EC569 Economic Growth
Seminar 2

İlhan Güner
School of Economics
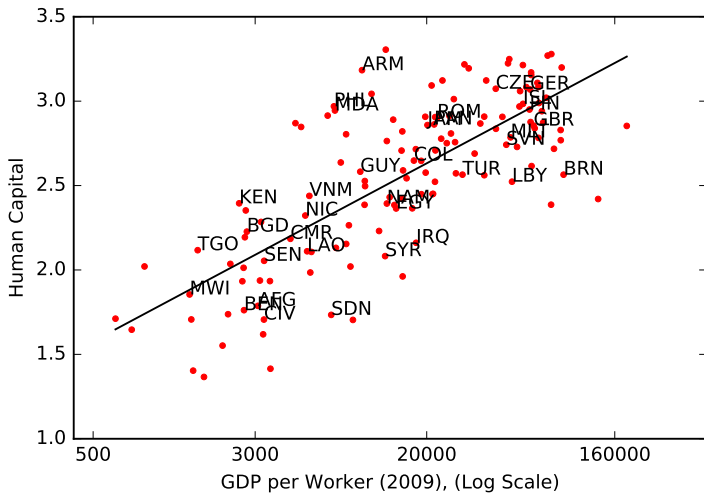University of Kent

February 13, 2019

Seminars

- Everyone must read the article and solve the questions
- Some articles are highly technical so focus on the big picture

Use the 'Weil Data' dataset on Moodle to make a scatter plot of average years in education (Column L) and GDP per worker (Column N, you should use a ratio/log scale) in 2009. What is the general relationship?

Barro, Robert J. "Human capital and growth." American economic review 91, no. 2 (2001): 12-17.

- Determinants of long-run economic growth
- Distinguishes between
  - quantity of education, measured by years of school attainment
  - quality of education, gauged by scores on internationally comparable examinations
- Quality of schooling is more important than the quantity

- Roughly 100 countries
- The growth rate is measured over three ten-year periods: 1965–1975, 1975–1985, and 1985–1995
- Three-stages least squares estimation with instruments
  - actual values of schooling, openness, and terms-of-trade variables
  - lagged values of other variables

TABLE 1—PANEL REGRESSION FOR GROWTH RATE

Independent variable	Coefficient
Log(per capita GDP)	0.107 (0.025)
Log(per capita GDP) squared	−0.0084 (0.0016)
Male secondary and higher schooling	0.0044 (0.0018)
Govt. consumption/GDP	−0.157 (0.022)
Rule-of-law index	0.0138 (0.0056)
Openness ratio	0.133 (0.041)
(Openness ratio) × log(GDP)	−0.0142 (0.0048)
Inflation rate	−0.0137 (0.0090)
Log(total fertility rate)	−0.0275 (0.0050)
Investment/GDP	0.033 (0.026)
Growth rate of terms of trade	0.110 (0.030)
Numbers of observations:	81, 84, 81
R^2:	0.62, 0.50, 0.47

Notes: The dependent variable is the growth rate of real per capita GDP for each of the periods 1965–1975, 1975–1985, and 1985–1995. Individual constants are included in each panel for each period. The log of real per capita GDP and the average years of school attainment are measured at the beginning of each period. Government consumption is measured exclusively of spending on education and defense. The openness ratio is the ratio of exports plus imports to GDP, filtered for the estimated relation of this ratio to country size, as measured by the logs of land area and population. The government consumption ratio, the openness ratio, the ratio of investment (private plus public) to GDP, the inflation rate (for consumer prices), the total fertility rate, and the growth rate of the terms of trade (export over import prices) are period averages. (For the last period, the government and investment ratios are for 1985–1992.) The variable openness ratio $\times$ log(GDP) is the openness ratio multiplied by the log of per capita GDP at the start of the period. The rule-of-law index is the earliest value available (for 1982 or 1985) in the first two equations and the period average for the third equation.

Estimation is by three-stage least squares. Instruments are the actual values of the schooling, openness, and terms-of-trade variables, and lagged values of the other variables. The earliest value available for the rule-of-law index (for 1982 or 1985) is included as an instrument for the first two equations, and the 1985 value is included for the third equation. Standard errors are shown in parentheses. The R^2 values apply to each period separately.

Results

- The level of GDP:
  - Significantly positive for log(GDP) and negative for the square of log(GDP)
  - Marginal effect for US in 1995 ($18,915 in 1985 prices) is -.058.
  - 10% increase in GDP (US marginal effect) $\Rightarrow$ .6% decrease in growth rate
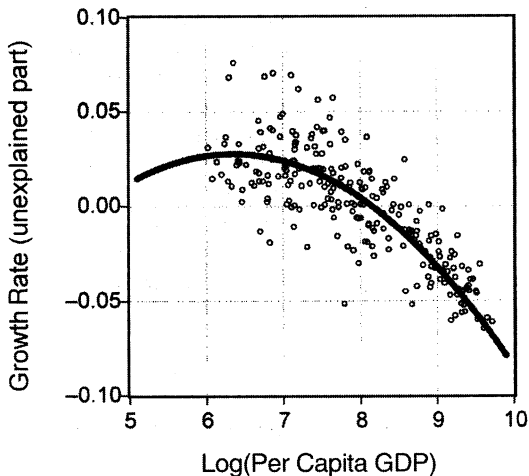
FIGURE 1. GROWTH RATE VERSUS LOG(GDP)

Notes: The variable on the vertical axis is the growth rate net of the estimated effect of all explanatory variables aside from log(GDP) and its square. The value plotted was normalized to make its mean value zero.

Results - 2

- Government consumption / GDP
  - Exclusively of spending on education and defense
  - Do not directly enhance productivity
  - Statistically significant negative impact on growth rate
  - 10 percentage points increase in G/Y ⇒ reduce growth rate on impact by 1.6 percent per year
- Rule of law
  - Statistically significant and positive
  - An improvement by one category (increase by .17) ⇒ increase growth on impact by .2%.

- International openness
  - (Exports + Imports) / GDP
  - Significantly positive effect
  - Significantly negative effect when interacted with log(GDP)
  - Impact of openness diminishes as a country gets richer
- Inflation rate
  - Marginally significant, negative effect
  - 10% percentage point increase in inflation reduces growth rate on impact by .14% per year.

- Fertility rate
  - Significant negative relationship
- Investment rate
  - Marginally significant (?) and positive
- Terms of trade
  - Export over import prices
  - Improvements in terms of trade $\Rightarrow$ economic growth

Effects of Education

- Given GDP, higher human capital implies higher human capital / physical capital
- Higher human / physical capital $\Rightarrow$ growth by
  - Absorption of superior technologies
  - Adjusting upward the quantity of physical capital (since human capital is harder to adjust)
- Statistically significant and positive effect
- An additional year of schooling $\Rightarrow$ growth rate goes up by .44% per year on impact
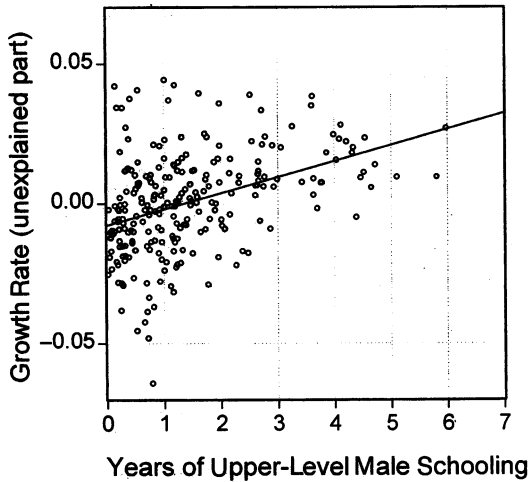
FIGURE 2. GROWTH RATE VERSUS SCHOOLING

Effects of Education, cont'd

- Female attainment at the secondary and higher levels of education
  - Statistically insignificant
  - Under utilization of females in labor force
- Male primary schooling
  - Statistically insignificant
  - Prerequisite for secondary education
  - Affects through secondary education
- Female primary schooling
  - Statistically insignificant
  - If fertility is not held constant, it becomes significant (.0039 (SE=.0013))
  - $\Rightarrow$ lower fertility $\Rightarrow$ higher growth

Quality of Schooling

- Scores on international examinations matter more than years of attainment on economic growth (Hanusbek and Kimko (2000))

TABLE 2—PANEL REGRESSIONS FOR GROWTH RATE: EFFECTS OF TEST SCORES

Independent variable	Regression			
	(i)	(ii)	(iii)	(iv)
Science score	0.129 (0.022)	—	—	0.064 (0.037)
Mathematics score	—	0.076 (0.022)	—	0.036 (0.029)
Reading score	—	—	−0.025 (0.040)	—
Overall test score	—	—	—	—
Male secondary and higher schooling	0.0019 (0.0011)	0.0019 (0.0013)	0.0013 (0.0018)	0.0020 (0.0012)
Numbers of observations:	37, 37, 36	34, 34, 33	32, 32, 32	34, 34, 33
R^2:	0.72, 0.45, 0.28	0.68, 0.52, 0.55	0.72, 0.39, 0.53	0.69, 0.52, 0.51

Independent variable	Regression			
	(v)	(vi)	(vii)	(viii)
Science score	0.060 (0.021)	—	0.034 (0.027)	—
Mathematics score	—	−0.001 (0.027)	−0.017 (0.029)	—
Reading score	0.034 (0.026)	0.074 (0.028)	0.067 (0.028)	—
Overall test score	—	—	—	0.125 (0.029)
Male secondary and higher schooling	0.0000 (0.0009)	0.0010 (0.0009)	0.0009 (0.0009)	0.0017 (0.0015)
Numbers of observations:	26, 26, 26	23, 23, 23	23, 23, 23	43, 43, 42
R^2:	0.82, 0.29, 0.53	0.74, 0.36, 0.55	0.76, 0.33, 0.54	0.65, 0.59, 0.37

Notes: Test scores from science, mathematics, and reading examinations are measured as percentage correct. The data used are a cross section, consisting of only one average score in each field per country. The overall test score, used in regression (viii), equals the science score, where available, and uses the reading score, adjusted for differences in average levels from the science scores, to fill in some additional observations. The test-score variables were entered into the system described in Table 1. The test-score variables are included in the instrument lists for each equation. For the other explanatory variables in the system, the estimated coefficient of the variable for male secondary and higher school attainment is shown, but the other coefficients are not shown. See the notes to Table 1 for additional information.

Results

- Science scores
  - Statistically significant and positive
  - One standard deviation increase in scores (by .08) $\Rightarrow$ 1% percent increase in growth on impact
  - Male schooling is marginally significant (?)
- Both quality and quantity of education matters, but quality matters more
- Math scores are also statistically significant and positive
- Reading scores are insignificant (puzzling)
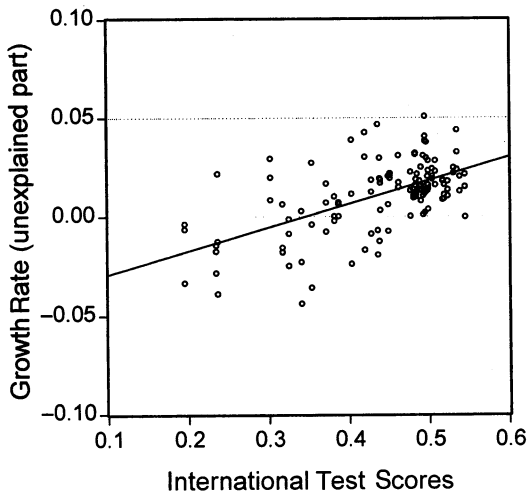- Reading scores becomes positive and significant once we include all scores

FIGURE 3. GROWTH RATE VERSUS TEST SCORES

What are the policy implications of Barro (2001)?

- Should the government invest more in secondary and higher education?
- Should the government fund/promote science subjects above others?
- Should there be a labor market policy that utilizes highly educated females?