

Indian Economic Growth, Development Accounting,  
and Health

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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 ( $A$ ):

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

## 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

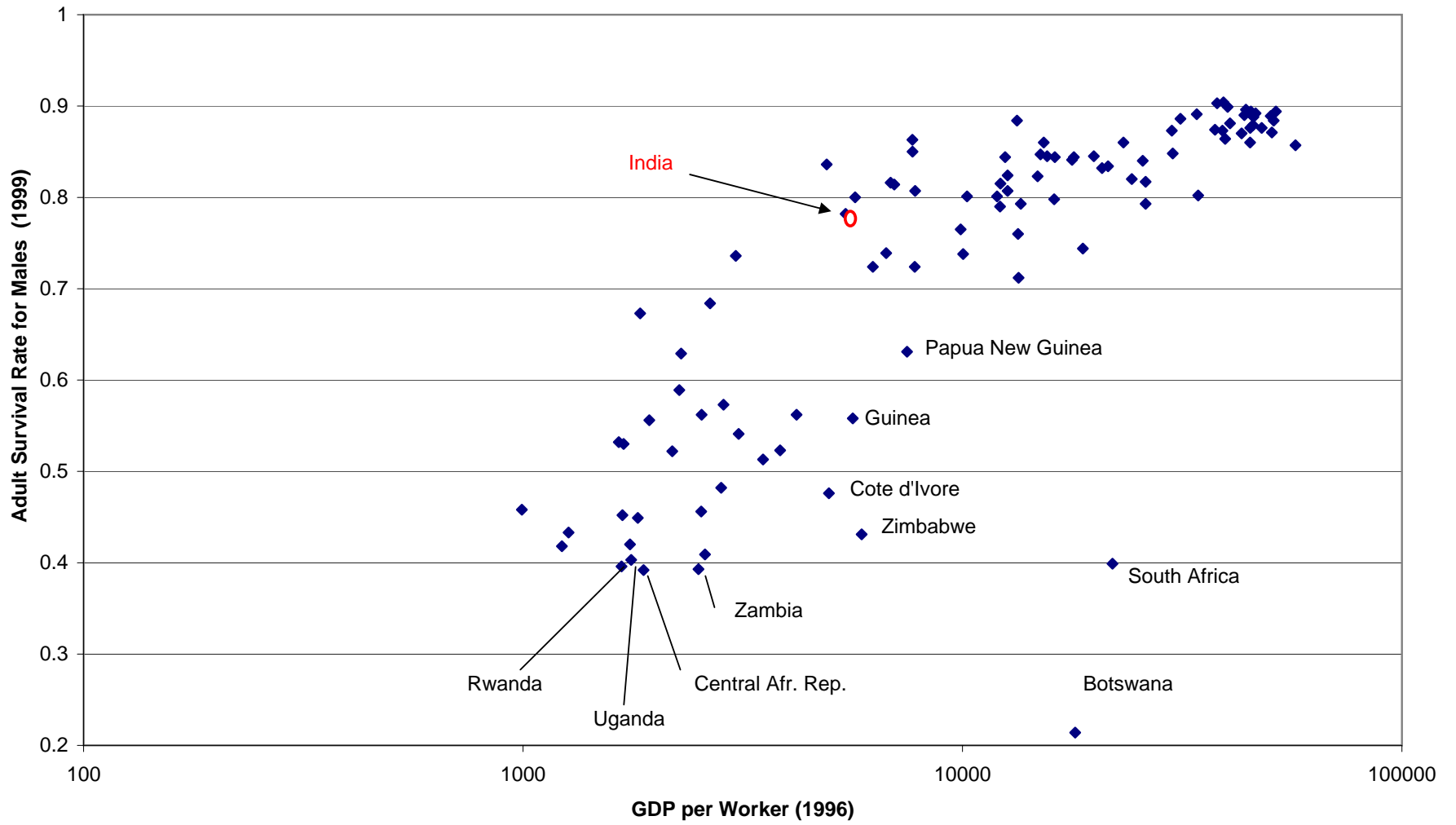
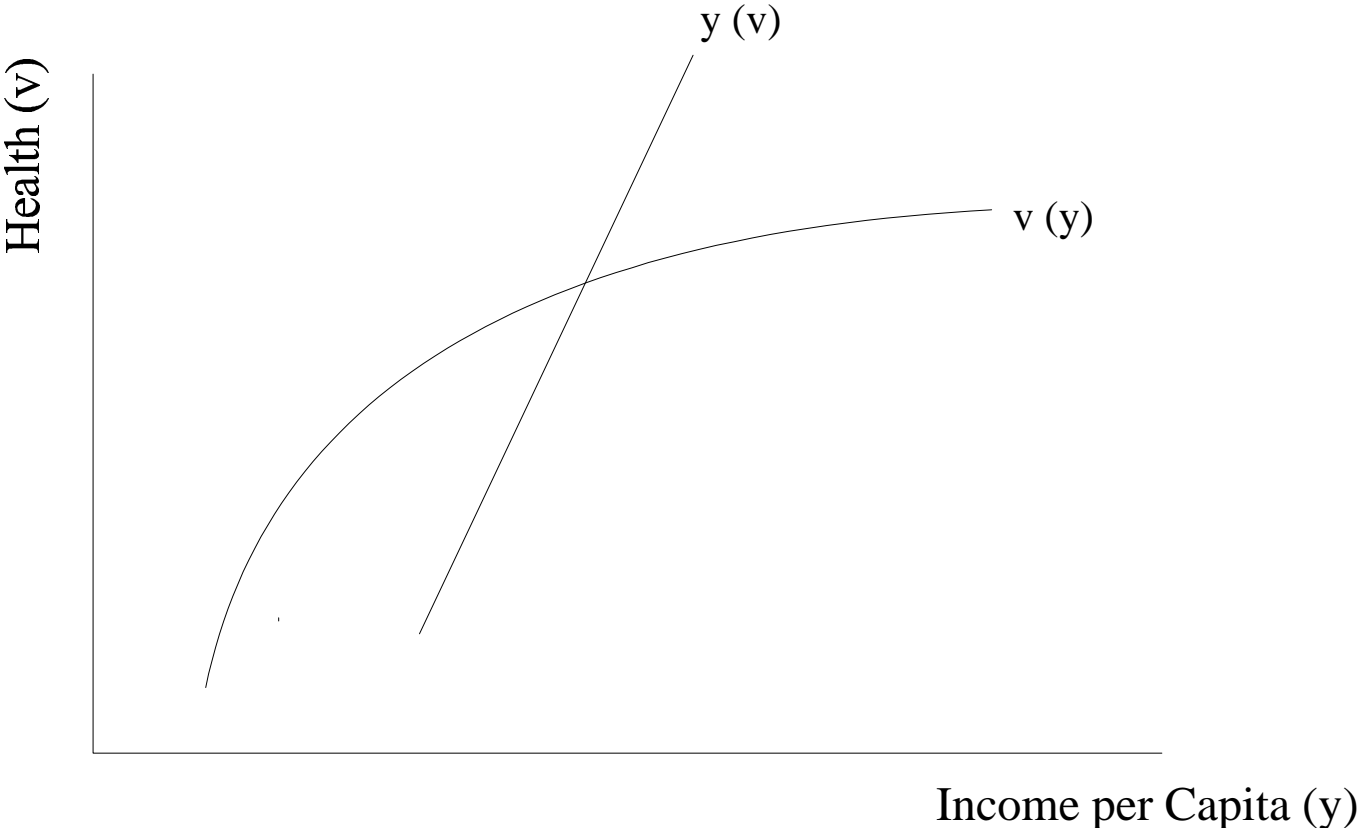


Figure 1

# The Relationship Between Health and Income



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

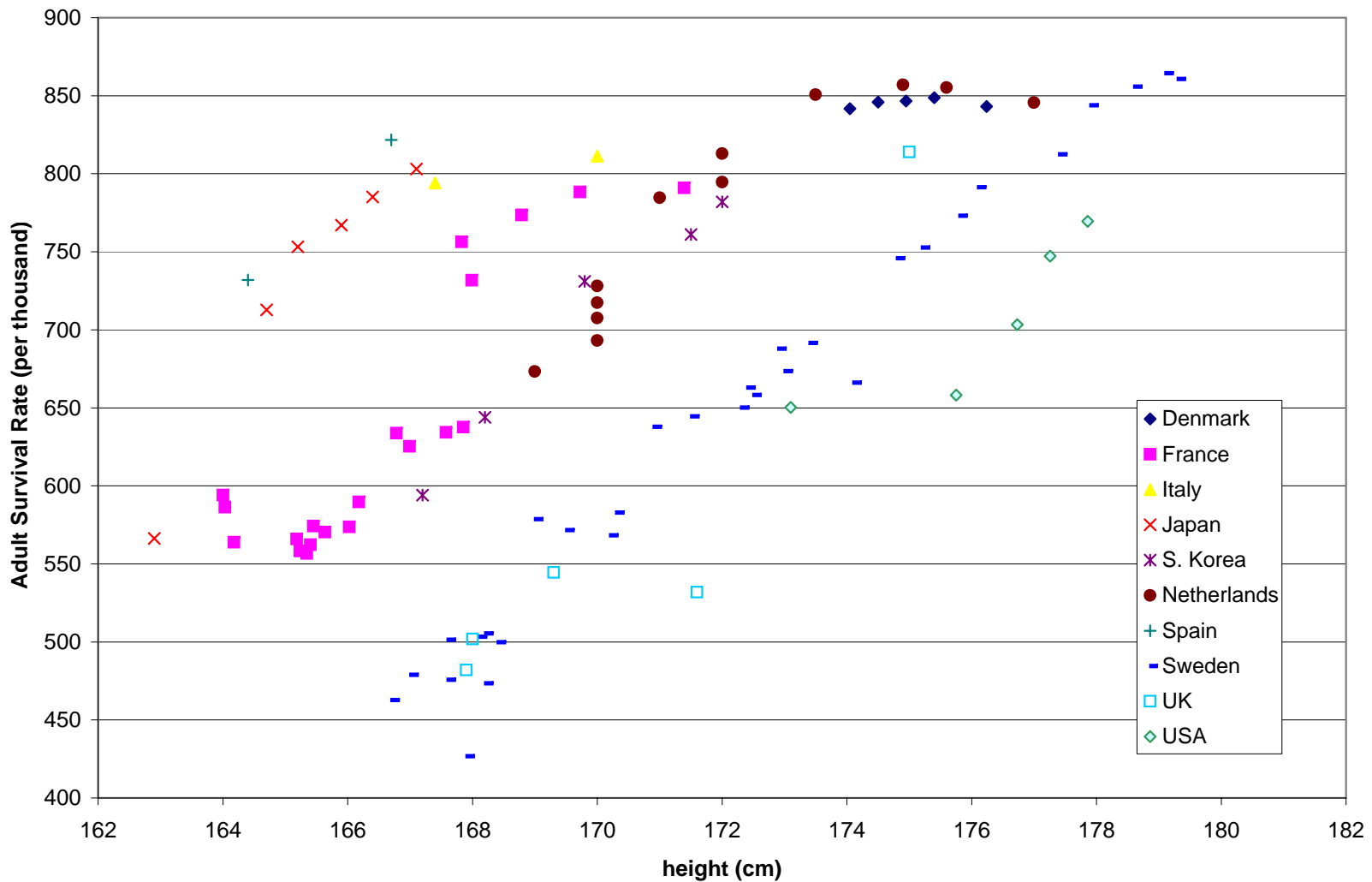
- Microeconomic studies of health and wages (Schultz *et al.*)
- Studies of identical twins with different birth weights (Behrman and Rosenzweig)
- Historical evidence on height and nutrition from Europe (Fogel)

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  $\approx 21\%$

Figure 4: Data on Height and Adult Survival



## 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:

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

Productivity Gap Not Accounting for Health Differences:

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

Productivity Gap Accounting for Health Differences:

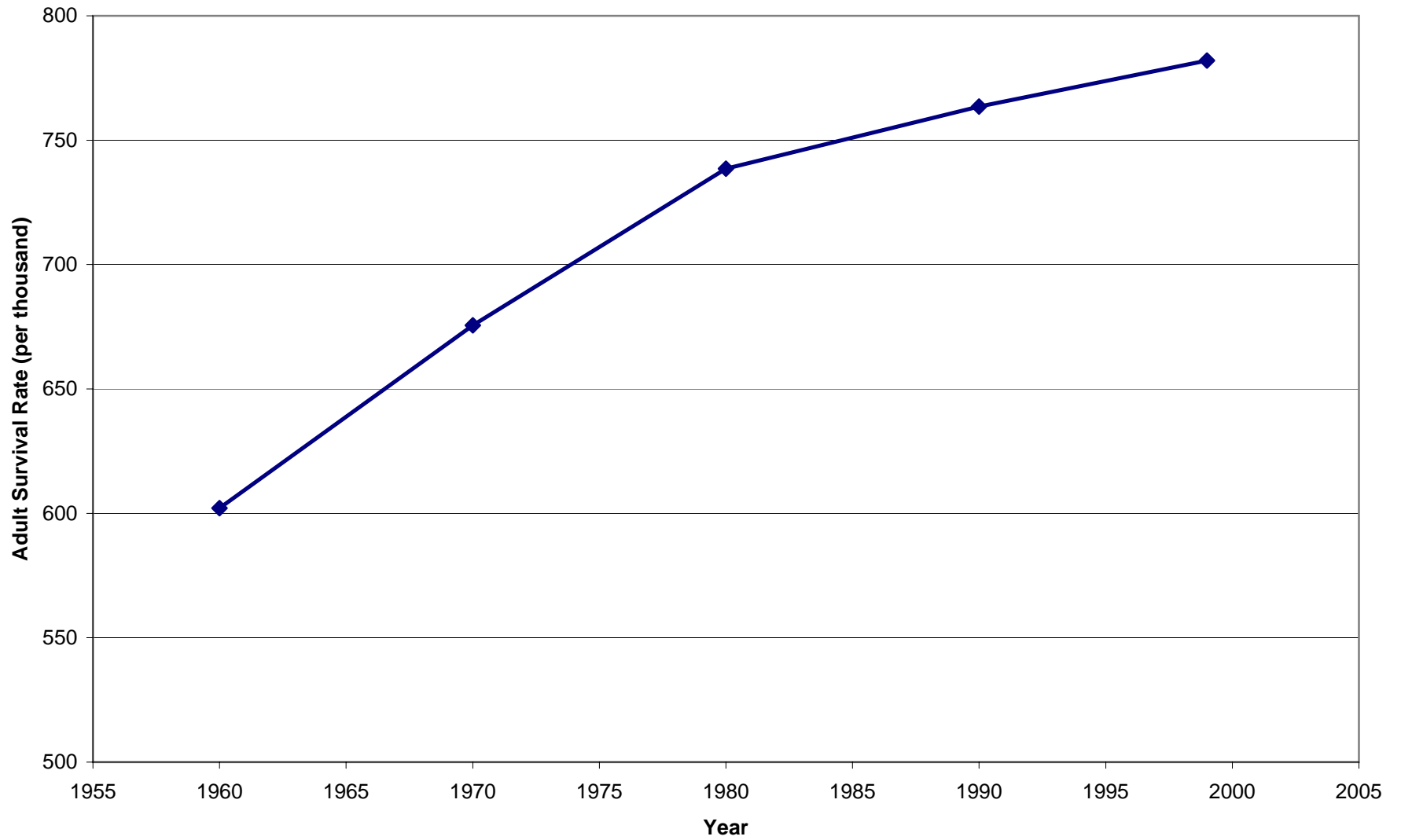
$$\frac{A_{India}}{A_{US}} = .386$$

## Cross-Country Variance Decomposition

Shares of Variation in $\ln(\text{Output per Worker})$ 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 $\ln(\text{GDP/Worker})$ from Eliminating Variance in Health		.366

Source: Weil (2005)

### Adult Survival Rate in India



## Annual Productivity Growth in India 1960-1999

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

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

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

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%
<b>INDIA</b>	<b>0.992</b>	<b>10.858</b>	<b>16.948%</b>

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