of nominal wage is a pro-growth factor, as the coefficient on $\ln W_{it}$ is positive and statistically significant at the 1 percent level. Such a result means that the level of nominal wage is below equilibrium, so an increase in the wage level is associated with higher employment.

CONCLUSIONS

This article presents an analysis of the relationship between the number of students at public and private HEIs and regional economic growth in Poland. Although a higher enrolment at the public HEIs is associated with lower private costs of education and a higher stock of high-skilled labour, which is supposed to accelerate economic growth, it should be noted that public expenditure on education can crowd out investments in the stock of physical capital and weaken incentives for *learning for doing* in the workplace, which could be detrimental to economic growth. Among significant benefits of private education for economic growth, the intertemporal transfer of human capital is frequently mentioned.

Based on the annual panel data of 16 voivodeships for the period of 2000-2011, it has been found – with the use of FE estimator – that an increase in the number of students (in *levels*) at public HEIs is of stronger positive effect on regional economic growth if compared with the student enrolment at private HEIs. For private HEIs, this result is confirmed for the estimates of educational variable in *first differences*. Our findings are robust to changes in specification of the regression model that controls for the level of nominal wage. Regardless of the specification of regression model, our results are in favour of the Nelson–Phelps approach, which implies that accumulation of the human capital stock is one of the factors behind economic growth. Positive growth effects are associated with an increase in the number of students at either public or private HEIs.

REFERENCES

Aghion P., Hewitt P. (1998) Endogenous Growth Theory, MIT Press, Cambridge, MA.

An G., Iyigun M. (2004) The export skill content, learning by exporting and economic growth, Economics Letters, Vol. 84, Issue 1, pp. 29–34.

Angelopoulos K., Malley J., Philippopoulos A. (2007) Public Education Expenditure, Growth and Welfare, CESifo Economic Studies Conference on Productivity and Growth (22-23 June, 2007), CESifo, Munich.

Ayed Zambaa A., Ben Hassen L. (2013) Education financing and growth using an overlapping generations model: A theoretical perspective, Economic Annals, Vol. LVIII, No. 197.

Baldacci E., Clements B., Gupta S., Cui Q. (2008) Social Spending, Human Capital, and Growth in Developing Countries, World Development, Vol. 36, No. 8, pp. 1317–1341.

Barro R. (2002) Quantity and Quality of Economic Growth [in:] Economic Growth: Sources, Trends, and Cycles, N. Loayza, R. Soto, K. Schmidt-Hebbel (eds.), Central Bank of Chile, Santiago, Edition 1, Vol. 6, Chapter 5, pp. 135–162.

Barro R., Sala-i-Martin X. (1995) Economic Growth, McGraw-Hill, N.Y.

Bassetti T. (2009) Education and Poverty in a Solow Growth Model [in:] Long-Run Growth, Social Institutions and Living Standards, N. Salvadori, A. Opocher (eds.), Edward Elgar, Cheltenhem, UK, pp. 133–157.

Benhabib J., Spiegel M. (1994) The Role of Human Capital in Economic Development: Evidence From Aggregate Cross-Country Data, Journal of Monetary Economics, Vol. 34, Issue 2, pp. 143–174.

Blankenau W., Simpson N. (2004) Public education expenditures and growth, Journal of Development Economics, Vol. 73, No. 2, pp. 583–605.

Bredt J., Sycz C. (2007) Education and Economic Growth: A Literature Review, Working Paper No. 50, Department of Education, Training and the Arts of Queensland Government, Brisbane.

Bronisz U., Heijman W. (2010) The Relationship Between Social Capital and Regional Competitiveness, Applied Studies in Agrobusiness and Commerce, No. 1, pp. 43–48.

Chałasińska-Macukow K. (2009) Uniwersytety są traktowane jak huty, Rzeczpospolita, 22 grudnia.

Daren C. (2007) Education and Economic Growth: Is There a Link?, MPRA Paper No. 18176, Munich Personal RePEc Archive, Munich.

Edwards D., Radloff A. (2013) Higher Education enrolment growth, change and the role of private HEPs, Australian Council of Educational Research, Hawthorn, VA.

Florczak W. (2006) Modelowanie sektora nauki i edukacji – makroekonomiczne ujecie systemowe [w:] Innowacyjność w budowaniu gospodarki wiedzy w Polsce, E. Okoń-Horodyńska, S. Pangsy-Kania (eds), Instytut Wiedzy i Innowacji, Warszawa, str. 16–32.

Geiger R. (1987) Privatization of Higher Education: International Trends & Issues, International Council for Educational development, Princeton, NJ.

Islam N. (1995) Growth Empirics: a Panel Data Approach, Quarterly Journal of Economics, Vol. 110, No. 4, pp. 1127–1170.

Karamalla-Gaiballa E. (2006) Oddziaływanie edukacji na przedsiębiorstwo – kierunki i uwarunkowania, Nauka i Szkolnictwo Wyższe, nr 1/27, str. 56–68.

Katircioĝlu S., Fethi S., Kilin C. (2010) A Long Run Equilibrium Relationship Between International Tourism, Higher Education and Economic Growth in Northern Cyprus, Ekonomska Istraživanja, Vol. 23, No. 1, pp. 86–96.

Krueger A., Lindahl M. (2001) Education for Growth: Why and For Whom?, Journal of Economic Literature, Vol. XXXIX, No. 4, pp. 1101–1136.

Kuciński K. (2009) Knowledge as a Factor of Growth and Production, Economics & Business Administration Journal, No. 1, pp. 34–41.

Lee C. (2010) Education and Economic Growth: Further Empirical Evidence, European Journal of Economics, Finance and Administrative Sciences, Vol. 23, No. 8, pp. 161–169.

Levine R., Renelt D. (1992) A sensitivity analysis of cross-country growth regressions, American Economic Review, Vol. 82, No. 4, pp. 942–963.

Lin S. (1998) Government education spending and human capital formation, Economics Letters, Vol. 61, Issue 3, pp. 391–393.

Lucas R. (1988) On the mechanics of economic development, Journal of Monetary Economics, Vol. 22, No. 1, pp. 3–42.

Marattin L. (2007) Optimal Fiscal Policy with Private and Public Investment in Education, University of Bologna, Bologna.

Miller R. (2007) Education and Economic Growth: From the 19th to the 21st Century, CISCO Systems, San Jose.

Minkiewicz B. (2007) Szkolnictwo wyższe [w:] Edukacja dla pracy. Raport o rozwoju społecznym Polska 2007, UNDP, Warszawa, str. 42–46.

Moretti E. (2004) Estimating the social return to higher education: evidence from longitudinal and repeated cross-sectional data, Journal of Econometrics, Vol. 121, No. 1–2, pp. 175–212.

Mueller N. (2007) (Mis-) Understanding Education Externalities**,** MPRA Paper No. 5331, Munich Personal RePEc Archive, Munich.

Nelson R., Phelps E. (1966) Investment in Humans, Technological Diffusion and Economic Growth, American Economic Review, Vol. 61, No. 1/2, pp. 69–75.

Papuzińska M. (2009) Szkoły z kasą, Polityka, Rok 52, Nr. 40, str. 12–14.

Pritchett L. (2001) Where Has All the Education Gone?, World Bank Economic Review, Vol. 15, No. 3, pp. 367–391.

Psacharopoulos G., Patrinos H. (2004) Human capital and rates of return [in:] International Handbook on the Economics of Education, G. Johnes, J. Johnes (eds.), Edgar Elgar, Cheltenham, UK, pp. 1–57.

Romer P. (1990) Endogenous technological change, Journal of Political Economy, Vol. 98, No. 10, pp. S71–S102.

Sianesi B., van Reenen J. (2003) The Returns to Education: Macroeconomics, Journal of Economic Surveys, Vol. 17, Issue 2, pp. 157–200.

Tomusk V. (2001) Enlightenment and minority cultures: Central and East European higher education reform ten years later, Higher Education Policy, Vol. 14, Issue 1, pp. 61–73.

Welfe W. (2008) A Knowledge-Based Economy: New Directions of Macromodelling, International Advanced Economic Research, Vol. 14, No. 2, pp. 167–180.

Yamada K. (2005) Public versus Private Education in an Endogenous Growth Model with Social Status, Economics Bulletin, Vol.15, No. 11, pp. 1–9.

Zha Q. (2006) The Resurgence and Growth of Private Higher Education in China, University of Toronto, Toronto, pp. 54–68.

Żyra J. (2013) Efekty ekonomiczne niedopasowań strukturalnych i kompetencyjnych w obszarze edukacji, Politechnika Krakowska im. Tadeusza Kościuszki, Kraków.