Human Capital and Economic Growth in Russian Regions

Bozhechkova Alexandra

Dzhunkeev Urmat

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Research relevance

- In the context of increasing uncertainty about the prospects for economic growth in both developed and developing countries, the issue of finding perspective sources of sustainable growth is especially important.
- One of these factors is human capital, which is the knowledge and skills of people that allow them to create value in the global economic system.
  - human capital as a key factor in innovation activity, as well as technology adoption
  - factor of increasing the competitiveness of the economy
  - exit factor from the middle-income trap

The Role of Human Capital in Economic Growth

- contributes to the development of R&D sector, technological progress, leads to the more efficient usage of production resources (Romer, 1990; Jones, 2002; Tsai et al., 2010; Kuznetsov, Michasova, 2010)
- creates a favorable environment for innovative activity (Zemtsov et al., 2016)
- provides high speed of convergence (Barro, Sala-i-Martin, 1995)
- promotes the adaptation of foreign technologies (Nelson, Phelps, 1966; Benhabib, Spiegel, 1994)
- increases efficacy of foreign direct investment (Borensztein et al., 1998)
- contributes to the formation of positive intragenerational (across society) and intergenerational (within each households) externalities (Bulina et al., 2021)
- increases the quality of the healthcare system (Baldacci et al. 2008; Yang, 2020)

Contribution of research to economic literature

- Solving the problem of reverse causality by instrumental variables (IV):
  - Exogeneous IV (Two-stage Least squares): number of educational organizations built during the Soviet Union
  - Internal IV (System Generalized method of moments): lags of human capital variables
- Applying a comprehensive approach to the measurement of human capital: number of current and graduated students, employment by different levels of education
- Determination of the sectoral specialization of regions by the share of the sector in gross value added:
  - Information set consists of macroeconomic indicators for 76 regions and 2005-2019 period. We exclude Moscow, Saint-Peterburg, Sevastopol and the Republic of Crimea, as well as Autonomous Areas with high oil production (Khanty-Mansiysk, Yamalo-Nenets, Nenets Autonomous Okrug).

Two-stage Least Squares: Identification Strategy (1/2)

- **Specification**: $\begin{cases} y_i = \beta_0 + \beta_1 \hat{x}_i + \mathcal{B} W_i + \epsilon_i \\ \hat{x}_i = \alpha_0 + \alpha_1 z_i + \mathcal{A} W_i + \vartheta_i \end{cases}$

where y_i – growth rates of the real gross regional product (GRP) per capita in i-th region;

$\hat{x}_i$ – human capital variables: number of current and graduated students by different levels of qualification;

w_i – control variables: gross fixed capital formation, foreign direct investment, import of machine and technologies, government expenditures (% of GRP); population growth rates;

z_i – number of educational organizations by different levels of qualification built as of 1990;

ϵ_i and ϑ_i – regression residuals.

- **Exogeneity condition**: $cov[z_i \epsilon_i] = 0$ – creation of educational organizations was based on government plan (Berkowitz et al., 2014; Alesina, Fuchs-Schundeln, 2007)
- **Relevance condition**: $cov[z_i \hat{x}_i] \neq 0$ – educational institutions built during the Soviet Union were the basis for the educational infrastructure of modern Russia

Two-stage Least Squares: Identification Strategy (2/2)

№	Human capital, 2005-2019 period	Instrumental variables, 1990 year
1	Number of students enrolled in training programs for qualified workers, employees	Number of schools; number of institutions of primary vocational education
2	Number of students graduated from training programs for qualified workers, employees	
3	Number of students enrolled in programs of secondary qualification specialists	Number of schools; number of institutions of secondary vocational education
4	Number of students graduated from programs of secondary qualification specialists	
5	Number of students enrolled in Bachelor’s and Master's programs	Number schools; number of high education institutions
6	Number of students graduated from Bachelor’s and Master's programs	
7	Number of personnel employed in R&D	

Two-stage Least Squares: Econometric Results (1/2)

	Number of students enrolled in secondary vocational training	Number of students graduated from training programs for qualified workers, employees	Number of students graduated from Bachelor's and Master's programs	Number of personnel employed in R&D
Constant term	-0,703***	-2,344***	-2,089***	3,619**
	(0,229)	(0,436)	(0,465)	(1,399)
Number of schools built as of 1990		0,173	0,515***	0,394
		(0,108)	(0,078)	(0,262)
Number of primary vocational education organizations built as of 1990	0,323*	0,722***		
	(0,174)	(0,108)		
Number of secondary vocational education institutions built as of 1990	0,778***			
	(0,165)			
Number of high education organizations built as of 1990			0,638***	1,020***
			(0,070)	(0,265)
F-statistics	**296,1*** **	**205,6*** **	**210,4*** **	**42,51*** **
Adjusted R^2	0,896	0,857	0,851	0,532
Number of observations	68	68	73	73

Instrumental variables are strong since F-statistics exceeds proposed rule-of-thumb:
10 (Staiger, Stock, 1997; Stock, Yogo, 2005) and 23.1 (Montiel Olea, 2012).

Two-stage Least Squares: Econometric Results (2/2)

	Growth rates of real GRP per capita, 2005-2019 period			
	Number of students enrolled in secondary vocational training	Number of students graduated from training programs for qualified workers, employees	Number of students graduated from Bachelor's and Master's programs	Number of personnel employed in R&D
Constant term	-2,582* (1,321)	-2,344*** (0,436)	-2,089*** (0,465)	3,619** (1,399)
Human capital	**0.009***** **(0.002)**	**0,173** **(0,108)**	**0,515***** **(0,078)**	**0,394** **(0,262)**
Control variables	Yes	Yes	Yes	Yes
Test for weak instruments (p-value)	0,00	0,00	0,00	0,00
Sargan test (p-value)	0.189	0.166	0.233	0.148
Wald test (p-value)	0,00	0,00	0,00	0,532
Adjusted R^2	0,27	0,21	0,22	0,17
Number of observations	67	67	72	72

Instrumental variables are exogeneous since we don't fail to reject the null hypothesis of Sargan test

System Generalized Method of Moments: Identification Strategy

- **Specification** (Arellano, Bond, 1991; Arellano, Bover, 1995; Blundell, Bond, 1998):

$$\Delta\ln(y_{i,t}) = \gamma_1\Delta\ln(y_{i,t-1}) + \gamma_2\Delta\ln(x_{i,t-1}) + \Gamma\Delta\ln(W_{i,t-1}) + \Delta u_{i,t}$$

where $y_{i,t}$ – real GRP in i-th region and year t; Δ – first difference operator;

$x_{i,t}$ – human capital variables: number of current and graduated students by different levels of qualification;

$W_{i,t}$ – control variables: gross fixed capital formation, foreign direct investment, import of machine and technologies, government expenditures (% of GRP); population growth rates;

$u_{i,t}$ – regression residuals.

- **Internal IV**: 2nd, 3rd lags of human capital variables
- **Exogeneity condition**: Overidentifying restriction test

System Generalized Method of Moments: Econometric Results (1/2)

	Growth rates of real GRP per capita, 2010-2019 period			
	Percentage of employees with secondary vocational education	Number of students graduated from training programs for qualified workers, employees	Number of students graduated from programs of secondary qualification specialists	Share of postgraduate students in the total population
Growth rates of GRP per capita, 1st lag	0,991*** (0,003)	1,000** (0,002)	1,006*** (0,003)	0,997*** (0,003)
Human capital	**0,030*** **(0.010)**	**0,006***** **(0,003)**	**0,021***** **(0,007)**	**0,009**** **(0,004)**
Control variables	Yes	Yes	Yes	Yes
Sargan test	0,994	0,994	0,994	0,995
Autocorrelation test, 1st order (p-value)	0,00	0,00	0,00	0,00
Autocorrelation test, 2nd order (p-value)	0,325	0,378	0,350	434
Wald Test (p-value)	0,00	0,00	0,00	0,00
Number of observations	1289	1276	1276	1272

Instrumental variables are exogeneous since we don’t fail to reject the null hypothesis of Sargan test

System Generalized Method of Moments: Econometric Results (2/2)

	Growth rates of real GRP per capita, 2010-2019 period			
	Number of students graduated from high educational institutions in agricultural regions	Number of students graduated from high educational institutions in oil production regions	Number of students graduated from high educational institutions in manufacture regions	Number of students graduated from programs of secondary qualification specialists in manufacture regions
Growth rates of GRP per capita, 1st lag	0,997*** (0,003)	0,997*** (0,004)s	0,996*** (0,004)	1,000*** (0,008)
𝕀[sector]	0,006 (0,013)	0,019 (0,018)	-0,033 (0,021)	0,060*** (0,023)
Human capital	0,00 (0,006)	0,007 (0,007)	-0,012 (0,008)	0,00 (0,015)
Human capital × 𝕀[*sector*]	**0,00 (0,006)**	**-0,010 (0,007)**	**0,023** (0,009)**	**0,054** (0,016)**
Control variables	Yes	Yes	Yes	Yes
Sargan test	0,99	0,99	0,99	0,99
Autocorrelation test, 2nd order (p-value)	0,451	0,457	0,436	0,238
Number of observations	1274	1274	1274	1289

Positive impact of high education is more pronounced in manufacture regions in comparison with agricultural and oil regions

Conclusion

- Russian regions are characterized by the positive influence of human capital with secondary and higher education on economic growth.
- The results obtained indicate that there is a potential for further economic growth due to investments in secondary general, professional and higher education and improving the quality of human capital.
- The highest return from higher education is observed in regions with a predominance of manufacturing industries. This is due to the significant dependence of the investment attractiveness of these regions (including for foreign investors) on the level of human capital and the possibilities of adjusting the regional labor market to technological innovations (advanced training of employees, on-the-job training, etc.).
- It is essential at the present stage to develop sectors with high added value of manufactured products that demand highly qualified human capital.

Thank You!

Reference