National Technology Systems for Manufacturing in Sub-Saharan Africa

Sanjaya Lall, University of Oxford,
sanjaya.lall@economics.oxford.ac.uk

Carlo Pietrobelli, University of Rome III
c.pietrobelli@uniroma3.it

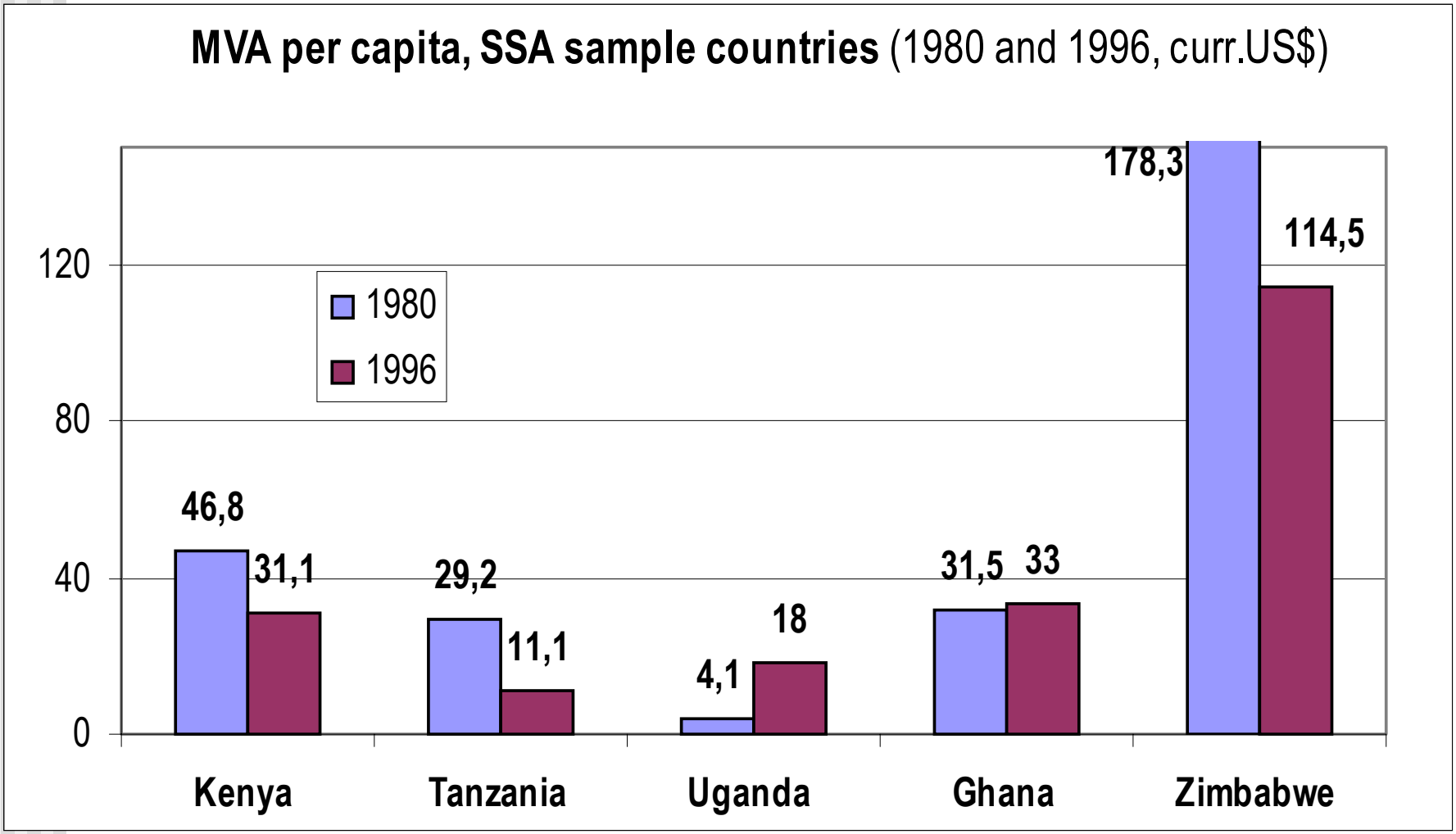
1st GLOBELICS Conference
INNOVATION SYSTEMS AND DEVELOPMENT STRATEGIES FOR THE THIRD MILLENIUM
Rio de Janeiro, 2-6 November 2003

Research questions:

Both a theoretical and empirical objective:

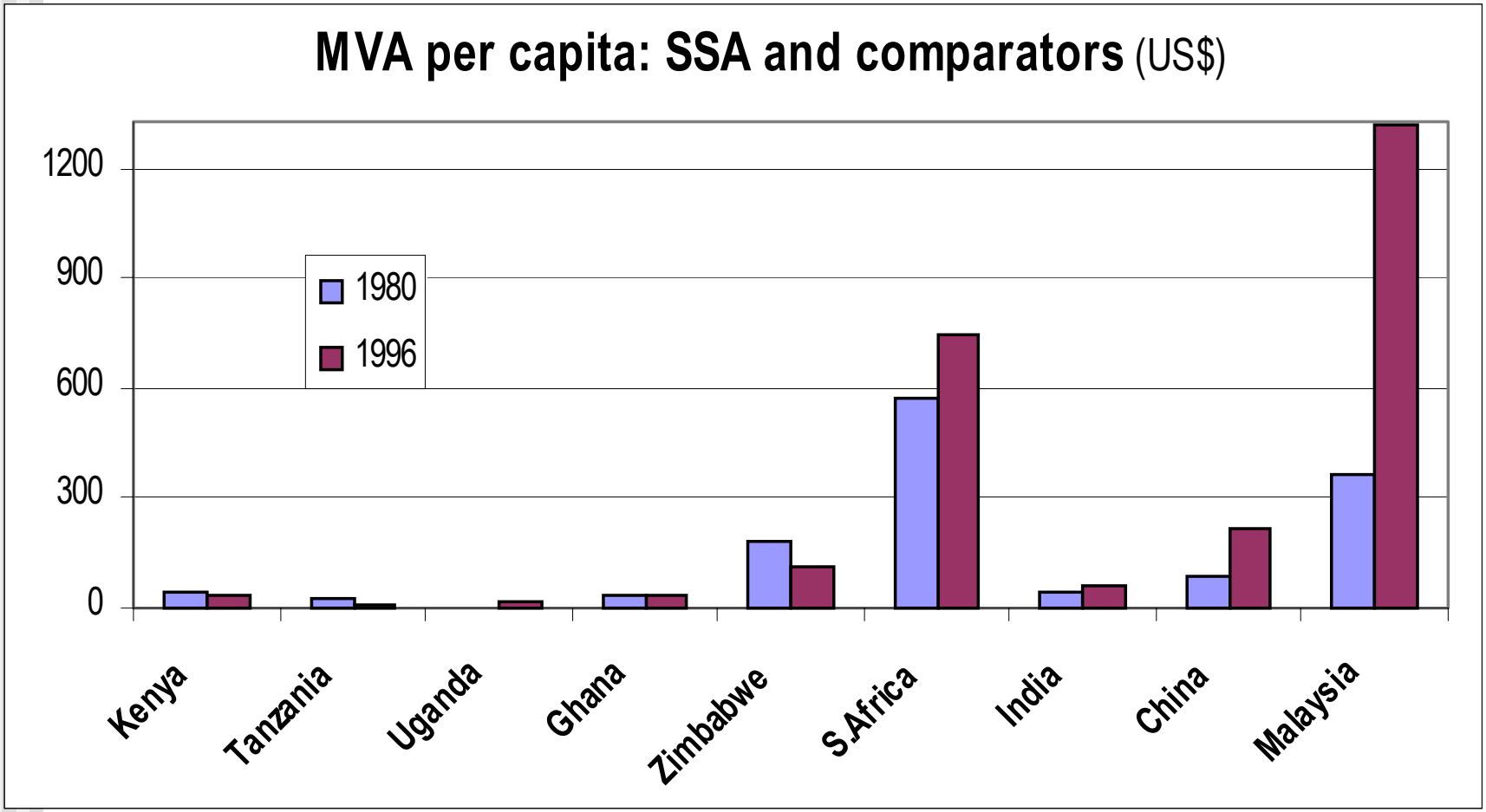
- **<u>Theoretically:</u> How useful is NIS literature for developing (African) countries? How to introduce a systemic approach in the study of these countries?**
- **<u>Empirically:</u> How to explain SSA poor manufacturing performance? May a systemic approach help?**

Manufacturing Performance



- **worsening manufacturing performance over time**

Manufacturing Performance

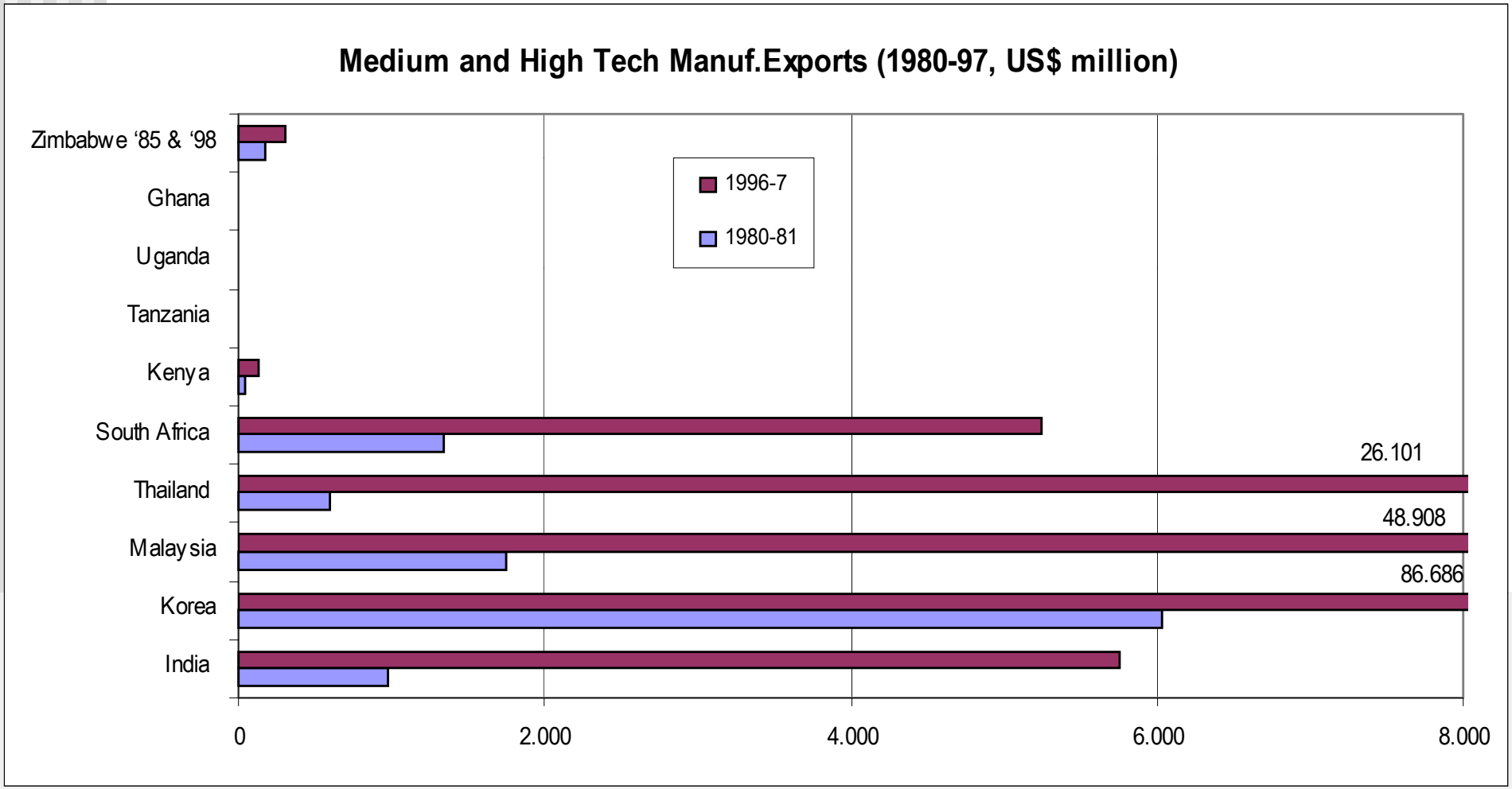


- **Worse <u>in comparative terms</u>:**

SSA vs. other developing countries

Worse Evolution in Manuf. Exports by Technology

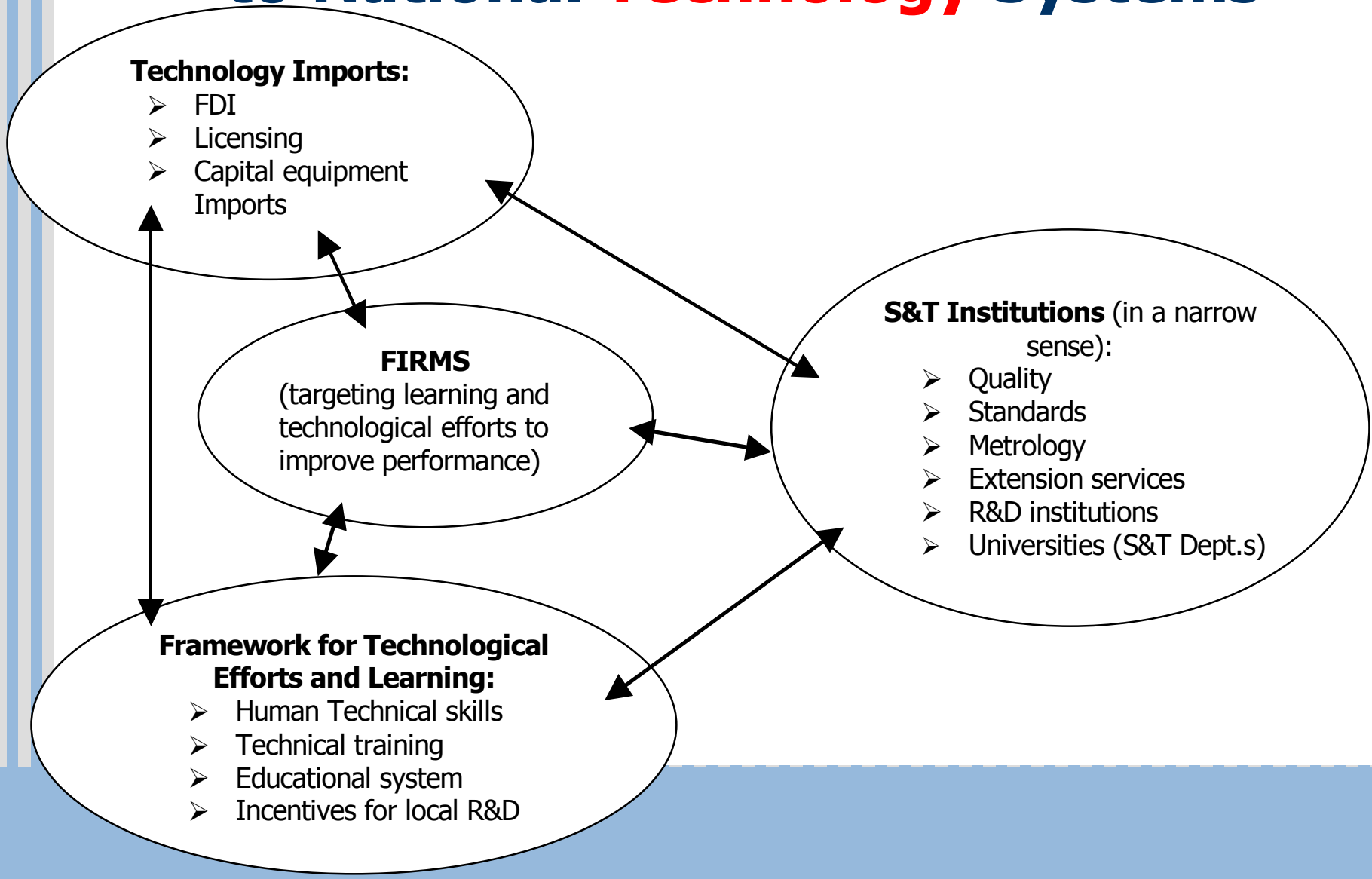
- SSA is not sharing the same trend towards trade in medium-high tech manufactures prevailing worldwide;
- Most manufacturing in SSA is technologically backward and local market-oriented;
- SSA has attracted less export-oriented FDI



A Conceptual Approach

- Idea that innovation occurs in a 'system' (i.e. interacting firms, organizations, research bodies, policy makers involved in technological activities);
- Central role of tacit knowledge, innovation uncertainty, and continuous interactions between agents;
- Most LDCs do not create new frontier technologies (i.e. do not have 'innovation systems')
- However, they do have **national systems** within which they **import, absorb, master, adapt and improve upon new technologies**;
- Such technological efforts are vital, and they have systemic elements;
- **Technology systems** in LDCs are more prone to failures

From National Innovation Systems to National Technology Systems



The Empirical Exercise

Technology systems in five Sub-Saharan African countries:

- **Ghana** and **Uganda** (the earliest liberalizers);
- **Zimbabwe** the most industrialized (before its recent problems);
- **Kenya** the next most industrialized in East Africa;
- **Tanzania** one of the weakest.

Field visits in 2000 and 2001, qualitative and quantitative analyses.

Access to Foreign Technology

many informal ways of importing technology: copying, reverse-engineering, migration, trade fairs, technical journals, …. Hard to measure;

We choose to focus on (easier to measure):

- **Imports of capital equipment**
- **Technology Licensing agreements**
- **Foreign Direct Investments (FDI)**

Equipment Imports (by technology)

- SSA relies on Equipment Imports more than on other sources of access to foreign technology;
- Yet only India at similar (low) levels;
- Other developing countries import much more.

Equipment Imports, US$ per capita, 1998

	Machinery imports	Electronics imports	Total equipment imports
Kenya	23.8	12.2	35.9
Tanzania	8.0	2.6	10.5
Uganda	2.6	0.5	3.0
Ghana	18.4	4.9	23.3
Zimbabwe	16.9	6.3	23.2
South Africa	444.0	394.8	838.8
India	4.9	2.4	7.3
China	20.1	22.9	43.0
South Korea	171.9	299.2	471.1
Malaysia	461.9	1160.8	1622.7
Thailand	142.7	151.7	294.4

Foreign Direct Investment

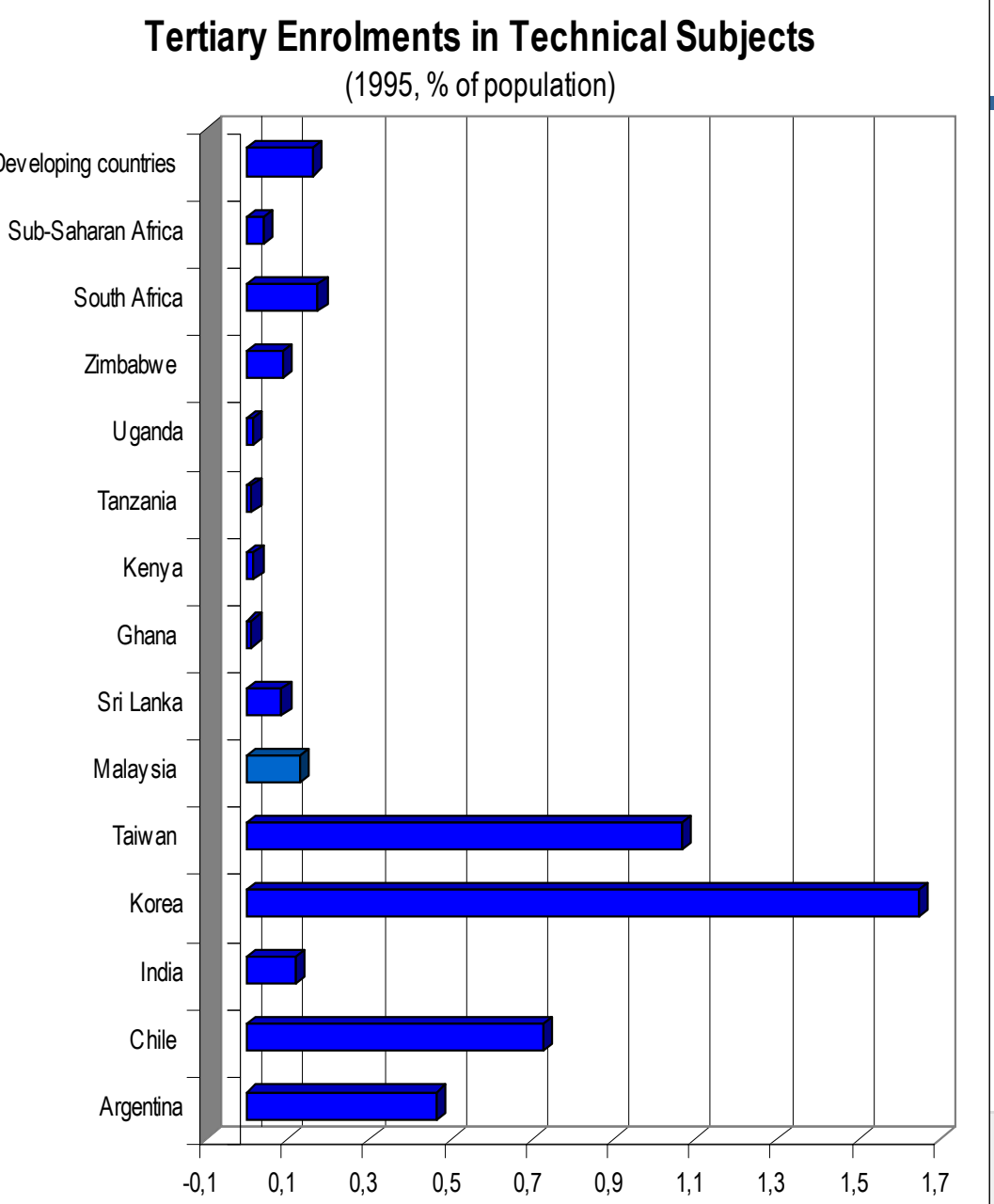
- A gradual increase in inflows into SSA, but the region's share remains very small;
- FDI concentrated in few resource-rich countries (Angola, Nigeria, South Africa)
- very little inflows in the manufacturing sector imply **little technology inflows**;

FDI Inflows (1988-2001)
(% of World Inflows)

	1988-93	2001
Sub-Saharan Africa	1.1	1.6
Latin America & Caribb.	6.9	11.6
South and East Asia	14.2	12.8

Foreign Technology Licensing

- SSA (excluding South Africa) paid US$84 million in 1997 for imported technology (1.5 % of the amount spent by the developing world)
- Kenya = US$39 million, South Africa = US$258 million;
- In the same year, Thailand spent US$813 million, India US$150 million and China US$543 million;
- **Licensing is clearly not a major channel of foreign technology inflow into SSA**



Framework for Technological Efforts and Learning: Skills

- **Technical skills** for industry (natural sciences, maths, engineering)
- **Dispersion is wider for technical subjects** than for general enrolments;
- 3 countries account for 44% of all developing countries' tech.enrol.s (China, India, Korea)
- 10 countries account for 76% of all developing c.s
- SSA has 12% of dev.ing c.s population but 3.1% of tech.tertiary enrolments

Technological Efforts

- Much effort is informal, yet only formal efforts could be measured
- R&D useful also in developing countries to adopt, master, adapt (Cohen and Levinthal)
- Micro studies provided evidence of scarce additional informal, firm-level efforts (tried with ISO)

R&D and S&ENG. (latest year available)

	S&ENG. in R&D per mill. pop.	R&D (% of GNP)	% performed in productive sector	% financed in productive sector
Developing countries	514	0.39	13.7	10.5
SSA (exc. S Africa)	83	0.28	0.0	0.6
Latin America & Carib	339	0.45	18.2	9.0
Mature NICs	2 121	1.50	50.1	51.2
New NICs	121	0.20	27.7	38.7

S&T institutions in SSA

……. The essential 'public goods' of technological efforts:

- **Metrology, Standards, Testing and Quality**
  - Standards as technical specifications and rules;
  - Increasingly demanded in world trade;
  - Reduce transactions costs, asymmetries, uncertainties;
  - Metrology provides measurement accuracy and calibration to apply standards
  - Contribute to diffusion of technology
- **R&D Institutions**

Institutions for Metrology, Standards, Testing and Quality (MSTQ)

- Ghana Standards Board (GSB)
- Standards Association of Zimbabwe (SAZ)
- Kenya Bureau of Standards (KEBS)
- Tanzania Bureau of Standards
- Uganda National Bureau of Standards (UNBS)

R&D Institutions

- **The largest and most active public R&D institutions in most African countries are involved in agriculture rather than manufacturing.**
- **Analysed in details:**
  - **Uganda's National Agricultural Research Organisation**
  - **Ghana's Food Research Institute**
  - **Uganda's Industrial Research Institute, a regional East African Community project in the 1970s**
  - **Tanzania's Industrial Research and Development Organisation**
  - **Kenya's Industrial Research and Development Institute**
  - **Ghana's Industrial Research Institute**

Summing up on S&T Institutions

Frequent features:

- **lack human and physical facilities;**
- **personnel with poor motivations and wages;**
- **little contacts – and little credibility – with productive sector;**
- **this also reflects technological *apathy* in much of local industry: firms do not demand technology, they are not active and aware of their technological needs;**
- **Little *systemic interaction* among them;**
- **Little relations with *educational institutions*.**

Conclusions and Policy Implications

- Despite liberalization and structural adjustment, manufacturing sector performance is disappointing;
- The analysis of the inadequacies of the technology system have often been neglected by literature on Africa;
- Need to strengthen the elements of the system and their interactions;

Two policy priorities:

1. Strengthen technology strategy formulation

- S&T policy only exists on paper, with low governments' priority, and
- both governments and industry lack a *technology culture*, do not appreciate its importance;

2. Coordinate and plan the technology system

- policy formulation is uncoordinated and spread over different bodies, often too weak to coordinate efforts.

Thank you!!

sanjaya.lall@economics.oxford.ac.uk

c.pietrobelli@uniroma3.it