TFP and Intelligence: a cross-national empirical evidence

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TFP & INTELLIGENCE: A CROSS-NATIONAL EMPIRICAL EVIDENCE

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ABSTRACT: *We investigate the effect of intelligence on total factor productivity (TFP) using cross section data for 108 countries over the period 2000-2011. We find that intelligence, measured by national IQ scores, increases average level of each country's TFP value relative to U.S.*

Keywords: *TFP, intelligence, IQ, cross-country, human capital*
JEL: E23

Introduction

While theoretical studies consider human capital to be the driver of economic growth, the link between human capital and TFP in growth accounting is far from being robust. Lucas (1988) and Mankew et al.(1992) advocate that human capital is in important determinant of productivity growth. More recently, Rath and Parida (2014) show that school attainment rate has positive effect on total factor productivity growth (TFPG) for five South Asian countries - India, Pakistan, Sri Lanka, Bangladesh, and Nepal over the period 1980-2011. Luckstead et al (2014), using specific functional specifications for output and the law of motion to decompose the US and Chinese productivity growth rates, shows that human capital explains more than 46 and 42 percents of TFP growth rates in USA and China accordingly.

On the other hand, Coe et al. (1997) fail to document that human capital has a positive effect on productivity growth. In addition, Miller and Upadhyay (2000) show that in middle-income countries human capital has a positive effect on productivity. A negative link between human capital and TFP emerges when they run the TFP regression on a sample of low-income countries.

Kumar and Kober (2012) using a panel of 74 countries, document that education does not seem to have effect on TFP, but indicators of health remain significant in their regressions. Temple (1998) revisits Mankew et al. (1992) and shows that the effect of education is remarkably sensitive to the measurement of human capital.

Hanushek (2013) while commenting on the link between human capital and economic growth argues that 'in comparing human capital across countries, it is necessary to assume that the schools across diverse countries are imparting the same amount of learning per year in all countries … In general, this is implausible'.

Indeed, in most of extant literature, human capital-growth nexus is determined by the preference for the proxy for human capital. Related studies proxy human capital by indicators of quantity of schooling and enrollment rates – conjecturing that schooling is the only antecedent of human capital and skills.

However, since the seminal work by Lynn and Vanhanen (2002) a novel line of literature has developed, where international variations in quality of human capital and development outcomes are linked to cross-country differences in intelligence (see e.g. Belasen & Hafer, 2013; Kanyama, 2014; Salahodjaev, 2015a; Salahodjaev, 2015b; Salahodjaev & Yuldashev, 2016; Salahodjaev, 2016). Extant studies document that intelligence is 'considered to be a powerful determinant of the economic success' (Daniele, 2013). Specifically, it has a positive effect on economic growth (Ram, 2007) and GDP per capita (Lynn and Vanhanen, 2006).
The goal of this study is to contribute to this debate by using national IQs as a measure of human capital in cross-section data framework.
The remainder of this paper is organized as follows: Section II provides the econometrical methods and data used in this study. Section III presents estimation results. Section IV concludes this study.

Data and Methodology

We collect data for a cross-section of 108 countries over the period 2000-2011. The dependent variable in this analysis is the average level of each country's TFP value relative to U.S. Data is obtained from Penn World Tables 8.0.
We deduce our main independent variable cognitive intelligence, measured by IQ, from Meisenberg and Lynn (2011). The dataset is updated version of Lynn and Vanhanen (2002) and contains mean IQ scores for 196 countries of the world. For countries with missing data, IQ scores were recovered based on school achievement results or provincial data from neighboring regions with similar culture.
We control for different antecedents of total factor productivity in our empirical estimations. Infrastructure is measured as the length of railway route available for train service per 100 000 square kilometers. Mitra et al. (2012) documents that infrastructure has a positive effect on TFP data set of the Indian manufacturing industry for the period 1994–2008.
FDI is measured as the average ratio of foreign direct investment to GDP for the period 2000-2011. FDI serves as important determinant in stimulating technology diffusion in developing countries (Liu, 2000).
Financial development (FD) is proxied by domestic credit to private sector relative to GDP for the period 2000-2011. We also use a dummy for countries with social legal origin from La Porta et al. (1999).
The data on infrastructure, FDI and financial development are from WDI.
To demonstrate the association between intelligence and TFP, We provide correlations between TFP and the IQ. Figure 1 illustrates that IQ is positively associated with total factor productivity. The correlation coefficient between TFP and intelligence is 0.52.
In summary the econometric model is as follows:

$$TFP_i = \alpha_0 + \alpha_1 I_i + X_i \beta + \varepsilon_i$$

where TFP is the dependent variable, I is intelligence proxied by mean-IQ scores, X is a set of control variables.

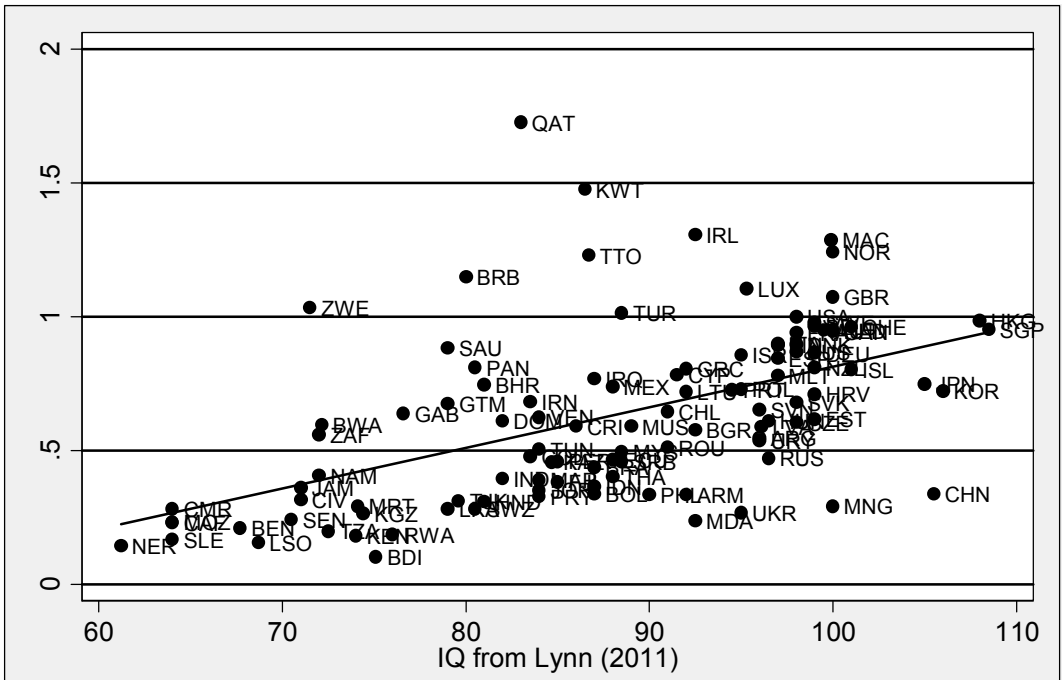

Figure 1. Intelligence and TFP

Results

The regression results for the baseline model and control variables are presented in Table 1. Column (1) displays the results from calculating equation (1), where only IQ is included on the right hand side. In line with the expectations, intelligence is significantly and positively related to TFP. Further, intelligence explains 27% of cross country variation in the average level of each country's TFP value relative to U.S. A one standard deviation rise in national IQ increases the average level of each country's TFP value relative to U.S by approximately 17%.

In column (2) we include infrastructure. As expected it has positive and significant effect on TFP. Our coefficient of interest, α_1, is still significant at 1% level. The R-squared of the model has increased from 0.27 to 0.32. In column (3) we introduce dichotomous variable for socialist countries. The results show that, this additional variable has negative effect on TFP. The significance of IQ remains intact.

Column (4) provides the estimates when FDI is included to the regression. In line with extant studies (see e.g. Alfaro et al., 2009) FDI is positively linked with TFP improvements, while the result for IQ and other control variables is unchanged.

Finally, column (5) includes domestic credit to private sector relative to GDP. It measures financial development in country i, but is insignificant. Intelligence, measured by IQ scores, remains significant at 1% level.

The above results are based on the assumption that IQ is an exogenous variable. To control for endogeneity of IQ we rely on IV approach. We use the proportion of the population living in the tropics, per capita dietary daily energy consumption, and the percentage contribution of carbohydrates, proteins and fats per capita daily macronutrients for 2005–2007 as instruments. The selection strategy of these variables is suggested by extant literature (Kanayama, 2014; Sachs, 2001). The results in column (6) show that intelligence

has positive and significant, at the 1% level of significance, effect on TFP. Nevertheless, the estimates of interest are now larger in values, compared to the coefficients in OLS approach.

Table 1
Regression results for the TFP

	(1)	(2)	(3)	(4)	(5)	(6) 2SLS
IQ	0.0152***	0.0115***	0.0136***	0.0137***	0.0128***	0.0327***
	(0.0019)	(0.0034)	(0.0028)	(0.0028)	(0.0036)	(0.0087)
Infrastructure		0.1969*	0.2445***	0.1950***	0.1817**	-0.0063
		(0.1052)	(0.0718)	(0.0732)	(0.0758)	(0.0940)
Socialist			-0.2756***	-0.2872***	-0.2728***	-0.4004***
			(0.0424)	(0.0424)	(0.0497)	(0.0907)
FDI				0.1051**	0.0993**	0.1248**
				(0.0434)	(0.0408)	(0.0523)
FD					0.0199	-0.1022
					(0.0385)	(0.0867)
Constant	-0.7063***	-0.4686*	-0.5940**	-0.6280**	-0.6213**	-1.8578***
	(0.1714)	(0.2810)	(0.2424)	(0.2410)	(0.2437)	(0.4916)
N	108	79	79	78	78	77
adj. R^2	0.27	0.32	0.49	0.49	0.49	0.23

Standard errors in parentheses
** p<0.1, ** p<0.05, *** p<0.01*

Conclusion

In this paper we investigated the effect of national intelligence on the TFP of a large sample of developing and developed countries. We document that intelligence, measured by mean-IQ scores, has a positive effect on TFP. The results remain robust even when we introduce a number of conventional antecedents of total factor productivity, including FDI relative to GDP and infrastructure. In addition, the significant positive link between IQ and TFP holds when we control for endogeneity of intelligence.

Consequently, our results may lend assistance to the hypothesis that "total factor productivity of an economy only increases if people 'work smarter' and learn to obtain more output from a given supply of inputs" (Law, 2000).

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