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Cognitive skill and technology diffusion: An empirical test

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ABSTRACT

Cognitive skills are robustly associated with good national economic performance. How much of this is due to high-skill countries doing a better job of absorbing total factor productivity from the world's technology leader? Following Benhabib and Spiegel (*Handbook of Economic Growth*, 2005), who estimated the Nelson–Phelps technology diffusion model, I use the database of IQ tests assembled by Lynn and Vanhanen (2002, 2006) and find a robust relationship between national average IQ and total factor productivity growth. Controlling for IQ, years of education is of modest statistical significance. If IQ gaps between countries persist and model parameters remain stable, TFP levels are forecasted to sharply diverge, creating a "twin peaks" result. After controlling for IQ, few other growth variables are statistically significant.

1. Introduction

Recent economic research, including Hanushek and Woessmann (2007), Jones and Schneider (2006), Weede and Kampf (2002) and Ram (2007), has shown that cognitive skill scores are robustly associated with good economic performance. The authors invariably find that cognitive skill scores have vastly more predictive power than traditional schooling measures.

The question of *whether* intelligence tests and other standardized tests are robust predictors of economic success has apparently been settled. The present paper turns to the question of why this is so. Herein, I focus on the following questions: How do differences in cognitive skills influence differences in productivity across countries? Is there a cognitive skill cutoff below which countries will fail to even conditionally converge? And after one accounts for differences in average cognitive skill in

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a country, which other conventional growth variables are reliable predictors of long-run productivity growth?

Since, following Benhabib and Spiegel (1994, 2005), estimated total factor productivity (TFP) is my productivity proxy, one should interpret "productivity differences" as including differences in managerial methods, political systems, and productivity-enhancing cultural norms that make one country more productive than another – thus, TFP includes more than just menus of manufacturing processes. Potrafke (2012) provides cross-country evidence that cognitive skills are robust predictors of lower national corruption, and Burks et al. (2009) and Jones (2008, 2011) provide experimental evidence that intelligence is a predictor of cooperative, pro-social behavior; these correlates may explain some portion of the documented relationship between cognitive skills and national productivity.

Benhabib and Spiegel (1994, 2005) estimated the technology diffusion model of Barro and Sala-i-Martin (1997); Benhabib and Spiegel used years of education as their measure of human capital, and found a modestly robust relationship that weakened considerably when additional control variables were added.

Instead, I use the database of national average IQ estimates assembled by Lynn and Vanhanen (2006) and psychometrically validated in Rindermann (2007a,b), and invariably find a robust relationship between national average IQ and the conditional rate of total factor productivity growth over the 1960–1995 period. In a horse race between IQ and education, national average IQ easily wins under all specifications. The results also hold even if only pre-1970 IQ scores are used.

One reason to use IQ tests rather than the international math and science test scores employed by Hanushek and Kimko (2000) and Barro and Lee (1996) is that IQ tests are much more widely available. For instance, Hanushek and Kimko have data from 31 countries, Barro and Lee from 23. By contrast, we have IQ scores from well over 100 countries, although limitations on other data shrink the sample considerably below 100. Further, the psychological profession has worked to make IQ scores comparable across time and space – indeed, a substantial number of the Lynn and Vanhanen observations come from country-wide "standardization samples" that are created when an IQ test is revised. As Jones and Schneider (2010) demonstrate, the positive relationship between IQ and year 2000 output per worker holds whether one uses verbal or visual IQ tests, whether one uses "culture reduced" or traditional IQ tests, and whether one uses pre-1980, pre-1970, or pre-1960 IQ tests. Arthur Jensen's 1998 book *The g Factor* provides the best overview of the IQ literature; Ian Deary's *Intelligence: A Very Short Introduction* (2001) provides a more accessible overview written by another prominent intelligence researcher. Hanushek and Woessmann (2010) provide a brief review of the literature on national IQ and economic growth.

Where these nation-level differences in reasoning skill come from is a matter of ongoing research in a variety of disciplines; for economists, the main lesson is that these differences appear to be quantitatively significant correlates of TFP. In the conclusion, I point to some literature that might begin to provide a micro-level explanation for this macroeconomic result.

2. Data

The primary data come from three sources: Benhabib and Spiegel (2005), Lynn and Vanhanen (2006), and Barro and Lee (1996); in additional robustness tests, data from Sala-i-Martin et al. (2004, henceforth SDM) are used. Lynn/Vanahanen and Barro/Lee provide the IQ and education level data, respectively. Total factor productivity (TFP) data come from Benhabib and Spiegel; I use it since it is the benchmark dataset in this literature. The TFP estimates start with output per person in a given country, and then remove the element of output per person that is explained by differences in capital per person: What is left is, of course, the Solow residual or total factor productivity. I will occasionally refer to this value simply as "productivity"; since I never need to distinguish between output per worker and TFP in this paper, this slight abuse of the language should come at little cost. Fig. 1 illustrates the relationship between national average IQ and log GDP in 1995.

The two education measures I use are the average years of schooling in the year 1960 along with the average years of schooling averaged across the years 1960–1995; both are used in Benhabib and Spiegel (2005). The latter is more likely to reflect endogeneity running from growth to education, but I