How far is Africa from the World Technology Frontier? Closing the South-South Technology Gap

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Great strides over the last decade……

- Six of the world's ten fastest growing economies of the past decade are in sub-Saharan Africa.

- Many countries have enjoyed growth in income per person of more than 5% a year since 2007.

- Many of the countries whose well-being has improved most in the past five years are in Africa.

but, a rocky road still lies ahead

- While the opportunities for development are important, several African economies remain fragile and suffering from underdeveloped infrastructure, and limited diversification of their productive structure.
- Poverty rates and inequality in many African countries remain unacceptably high.
- Africa is the only continent where per capita food production has declined over the past 30 years and where unemployment rates remain extremely high.

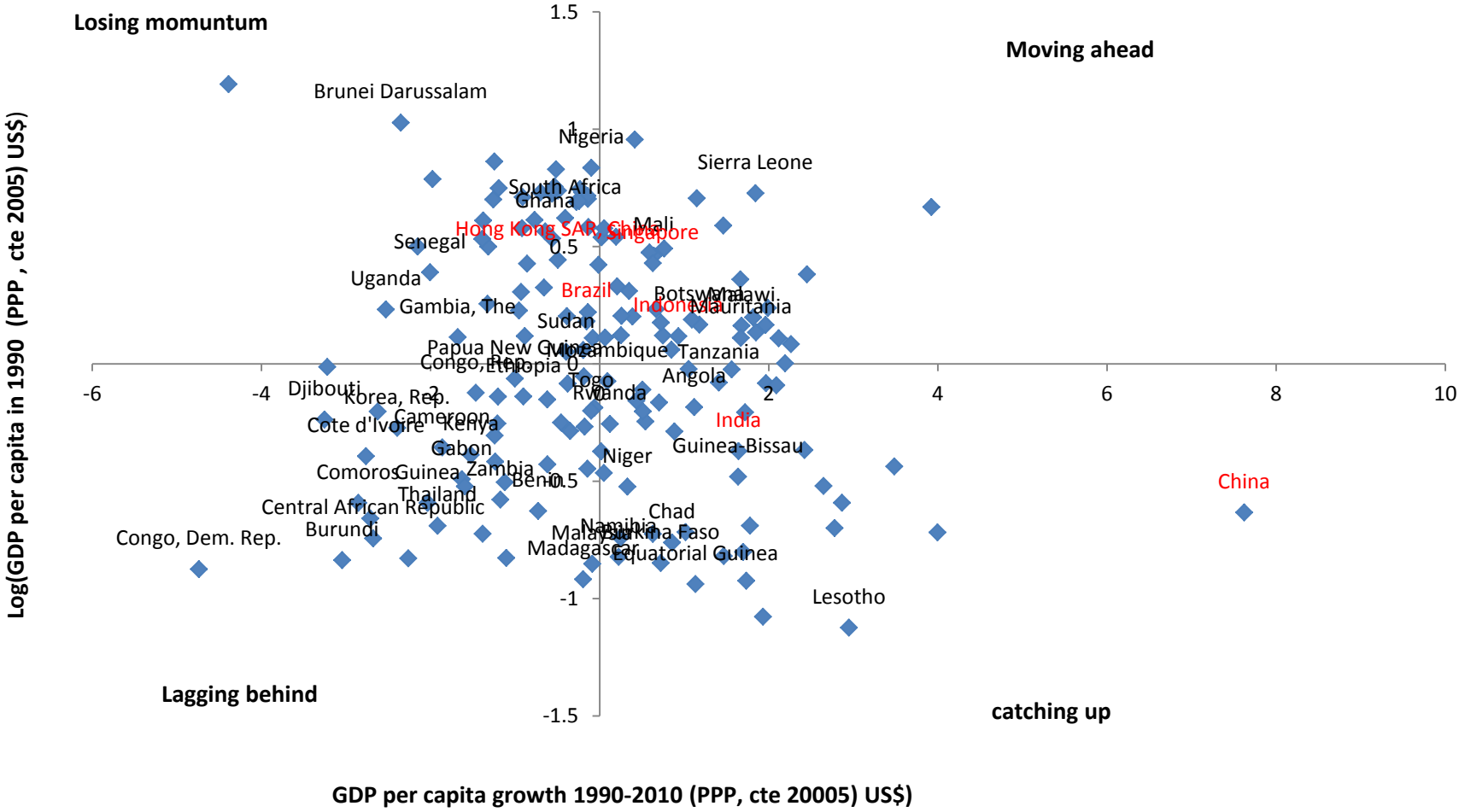
Main Questions

1. **Why do some countries succeed in catching up, while Africa falls behind?**

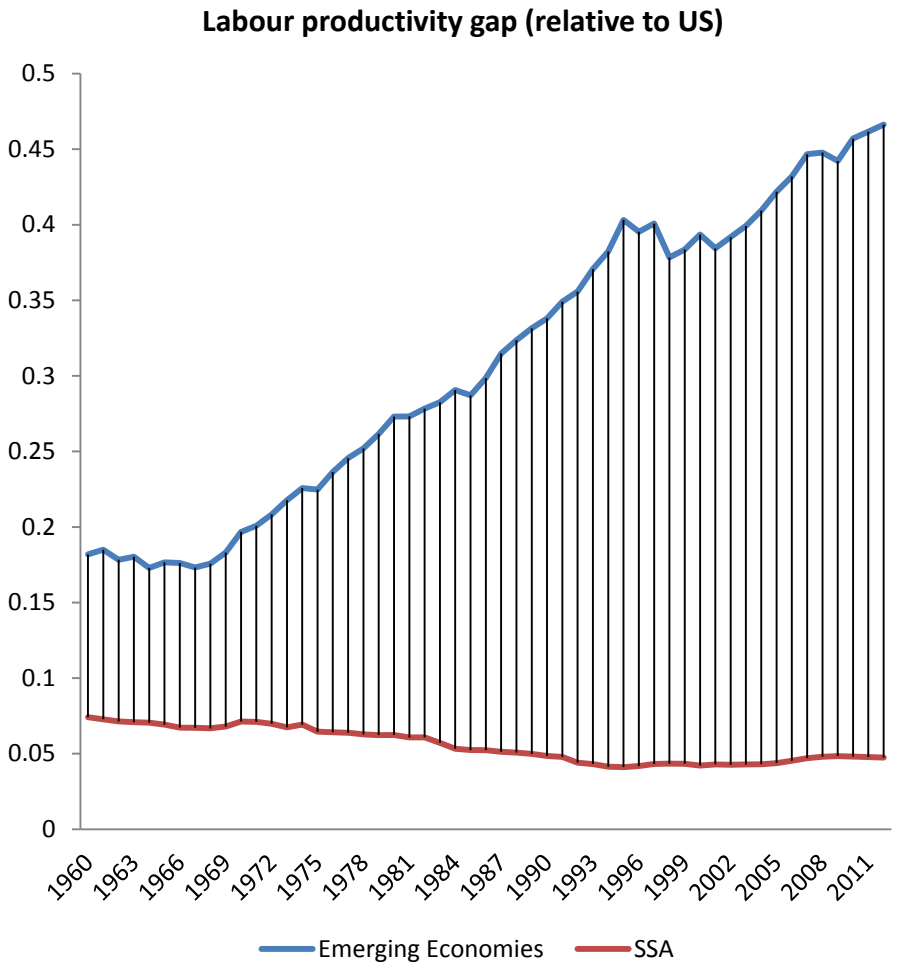
2. **What critical factors for catch-up are?**

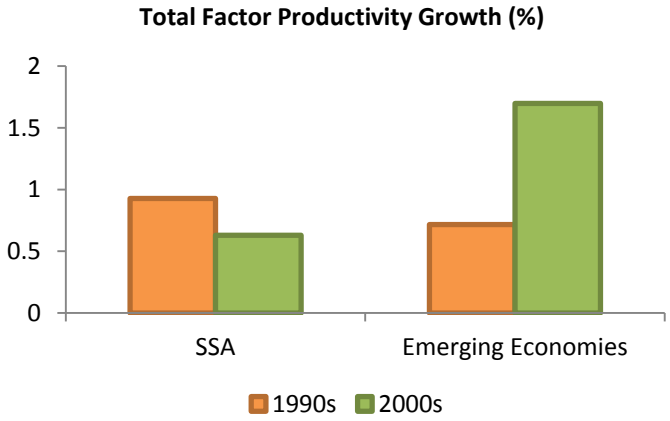
Convergence in GDP per capita over 1990-2010

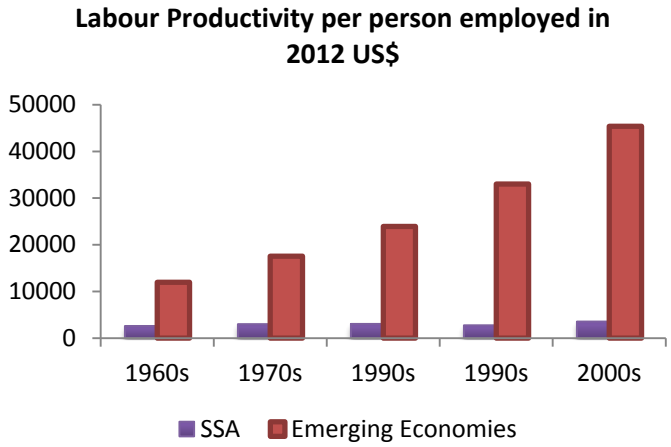
- Due to good performance during the last two decades some African have moved closer to the frontier.
- But, there are still many African countries in the group that falls behind.
- The nature of African growth, with its dependence on mineral and mining sectors means that growth has not necessarily contributed to a reduction in inequality.



Africa lags behind emerging economies in productivity.







Labour productivity relative to Emerging Economies

1960s	1970s	1990s	1990s	2000s
21%	**17%**	**12%**	**8%**	**8%**

Levels of output and input per capita and productivity (U.S. = 100 in 2000).

Group Summaries	Output per capita			Input per capita			Productivity		
	2000	2005	2009	2000	2005	2009	2000	2005	2009
World	20.66	23.11	25.09	46.98	48.47	51.59	43.98	47.67	48.64
G7	85.039	90.59	90.18	92.25	94.95	96.46	92.19	95.41	93.49
Developing Asia	7.2017	9.54	12.67	25.00	28.73	35.13	28.80	33.21	36.06
Non-G7	71.74	77.43	79.14	84.15	90.95	96.15	85.25	85.13	82.31
Latin America	21.373	22.97	25.04	33.52	36.16	40.96	63.77	63.52	61.13
Eastern Europe	19.269	25.75	29.60	36.04	37.08	40.25	53.47	69.44	73.55
Sub-Sahara Africa	4.3387	4.84	5.32	15.74	16.85	18.73	27.56	28.72	28.37
N. Africa & M. East	15.317	17.56	19.07	28.53	31.28	34.45	53.69	56.12	55.37

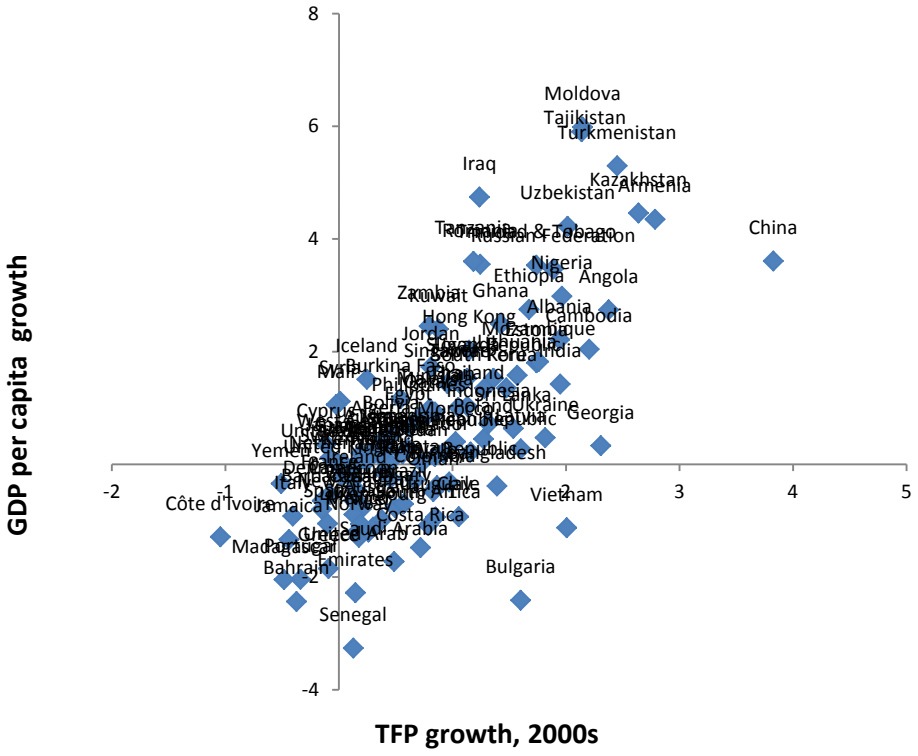
Source: Table 3 of Jorgenson and Vu (2011), JPM.

	Period 1989-1995				Period 2000-2004			
	GDP Growth	Capital Input	Labour input	TFP	GDP growth	Capital Input	Labour Input	TFP
World	2.34	1.34	0.7	0.29	3.25	1.35	0.68	1.22
SSA	1.8	0.52	2.56	-1.28	4.22	1.55	1.8	0.88
MENA	4.03	00.95	2.61	0.47	4.4	1.1	1.74	1.56

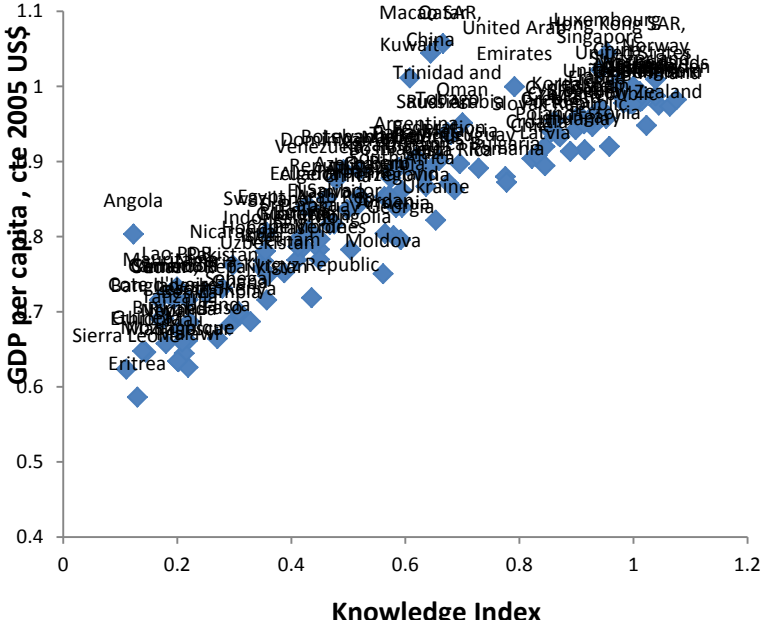
Literature: Main drivers of catching-up

1. Capital accumulation
2. Institutional conditions
3. Knowledge/Human Development
4. Social capital/Infrastructural Bottlenecks

Growth Variations and TFP Gaps



Very high correlation between the level of GDP per capita and TFP growth



Very high correlation between the level of income and the level of knowledge

Africa is not investing enough in knowledge

Regional totals for R&D Expenditure (GERD) 2002 and 2009

	GERD (in billions PPP$)		% world GERD		GERD as % of GDP		GERD per capita (in PPP$)	
	2002	2009	2002	2009	2002	2009	2002	2009
World	**787.7**	**1,276.9**	**100.0%**	**100.0%**	**1.70%**	**1.77%**	**125.5**	**187.3**
Developed countries	650.0	931.5	82.5%	72.9%	2.22%	2.32%	543.0	756.6
Developing countries	136.4	343.3	17.3%	26.9%	0.83%	1.11%	31.1	71.9
Least developed	1.3	2.1	0.2%	0.2%	0.22%	0.20%	1.8	2.6
Americas	**319.2**	**457.5**	**40.5%**	**35.8%**	**2.08%**	**2.13%**	**372.9**	**494.6**
North America	297.2	417.5	37.7%	32.7%	2.57%	2.72%	929.5	1,222.9
Latin America and the	22.0	40.0	2.8%	3.1%	0.59%	0.66%	41.0	68.6
Europe	**236.4**	**363.4**	**30.0%**	**28.5%**	**1.66%**	**1.76%**	**297.7**	**448.7**
European Union	205.7	300.3	26.1%	23.5%	1.76%	1.92%	424.5	602.2
Commonwealth of	16.9	37.0	2.1%	2.9%	1.18%	1.19%	81.6	183.2
Central, Eastern and	13.7	26.1	1.7%	2.0%	1.19%	1.36%	134.7	238.9
Africa	**7.0**	**11.8**	**0.9%**	**0.9%**	**0.42%**	**0.41%**	**8.2**	**11.8**
South Africa	2.3	4.7	0.3%	0.4%	0.73%	0.93%	50.6	95.5
Other Sub-Saharan	1.9	3.4	0.2%	0.3%	0.30%	0.29%	3.1	4.6
Arab States in Africa	2.5	3.7	0.3%	0.3%	0.36%	0.31%	13.6	17.7
Asia	**214.0**	**421.8**	**27.2%**	**33.0%**	**1.48%**	**1.62%**	**57.1**	**104.2**
Japan	108.2	137.1	13.7%	10.7%	3.17%	3.36%	858.1	1,083.5
China	39.2	154.1	5.0%	12.1%	1.07%	1.70%	30.5	115.5
Israel	7.1	8.8	0.9%	0.7%	4.59%	4.27%	1,138.0	1,211.2
India	13.3	...	1.7%	...	0.74%	...	12.2	...
Commonwealth of	0.5	1.0	0.1%	0.1%	0.25%	0.23%	7.0	13.4
Newly Industrialised	39.7	78.7	5.0%	6.2%	1.44%	1.83%	98.3	178.8
Arab States in Asia	1.2	2.3	0.1%	0.2%	0.13%	0.14%	11.4	17.9
Other in Asia (excl.	4.8	11.0	0.6%	0.9%	0.31%	0.42%	7.2	15.2
Oceania	**11.2**	**22.4**	**1.4%**	**1.8%**	**1.66%**	**2.20%**	**350.5**	**622.4**

Source: UNESCO Institute for Statistics (UIS) estimations, October 2011.

Business environment is not favorable for innovation and knowledge diffusion

Global Competitive Index and some pillars for regions (2012-13)

	Institutions	Technological adoption	Innovation and sophistication factors	Efficiency enhancers	Basic requirements	GCI
			Values			
Regions according to Stages of Development						
Advanced Economies (average)	4.95	5.58	4.79	4.97	5.46	5.02
Asian Tigers (average)	5.15	5.77	5.01	5.36	5.95	5.37
Developing Asia (average)	3.87	4.65	3.60	4.02	4.42	4.18
Emerging and Developing Economies (average)	3.75	4.54	3.37	3.81	4.23	3.94
Middle East and North Africa (average)	4.20	4.77	3.55	3.95	4.71	4.22
Sub-Saharan Africa (average)	3.74	4.34	3.19	3.46	3.73	3.58

Source: Global Competitiveness Report 2012-13. Tables, Data Platform

Africa is still lagging behind in Human Development

Human Development Index and its Components

	Human Development Index (HDI)	Life expectancy at birth	Mean years of schooling	Expected years of schooling	Gross National Income (GNI) per capita	Non-income HDI
	Value	(years)	(years)	(years)	(Constant 2005 PPP$)	Value
	2011	2011	2011	2011	2011	2011
Regions						
East Asia and the Pacific	**0.671**	**72.4**	**7.2**	**11.7**	**6,466**	**0.709**
Europe and Central Asia	**0.751**	**71.3**	**9.7**	**13.4**	**12,004**	**0.785**
Latin America and the Caribbean	**0.731**	**74.4**	**7.8**	**13.6**	**10,119**	**0.767**
South Asia	**0.548**	**65.9**	**4.6**	**9.8**	**3,435**	**0.569**
Sub-Saharan Africa	**0.463**	**54.4**	**4.5**	**9.2**	**1,966**	**0.467**
World	**0.682**	**69.8**	**7.4**	**11.3**	**10,082**	**0.683**

Source: Adapted from Table 1, Human Development Report 2011, The UN

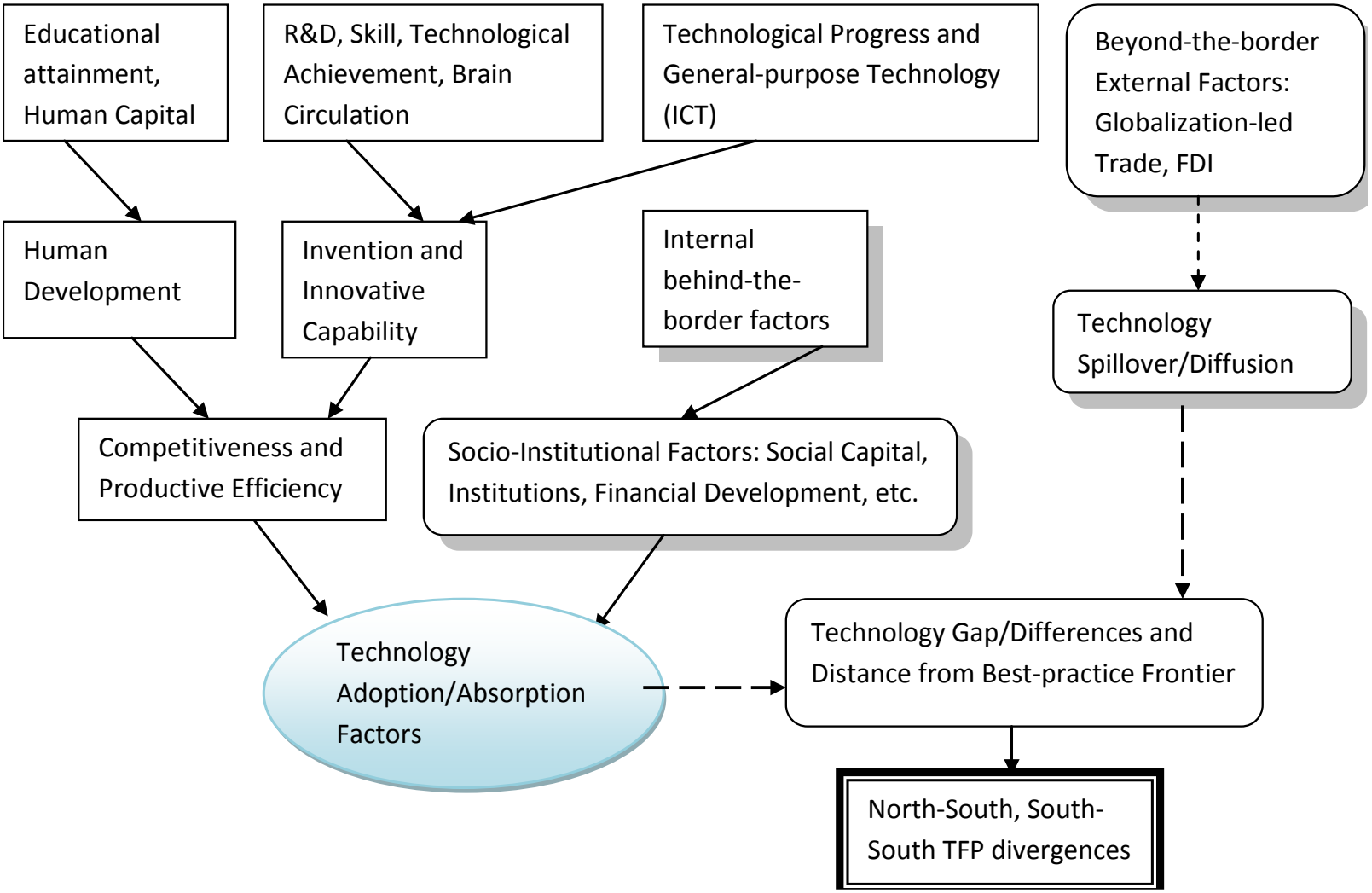
African countries' knowledge position is not on line with the level of economic development

	KEI		Economic Incentive		Innovation		Education		ICT	
	recent	2000	recent	2000	recent	2000	recent	2000	recent	2000
East Asia and the Pacific	5.32	5.79	5.75	6.06	7.43	7.43	3.94	3.68	4.14	5.98
Latin America	5.15	5.54	4.66	5.14	5.8	6.14	5.11	5.07	5.02	5.8
MENA	4.74	5.16	5.41	5.41	6.14	6.44	3.48	3.8	3.92	4.97
SSA	2.55	3.04	2.91	3.13	3.95	3.95	1.44	1.7	1.9	3.36
World	5.12	5.95	5.45	5.61	7.72	7.75	3.72	3.89	3.58	6.53

Source: WB

Conceptual Framework

Principal pathways underlying mechanism behind distance from technological frontier



Model Specification

The general model to be estimated is defined as follows :

$$Technology\_Gap_{it} = \alpha_i + \beta_1 X_{it} + \epsilon_{it}$$

Technology gap: Measured using meta-frontier approach

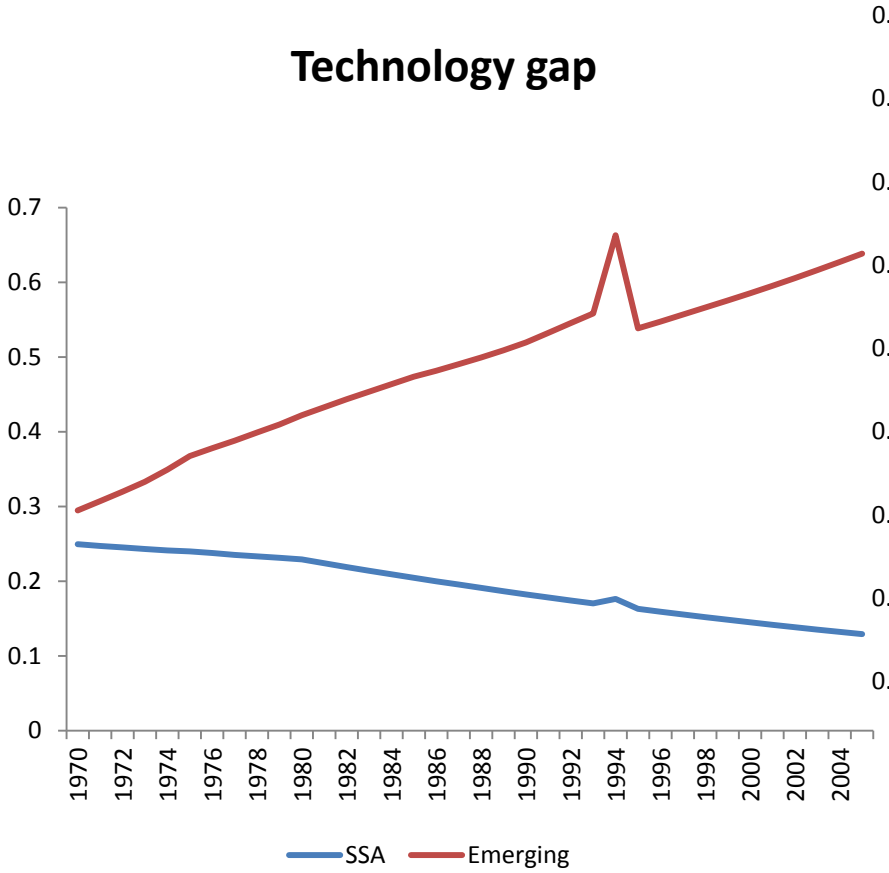
X_{it} includes:

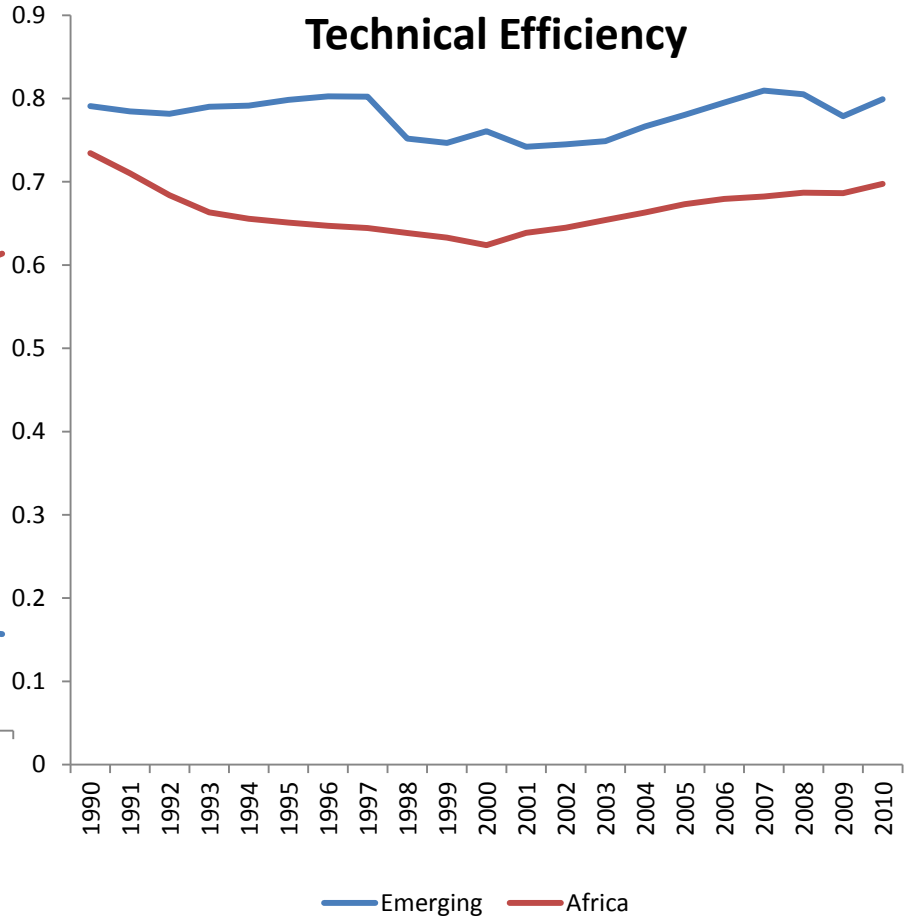
- An indicator of human development (health, education, demography).
- An indicator of financial development.
- An indicator of liberalization.
- An indicator of the quality of business environment.
- An indicator of the quality of infrastructure.
- An indicator of knowledge.

1. **Emerging dynamic South** : Brazil, South Korea, Singapore, Taiwan, South Africa, India, and China.

2. **Advance Economies:** OECD countries

3. **African Economies:** Angola, Burkina Faso, Cameroon, Côte d'Ivoire, DR Congo, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mali, Mozambique, Niger, Nigeria, Senegal, Sudan, Tanzania, Uganda, Zambia, Zimbabwe.





The increasing technology gap relative to the global technology suggests that the capacity of the region to absorb the new technology is very limited and that the region still lacks of real engines for economic growth.

Main causes of technology gap in Africa

Dependent variable : Technology Gap Ratio		Model 1	Model 2
Infrastructure Quality		0.095 (0.013)	0.11 (0.018)
Human Development		0.221 (0.056)	0.22 (0.05)
Business Environment		0.038 (0.005)	0.03 (0.02)
Trade		0.04 (0.02)	0.038 (0.006)
Knowledge		0.006 (0.003)	0.004 (0.001)
Africa/Emerging Economies	**Infrastructure Gap**		-0.07 (0.03)
	Human Development Gap		-0.061 (0.02)
	Business environment Gap		-0.01 (0.0017)
L1.techgap		0.81 (0.032)	0.82 (0.034)

- Knowledge capabilities backed by good infrastructure, human development, openness, and favorable business environment are essential to succeed in catching up.
- Africa's poor infrastructure and lack of human development are the most significant barriers to technology catch-up.

Conclusion

- Growing external demand for Africa's exports and growing internal demand combined with high potential in agriculture and renewable energy provide Africa with a unique opportunity to become a global growth pole over the next decade.

- However, African countries cannot expect an improvement in economic performance unless they succeed to improve their ability to acquire and adapt to new technologies.

- The development processes in the region is distorted and essential reforms are needed if these are to remain viable in the global economy.

- An effective reform approach in African countries can be based on the following actions: building market institutions, developing political institutions, ameliorating the investment climate, strengthening the rule of law and combating corruption. The African countries have also to encourage the private sector to improve youth employment, develop the financial sector which is shown to be very important in increasing the economic efficiency.