



Productivity Change in Health Services: An Empirical Analysis and Exploration of Institutional Determinants

Ravi P. Rannan-Eliya

Institute for Health Policy



Outline

Conceptual perspective

Empirical analysis

Scaling up experience

Conclusion

Perspective and Motivation

- Evidence and growing consensus that medical treatment is critical mechanism enabling lower mortality in developing countries post-1945
- Health MDGs require major expansions in the delivery of medical services to sick individuals
- Global estimates of required funding
 - US\$ 13 (WDR 93) \leftrightarrow US\$ 38 (CMH 02)
- Current levels of financing (public) US\$ 5-12
- Unlikely “financing gap” can be met solely by new funding

Perspective and Motivation

- All global estimates of the funding gap assume fixed productivity or technical efficiency
- Commission on Macroeconomics and Health
 - “Considerable technical inefficiency/variations observed in developing countries, but no evidence of change in technical efficiency in developing countries”
 - ... Ergo, productivity improvement cannot finance scaling up
- WHO Project to compile health service cost data - no analysis done for technical efficiency change
- General reluctance of funding agencies to acknowledge potential for efficiency savings - may undermine lobbying agenda?

Perspective and Motivation

But ...

- Productivity change has been a major resource enabling expansion of service provision in OECD health systems given budget constraints
- Efficiency savings routinely budgeted for in UK, Japan, Spain, etc.
- Well documented to occur in OECD nations, although not documented in developing economies
- Major topic of research in OECD countries, but almost never examined in developing economies, where fiscal constraints are tighter

Literature

- **Learning-by-doing hypothesis - provides expectation of productivity growth**
 - Learning-by-doing early explanation for unknown variance in growth models (Arrow, 1962)
 - Learning of organizational knowledge stored in routines, protocols, norms, methods of organization, etc
 - *A priori* expectation for medical services given complex nature of production
 - Learning-by-doing -> Cost of production ↓ \equiv Productivity improvement
 - Cost reduction enables societies to consume increased volumes of medical services (whose quality is improving) → Mortality ↓
- **Empirical evidence**
 - No previous literature on productivity change over time in developing countries - some evidence for OECD nations

Empirical Analysis

- To estimate long-term trends in productivity in developing country health systems (1901-2002)
- To develop appropriate methods and identify suitable data sources

Study Methodology

- Productivity measured using index approach
 - Econometric approaches not suitable for historical time-analysis; also problem with consistency of results
 - Index is inverse of unit costs
 - Non-quality adjusted (Quality = clinical efficaciousness)
 - Functionally similar to that recommended by Eurostat
- Index measure

$$\text{Cost index, } I_t = \frac{x_t \div Y_t}{\sum_{r=1}^2 z_{rt} w_r}$$

- X_t = Expenditure at time, t ; Y_t = GDP per capita at time, t
- Z_{rt} = Vector of outputs (inpatient + outpatient episodes)
- W_r = Cost weights for outputs

Data: Variables

- Restriction to public sector
 - For many countries >90% of inpatient modern care, and bulk of outpatient modern care prior to 1970s
- Variables
 - Annual number of outputs
 - ✧ inpatient admissions
 - ✧ outpatient visits/attendances
 - Expenditures
 - ✧ Expenditures at facility level
 - ✧ Total expenditures of health ministries
- Data sources
 - Archive collections in London, Cambridge and Harvard - Administrative reports of health departments, national statistical publications
 - Common datasets - Mitchell (2003), Maddison PPP database, WB WDI
 - Ad-hoc studies of cost shares + assumptions

Data: Countries

- Americas
 - Bahamas, Jamaica
- Europe
 - Cyprus, Malta (England & Wales, Scotland, Northern Ireland)
- Africa
 - Botswana, Kenya, Malawi, Mauritius, Seychelles, Somaliland, Sudan, Swaziland, Tanzania, Uganda
- Asia
 - Hong Kong, Malaysia, Singapore, Sri Lanka
- Middle East
 - Bahrain, Tunisia
- Oceania
 - Fiji, Tonga (Australia)

Data: Coverage

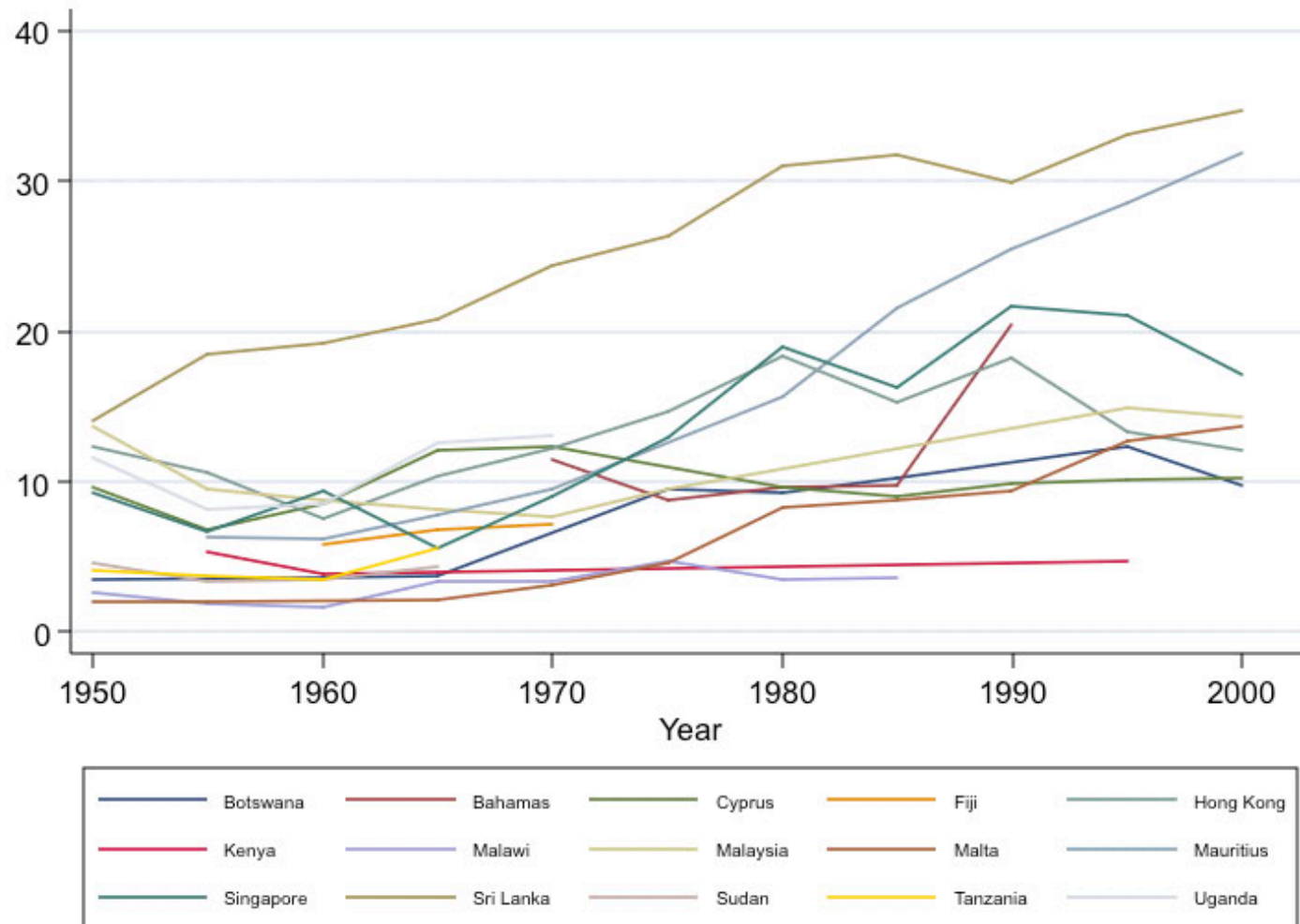
- Nominal productivity data
 - 23 countries
 - Time-span 1927-2002
- Final productivity data set smaller owing to lack of GDP data
 - 21 countries
 - Time span 1927-2002
 - 837 country-years
 - Predominantly ex-British Crown Colonies

Results

- Sustained productivity trends observed at country level
 - Rates of change typically sustained for 3-4 decades
 - Pattern consistent with incremental productivity growth through learning-by-doing
 - Range of -1.3% – +4.3% (mean 0.8%) during 1946-2002
 - 20% of sample have negative trends
 - Rest have zero or positive trends (up to 4.3%)
 - Distribution of results [-1.3% to +4.5%]
 - Normal distribution overlapping zero - common in firm studies
 - Mean=0.8% is substantial - implies halving of unit costs every 80 years or 16% reduction in costs between 1995 and 2015

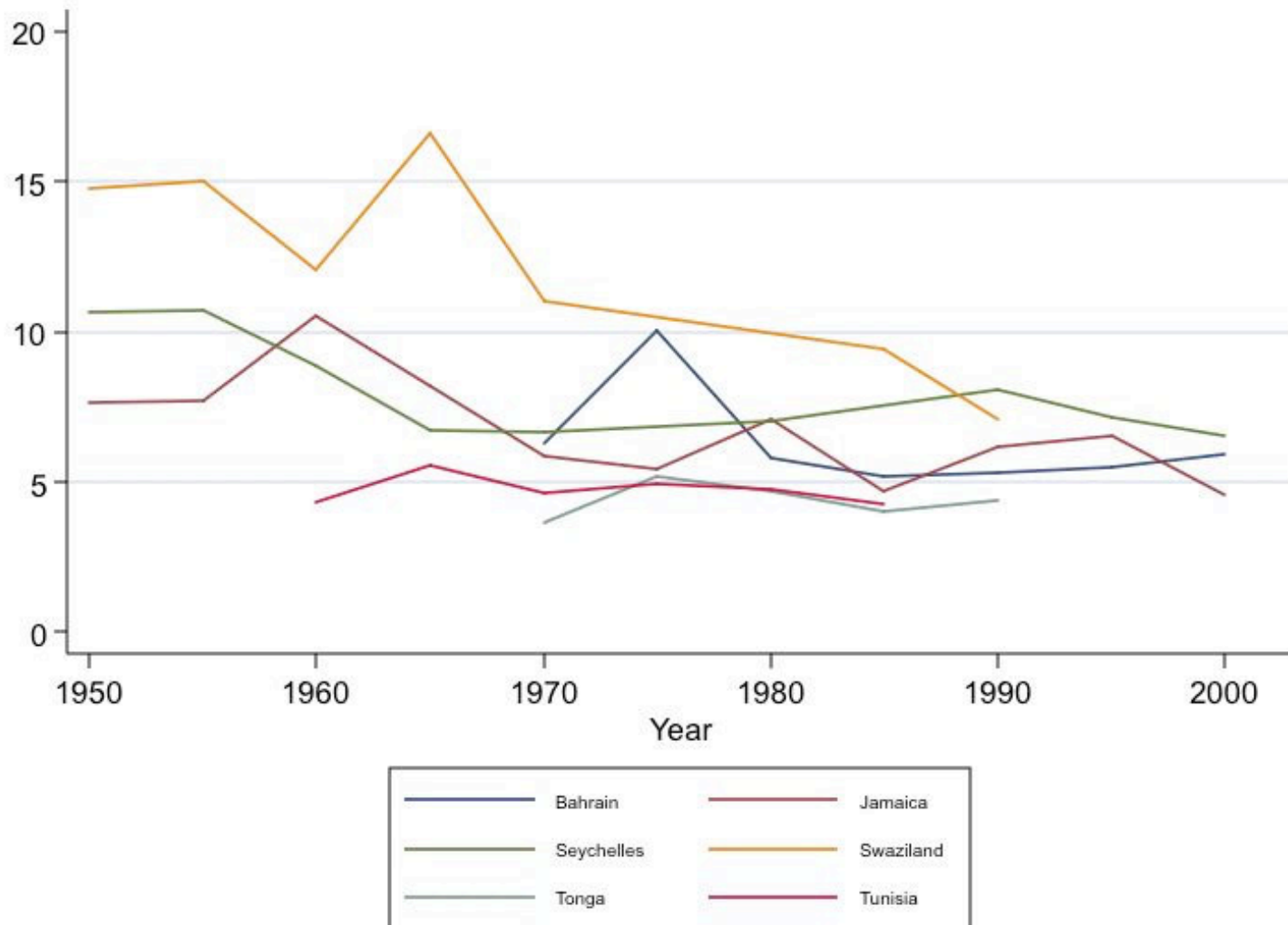
Productivity trends 1946-2002

Countries where trend was positive



Productivity trends 1946-2002

Countries where trend was negative

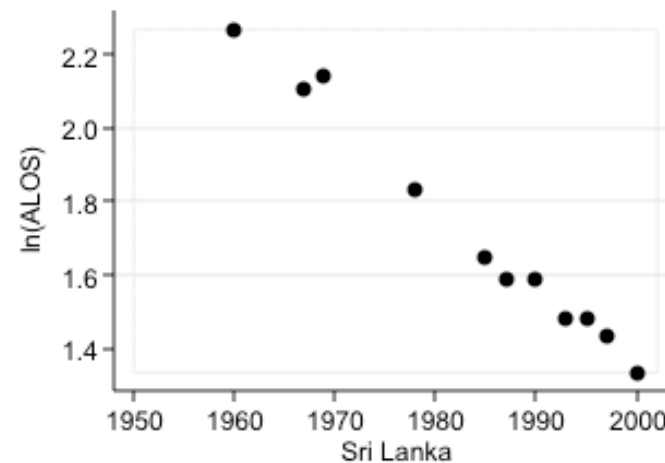
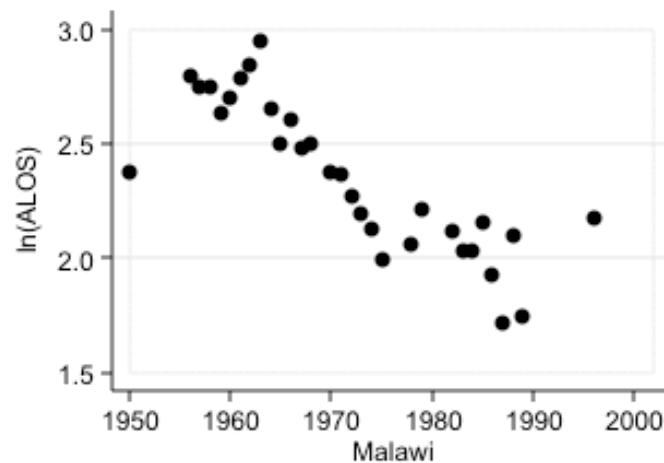
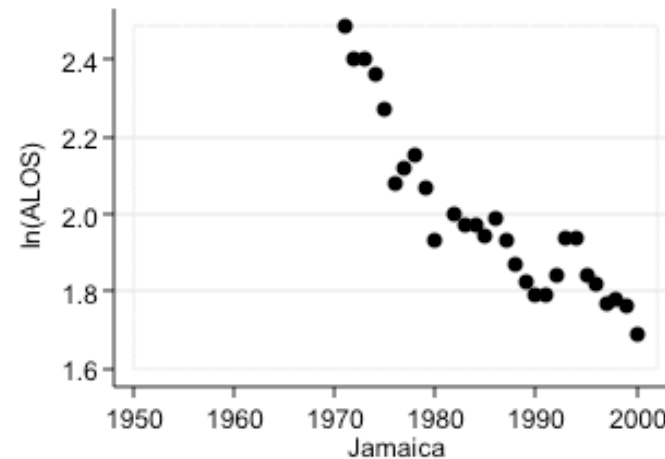
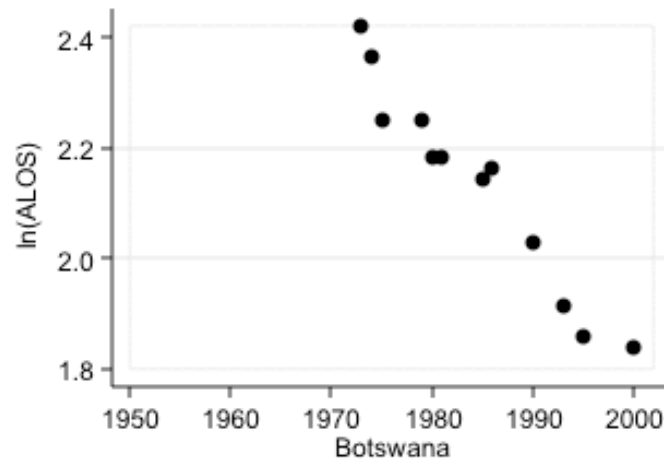


Results

- Indirect productivity indicators reinforce evidence of productivity improvement
 - Declining ALOS despite constant bed-occupancy rates
 - Increasing bed throughput rates
 - Declining case fatality rates (>1945)

ALOS 1950-2002

Trends in Log(ALOS) for selected countries



Problems

o Failure to adjust for quality

- Biases results downwards - clinical quality can be assumed to have increased

o Income per capita in index maybe confounder

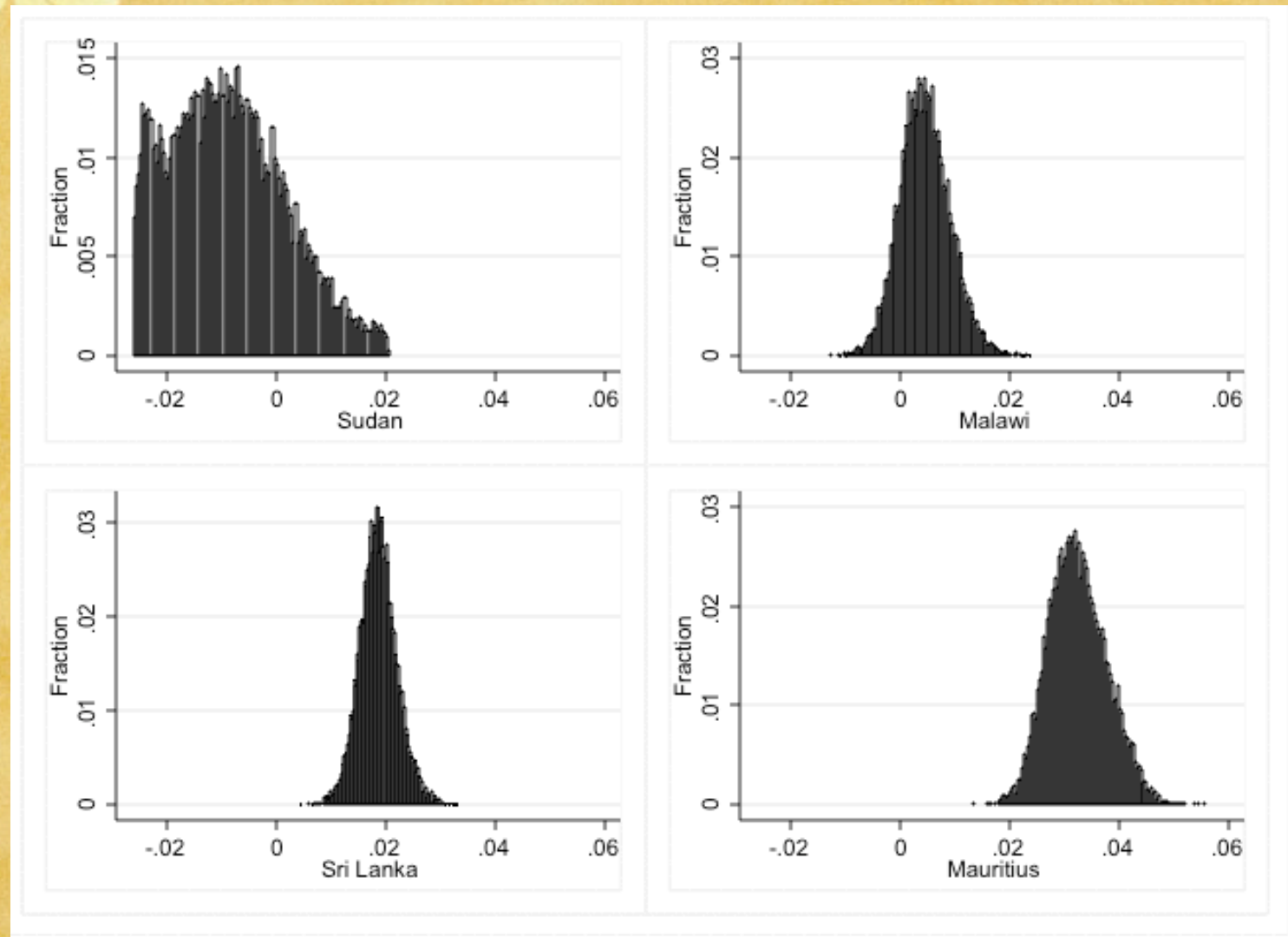
- Explains 76% of variance in cross-section (Adam & al, 2003)
 - ✎ Tested using random-effects model with time and per capita income as covariates: half of increase remains, coefficient on Y is 0.72

o Potential bias from assumptions about cost shares

- Facility share of budgets, Inpatient share of facility costs
 - ✎ Investigated by Monte Carlo analysis: Replaced shares by random-walks (100,000 trials)
 - ✎ Results robust in MC

Robustness of cost shares:

Simulated Monte Carlo estimates of productivity trends



Findings

- Evidence for substantial and sustained increases in productivity in many developing countries during mortality decline
 - Annual rates of change (0%-5%) comparable to those reported in OECD
 - Generalizability limited by nature of sample (Institutional history? - many were British Crown Colonies)
- Cost reduction associated with quality improvement:
 - Continuous reductions in ALOS, bed-turnover rates
 - Continuous reductions in case fatality rates
- Implications
 - Cannot assumed fixed unit costs in developing countries (typical CMH/Scaling-up assumption)
 - Cost-reduction significant enabler of expansion in services
 - No evidence that civil service-model, centralised health systems return poor productivity performances

Technical efficiency gains during scaling-up: Sri Lanka

Year	GDP (US\$ 1995 per capita)	IMR	Health spending (US\$ 1995 per capita)	Outputs (Out- patients)	Outputs (In- patients)
1948	255	92	4.3	1.1	0.09
1960	279	57	5.4	2.3	0.14
12 yrs	+9%	-38%	+ 25%	+110%	+55%

Contribution of increased spending = <25%

Contribution of technical efficiency gain = >75%

Technical efficiency gains during scaling-up: Botswana

Year	GDP (US\$ 1995 per capita)	IMR	Health spending (US\$ 1995 per capita)	Outputs (Out- patients)	Outputs (In- patients)
1960	287	118	5	0.4	3.1
1980	1,458	62	20	1.6	6.8
20 yrs	+408%	-48%	+ 315%	+300%	+119%

Contribution of increased spending = <0%

Contribution of technical efficiency change = >50%

Technical efficiency gains during scaling-up: Uganda

Year	GDP (US\$ 1995 per capita)	IMR	Health spending (US\$ 1995 per capita)	Outputs (Out- patients)	Outputs (In- patients)
1955	284	150	1.8	0.5	0.13
1969	344	112	3.7	1.2	0.40
14 yrs	+21%	-26%	+ 105%	+150%	+210%

Contribution of increased spending = <70%

Contribution of technical efficiency change = >30%

Conclusion

- Productivity change does occur in developing country health systems
- Productivity change is on average positive, and can be a major means of financing expansion
- Productivity change did play a substantial role in many countries scaling up
- Institutional factors appear to be important, but not in the manner often assumed
- Productivity change - understanding its determinants should be highest priority