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THE IMPACT OF HUMAN CAPITAL ON LABOUR PRODUCTIVITY REGARDING 'ET 2020' TARGETS

Case study

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Abstract

This paper is intended to clarify the European Commission's Education and Training (ET 2020) strategy, focusing primarily on the dimension of educational attainment. According to the ET 2020, the percentage of the population aged between 30 and 34 who have completed their tertiary education, should be at least 40% by 2020. Meanwhile, also forecasts a reduction in the early school leaver rate to less than 10%.
The purposes of this study are to explore the present educational attainment performance in various OECD countries and to analyse the determinants of productivity growth regarding these educational targets. We found that in long run, an increase in the level of human capital resulted in a greater increase in productivity in those countries where the tertiary education and early school leaver ratios targets are achieved. Our conclusions highlight that educational reforms are needed to rethink the establishment of knowledge societies.

INTRODUCTION

The European collaboration in education and training for the period up to 2020 should be recognized in the strategic framework which encompasses a lifelong learning perspective. Indeed, this fundamental principle could support learning systems from early childhood education and schools through to higher, vocational education and training and adult learning. The report published by the EC (2009) also emphasized that efficient investment in human capital through education and training systems is an essential component of Europe's strategy to deliver high levels of sustainable, knowledge-based economic growth, productivity and competitiveness.

The quality of education has improved worldwide and Europe must respond to the increased supply of higher-skilled workers. If this is achieved, the concentration of human capital can stimulate European productivity and outline the future performance of labour market (EC, 2012). In the area of education, the 'Europe 2020' strategy (EC 2010) established two main, interconnected targets. The first objective is to reduce the number of early school leavers, which affects five million Europeans (50% of early school leavers are unemployed), the other is to increase the proportion of young adults who have completed tertiary education. The inadequate rate of tertiary education is responsible for the high level of unemployment among graduates.

The European Commission (EC 2015) defines early school leavers as people aged between 18 and 24 who have only lower secondary education or less and are no longer in education or training. The tertiary educational attainment indicator is defined as the percentage of the population (aged 30-34) who have successfully completed tertiary studies (e.g. universities, high schools, higher technical institutions, etc.). This educational attainment corresponds to ISCED (International Standard Classification of Education) 2011 levels 5 and 6. (UNESCO, 2012). Meanwhile, the 'Europe 2020' strategy forecasts a reduction in the early school leaver rate to less than 10%, coupled with an increase in the percentage of the population completing tertiary education to at least 40% by 2020.

These targets are particularly essential because education has played an important role in employment and competitiveness by increasing long-term growth. More concretely, according to the predictions of the European Centre for the Development of Vocational Training (CEDEFOP 2013), this educational expansion will have to continue in the coming years if skills supply is to keep pace with the increasing demand for high-skilled labour. In their estimations, the number of high-qualified workers will increase by about 13%, whereas low-qualified workers will see their numbers decline by 12% by 2020.

Despite the remedial progress achieved over the last few decades in the percent-ages of those qualifying from higher education and the ratio of early school leaving, in too many OECD countries these indicators still remain at unfavourable levels and the EU-28 averages are lower than the expected educational targets. Figure 1 represents the rate of attainment in tertiary education and the early school leaving in the 28 member states of the EU. Our estimations are based on the currently available Eurostat (2015) database.

The distance from the educational targets of 40% and 10% differs widely in each country. Those countries who could not reach both of the targets by 2014 are mostly the Mediterranean countries (namely Italy, Malta and Portugal) and some transition countries, such as Bulgaria, Hungary and Romania. Although a few of them (Greece and Croatia, Czech Republic, Latvia and Slovakia) have been able to reduce the early school leavers ratio to under 10%, not surprisingly, Germany drooped below the criteria. The risk of early school leaving is extremely high in Germany thanks to the expanded foreign-born and native-born gap combined with the sex and migrant status of employment (EC, 2014a). Only the United Kingdom and Estonia have not yet reached the goal of reducing early school leavers to 10%, although educational attainment has exceeded 40% in these countries.

Thum and Roth (2010) stated that not achieving these educational targets might adversely affect the economy through two main channels. Firstly, owing to the lower employment probability, lower educated and skilled workers are less likely to participate in the labour market and contribute lower productivity. Secondly, those who are not integrated in the labour market will probably become more dependent on social transfers.

The purpose of this study is to demonstrate clearly that the impact of skilled employees on productivity growth really is better than in those countries who cannot achieve the ET 2020 targets. Our research represents a cross-section analysis of various OECD countries, focusing on the effects of human capital on output per capita in respect of higher tertiary school attainment and lower early school leaving. In search of more in-depth explanations, we applied dynamic panel regression models for the period between 2000 and 2011 to test how employment, investment, and human capital correlate with productivity in the long run. In the following sections, we first present the data available and the methods applied. Finally, we attempt to draw a number of brief conclusions from the results of our analyses, which will hopefully

contribute to clarifying the empirical and policy debates on the existent contribution of higher educational attainment to economic performance.

BRIEF LITERATURE REVIEW

Considering the theoretical background of our research, it must be noted that the role of human capital (HC) did not receive much attention in the early neo-classical economic models. The contribution of HC to economic growth became especially popular in the literature after the rise of human capital theories advocated by Schultz (1961) and Becker (1964). In the 1950s, Solow (1956) was the first to argue that it is not only changes in production resources, such as in capital and labour input, which can impact on output growth. Later, Nakamura (1981, pp.263) noted that the human factor is critical for the betterment of our life, and defines human capital as "labour, managerial skills, and entrepreneurial and innovative abilities – and such physical attributes as health and strength." This idea made it possible to introduce human capital into new theories dealing with endogenous economic growth. Consequently, a certain stock of human capital, which can be thought of as the sum of all the education and training the workers have received, serves to increase productivity.

In the first human capital augmented models, pioneered by Lucas (1988), human capital was inserted as a factor of production similar to physical and labour accumulation. Just like physical capital, total human capital is assumed to accumulate by a certain exogenous fraction of output being added. A result of this extension is that output growth is positively influenced by human capital growth. In this approach, human capital is represented as skills which are embodied in a worker and also a rival and excludable good (Barro and Sala-i-Martin, 2004).

In another model, pioneered later by Romer (1989), the neo-classical growth model is followed, in the sense that technological change works on output growth at the level of human capital. In this case human capital influences new technologies directly, because it is used as an input in Research and Development (R&D) related activities and is visible in the worker's knowledge and ideas. The empirical results also found that the effects of human capital on economic growth were frequently reflected by low, positive and significant coefficients (Lee and Barro, 1993), (Soto and Cohen, 2001), (Krueger and Lindahl, 2001) and (Teulings et al., 2010), but a negative relationship was reported in the study of Spiegel and Benhabib (1994). The contribution of our research is to expand these findings in respect of educational attainment.

Based on the findings of the literature reviewed above, the current study forms three hypotheses:

- ***H1:*** Human capital impacts positively on productivity growth in the examined OECD countries.
- ***H1a:*** An increase in the level of human capital can increase productivity growth more in those countries where the tertiary education rate is at least 40%.
- ***H1b:*** An increase in the level of human capital can increase productivity growth more in those countries where the early school leaver rate is less than 10%.

SAMPLE AND METHOD

The University of Groningen supported a publicly available Penn World Table (PWT) 8.1. Release to examine various OECD countries until 2011. The latest (8.1) release, developed by Timmer et al., (2015), provides a unique database, where it is possible to research, among other factors, output (real GDP at constant 2005 national prices in 2005 US$), employment (number of persons engaged), investment (investment share of PPP converted GDP per capita at 2005 constant prices) and human capital accumulation across countries and over time. PWT also includes an index of human capital per worker based on the aver-age years of schooling, interpolated from Lee and Barro (2013), and an assumed rate of return for primary, secondary and tertiary education, as in Caselli (2005).

Taken together, the coefficients of long run GDP per capita, investment share, engaged employment and human capital refer to the period between 2000 and 2011. In order to compare cross-country time-series, in respect of 'EU-2020' educational targets, we have an unbalanced panel data from each of the 28 OECD countries, and four country groups, to measure the existing relationship between human capital and productivity growth. The OECD countries are divided into four subgroups.

Our estimations are based on a Cobb-Douglas production function. According to the suggestion of Weil et al. (1992), we express the role of human capital as follows. In this traditional model, output per capita (productivity) equals the rate of investment in physical capital, the rate of employment growth, and the level of human capital. We also assume that there is no strong reason to expect a depreciation rate, and the rate of long run technological change is constant, and TFP does not vary greatly across countries. Moreover, the output elasticity of capital and labour are also constants, and constant return to scale is determined by the available technology.

Taking into account new endogenous growth theories, our models include the lagged dependent variables among the repressors. A dynamic regression specification requires exceptional

instrumentation of these lagged endogenous variables, for which we used the empirically offered GMM estimators, developed by Bond and Arrelano (1991). These methods employ lagged levels of the dependent and predetermined variables, as well as differences between the exogenous variables as instruments. In our model specifications the economy tends toward long run equilibrium. The extent of economic growth generally affects the rate at which per capita output approaches its steady state value.

After taking the first difference of the dependent variable of productivity growth (Y), we will test the following factors at a given time t in county i:

- the first independent variable refers to the lagged productivity growth $Y_{i,t-1}$,
- s_k represents the share of investment within output,
- n is the average growth rate of labour,
- the rate of g and δ are assumed to be constant (0.05), as in Weil et al. (1992),
- hc denotes the average level of human capital,
- Δvar – variable in first difference,
- Δvar_{t-1} – lagged differences of variables,
- ln – in logarithm,
- e – is the error term.

The final step was to specify our multivariable panel regression model:

$$\Delta ln(Y)_{i,t} = \beta_o + \beta_1 \Delta ln(Y)_{i,t-1} + \ln(s_k)_{i,t} + \ln(\mathrm{n} + \mathrm{g} + \delta)_{i,t} + \ln(\mathrm{hc})_{i,t} + \varepsilon_{i,t}$$

RESULTS

The panels under review represent unequal sample sizes encompassing the period 2000–2011, covering 28 OECD countries and 224 observations, and Group A, B, C, D contain 16, 12, 19 and 9 countries respectively, divided according to educational targets. In the following section we first examine the effects of human capital according to the new endogenous theories for productivity. Table 1 represents the results of our estimations. In this table, the long run impact of investment, employment and human capital on productivity growth are represented. The descriptive statistics (means, standard deviations, correlation matrix etc.) of the variables used in the regressions are reported in Table 2 and 3.

In our estimation the two-step GMM estimators are preferred, as Windmeijer (2005) suggests, in order to handle the proposition of downward biased standard errors. After the estimation of the regressions, we used numerous standard econometric tests to verify the accuracy of our results. In every case, significant Wald tests confirmed the valid dynamic model specifications. The correlation between the observations was ruled out by Bond and Arrelano's (AR) autocorrelation tests. The Sargan tests, restricted later by Hansen (1982), were also used to test for the presence of over-identifying problems arising from the instruments, and the null-hypotheses assuming their presence were obviously rejected. The results of these tests are also presented in more detail in Table 1 below.

In our dynamic models, the first control variable represents the lagged values of the dependent variable (Y_{it-1}). Except for Group D we realised significant and positive coefficients. This affiliation, ceteris paribus, implies an existence of convergence among the examined OECD countries. Moreover, investment ratios (s_k), as expected by the neoclassical theories, showed significantly positive p-values in each model. According to the literature, the ratio of employment growth, depreciation and technological progress (n+g+δ) negatively correlated with productivity in each model.

In order to exemplify the robustness check of our estimations we measure the impact of human capital on output per capita in different OECD country groups. Essentially, the effect of human capital accumulation on productivity growth does not seem to be large (ranged from 0.17 to 0.32). In both models, our calculations indicate that changes in human capital correlated significantly and positively with productivity growth.

We can accept H1a and H1b hypotheses, as well. However, a 1% increase in the level of human capital increased productivity changes better than in those countries (GROUP A) where the tertiary education rate is at least 40%. Consequently, a 1% increase in the level of human capital increases productivity better than in those countries (GROUP C), where the early school leaver rate is less than 10%.

CONCLUSIONS

In this study the first objective was to analyse the educational attainment in various OECD countries. The distance from the educational targets of tertiary education (more than 40%) and early school levers (less than 10%) differs widely in each country. Although the EU's ET 2020 Agenda has taken an important step forward by setting these targets, many countries, including the biggest European economies, will clearly not be able to meet this benchmark by 2020. However, Germany has still not increased the percentage of tertiary education to more than 40%.

Our results highlight that an increase in the level of human capital resulted in more productivity growth in those countries where tertiary education is higher than 40%, and where the early school leaver rate is less than 10%. However, it is clear that higher levels of human capital are linked to better economic performance.

These results anticipate the increasing role of human capital over the next decades and the quality of education will be as important as quantity in attaining global competitiveness. Thus, the improvements in the quality of education and training aim to promote stable long run economic growth.

The Director General for Education and Culture of the European Commission (X. P. Monné) outlined that the Educational and Training Agenda should ensure political commitment and funding to fight against inequalities in education (EC, 2014b). 'ET-2020' Strategic Objectives suggested focusing on the promotion of equity, social cohesion and active citizenship. The key findings of the Study on Youth Work also emphasized improving the use of new ICT technologies in education, and developing didactic approaches to help educators become competent users of innovations. Thus, the report highlighted the need to reconsider the performance-driven culture of education systems, which disaffects the most disadvantaged learners and to promote access to tertiary education for this group. From this perspective, our analysis suggests that policy-makers should intend to reduce the cost of education regarding, as Fenyves et al., (2015) suggested, the elimination of 'skill-gaps' by motivating low-skilled workers to learn more in order to enhance productivity growth.

REFERENCES

[1] Becker, G. S. (1964). *Human Capital*. New York: NBER.

[2] Bond, S. & Arellano, M. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an application to Employment Equations. *Review of Economic Studies, (58),* 277-297.

[3] Caselli, F. (2005). Accounting for Cross-Country Income Differences. In Durlauf, S. N. &. Aghion (Eds). Handbook of Economic Growth 1A: 679-741. Elsevier.

[4] CEDEFOP (2013). Quantifying Skill Needs in Europe Occupational Skills Profiles: Methodology and Application. *Research Paper, (30*), 1-144.

[5] EC (2009). Notices from European Union Institutions and Bodies, Council conclusions of 12 May 2009 on a strategic framework for European cooperation in education and training (ET 2020). *C 119(2),* 1-9.

[6] EC (2010). Europe 2020 – A European Strategy for Smart, Sustainable and Inclusive Growth, Communication from the European Commission."
http://ec.europa.eu/eu2020/pdf/COMPLET%20EN%20BARROSO%20%20%20007%20-%20Europe%202020%20-%20EN%20version.pdf
Accessed: 5. September. 2015.

[7] EC (2012). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Rethinking Education: Investing in skills for better socio-economic out-comes. *COM (669),* 1-17.

[8] EC (2014a). Education and Training Monitor.",
http://ec.europa.eu/education/library/publications/monitor14_en.pdf , Accessed: September. 10. 2015.

[9] EC (2014b). European Education, Training and Youth Forum 2014: Report. http://ec.europa.eu/education/events/2014/1006-ety-forum_en.htm, Accessed: September. 10. 2015.

[10] EC (2015). European Benchmarks in Education and Training.
http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=URISERV:c11064,
Accessed: September. 5. 2015.

[11] EUROSTAT (2015) Headline Educational EU 2020 Indicators, http://ec.europa.eu/eurostat/data/database
Accessed: September. 8. 2015

[12] Fenyves, V., Tarnóczi, T., Bács, Z., & Kovács, D. (2015). Comparative Analysis for the Practical Practice of Cost Calculation. *Annals of the University of Oradea Economic Science, 24*(1), 976-981.

[13] Hansen, L. P. (1982). Large Sample Properties of Generalized Method of Moments Estimators. *Econometrica 50*(4), 1029-1054.

[14] Lee, J. W. & Barro, R. J. (1993). Institutional Comparisons of Educational Attainment. *Journal of Monetary Economics 32*(3), 363-394.

[15] Lee, J. W. & Barro, R. J. (2013). A New Data Set of Educational Attainment in the World, 1950-2010. *Journal of Development Economics (104):* 184-198.

[16] Lindahl, M. & Krueger, A. B. (2001). Education for Growth: Why and For Whom? *Journal of Economic Literature 39*(4), 1101-1136.

Lucas, R. E. (1988). On the Mechanics of Economic Development. *Journal of Monetary Economics 22*, 3-42.

[17] Nakamura, J. I. (1981) Human Capital Accumulation in Premodern Rural Japan. The *Journal of Economic History 41*(2), 263-281.

[18] Romer, P. M. (1989). Human Capital And Growth: Theory and Evidence. *Carnegie-Rochester Conference Series on Public Policy, 32*(1), 251-286.

[19] Sala-i-Martin X. & Barro, R. J. (2004). *Economic Growth*, 2nd Eds., Massachusetts, Institute of Technology.

[20] Spiegel, M. M. & Benhabib, J. (1994). The Role of Human Capital in Economic Development: Evidence from Aggregate Cross-Country and Regional U.S. Data. *Journal of Monetary Economics 34*(2), 143-173.

[21] Schultz, T. (1961). Investment in Human Capital. *American Economic Review*, *51*(1), 1-17.

[22] Solow, R. M. (1956). A Contribution to the Theory of Economic Growth. *The Quarterly Journal of Economics 70*(1), 65-94.

[23] Soto, M. & Cohen, D. (2001). Growth and Human Capital: Good Data, Good Re-sults, *Journal of Economic Growth. 12*(1), 51-76.

[24] Teulings, C. Portela, M. & Alessie, R. (2010). Measurement Error in Education and Growth Regressions. *Scandinavian Journal of Economics 112*(3), 618-639.

[25] Timmer, M. P. Feenstra, R. C. & Inklaar, R. 2015. The Next Generation of the Penn World Table. forthcoming *American Economic Review*, available for download at www.ggdc.net/pwt

[26] Thum A. E. & F. Roth (2010). The Key Role of Education in the Europe 2020 Strategy. *CEPS Working Document, 338*, 1-19.

[27] UNESCO (2012). International Standard Classification of Education ISCED 2011. Accessed http://www.uis.unesco.org/Education/Documents/isced-2011-en.pdf

Accessed: September. 5. 2015.

[28] Weil, D. N. Mankiw, G. N. & Romer, P. M. (1992). A Contribution to the Empirics of Economic Growth. *The Quarterly Journal of Economics 107*(2), 407-437.

[29] Windmeijer, F. (2005). A Finite Sample Correction for the Variance of Linear Efficient Two-Step GMM Estimators. *Journal of Econometrics 126*(1), 25-51.

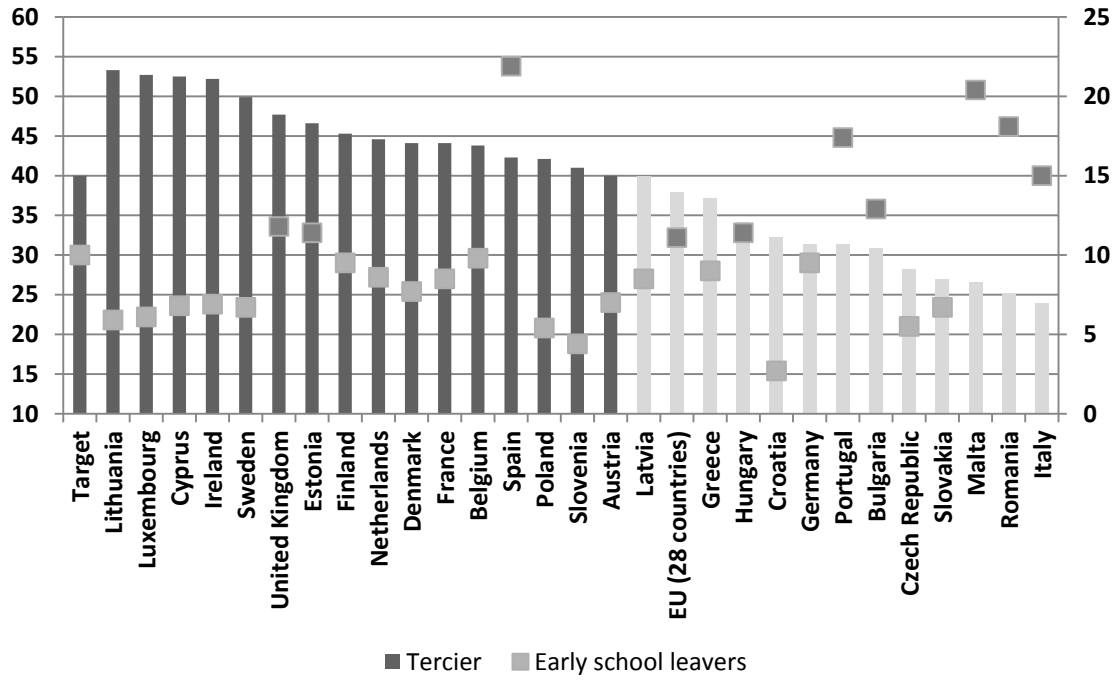

Figure 1. Tertiary educational attainment (left axis) and early school leavers (right axis) ratios (%) in EU-28 countries, 2014

Source: based on Eurostat (2015).

Table 1. Dynamic panel regression of output per capita in OECD countries, 2000-2011

Dependent variable: $\Delta\ln(Y)_{it}$

Independent variables	OECD-28	GROUP A	GROUP B	GROUP C	GROUP D
constant	**-0.716**	**-0.615**	**-0.682**	**-0.781**	**0.506**
	(-3.71)*	(-3.27)***	(-5.61)***	(-6.81)***	(-1.91)*
$\Delta\ln(Y)_{it-1}$	**0.694**	**0.679**	**0.452**	**0.869**	0.175
	(5.91)***	(6.02)***	{5.02}***	(7.32)***	(1.14)
$\ln(s_k)_{it}$	**0.121**	**0.106**	**0.404**	**0.147**	**0.111**
	(4.89)***	(11.78)***	(2.76)***	(5.83)***	(5.77)***
$\ln(n+g+\delta)_{it}$	**−0.226**	**−0.136**	**−0.53**	**−0.270**	**−0.168**
	(-2.44)**	(-2.51)**	(-3.35)***	(-3.27)***	(-1.87)*
$\ln(hc)_{it}$	**0.322**	**0.273**	**0.181**	**0.299**	**0.174**
	(2.32)**	(1.76)*	(1.69)*	(3.21)***	(1.92)*
Number of observations	**224**	**128**	**96**	**162**	**72**
Number of countries	**28**	**16**	**12**	**19**	**9**
Number of instruments	**12**	**12**	**12**	**12**	**12**
Wald-test	**91.05****	**407.38*****	**933.14*****	**197.2*****	**369,6*****
AR-test	**(-2.25)****	**(-1.62)***	**(-1.91)***	**(-2.05)****	**(-1.55)****
Sargan-test	**15.12**	**10.94**	**8.86**	**1.43**	**1.59**

*Note: Heteroscedasticity robust z-statistics are in parentheses. Letters in the upper index refer to significance: ***: significance at 1 per cent, **: 5 per cent, *: 10 per cent. P-values without an index mean that the coefficient is not significant even at the 10 per cent level. GROUP A: AUS, BEL, CYP, DEN, EST, FIN, FRA, IRE, LTH, LUX, NED, POL, SLV, SPA, SWE, UK. GROUP B: BUL, CZE, GER, GRE, HRV, HUN, ITA, LTV, MLT, POR, ROU, SLK. GROUP C: AUS, BEL, CZE, CYP, DEN, FIN, FRA, GER, GRE, HRV, IRE, LTH, LTV, LUX, NED, POL, SLK, SLV, SWE. GROUP D: BUL, EST, HUN, ITA, MLT, POR, ROU, SPA, UK.*

Source: based on own calculations.

Table 2. Descriptive statistics of the variables used in the regressions in OECD-28 countries, 2000-2011

Variable	**Observation**	**Mean**	**Std. Dev.**	**Min**	**Max**
$\Delta\ln(Y)_{it-1}$	308	0.017	0.031	-0.087	0.158
$\ln(s_k)_{it}$	308	3.154	0.194	2.491	3.593
$\ln(n+g+\delta)_{it}$	308	0.055	0.025	-0.089	0.123
$\ln(hc)_{it}$	308	1.089	0.071	0.874	1.262

Source: based on own calculations and Timmer (2015).

Table 3. The correlation matrix of dependent variables

Variables	$\Delta\ln(GVA)_{it-1}$	$\ln(s_k)_{it}$	$\ln(n+g+\delta)_{it}$	$\ln(hc)_{it}$
$\Delta\ln(GVA)_{it-1}$	1			
$\ln(s_k)_{it}$	-0.033	1		
$\ln(n+g+\delta)_{it}$	-0.486	-0.584	1	
$\ln(hc)_{it}$	0.281	0.433	-0.506	1

Source: based on own calculations and Timmer (2015).