Indian Economic Growth, Development Accounting, and Health

David N. Weil

Brown University and NBER

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Development Accounting: The Basic Approach

y = GDP per worker

x = factors of production per worker

A = productivity

k = physical capital per worker

h = human capital per worker

s = years of schooling per worker

$$y = Ax$$

$$x = k^{1/3}h^{2/3}$$

$$h = e^{\phi(s)}$$

$$\frac{X_{India}}{X_{US}} = \left(\frac{k_{India}}{k_{US}}\right)^{1/3}\left(\frac{h_{India}}{h_{US}}\right)^{2/3}$$

$$\frac{y_{India}}{y_{US}} = \frac{A_{India}}{A_{US}}\frac{X_{India}}{X_{US}}$$

Development Accounting Applied to India
(data for 1998/1999)

Output per Worker relative to US (y): .086

Physical Capital per Worker relative to US (k): .047

Years of education per worker India: 4.77
Year of education per worker US: 12.77

Human capital in India Relative to US (h): .555

$$\frac{h_{India}}{h_{US}} = e^{\phi(4.77)-\phi(12.77)} = 0.555$$

Factors of production in India Relative to US (x):

$$\frac{x_{India}}{x_{US}} = .047^{1/3} \times .555^{2/3} = .245$$

Productivity relative to US (A):

$$\frac{A_{India}}{A_{US}} = \frac{\frac{y_{India}}{y_{US}}}{\frac{x_{India}}{x_{US}}} = \frac{.086}{.245} = .351$$

Development Accounting in a Cross Section of Countries

All Data is Relative to the United States

Quintile	Output per Worker	Physical Capital per Worker	Human Capital per Worker	Factors of Production Per Worker	Productivity
1	.036	.019	.472	.157	.236
2	.110	.088	.623	.320	.349
3	.227	.199	.668	.441	.522
4	.508	.601	.794	.711	.714
5	.812	1.15	.867	.950	.859
India	.086	.047	.555	.245	.351

Source: Weil (2004)

Growth Accounting Results for a Cross Section of Countries
(1960-1998)

Quintile	Output Growth Rate	Growth Rate Of Factors Of Production	Growth Rate Of Productivity	Sample Countries
1	-.41%	0.59%	-1.00%	Mozambique, Malawi, Venezuela, Bolivia
2	1.00%	0.88%	.12%	Kenya, Mexico, Philippines
3	1.55%	1.21%	.24%	USA, Canada, Uganda, Colombia
4	2.28%	1.23%	1.05%	Israel, Norway, Chile, India
5	3.71%	2.38%	1.38%	Japan, Ireland, S. Korea, Italy
India	2.75%	1.77%	0.97%	

Source: Weil (2004)

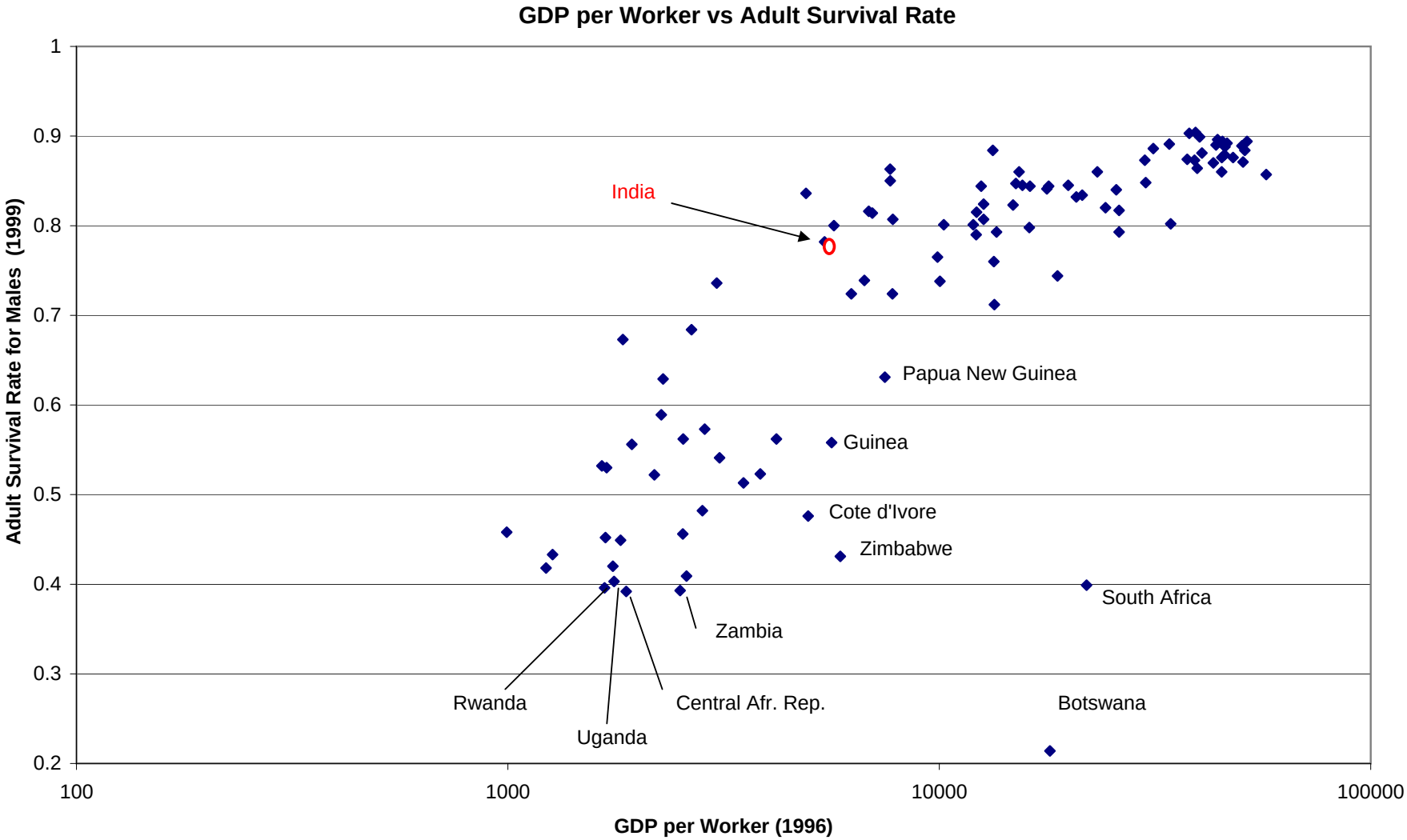
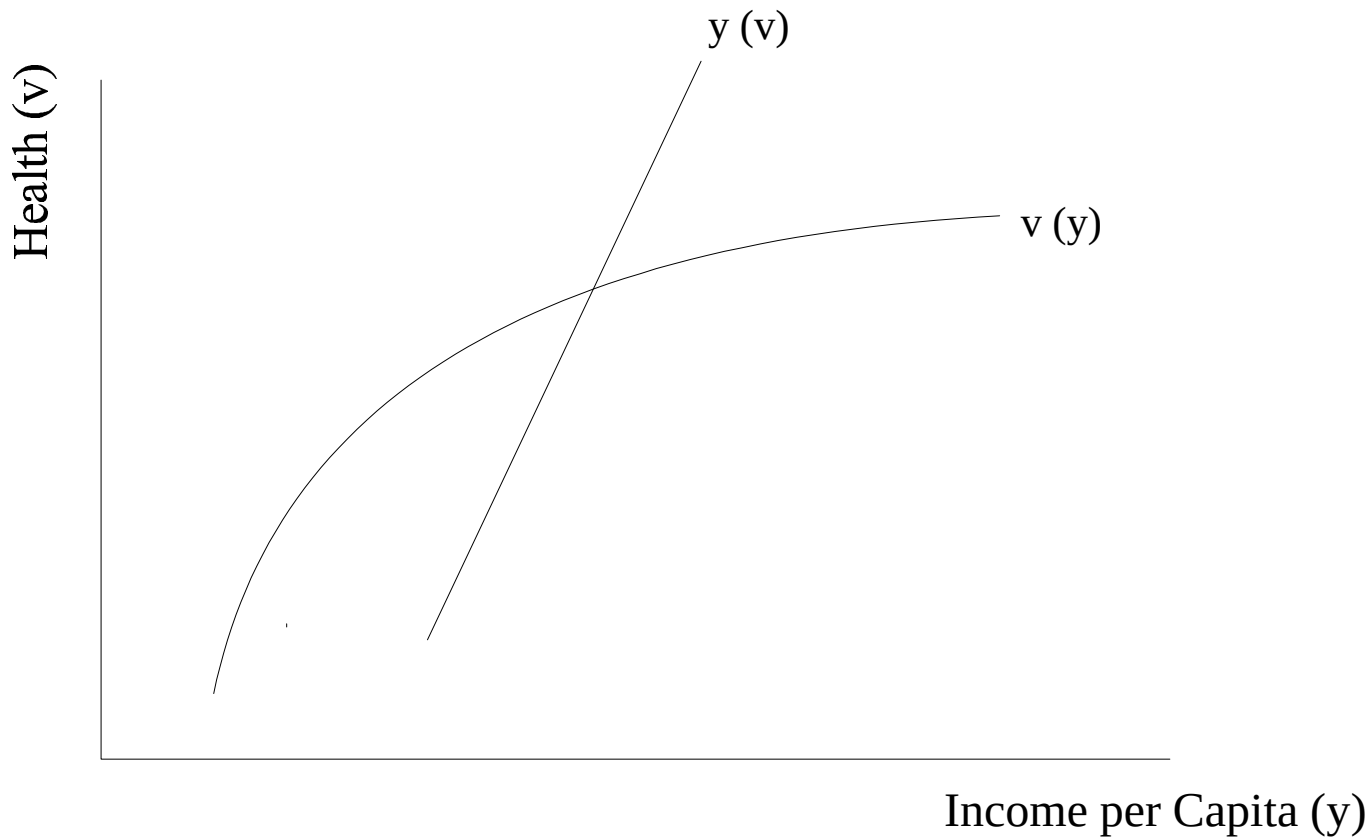

GDP per Worker vs Adult Survival Rate
Adult Survival Rate for Males (1999)
GDP per Worker (1996)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
100
1000
10000
100000
India
Papua New Guinea
Guinea
Cote d'Ivore
Zimbabwe
South Africa
Zambia
Rwanda
Uganda
Central Afr. Rep.
Botswana

Figure 1

The Relationship Between Health and Income



How do we learn about the structural effect of health on productivity?

- Microeconomic studies of health and wages (Schultz *et al*.)
- Studies of identical twins with different birth weights (Behrman and Rosenzweig)
- Historical evidence on height and nutrition from Europe (Fogel)

The Bottom Line (Weil, 2005)

1 cm. extra height due to better health raises wages by $\approx$ 7.2%

Increase in Adult Survival Rate by 0.1 raises wages by $\approx$ 21%

Applying Health Adjustment to Indian Data

v = human capital in the form of health

$$x = k^{1/3}(vh)^{2/3}$$

$ASR_{US} = .857$

$ASR_{India} = .782$

$$\frac{v_{India}}{v_{US}} = e^{1.9\times(.782-.857)} = .867$$

Increase in Indian Income from an Immediate Shift to US level of Health:

$$= \left(\frac{v_{US}}{v_{India}}\right)^{2/3} = 1.10 \qquad (10\%)$$

Productivity Gap Not Accounting for Health Differences:

$$\frac{A_{India}}{A_{US}} = .351$$

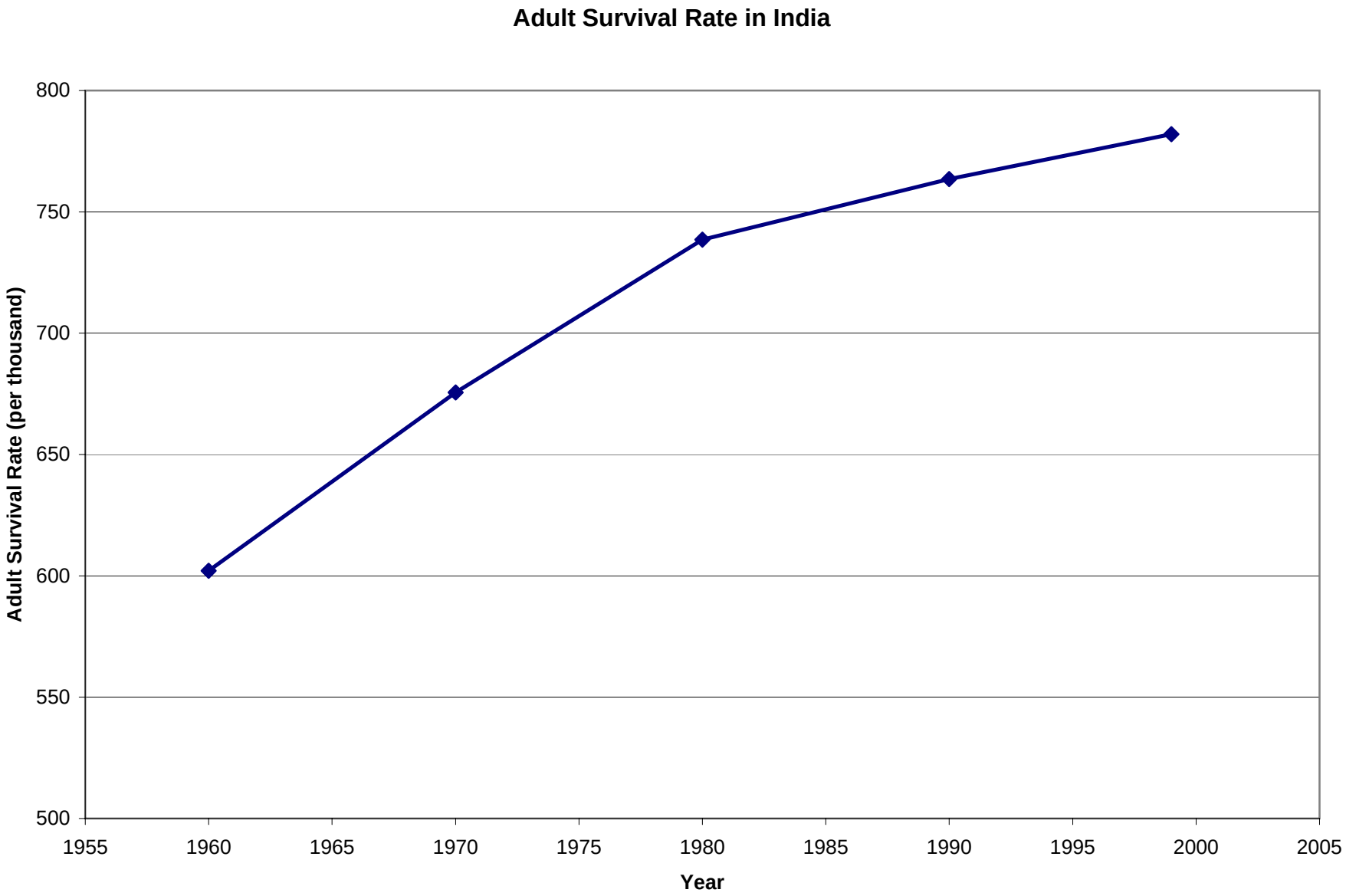
Productivity Gap Accounting for Health Differences:

$$\frac{A_{India}}{A_{US}} = .386$$

Cross-Country Variance Decomposition

Shares of Variation in ln(Output per Worker) Attributable to Each Factor		
	Not Accounting for Health	Accounting for Health
physical capital, *K/Y*	.185	.185
human capital from education, *h*	.232	.232
health, *v*		.226
productivity, *A*	.583	.357
Implied Reduction in Variance of ln(GDP/Worker) from Eliminating Variance in Health		.366

Source: Weil (2005)


Adult Survival Rate in India
800
750
700
650
600
550
500
Adult Survival Rate (per thousand)
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year

Annual Productivity Growth in India 1960-1999

$ASR_{India,\ 1960} = .602$

$ASR_{India,\ 2000} = .782$

$$\frac{v_{India,2000}}{v_{India,1960}} = e^{1.9\times(.782-.602)} = 1.408$$

Productivity Growth:

Not Accounting for Health: 0.97% per year

Accounted for by Health: 0.57% per year

Residual: 0.40% per year

Blood Hemoglobin (g/dl) in Indian Women Aged 15-49 (1998)

State	St. Dev.	Mean	Productivity rise with $E_o = 1.5$; $L_o = 12$
Andhra Pradesh	1.068	10.906	16.530%
Arunachal Pradesh	0.667	10.687	18.937%
Assam	0.874	10.449	23.032%
Bihar	0.857	10.606	20.431%
Delhi	1.009	11.143	13.289%
Goa	1.013	11.252	12.015%
Gujarat	1.155	11.005	15.555%
Harayana	1.094	10.982	15.608%
Himachal Pradesh	0.914	11.120	19.169%
Jammu & Kashmir	0.924	10.694	16.530%
Karnataka	1.231	11.137	14.278%
Kerala	0.906	11.579	8.126%
Madhya Pradesh	0.930	10.802	17.581%
Maharashtra	1.093	10.941	16.139%
Manipur	1.100	11.515	9.662%
Meghalaya	1.160	10.508	22.562%
Mizoram	0.921	10.946	15.522%
Nagaland	1.049	11.210	12.658%
Orissa	0.800	10.632	19.942%
Punjab	1.100	11.139	13.695%
Rajasthan	1.055	10.940	16.029%
Sikkim	1.006	10.617	20.531%
Tamil Nadu	0.989	10.738	18.653%
Uttar Pradesh	1.005	10.933	15.959%
West Bengal	0.792	10.643	19.756%
INDIA	**0.992**	**10.858**	**16.948%**

Source: Gauri Kartini Shastry, data from National Family Health Survey conducted in 1998