Hall and Jones

Consider the 35-fold difference in output per worker between the United States and Niger. Different capital intensities in the two countries contributed a factor of 1.5 to the income differences, while different levels of educational attainment contributed a factor of 3.1. The remaining difference-a factor of 7.7-remains as the productivity residual.

Our hypothesis is that differences in capital accumulation, productivity, and therefore output per worker are fundamentally related to differences in social infrastructure across countries.

Social Infrastructure → Inputs, Productivity → Output

By social infrastructure we mean the institutions and government policies that determine the economic environment within which individuals accumulate skills, and firms accumulate capital and produce output.

A social infrastructure favorable to high levels of output per worker provides an environment that supports productive activities and encourages capital accumulation, skill acquisition, invention, and technology transfer. Such a social infrastructure gets the prices right so that, in the language of North and Thomas [19731, individuals capture the social returns to theiractions as private returns.

Our approach is different: we try to explain the variation in long-run economic performance by studying directly the cross-section relation in levels

$$Y_i = K_i^{\alpha}(A_i H_i)^{1-\alpha}, \quad H_i = e^{\phi(E_i)} L_i, \quad h_i = \frac{H_i}{L_i}$$

$$\frac{Y_i^{\frac{1}{1-\alpha}}}{L} = \frac{Y_i^{\frac{\alpha}{1-\alpha}} Y_i}{L} = K_i^{\frac{\alpha}{1-\alpha}} (A_i h_i)$$

$$y_i = \frac{Y_i}{L_i} = \left(\frac{K_i}{Y_i}\right)^{\frac{\alpha}{1-\alpha}} h_i A_i, \qquad h_i = \frac{H_i}{L_i}$$

where E is educational attainment, or years of schooling.

This equation allows us to decompose differences in output per worker across countries into differences in the capital-output ratio, differences in educational attainment, and differences in productivity.

We follow David [1977]; Mankiw, Romer, and Weil [1992]; and Klenow and Rodriguez [I997] in writing the decomposition in terms of the capital-output ratio rather than the capital labor ratio, for two reasons. First, along a balanced growth path, the capital-output ratio is proportional to the investment rate, so that this form of the decomposition also has a natural interpretation. Second, consider a country that experiences an exogenous increase in productivity, holding its investment rate constant. Over time, the country's **capital-labor** ratio will rise as a result of the increase in productivity. Therefore, some of the increase in output that is fundamentally due to the increase in productivity would be attributed to capital accumulation in a framework based on the **capital-labor** ratio.

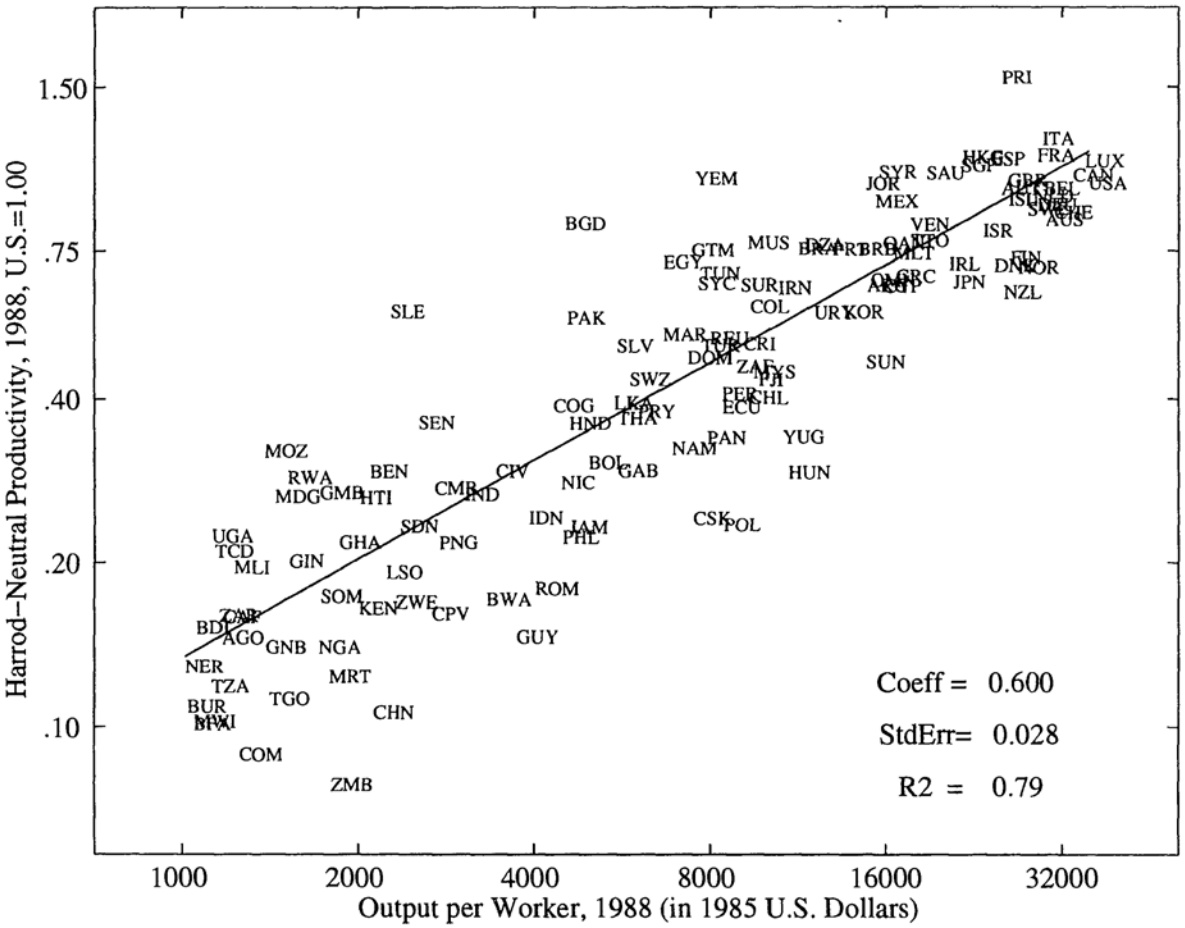

FIGURE I
Productivity and Output per Worker

TABLE I

PRODUCTIVITY CALCULATIONS: RATIOS TO U. S. VALUES

Country	Y/L	Contribution from $(K/Y)^{\alpha/(1-\alpha)}$	Contribution from H/L	Contribution from A
United States	1.000	1.000	1.000	1.000
Canada	0.941	1.002	0.908	1.034
Italy	0.834	1.063	0.650	1.207
West Germany	0.818	1.118	0.802	0.912
France	0.818	1.091	0.666	1.126
United Kingdom	0.727	0.891	0.808	1.011
Hong Kong	0.608	0.741	0.735	1.115
Singapore	0.606	1.031	0.545	1.078
Japan	0.587	1.119	0.797	0.658
Mexico	0.433	0.868	0.538	0.926
Argentina	0.418	0.953	0.676	0.648
U.S.S.R.	0.417	1.231	0.724	0.468
India	0.086	0.709	0.454	0.267
China	0.060	0.891	0.632	0.106
Kenya	0.056	0.747	0.457	0.165
Zaire	0.033	0.499	0.408	0.160
Average, 127 countries:	0.296	0.853	0.565	0.516
Standard deviation:	0.268	0.234	0.168	0.325
Correlation with Y/L (logs)	1.000	0.624	0.798	0.889
Correlation with A (logs)	0.889	0.248	0.522	1.000

The elements of this table are the empirical counterparts to the components of equation (3), all measured as ratios to the U. S. values. That is, the first column of data is the product of the other three columns.

1988 output per worker in five countries with highest levels of output per worker was 31.7 times the output per worker in five lowest countries (based on geometric average: $\left(\prod_{i=1}^{n} a_i\right)^{\frac{1}{n}}$).

Relatively little of this difference was due to physical and human capital: differences in capital intensity and human capital per worker contributed factors of 1.8 and 2.2, respectively, to the difference in output per worker. Productivity, however, contributed a factor of 8.3 to this difference: with no differences in productivity, output per worker in the five richest countries would have been only about four times larger than in the five poorest countries. In this sense, differences in physical capital and educational attainment explain only a modest amount of the difference in output per worker across countries.

The reason for the lesser importance of capital accumulation is that most of the variation in capital-output ratios arises from variation in investment rates. Average investment rates in five richest countries are only 2.9 times larger than average investment rates in five poorest countries. Moreover, this difference gets raised to the power a/(l - a) which for a neoclassical production function with a = 1/3 is only 50%–so it is the square root of the difference in investment rates that matters for output per worker. Similarly, average educational attainment in five richest countries is about 8.1 years greater than average educational attainment in five poorest countries, and this difference also gets reduced when converted into an effect on output: each year of schooling contributes only something like 10 percent (the Mincerian return to schooling) to differences in output per worker.

Given the relatively small variation in inputs across countries and the small elasticities implied by neoclassical assumptions, it is hard to escape the conclusion that differences in productivity -the residual-play a key role in generating the wide variation in output per worker across countries.

The central hypothesis of this paper is that the primary, fundamental determinant of a country's long-run economic performance is its social infrastructure. By social infrastructure we mean the institutions and government policies that provide the incentives for individuals and firms in an economy. Those incentives can encourage productive activities such as the accumulation of skills or the development of new goods and production techniques, or those incentives can encourage predatory behavior such as rent-seeking, corruption, and theft.

To examine the quantitative importance of differences in social infrastructure as determinants of incomes across countries, we hypothesize the following structural model where S is social infrastructure, and X other variables:

$$\ln \frac{Y}{L} = a + \beta s + \varepsilon$$

$$S = \gamma + \delta \ln \frac{Y}{L} + X\theta + \eta,$$

S is measured by openness and measures from Political Risk Surveys. X needs instruments: distance to equator (West European influence), extent to which primay European languages (English, French, German, Portuguese, and Spanish) are spoken, and the (log) predicted trade share of an economy. {the (log) predicted trade share of an economy: $F = G\frac{(M_i)^{\alpha}(M_j)^{\beta}}{(D_{ij})^{\gamma}}$, F is total exports+imports, $M's$ are GDPs, D_{ij} is distance.}

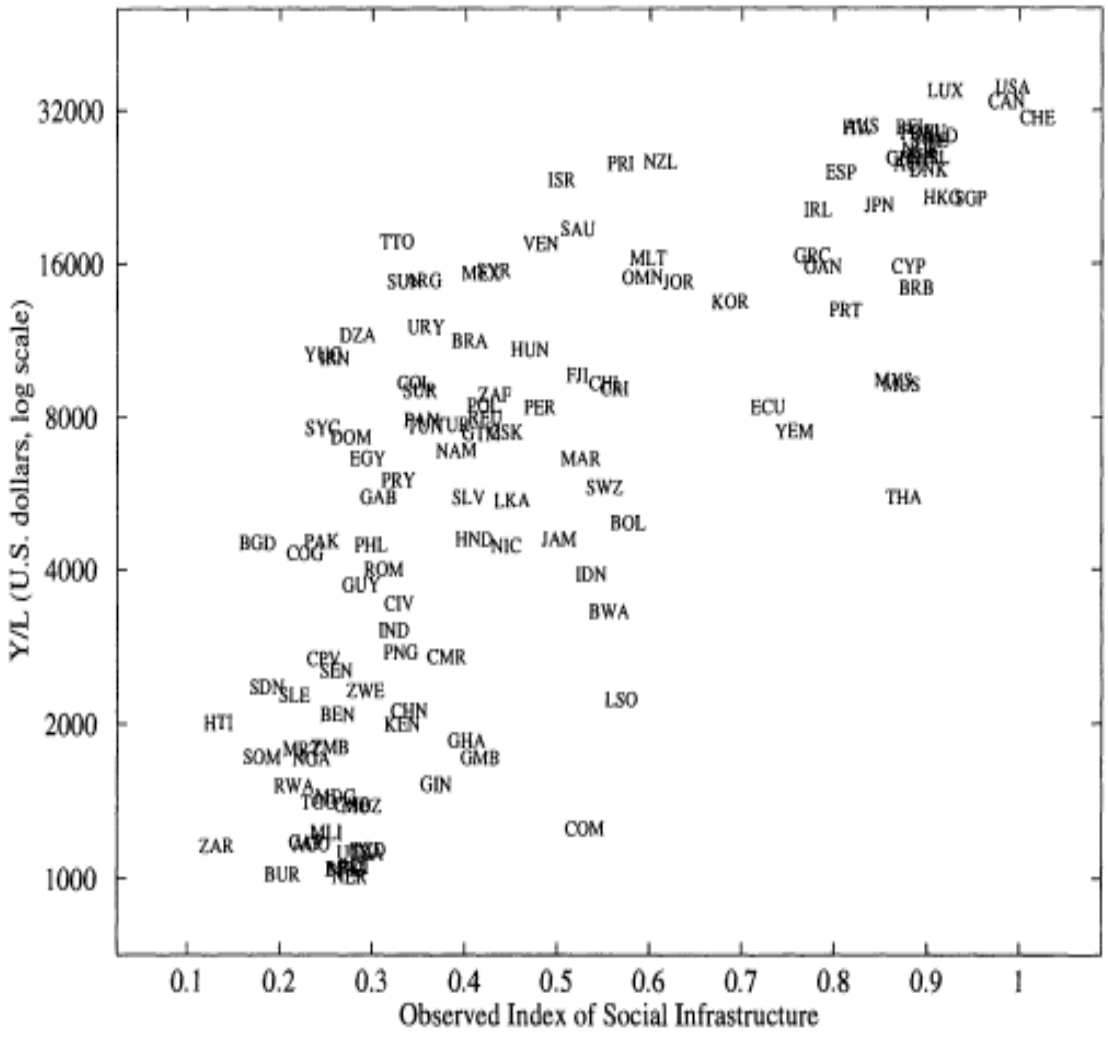

FIGURE II
Social Infrastructure and Output per Worker

TABLE II

BASIC RESULTS FOR OUTPUT PER WORKER

$\log Y/L = \alpha + \beta\tilde{S} + \tilde{\epsilon}$

Specification	Social infrastructure	OverID test p-value test result	Coeff test p-value test result	$\hat{\sigma}_{\tilde{\epsilon}}$
1. Main specification	5.1432	.256	.812	.840
	(.508)	Accept	Accept	
Alternative specifications to check robustness				
2. Instruments:	4.998	.208	.155	.821
Distance, Frankel-Romer	(.567)	Accept	Accept	
3. No imputed data	5.323	.243	.905	.889
79 countries	(.607)	Accept	Accept	
4. OLS	3.289	—	.002	.700
	(.212)		Reject	

The coefficient on Social infrastructure reflects the change in log output per worker associated with a one-unit increase in measured social infrastructure. For example, the coefficient of 5.14 means than a difference of .01 in our measure of social infrastructure is associated with a 5.14 percent difference in output per worker. Standard errors are computed using a bootstrap method, as described in the text. The main specification uses distance from the equator, the Frankel-Romer instrument, the fraction of the population speaking English at birth, and the fraction of the population speaking a Western European language at birth as instruments. The OverID test column reports the result of testing the overidentifying restrictions, and the Coeff test reports the result of testing for the equality of the coefficients on the *GADP* policy index variable and the openness variable. The standard deviation of $\log Y/L$ is 1.078.

Our major findings can be summarized by the following points:

1. Many of the predictions of growth theory can be successfully considered in a cross-section context by examining the levels of income across countries.

2. The large variation in output per worker across countries is only partially explained by differences in physical capital and educational attainment. Paralleling the growth accounting literature, levels accounting finds a large residual that varies considerably across countries.

3. Differences in social infrastructure across countries cause large differences in capital accumulation, educational attainment, and productivity, and therefore large differences in income across countries.

4. The extent to which different countries have adopted different social infrastructures is partially related to the extent to which they have been influenced by Western Europe. Using distance from the equator and language data, we conclude that our finding that differences in social infrastructure cause large differences in income is robust to measurement error and endogeneity concerns.

Sachs-Warner (1995) Regressions:
Economic Convergence and Economic Policies

Dummy variables =1 if: SOC: Socialist, EDU:Extremely Disruptive Unrest, RIGHT: Political Repression, BMP: Black Market Premium 70-80es, OWQID: high quota on intermediate and capital goods EXM: highly regulated state run export monopolies, PNQ either SOC, EDU or RIGHT equals 1, 0 otherwise, ONQ =either BMP, OQWID, SOC or EXM =1, 0 otherwise.

Table 5. Growth Effects of the Political and Openness Measures

Dependent Variable: G7089

	(4)	(5)
Constant	9.912	8.282
(t-ratio)	(5.344)	(4.408)
SOC	-1.267	
	(-1.820)	
EDU	-0.624	
	(-1.391)	
RIGHT	-0.670	
	(-1.227)	
PNQ		-0.764
		(-1.852)
BMP	-2.246	
	(-6.026)	
OWQID	-0.848	
	(-1.958)	
EXM	-1.885	
	(-3.584)	
ONQ		-2.770
		(-5.851)
LGDP70	-0.839	-0.568
	(-3.800)	(-2.595)
R bar 2	0.446	0.311
Mean dv.	1.583	1.512
Standard Error	1.587	1.824
Sample Size	95	114
Significance levels for F tests:		
H0: β(SOC)-β(EDU)-β(RIGHT)	0.789	
H0: β(BMP)-β(EXM)-β(OWQID)	0.035	
H0: β(PNQ)-β(ONQ)		0.008