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Test Scores and Economic Growth: Update and Extension

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Abstract: Research indicates that education quality – measured by test scores in international student surveys – predicts economic growth. In this paper, we extend previous findings up to 2016 and analyse test scores of upper-secondary school students only. We find that the positive relationship between growth and test scores holds in both cases. The share of top-performing students exhibits a stronger correlation with economic growth than does the share of students who meet basic requirements.

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1. Introduction

The wealth of nations varies with levels of human capital. Research has demonstrated a strong relationship between countries' performances in international student surveys, such as PISA and TIMSS, and their per-capita growth rates (Hanushek and Woessmann 2015). In this paper, we provide an update of the cross-country evidence presented by Hanushek and Woessmann (2015). We also use test scores among upper-secondary school students in TIMSS 1995 to investigate whether upper-secondary school quality predicts growth.[1]

We find that the positive relationship between growth and test scores holds when economic growth is measured up until 2016. The relationships holds both when using test scores from all students in primary and secondary schools and when using test scores from students in the last year of upper-secondary school.

Our estimates also indicate a high impact of top-performing students. The share of top-performing students exhibits a correlation with economic growth that is five times as strong as the correlation between the share of students who meets basic requirements and economic growth.

2. Previous research on the impact of education on growth

For long, empirical research on the relationship between human capital and economic growth focused on measures of education quantity, such as school-enrolment rates and average years of schooling (e.g. Barro 1991; Castelló-Climent and Hidalgo-Cabrillana 2012; Delgado et al. 2013; Krueger and Lindahl 2001; Gennaioli et al. 2013; Sala-i-Martin et al. 2004). However, more recent research finds that it is the quality of education – as measured by test scores in international student surveys – that matter for economic growth (Hanushek and Woessmann 2015).

The shift in focus from measures of education quantity to quality has been crucial to understand growth. In a study of 50 countries in the period 1960–2000, Hanushek and Woessmann (2008) find a strong impact of education quality on growth: a one standard deviation increase in test scores raises growth by up to 2 percentage points, while average years of schooling has no effect.

Researchers have used several techniques to investigate whether these findings reflect a causal relationship, for example by using school-system features as instrumental variables (Hanushek and Woessmann 2012a, 2012b) and investigating the relationship between changes in test scores and changes in growth (Hanushek and Woessmann 2012b). These studies suggest that the relationship is causal. Still, some doubts remain due to intricate measurement problems (Lindahl 2015).

Finally, we recognise that test scores do not merely pick up students' cognitive skills, but also capture non-cognitive skills, such as conscientiousness, that seem to influence

[1] For a related policy-oriented paper focusing on economic growth in Sweden and how it can be increased by education policies, see Heller-Sahlgren and Jordahl (2019).

growth to the same extent as cognitive skills (see Balart et al. 2018). In other words, test scores appear to be a good measure of both cognitive and non-cognitive skills of importance for growth.

3. Test scores and economic growth

To examine the relationship between test scores and per-capita GDP growth, we use test scores obtained from Hanushek and Woessmann (2012b) for 50 countries – constructed from international tests in mathematics and science, conducted in primary and secondary school between 1963 and 2003 – and per-capita GDP data in 2011 US dollars, adjusted for purchasing power, between 1960 and 2016 from the Maddison Project Database (Bolt et al. 2018). While Hanushek and Woessmann (2012b) studies growth up to 2000 (and 2007), our longer period includes the 2008 financial crises and its aftermath. In the analysis, we adjust for differences in the GDP per capita and years of schooling in 1960.[2]

The regression results in column (2) in Table 1 suggest that a one standard deviation increase in test scores raises growth by 1.3 percentage points. Initial GDP per capita and years of schooling together explain 46 per cent of the variation in growth in column (1) – a figure that increases to 80 per cent when we add test scores in column (2). Adding test scores also reduces the coefficient for years of schooling close to zero. We exclude Zimbabwe – an extreme outlier – in our main specification. However, in column (3), we include Zimbabwe, and the estimates are by and large similar.

Table 1. International test scores and per-capita GDP growth

	(1)	(2)	(3)
		1960-2016	
	Excluding Zimbabwe	Excluding Zimbabwe	Including Zimbabwe
Average test score		0.013***	0.014***
		(-0.002)	(0.002)
Years of schooling (1960)	0.002***	0.000	-0.000
	(0.001)	(0.000)	(0.001)
(log) GDP per capita (1960)	-0.013***	-0.011***	-0.010***
	(0.002)	(0.001)	(0.002)
Adjusted R^2	0.46	0.80	0.65
n	49	49	50

Note: Significance levels: *p<0.1; **p<0.05; ***p<0.01. Robust standard errors in parentheses.

Our results for the period 1960–2016 largely correspond to those of Hanushek and Woessmann for 1960–2000. If anything, our results are slightly weaker, which appears to be explained by differences in the growth period analysed. If we instead study the period 1960–2000, we find that a one standard deviation increase in test scores raises growth by 1.9 percentage points.

[2] More specifically, we adjust for the natural logarithm of GDP per capita and the average years of schooling in the populations in 1960. The first variable is obtained from Bolt et al. (2018) and the latter from Barro and Lee (2013).

The impact of upper-secondary school tests scores

Next, we investigate the relationship between results in TIMSS 1995 among students in the final year of upper-secondary school and average annual growth in the period 1990–2016. These data are only available for 21 countries.

The results are reported in Table 2. While the impact is smaller compared with the results in Table 1, which is obtained using scores from tests conducted in primary, lower-secondary, and upper-secondary school, it is important to note the shorter growth period analysed and that the number of countries included is fewer than half compared with Hanushek and Woessmann's dataset. The relationship in Table 2 suggests that countries scoring one standard deviation higher in TIMSS 1995 had 0.61 percentage points higher growth annually between 1990 and 2016.

Table 2. Upper-secondary school quality and per-capita GDP growth

	1990–2016
TIMSS 1995 score	0.006***
	(0.002)
Years of schooling (1995)	0.001*
	(0.0001)
(log) GDP per capita	−0.009***
	(0.0003)
Adjusted R2	0.37
n	21

Note: Significance levels: *p<0.1; **p<0.05; ***p<0.01. Robust standard errors in parentheses.

Students reaching basic literacy and top-performing students

In this section, we analyse the relationship between growth and (1) the share of students reaching basic literacy as well as (2) the share of top-performing students in international tests. The former is defined as the share who score at least 400 points – equivalent to one standard deviation below the OECD average – in Hanushek and Woessmann's dataset, while the latter is defined as the share who score at least 600 points – equivalent to one standard deviation above the OECD average – in this dataset.

The results in Table 3 show that both groups of students matter for growth, but that top-performing students are considerably more important than students reaching basic literacy. While a 10-percentage point increase in the share of students reaching basic literacy raises the annual growth rate by 0.18 percentage points, an equivalent increase in the share of top-performing students raises the annual growth rate by 0.87 percentage points.[3] In comparison, Hanushek and Woessmann (2012b) found corresponding effects of 0.3 and 1.3 percentage points. Although the estimates have decreased somewhat, the ratio has remained roughly constant.

[3] We analysed the potential interaction between the share of students reaching basic literacy and the share of top-performing students but found little evidence of any interaction effects.

Table 3. Basic literacy, high-performers, and per-capita GDP growth

	(1)	(2)
	1960–2016	
	Excluding Zimbabwe	Including Zimbabwe
Share of top-performing students	0.087***	0.106***
	(0.024)	(0.030)
Share of students reaching basic literacy	0.018***	0.015***
	(0.006)	(0.006)
Years of schooling (1960)	-0.000	-0.000
	(0.000)	(0.000)
(log) GDP per capita (1960)	-0.011***	-0.009***
	(0.001)	(0.002)
Adjusted R^2	0.79	0.64
n	49	50

Note: Significance levels: *p<0.1; **p<0.05; ***p<0.01. Robust standard errors i parentheses.

4. Conclusion

In this note, we confirm that student achievement in international surveys, such as PISA and TIMSS, translates into economic growth. Our investigation extends previous studies by calculating growth based on per capita GDP up until 2016 and by confirming the positive relationship also for test from upper-secondary education.

Like previous studies, we find that the impact of the share of top-performing students on economic growth is considerably stronger than the impact of the share of students reaching basic literacy. In consequence, a growth promoting education policy should both ensure that gifted children are able to reach their potential and that all students reach basic requirements.

On a general level, education reform is bound to be an important ingredient in any long-term growth strategy. Although education has several non-economic benefits, the economic benefits provide a strong motivation for future research that links education reform to international test scores and – in turn – to economic growth.

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