IQ and economic growth: Further augmentation of Mankiw–Romer–Weil model

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Abstract

Solow’s growth model is further augmented to include IQ in addition to proxies for education and health. The estimates indicate that IQ variable greatly erodes the size and significance of education and health parameters and dominates even a measure of institutional quality.

Keywords: IQ; Economic growth; Education; Health; Institutions

JEL classification: O47; O15; I29; J24

1. Introduction

The widely-cited work by Mankiw, Romer and Weil (1992) augmented the Solow (1956) growth model by including a proxy for human-capital accumulation in their cross-country regressions. They concluded that the augmented model does very well and inclusion of the human-capital variable removes several anomalous characteristics of the textbook Solow model.

Knowles and Owen (1995) considered the effect of including a proxy for health as another dimension of human capital, and stated that per-capita income growth had a more robust relation with health than with the education variable of Mankiw, Romer and Weil (MRW).

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Taking advantage of the relatively recent compilation of national IQs by Lynn and Vanhanen (2002), and using the MRW framework, this paper seeks to make a contribution along four dimensions. First, treating IQ as a fundamental aspect of human capital, the study considers how IQ does relative to MRW’s education variable. Second, it compares the role of IQ with that of the health proxy of Knowles and Owen (KO). Third, a direct comparison is provided of the roles of MRW’s education variable, KO’s health proxy, and IQ. Fourth, going slightly beyond the MRW framework, role of IQ is compared with that of “institutions” which have been widely suggested as a major determinant of resource accumulation and technical change and hence of national well-being and economic growth.

2. Model, data, and the main results

MRW (1992, p. 426, Table V) specification is used as the basic framework. Derived from a production function, it may be written as

\[
\ln(Y_{85}/Y_{60})_i = a_0 + a_1 \ln(Y_{60})_i + a_2 \ln(I/GDP)_i + a_3 \ln(n + g + \delta)_i + a_4 \ln(SCHOOL)_i + u_i
\]

where \(Y_{85}\) and \(Y_{60}\) denote GDP per working-age person in 1985 and 1960, \(I/GDP\) is average ratio of investment to GDP over the period 1960–1985, \(n\) denotes the rate of population growth, \(g\) is the rate of technical change, \(\delta\) is the rate of depreciation of physical capital, SCHOOL is the average percentage of working-age population in secondary school over the period 1960–1985, and \(u\) is the standard random term. The value for \(g + \delta\) is assumed to be 0.05 by MRW and KO.

As shown in the derivation by Knowles and Owen (1995, pp. 100–102), their proxy for health can be added as another variable in Eq. (1). The proxy they used is \(-\ln(80 - LE)\), where \(LE\) is the life expectancy at birth in year 1985, and is denoted as \(\ln(x)\).

Following the logic of KO’s derivation, logarithmic transform of IQ can also be added to Eq. (1) as another proxy for human capital in the same way as health capital was included by them.

As the work by KO and some other scholars indicates, use of data provided in MRW’s Appendix for 1960–1985 greatly facilitates the extension undertaken in the present study. The focus is on their non-oil sample of 98 countries, and their data cover all variables of Eq. (1). Like KO, most information on life expectancy is taken from World Development Report 1987 (World Bank, 1987, pp. 202–203).

Data on IQ are taken from the compilation by Lynn and Vanhanen (2002, pp. 73–80). As explained by them (pp. 197–225), they first calculated mean IQs for 81 countries from intelligence tests administered in these countries. This was done by setting the mean IQ in Britain at 100 with a standard deviation of 15, and by calculating mean IQs for other countries relative to that yardstick. Since the dates of the tests from which national averages are derived vary considerably, appropriate adjustments were made so as to be consistent with the British test that constitutes the benchmark. The benchmark year corresponds roughly to 1979 and is thus temporally congruent with the MRW data. While direct averages were calculated for 81 countries, estimates for many others were based on the numbers for neighboring or comparable countries. Lynn and Vanhanen (2002, pp. 22–23 and elsewhere) have also explained that intelligence tests, constructed mainly in the U.S. and Britain, have been administered to representative samples of the population in many countries since the 1920s, and comparisons of the national mean IQs have produced a consistent cross-country IQ pattern.
It may be noted that IQ is similar to the concept of general ability that has been discussed extensively in the human-capital literature. Lynn and Vanhanen (2002, pp. 22–25) explain that intelligence may be conceptualized as general ability that affects the efficiency of learning, problem solving, and the performance of a wide range of tasks. It is an important determinant of educational attainment, achievement, earnings, health, and social status. Starting with Arrow (1973) and Spence (1973), human-capital literature contains an extensive discussion of the role of ability in educational attainment, market earnings, household production and health.

A quick view of the data is provided in Table 1 where sample statistics and simple correlations are presented. The table includes the basic MRW variables, life expectancy (LIFE) and IQ, and also a measure of institutional quality (INST) that is introduced later. The main point indicated by the table is that the variables show a reasonable degree of dispersion in the sample and most correlations are of the expected kind.

Columns (1) to (4) in Table 2 report the basic estimates obtained through the ordinary least-squares procedure. Five points may be noted from the estimates.

First, MRW (1992, p. 426, Table V) estimates are almost exactly replicated, indicating accuracy of the data and Eq. (1).

Second, when KO’s health variable \([\ln(x)]\) is added, their basic point is replicated well, and health shows a stronger significance than the education variable, although both are significant at the 1% level.

Third, when IQ is added to the MRW model, IQ shows high significance, and the education variable is no longer significant at the 5% level. Therefore, while health does do well, as KO suggested, IQ seems to do much better.

Fourth, when education, health, and IQ are simultaneously included, IQ shows by far the strongest association with output growth. Education variable loses significance even at the 10% level, and size and significance of the health variable are substantially eroded.

Fifth, therefore, while the estimates are consistent with MRW’s suggestion that the augmented Solow model does well in a cross-country context when human capital is included, IQ shows the most powerful augmentation effect. Also, although the position articulated by Knowles and Owen (1995) broadly holds, it gets modified since IQ does better than both education and health as a proxy for human capital.

Table 1
Descriptive statistics and correlations

<table>
<thead>
<tr>
<th>Part A: Descriptive sample statistics</th>
<th>Mean</th>
<th>S.D.</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(Y85/Y60)</td>
<td>0.45</td>
<td>0.45</td>
<td>98</td>
</tr>
<tr>
<td>I/Y (%)</td>
<td>17.67</td>
<td>7.92</td>
<td>98</td>
</tr>
<tr>
<td>SCHOOL (%)</td>
<td>5.40</td>
<td>3.47</td>
<td>98</td>
</tr>
<tr>
<td>LIFE (years)</td>
<td>61.46</td>
<td>11.17</td>
<td>98</td>
</tr>
<tr>
<td>IQ</td>
<td>83.60</td>
<td>12.22</td>
<td>98</td>
</tr>
<tr>
<td>INST</td>
<td>4.60</td>
<td>1.22</td>
<td>53</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part B: Simple correlations</th>
<th>ln(Y85/Y60)</th>
<th>I/Y</th>
<th>SCHOOL</th>
<th>LIFE</th>
<th>IQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/Y</td>
<td>0.57</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCHOOL</td>
<td>0.44</td>
<td>0.63</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LIFE</td>
<td>0.51</td>
<td>0.69</td>
<td>0.88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IQ</td>
<td>0.55</td>
<td>0.61</td>
<td>0.78</td>
<td>0.89</td>
<td></td>
</tr>
<tr>
<td>INST</td>
<td>0.42</td>
<td>0.49</td>
<td>0.14</td>
<td>0.26</td>
<td>0.17</td>
</tr>
</tbody>
</table>

The variables are defined in the text.
It should perhaps be noted that although Lynn and Vanhanen (2002) themselves did an extensive study of the relation between national IQs and wealth of nations, their useful work focuses mainly on correlational structures, and MRW model provides a nice framework for looking at IQ along with two conventional human-capital proxies.1

Despite the fact that the MRW framework is specified in the context of Solow model, it seems instructive to extend it to see how IQ does in a cross-country growth context relative to some other variables that have been considered important. While there is a long list of such variables, institutional quality has been suggested by some scholars as a fundamental determinant of human and physical capital accumulation and technical change. For example, Rodrik et al. (2004) recently concluded that quality of institutions trumps everything else.

An ad hoc augmentation of MRW model is undertaken by adding (logarithm of) institutional quality (INST) as another exogenous variable. Although many different proxies have been used for institutional quality, the present study uses the one that underlies the widely-cited work by Burnside and Dollar (2000), and was found to be among the most significant variables. As explained by them (p. 850), the variable captures security of property rights and efficiency of government bureaucracy. Since the values of the variable are for the year 1980, it is, like life expectancy and IQ, temporally congruent with the MRW data set. Burnside–Dollar study includes 56 middle- and low-income developing countries of which 53 are common to MRW data set.

Column (5) in Table 2 reports estimates of a regression that includes institutional quality besides education, health, and IQ. It is easy to see that although the institution variable retains statistical

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1 Treating IQ as one useful measure of human capital, Jones and Schneider (2006) use “Bayesian Averaging of Classical Estimates” (BACE) approach of Sala-i-Martin et al. (2004) to study robustness of IQ in growth regressions.
significance in the presence of IQ (and education and health), the IQ variable is much stronger. Therefore, one can say that IQ is a sturdy variable, institutions do not “trump” it, and both education and health look quite weak when IQ and institutional quality enter the regressions.

3. Concluding remarks

Using recent data on national IQs for a large number of countries, a comparison is made of the performance of three human-capital proxies in the augmented Solow model proposed by Mankiw et al. (1992). The main points of the study may be summarized in four statements. First, while education does very well in the MRW framework, as they reported, the life-expectancy variable does somewhat better, as indicated by Knowles and Owen (1995). Second, when IQ is entered along with MRW’s education term, IQ shows high significance, and the education variable is no longer significant at the 5% level. Third, when IQ is entered along with education and health, education is not significant even at the 10% level, and although health shows significance, IQ is clearly the strongest proxy for human capital. Fourth, when MRW model is extended in an ad hoc manner to include institutional quality along with IQ, education and health, IQ term is seen to be the strongest. Two additional observations also seem useful. First, given the uncertainties about interpretation of measured IQs, recency of the compilation by Lynn and Vanhanen (2002), and possible controversies on the implications of the cross-country IQ patterns, the conclusions are offered with considerable humility and a note of caution. Second, like MRW and KO, this study does not consider questions about the exogeneity of the human (and physical) capital variables. However, it is possible to believe that if there is a significant “feedback” from economic growth, it is likely to be weaker for IQ than for schooling, health, and physical capital. It is hoped that patterns reported in this paper will serve as a useful starting point for treating IQ as an important dimension of human capital in cross-country studies of economic growth.

References