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Dependence on Primary Commodities and Poverty Traps in Sub-Saharan Africa:

Devising strategies and building capabilities for diversification

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DEPENDENCE ON PRIMARY COMMODITIES AND POVERTY TRAPS IN SUB-SAHARAN AFRICA

Devising strategies and building capabilities for diversification

Alexis Habiyaremye[1]

Abstract

This paper analyses the poverty traps problem of Sub-Saharan African (SSA) countries and their dependence on a few primary export commodities in their trade relationships with the rest of the world. We argue that traditional approaches to development and industrialization have failed to take account of the necessity of building appropriate technological capability for SSA countries to acquire, master and effectively apply modern technologies. Taking lessons from the failure of these traditional approaches, we place the national systems of innovation (NSI) approach and the adequate technological capability building (TCB) at the source of economic diversification needed to reduce dependence on primary commodities and disentangle poverty traps in SSA countries.

Keywords: Poverty traps, capability building, systems of innovation for development
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1. INTRODUCTION

One of the most recurrent issues in economic debates is explaining growth and income differences between economies. Income and wealth distribution around the world has shown large and persistent disparities that are still only partially explained by existing economic theories. The increasing trend of global trade and cross-border capital flows of the last decades has once again unveiled and confirmed the marginalization of Sub-Saharan Africa (SSA) in the world economy. This growing globalization is perceived by many to spread the benefits of free trade and to facilitate technology transfer that will eventually contribute to reducing poverty in large parts of the developing world. However, it is also increasingly seen by some observers to carry and disseminate the domination of the neo-classical economics in the realm of international policy making and to fail to take account of the particular circumstances in developing countries.

This dominance is incarnated *inter alia* by the stringent policy recommendations based on the neoclassical orthodoxy that are invariably tied to loan agreements between developing countries and international financial institutions, namely the International Monetary Fund (IMF) and the World Bank. Confronted with debt crisis and forced to invoke the help of international financial institutions during the 1980s, many SSA countries have often been forced to dismantle their institutions and regulatory bodies in order to meet the ideal forms conveyed by the neo-classical vision of markets and public policy. In this regard, Stein (1999) explains how the structural adjustment measures based on such a vision have eroded the results of years of development efforts in a number of SSA countries. After analyzing the impact of the IMF adjustment programs on Science and technology in 4 SSA countries, Enos (1995) also found the structural adjustment programs to shift research and development efforts only towards areas of greater interest for foreign donors at the expense of areas of interest to indigenous development.

The problem of extreme poverty in SSA, where more than 75% of the population live on less than US$2 a day and a third of the population suffers undernourishment (see figures 1A and 1B), has been a subject of continuous debates among the aid donors in developed countries and international financial institutions. From the early1960s onwards, when most of SSA countries regained their independence, bilateral and multilateral aid programs have been set up at various periods to help alleviate the poverty in Africa. However, despite all achievements of aid and assistance programs the unavoidable constatation is that anno 2004, SSA is still tightly caught in a poverty trap from which decades of development aid, technical assistance and structural adjustment programs(SAP) have failed to liberate it (see Muchie, 2005).

People living on less than $1 a day

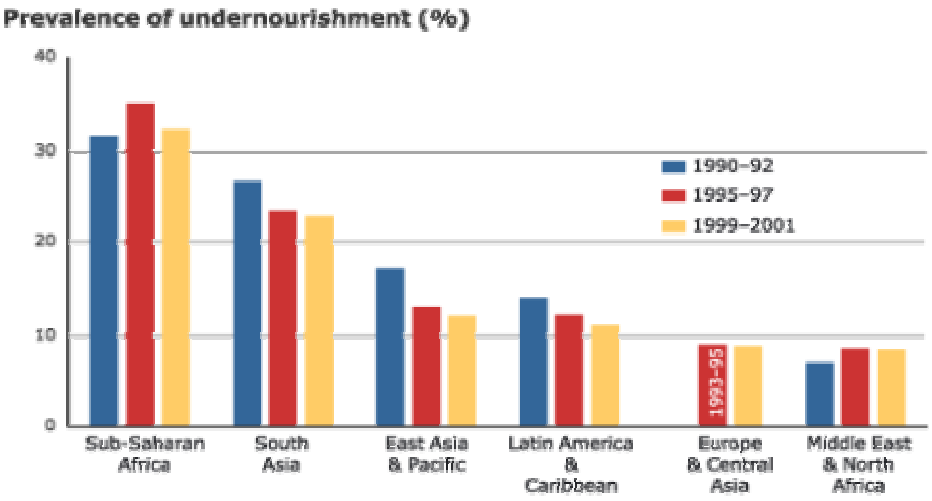
	millions		%	
	1990	**2001**	**1990**	**2001**
East Asia and Pacific	472	284	29.6	15.6
China	377	212	33.0	16.6
Europe and Central Asia	2	18	0.5	3.7
Latin America and Caribbean	49	50	11.3	9.5
Middle East and North Africa	6	7	1.6	2.4
South Asia	462	428	40.1	31.1
Sub-Saharan Africa	227	314	44.6	46.5
Total	**1,219**	**1,101**	**27.9**	**21.3**

People living on less than $2 a day

	millions		%	
	1990	**2001**	**1990**	**2001**
East Asia and Pacific	1,116	868	69.9	47.6
China	830	596	72.6	46.7
Europe and Central Asia	58	94	12.3	19.7
Latin America and Caribbean	125	128	28.4	24.5
Middle East and North Africa	51	70	21.4	23.2
South Asia	958	1,059	85.5	76.9
Sub-Saharan Africa	382	514	75.0	76.3
Total	**2,689**	**2,733**	**61.6**	**52.8**

Source: World Bank data

Figure 1A: African poverty in figures



Source: FAO 2003, *The State of Food Insecurity in the World*

Fig 1B: African poverty in relative terms

In addition to the direct devastating effects that poverty exerts on the SSA population, poverty in Africa goes often hand in hand with unequal income distribution and has therefore pernicious effects on the growth potential of these economies. Indeed, debates related to the issue of

reverse causation between growth and poverty brought to light the negative effects of income inequality on economic growth. For example, Clark (1995) analysed the impact of income inequality on growth performance and found a strong evidence of a negative correlation between inequality and growth. In a different context, Persson and Tabellini (1994) also show that inequality is harmful to growth. While poverty reduction is difficult to imagine in a country where no economic growth is taking place, reducing poverty has potential positive effects on economic growth through its reduction of inequality.

This paper analyses some of the symptoms of poverty in SSA countries and reviews the traditional approaches to responding to the African poverty problems on the basis of the conventional wisdom inspired by the neo-classical doctrine. Following Feinson (2003), it argues that for a complete understanding of the SSA problems macroeconomic theories alone are not a sufficient tool. Drawing on the growing literature on National Systems of Innovation (NSI), it stresses the necessity of initiating appropriate innovation policies in SSA countries.

The NSIs are complexes of regulations, institutions, human capital and government programs involved in the process of linking science and technology to economy (Feinson., 2003). Freeman (1987) defines NSI as "networks of institutions in the public and private sector whose activities and interactions initiate, import modify and diffuse new technologies". The most crucial new insight brought in by the use of NSI as a framework is the realization that linear approaches to technology, and specific tactics or regulations will not be sufficient to bring a developing nation to a technological track. In the NSI approach, countries must invest to build an integrated capacity for innovation that allows for considerable flexibility in how a variety of policy tools are wielded and measure successes of the whole NSI (Feinson, 2003).

Our purpose is thus to propose the NSI approach as a supplement and an alternative framework to addressing and analyzing African poverty problems. The paper places the national systems of innovation and adequate technological capability building (TCB) at the centre of growth promotion and poverty reduction analysis and investigates TCB's effect on innovation and economic diversification in SSA countries.

The next section discusses some of the structural symptoms of poverty traps and the problems caused by dependence on primary commodities. Section 3 reviews the role of technology adoption in laying the foundations of long-term growth and poverty reduction. Section 4 presents the NSI as an alternative framework to analyse and address the SSA poverty problem. The paper ends with some considerations on capability building and provides some policy relevant conclusions.

2. SOME OF THE STRUCTURAL SYMPTOMS OF THE SSA POVERTY TRAPS

2.1 Marginalisation from the world economy

African countries have not benefited from the tremendous expansion of world economy and increased productivity of the post-WWII period in various parts of the world. During this period, many SSA's economies have been performing poorly for many decades without significantly affecting the good performance of other world regions. SSA seems therefore to be almost disconnected from the global economy when it comes to growth. Even its insignificant share in world trade has been declining since the mid-1960s. While African trade constituted between 4.1 and 4.9 of world trade in the period 1960-1965, its value had declined to 2,3% of world trade in 1987(UNCTAD, 1993). Africa's exports went similarly from 4.7% to 2.0% of world exports between 1975 and 1990. All of this happened while the world exports were growing at 2.5 percent per annum (UNCTAD, 1993).

The decline was even worse for the least developed countries in SSA with their share of 0.6% declining to 0.2% over the same period (Wangwe, 1995). This drastic decrease of the SSA presence in world trade was not only the result of the deterioration of the terms of trades(due to low income elasticity of demand) in primary commodities on which Africa is mainly dependant, but also of the loss of competitiveness in manufactures. SSA manufactured exports, which are a tiny fraction even when compared only to other developing countries, showed an equally steep decrease. Their share went from 5.2% of developing countries exports in 1975 to 2.5% in 1990. The share of Africa as a whole in world exports has declined from 7.3% in 1948 to a low 1.5% in 2001(ADB, 2004). This is another illustration of how SSA has increasingly been marginalised in the world economy.

2.2. Declining terms of trade and dependence on primary commodities

Since mid-1980s, a substantial fall in the world prices of principal primary commodities and raw materials has led to a serious deterioration of the terms of trade of most SSA countries. The income loss from falling terms of trade of SSA countries constitutes undoubtedly the largest single mechanism through which real economic resources are transferred from poor to developed countries. A report of the secretariat of the United Nation Conference on Environment and Development (UNCED) in 1991 showed that for SSA, a 28% fall in terms of trade between 1980 and 1989 led to an income loss of $16 billion in 1989 alone. In the four

years 1986-1989, Sub-Saharan Africa suffered $56 billion income loss, or 15-16% of GDP in 1987-1989. Data from the UNCTAD reveal that this deterioration had still not reversed in 2003.

The world trading system has proved to be disadvantageous to countries whose main participation in the global trade has been the export of raw material and primary commodities while importing finished products. In the 1990, the general level of commodities price fell even more, leaving SSA and other commodity dependent countries with a permanent deterioration of terms of trade (Khor, 2000). Although primary commodity prices recovered somewhat in the early 2000s the price of commodities important to SSA countries continued to fall. As an example, prices of cotton, sugar and copper halved between 1995 and 2002 while coffee collapsed to a third of its 1995 price.

This deterioration of terms of trade has further exacerbated the marginalisation of SSA, leading to a shrinkage of the already small SSA participation in world trade. Africa's marginalisation from the global economy is directly linked to the worrisome dependence on primary commodity exports of the SSA's economies in their trade relations. The Hirschman concentration index, which measures the relative importance of individual products in a country's export was around 0.49 for SSA countries, which is relatively high compared to 0.15 for Asian middle income countries and 0.11 for OECD countries during the 1990s and was still as high in 2001(Ng and Yeats, 1996; African Development Report, 2004).

This primary commodity dependence subjects those economies to recurrent fluctuations of their export earnings and renders them more vulnerable to poverty traps.

In a recent study, Sachs et al. (2004) identified the main characteristics of these poverty traps as being:

- A level of capital so small that it falls below the threshold needed to start modern production processes;
- Very low levels of savings, which make the capital accumulation impossible;
- High rates of population growth from the rural poor who see young children as an economic asset because of the household chores they perform.

According to Sachs et al. (2004), these three factors --capital thresholds, savings traps, and demographic traps-- are all acting together. " It is quite possible that no single one of these factors would be sufficient by itself to cause a poverty trap, but they do so in combination," writes Sachs. Sachs et al. (2004) attribute the poverty traps to the following factors:

- Very high transport costs, with many Africans living in the interior of a continent with few navigable rivers.

- Low agricultural productivity, with erratic rainfall, few rivers for irrigation, and not enough fertiliser to replace nutrients in an increasingly withered soil.
- A very high disease burden, especially from HIV/AIDS and malaria: climatic and biological factors make African malaria particularly intractable.
- Adverse geopolitics, including ruthless exploitation by colonial powers that drew up African borders with no thought to ethnicity. A vast slave trade stretching centuries back undermined state formation.
- A very slow diffusion of technology from abroad.

Barro and Sala-i-Martin(2003) present a growth model characterised by two production technologies that help understand how poor countries may remain confined in low growth equilibrium if they fail to pay the set up cost needed to bring a more productive technology into use.

SSA's poverty traps and dependence on primary commodities can mostly be seen as idiosyncratic to tropical Africa. While developing countries in other regions of the world have gradually reduced their dependence on primary commodities during the last decades, SSA countries have hardly seen any change in their export composition. In 1980, three quarters of developing countries' exports were primary commodities. By 2001, around 80% were manufactures (Collier and Dollar, 2001). Developing countries as a group are thus no longer dependent upon primary commodities. Africa has missed this transformation and did not seize the opportunity to expand its economy into the global market for manufactures; most African countries remain highly dependent upon exports of a few primary commodities. Despite substantial effort aimed at diversification of exports, the proportion of export accounted for by primary commodities was still 94 % in 1987 in low income SSA countries and fell only slightly from 95 to 90% in middle income countries between 1965 and 1987(Stewart, Lall & Wangwe,1992)

A recent World Bank study (Collier, 2002) explains how such primary commodity dependence generates serious problems. It reviews empirical evidence that link primary commodity export to three main problems:

- The most common problem is dealing with the volatility of world prices and exorcising the so-called "resource curse" in the case primary commodities are natural resources.
- A second serious problem is that recently, empirical evidence has accumulated showing that primary commodity dependence is associated with various dimensions of poor governance. Some routes have been analyzed through which this association may be

causal (Sachs and Warner, 1995; Auty, 2001, Pritchett et al., 2001; Hoff and Stiglitz, 2002).

- The third major problem, associated with dependence on primary commodity exports is the risk of civil wars. As an illustration, Collier and Hoeffler (2001) have found the risk of civil wars arising from primary commodity exports to be substantial.

This last relationship is particularly worrisome as civil wars have persistently been raging in many African countries during the last decades. Thirty years ago, Africa had a lower incidence of civil war than other developing regions. Over the past thirty years it has had a rising incidence of civil wars whereas the incidence in other regions has been declining. Now Africa has a higher incidence of civil war than other regions (Collier 2000). The serious damages to the economy that are brought by wars have been recognized since ancient times as testified by the following arguments developed by M.Tullius Cicero, when the insurrection of eastern provinces initiated by King Mithridates of Pontus in 88 BC, was threatening to choke the Roman economy:

"Therefore, Roman citizens, if you want to retain[…] the dignity of peace, you have to defend this province, not only against calamity, but even against the fear of calamity. Indeed, in most other things, the damage is incurred when the calamity comes; however, when it is about (tax-) revenue, the loss is incurred not only at the advent of the evil itself, but the very fear of war brings calamity. Indeed, as the troops of the enemy are approaching, even if they do not make any irruption, the cattle in villages are abandoned in the pastures, the ploughs are deserted on the fields, and the merchant ships remain idle in the harbours. […]. As a result, what has been gathered in so many years of efforts is lost because of one rumor of danger and one fear of war" [2]

Africa's continued dependence upon primary commodities, in contrast to diversification observed in other developing regions, is central to its problem of civil wars, both directly, and indirectly through its connection to poor governance and poor growth performance. Dependence on primary commodities is therefore problematic as it reinforces the trap-like characteristics of African poverty. One of the biggest development challenges facing SSA is to address this dependence by engaging in a large-scale economic diversification away from primary commodities. The serious problems posed by the dependence on primary commodities in many African countries beg the question whether economic diversification is possible in SSA countries. Since export diversification is usually associated with a better growth performance

[2] From M.Tullii Ciceronis " De Imperio Cn.Pompei sive pro Lege Manilia". Free translation of the original text by the author.

(e.g. De Ferranti et al., 2002), solving the problem of primary commodity dependence is desirable on multiple grounds.

3. TRADITIONAL APPROACHES TO ADDRESSING AFRICAN POVERTY

3.1. Technology, growth and poverty reduction

The multiplicity of theories that attempt to explain income differences has not facilitated the finding appropriate solutions to the problem of extreme poverty in large parts of the world. However, many economists seem to agree that technological backwardness is the major culprit of much of the poverty observed around the world (e.g. Wolff, 2001; 2004). Any long-term solution to the problem of poverty must therefore address the issue of narrowing the large technological divide between poor and advanced nations.

The role and the speed of technology adoption in the process of economic development has been a recurrent theme in the economic literature. In the related debates, the various research avenues have widely recognised technological advance as the principal determinant of long-term growth performance of economic entities, be they firms or nations. Both standard neoclassical growth theory and the more recent endogenous growth theories pointed out that technological differences across nations were the primary explanation of long-term growth differences as well as of wealth and income inequality around the world (Solow, 1957; Romer, 1990). Narrowing the technology divide between advanced and backward countries is thus a key element in reducing income inequality and poverty in the world. It implies that technologically less developed countries find means to adopt absorb and utilise existing technologies developed in the advanced countries at a faster pace than the rate at which technological innovation of the technological leaders takes place (Gerschenkron, 1962; Nelson and Phelps, 1966; Benhabib and Spiegel 2002; Narula, 2004). Indeed, this catch–up hypothesis first advanced by Gerschenkron (1962) appears to be validated by subsequent empirical investigations, provided that the technological lagging countries have a sufficient level of human capital (Benhabib & Spiegel, 2002; Stokke, 2004) to sustain technology adoption and utilisation.

Consequently, African countries, like other developing nations confronted with slow economic growth, have placed high expectations in the acquisition of technology as a means to increase their productive capabilities and to catch up with advanced countries. Growth and trade theories diverge however in their explanation of the generation and diffusion of technology and have not been of much help for those in quest of foreign technology. Neoclassical theory considers technology as both universally available and applicable, and explains technological differences as variations in the endowments of production factors and infrastructure (Stokke, 2004). In contrast, endogenous growth theories consider that technology differences and the limited

capability of developing countries to absorb new knowledge are the main reasons for persistent low productivity, and therefore for poverty (Lucas, 1990). But none of these theories gives sufficient guidance as to why a considerable number of least developed countries (LDC) fail to adopt even relatively less advanced technologies or what they could do in order to access them.

The continuous technological accumulation process and the reduction of the technology gap in East Asia between the 1960s and 1990s have gone hand in hand with a spectacular, sustained economic growth and an even impressive poverty reduction. Over the same period, Sub-Saharan Africa has been further falling behind the rest of the world both in technology acquisition and income (Wangwe, 1995). This widening of the technological gap has further exacerbated the technological challenge of the most impoverished continent that powerlessly sees its population inextricably caught in poverty traps (Sachs et al., 2004).

Since technological advance is recognized as the driving force of long-term economic growth, technology adoption and utilization in developing countries is still largely considered as the key to poverty reduction for obvious reasons. Indeed, since the 1950s and 1960s, it was generally believed that rapid economic growth and industrialization in developing countries would automatically remove poverty through a "trickle down" effect on the poor and the underprivileged(Bhalla, 1994). However, the growth maximization strategies pursued in many developing countries under the influence of this thinking did not lead to any substantial trickle down to make any impact on the unemployment and poverty problem. In some cases, especially in Africa, empirical evidence generated during the 1970s showed that there was even an absolute decline of the standards of living of the lower income groups (see e.g Bhalla, 1994).

3.2. Foreign assistance and structural adjustment programs

Poverty reduction in developing countries has long been analysed in industrialised countries from the point of view of development assistance and technical cooperation. While the positive effects of foreign aid inflows on poverty reductions can't be ignored, the aid structure and the conditions tied to the assistance programs have been designed in such a way that the root causes of poverty have long remained unaddressed by development aid. As a result the solutions presented by the development assistance have proved to be far from effective in reducing poverty. This has resulted in decades of well intended development assistance that has failed to liberate SSA from its poverty traps and rather plunged it in debt traps (Nyang'oro,1992; Muchie, 2003).

Various reasons have been advanced to explain the causes of SSA's inextricable poverty traps. They range from bad governance, civil wars, corruption and inadequate economic structures

inherited from the colonial era. Over the last 4 decades, the donor community has attempted to address these issues in its aid policies, but success of the approaches taken so far has yet to materialise. More in particular, the decades of structural adjustments have proved to be an outright failure and the 1980s have come to be known as the "lost decade" in SSA (e.g. Nyang' oro, 1992; Oyeyinka , 2004). They saw the submersion of Africa in a marsh of exorbitant debts whose servicing has become the most important cause of resource drain of the continent. Cummings(1992) documents large outflows of resources leaving Africa to go to the rich as a result of the aid arrangements:

> *"As a matter of fact, at the end of the first year of the special UN recovery program (1987) the world economy actually took $14 billion more from Africa in the form of debt servicing and lowered commodity prices than it returned in the form of development assistance and private lending. Finally, from 1986 through early 1978 African countries transferred three and one-half times as much money to the International Monetary Fund as they received from it in 1985" (1992:34).*

A large number of analysts have attempted to understand the causes of the SAP failure in SSA by analysing the effects of participating in IMF structural adjustment programs and adopting its coercive policy recommendations on growth, on the science and technology and on poverty reduction. While studies conducted by the IMF itself or the World Bank tend to report positive effects of the participation (see e.g IMF, 1996; Treichel, 2005), most other studies indicate a rather mixed picture. Przeworsky &Vreeland (2000) for example, indicate that even after correcting for selection bias, participation in the structural adjustment programs of IMF was ineffective or even has a negative effect on growth, on technological capability building and on poverty reduction. They find that these effects are not compensated in the long run after the countries emerge from these programs.

One of the explanations for these adverse effects is that the policy recommendations that are tied to the SAP contain features that impede growth in the short run without having sufficient compensating effects for growth in the long term. Invariably, stabilisation packages of the IMF and the World Bank's structural adjustment loans entail stringent conditions that are in direct conflict with long-term development strategies in African countries. The very large cuts in public spending imposed by those packages, namely expenditure on developing human capital through health, education and training, cuts in expenditures on R&D in essential domains and on infrastructure, all adversely affect medium- term development efforts. Stagnation and even reversals of the modest accomplishments in human capital formation are particularly harmful: by handicapping African economies in areas where they are particularly weak, they make it difficult for African economies to develop in the long run. Fall in investment that accompanied adjustment policies is equally alarming. Stewart, Lall & Wangwe (1992) estimate that a reversal

of such cuts in priority areas- and indeed expansion of such expenditures- is essential for African countries to build their economic capabilities.

Stein (1999) also analysed the implications of the IMF policy instruments in the SSA context and found that the application of neoclassical theory underlying the SAP has presented many flaws and inconsistencies which explain its failure in Africa. He cites, among other factors, the destructive character of the policies that do not take into account the SSA context in which the theoretical assumptions forming the fundament of the theories are not fulfilled. Many of the adopted policies were too simplistic to achieve the delicate objective of combining efficient use of resources with local capability building. They have generally tended to diminish SSA control and experience, thereby jeopardising African possibility of building a dynamic comparative advantage in non-traditional areas.

After decades of development aid, technical assistance and the `lost decade` of ineffective structural adjustment programs, considerable research effort has been devoted to the effectiveness of development aid in reducing poverty and fostering economic growth (World Bank, 1998; Burnside & Dollar, 2000; Collier & Dollar, 2001). Debates on the efficacy of aid have heated up again after the much influential findings of Burnside and Dollar (2000), who reached the conclusion that aid indeed favours economic growth, but only in the presence of a good policy environment – one characterized by small budget deficits, low inflation, and openness to foreign trade.

Despite the influence of these findings on aid policies of some European countries, the volumes of aid flows have continued to shrink. Even the effectiveness of aid in a good macroeconomic environment has been repeatedly challenged (Dayton-Johnson & Hoddinott, 2003; Beynon 2001; Dalgaard and Hansen, 2001, etc.).The challenge of poverty reduction in Sub-Saharan Africa through foreign aid has thus only increased in dimensions. Initiatives by the United Nations to address these challenges worldwide through the so-called Millennium Development Goals (MDG) have received much publicity, but various specialists continue to question the effectiveness of MDG and to wonder whether they will be achieved more successfully than the stated objectives of previous bilateral and multilateral development aid initiatives.

For instance, Addison, Mavrotas and McGillivray (2003) estimate that the principal MDG target - reducing the proportion of people living in extreme poverty to half the 1990 level by 2015 - on current trends will not be achieved in sub-Saharan Africa. According to them, even seemingly optimistic forecasts suggest the MDG income poverty target will not be achieved in sub-Saharan Africa until 2147, some 132 years later than the targeted 2015. They see prospects for the achievement of other MDG targets in sub-Saharan Africa by 2015 as being just as dismal. Cutting child mortality by two-thirds and achieving universal primary education, for example, will not be achieved until 2165 and 2129, respectively, according to recent forecasts (UNDP,

2003). Disentangling the SSA poverty trap will therefore remain a challenge for many years to come, as illustrated by Enos' estimations (Enos, 1995)

3.3. Incomplete diagnoses, insufficient remedies

One of the reasons of the failure of development policies in Africa is undoubtedly the application of the neoclassical theories in finding solutions to crises in an environment where the underlying assumptions were not fulfilled (Stein 1999). The neoclassical view of the how markets behave has gradually come to dominate financial markets and impose its vision of what constitute sound or rational policy. Various crises in several parts of Africa have therefore been analysed through the neo-liberal vision that has forced many countries to dismantle their institutions and regulatory bodies that were estimated to be at odds with the ideal concepts of self regulated markets.

As this vision has permeated international financial institutions like the IMF for many decades, it has been the main source of diagnosis of economic crises in many developing countries, especially in SSA. Virtually all economic crises have thus been indistinctly attributed to market distortions and the state has so often been readily identified as the big culprit. The response to the crises has been the credo of the neo-liberal thinking: more market, more trade, more liberalisation, get the price right by more privatisation, no government intervention. Since the World Bank shifted toward the orthodox neo-liberal model around 1980 and joined the IMF in this doctrine (Stein, 1999), African countries in need of loans have had little other choice than to agree with the terms and conditions dictated by this vision. While the World Bank has a focus on development in the medium and long term and the IMF on stabilisation in the short run, in practice, there is little difference now in loan periods and conditions of these two institutes. IMF agreements have now become a prerequisite, not only for adjustment lending from the World Bank, but also for debt relief in the London and Paris Clubs and for many bilateral assistance programs (Stein 1999).

The extreme plight of Sub- Saharan Africa and the failure of several decades of development aid and structural adjustment programmes to take SSA countries out of poverty and debt traps call for the exploration of new approaches that put self-enabled development at the heart of the analysis. A comprehensive diagnosis of poverty based on this view seems more appropriate and more likely to provide the basis for solutions that address not only the symptoms but also the roots of the African poverty traps. This systems approach is based on human capital, learning and absorptive capacity necessary to organise institutions, to build and manage infrastructure, and to create the necessary policy environment in which aid, trade and technology adoption work together to effect economic growth and poverty reduction.

3.4. The inadequacy of applying neo-classical induced policies in the SSA context

The role of technological progress in determining the long-run productivity has been a subject of many theoretical and empirical analyses and hardly needs any further elaboration here. As stated section 3.1, the recognition of the importance of technological advance as the engine of long term growth is shared by the neoclassical growth theory and other more recent ones. However, the neoclassical theory and much of the traditional literature in general, has neglected the need for, and the production of technological activity in developing countries. The analysis of the African development problems through the orthodox neoclassical view has systematically disregarded the technology and learning aspects.

Neoclassical literature simply takes technology to be freely available to all countries and, within each country, to all firms. As many authors have expressed this, technological advance is assumed to fall like manna from the heaven!(e.g. Katz, 1994). According to this theory, countries productivity is determined by the capital- labour ratio present in their production function and this ratio is simply chosen in accordance with the factor price ratio which is determined by the relative endowment of physical capital and labour. The factors endowment available in the economy is also at least partly exogenously determined: labour is determined by the country's population and its growth rate, while the capital is accumulated through continuously investing a portion of the output that is determined by the saving rate.

In this setting, growth is achieved by more factor inputs utilization with constant returns to scale, better input utilization (productivity increase as a result of learning effects, scale economies, and more efficient factors allocation) or technological progress. However, even though in the short-run productivity improvements can be achieved through a more efficient allocation of resources or more factors inputs, the gains from such improvements are limited in time. The long-run productivity of a country's economy depends primarily on that country's ability to achieve technological progress. After all short-run improvement possibilities have been exhausted, subsequent progress depends to a large extent on a country's generating and applying new technologies.

The assumption of free and readily and universally applicable technology in the traditional approaches has a fallacious feature that carries the potential to impede technological effort in developing countries. One of the consequences of this assumption of the free availability of technology is to confine development thinking in terms of static comparative advantage determined by relative factor endowment. These approaches to technology also assume that all innovations and technological advance originate from developed countries: developing countries are assumed to receive all relevant improvements from developed countries at no cost and

without any problem in assimilating the transferred technology. Adaptation here is considered irrelevant, since alternatives are available for all factor prices. Following such reasoning, any technological effort to build technological capabilities or to establish a dynamic comparative advantage in a certain technology is a waste of time and resources.

As Lall (1992) explains, the general thrust of these conventional approaches to development is to minimise, not only the role of technological activity in developing countries, but also the need of policy to induce, support and protect such activities. Those approaches have tended to confine their policy recommendations to prescriptions like "getting prices right", reduction or elimination of protection, deregulation, privatization, free international flows of capital and technology, and elimination of government intervention in industrial activity. Only since the publication of World Bank' s(1993) East Asian Miracle, some moderate neoclassical thinkers have started to admit the need for intervention in industry, but even these admit only the so called neutral or " functional" to support the market working in the presence of market failure.

In conclusion, the neoclassical approaches have ignored and largely continue to disregard the complex nature and the substantial costs of technological learning in developing countries, as well as its dynamic benefits resulting from the externalities it generates. The failure of its application to analysing African poverty problems supports the argument that as such, macroeconomic theory and policy alone, as conveyed by the neoclassical vision, are simply not sufficient for guiding development. Innovation policy is necessary as well, even though policy to support innovation systems may sometimes conflict with standard macroeconomic dogmas. Moreover, according to Feinson (2003), the environment necessary for fostering systemic learning, a -key element in the innovation policy- requires substantial deviations from pure market thinking.

4. DIAGNOSING AFRICAN POVERTY IN A NEW ANALYTICAL FRAMEWORK: NSI

4.1. National Systems of Innovation as Analytical Framework

It is increasingly accepted that innovation is one of the most important source of competitive advantage and long-term economic growth in all countries. In essence, successful economic development is intimately linked to a nation's capacity to acquire, absorb, apply and disseminate modern technology within its economy. Successful economies are characterized by a complex integrated system for translating new knowledge and innovation in productive economic capacity (Feinson, 2003). Such systems now known as "National Innovation Systems (NISs) or National Systems of Innovation (NSI) are increasingly being recognized as both a supplement and an alternative analytical framework to standard macroeconomic perspective on development.

According to Lundvall (1999), the concept of national systems of innovation can be traced back to Friedrich List(1841), who took into account a wide set of national institutions (such as those engaged in education and training) as well as infrastructures (like networks of transportation of people and commodities) as crucial to the process of the development of productive forces. The modern revival of this concept has emerged some 20 years ago under various approaches including the Aalborg University approach (Lundval, 1985) and the US- approach (Nelson1988). This Notion of NSI was introduced into contemporary debate by Freeman (1987) who defined it as "the network of institutions in the public and private sectors whose activities and interaction initiate, import modify and diffuse new technologies".

Abramovitz (1989) was among the firsts to recognize that the exploitation of the catch-up potential resulting from technological backwardness, as proposed by Gerschenkron (1962), was dependent on the country's "social capability" or national absorptive capacity. The notion of NSI is thus closely related to absorptive capacity, a concept pioneered by Cohen and Levinthal (1990) and defined as the ability to recognize the value of new, external knowledge, assimilate it and apply it to commercial ends.

By now, it is widely recognised that productivity growth in developing countries depends considerably on the ability of their economic units to acquire, internalise and utilise knowledge developed elsewhere and potentially made available to them (Narula, 2004). This ability known as "absorptive capacity" is a necessary condition for developing countries to successfully exploit external sources of knowledge and generate own innovations. In the technology transfer

and innovation literature, absorptive capacity is defined on the basis of its components, among which human capital takes a prominent place.

Narula (2004) identifies these components as being:

- **Basic infrastructure** such as:

  Telephones, roads, railways, electricity, basic skilled human capital (primary and secondary education) , hospitals

- **Advanced infrastructure** like:

  universities, advanced skilled human capital (tertiary education), research institutes, banks, insurance companies

- **Firms** Domestic firms with appropriate human and physical capital to internalize technology flows and MNE affiliates (acting both as users and creators of technology flows)

- **Formal and informal institutions:**

  Intellectual property rights regime, technical standards, weights and measures, incentives and subsidies to promote adoption and creation of new technologies, taxation competition policy.

A close examination of these components reveals the prominent role played by the human capital in each of them: basic and advanced infrastructure must be managed, operated and maintained by qualified personnel; firms, advanced infrastructure and institutions need competent and skilled human capital to manage them and ensure an efficient functioning. Indeed, as Criscuolo and Narula (2002) indicate, much of the extant work at both the macro-level and micro-level correctly considers it axiomatic that the primary determinant behind technological accumulation and absorptive capacity is human capital. They stress the commonality share between the definition of human capital and the concept of absorptive capacity and the fact that several empirical studies have in fact used human capital measures as proxies for absorptive capacity. Human capital is thus the core with which physical infrastructure and institutions interact to form absorptive capacity; its preponderant importance in capability building can't be overemphasised. During the catching-up stage, absorptive capacity supports the accumulation of technological knowledge, and technological advances support the further development of absorptive capacity in a cumulative, interactive and virtuous process.

Schematically, NSI can be represented as a systemic ensemble of people organization institutions interacting and fulfilling various interconnected functions that are essential to effecting technological change (figure 2). Alternatively it can be represented as a set of actors,

institutions and linkages that together implement the innovation strategy. To understand the functioning of innovation systems it is indispensable to conceptualise the knowledge flows and linkages among its actors (figure 3 in the next section).

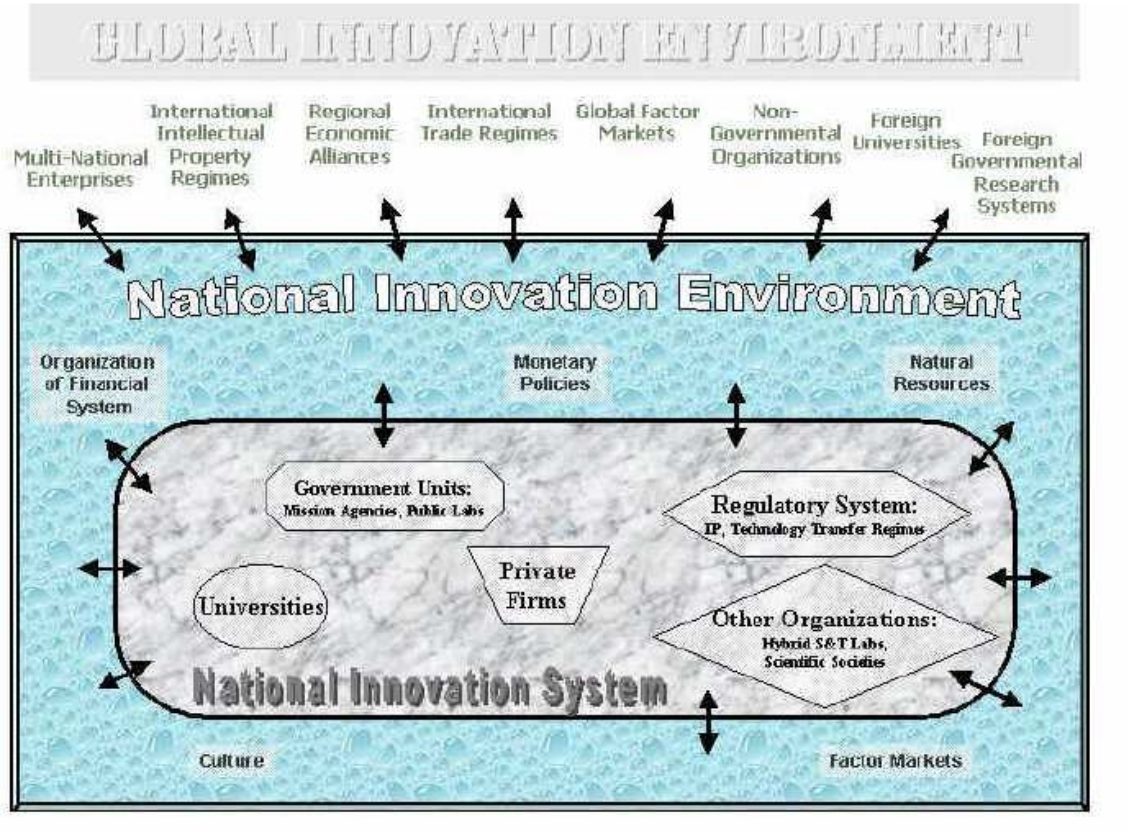


Figure 2: National System of Innovation and its environment.

Source: Bozeman et al.1993

4.2. Actors institutions and linkages in a national system of innovation

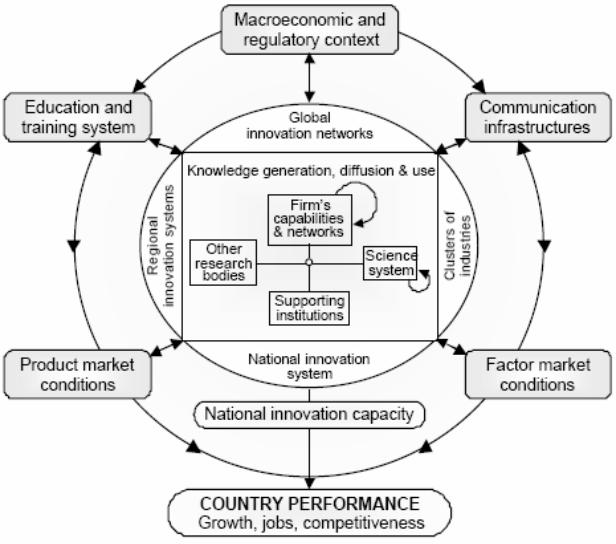
Various attempts have been made to schematize the flow of information and resources between environment and national systems of innovation and to map the actors and linkages that make them function. An analytical distinction has been made between a narrow NSI concept, which includes the institutions and policies directly involved in scientific and technological innovation and a broad NSI perspective which takes into account the cultural, social and political environment of the country being examined. The narrow version is an integrated system of economic and institutional agents directly linked to the promotion of the generation and use of innovation in the national economy (Adeoti, 2002) whereas the broad version includes, in addition to the components of the narrow system, all economic, political and social institutions affecting learning, research and innovation activities.

While there is a great variety in national economies and tremendous complexities within the systems themselves, it is possible to identify the key actors of a NSI. According to OECD, NSI institutions and actors, defined in the narrow context, can be divided into five main categories:

1. Governments (local, regional, national and international with different weights by countries) that play a key role in setting broad policy direction;
2. Bridging institutions such as research councils and research associations which act as intermediaries between government and the performers of the research;
3. Private enterprises and research institutes they finance;
4. Universities and related institutions that provide key knowledge and skills;
5. Other public and private organizations that play a role in the national innovation systems (public laboratories, technology transfer organizations, joint research institutes patent offices training organizations, etc.)

The broad definitions of NSI includes in addition to the above components all institutions affecting learning and research in a country, e.g. a nation's financial system, its monetary policy, the internal organisation of private firms, the pre-university educational system, labour markets regulatory policies and institutions. Conceptually the narrow is embedded within the broad system as depicted in an OECD schematic representation:

Figure 3. Actors and linkages in the innovation system



Source: OECD, Managing National Innovation Systems, 1999

The NSI linkages which reflect the absorptive capacity of the entire system are determined by the flow of knowledge and resources between the narrow and the broad levels and amongst the

institutions and organizations via the formal and the informal routes. The individual institutions that make up both the broad and the narrow innovation system are important, but the intensity and variability of knowledge flows among constituents of a national system are the critical determinant of its functioning (Feinson, 2003). For this reason, it has been suggested that policy makers should shift their interest from steady structures and absolute measures of innovative activities to the different types of interaction among actors within and beyond the boundaries of a national system of innovation.

One of the most important attributes of NSI is "learning", because successful economies are those that learn. Learning economies become able to take the ideas embodied in existing scientific knowledge and technologies and translate them into innovations. According to Bozeman et al., (2003), this capacity is not simply a matter of understanding how technologies work but also why they work. A continuous learning is of particular importance as NSI are intended to fulfill crucial functions in a dynamic, constantly evolving environment of technical change.

Indeed, in order to be a catalyst of sustainable technical change, NSI must fulfill the following functions, according to Johnson (2000):[3]

- Supply of incentive for firms to engage in innovative activities
- Supply resources (capital and competences)
- Guide the direction of search (influence the direction in which actors deploy resources)
- Recognise the potential for growth (identify technological possibilities and economic viability).
- Facilitate the exchange of information and knowledge
- Stimulate/ create markets
- Reduce social uncertainty about how others will act and react
- Counteract resistance to change that may arise in society when innovation is introduced(provide legitimacy for the innovation).

Hekkert et al.(2005) propose a set of indicators that may be used to assess the fulfillment of these functions in an system of innovation. As a result of interaction among the various functions, they may have reinforcing features with the fulfillment of a given function having a

[3] Alternative lists of NSI functions have been suggested by Richne (2000), Johnson and Jacobson(2001), Liu & White (2001), Jacobson et al.(2004)and Hekkert et al.(2005), but all share the same core functions and attributes.

positive effect on the other and vice- versa. The overall performance of the system is assessed on the basis of the diffusion of technology over time.

4.3. Distinguishing between developed and developing countries' NSI

The application of NSI as a framework of analysis must be articulated around the various functions that national innovation systems perform. This means that countries, industrial sectors and firms assess their success in effecting technological change by evaluating the overall performance of the functions of their innovation systems. Dutrenit (2004) distinguishes two strands of literature on the functioning of NSI and capability building: one is based on developed countries context and therefore emphasises maintaining and renewing core capabilities competencies in the most innovative firms; the other based on the situation in industrial latecomers focuses on the building up of technological capabilities. As a consequence of contextual and institutional differences between developed and developing countries' innovation systems, it has been argued that developing countries need their own specific approach to NSI (Juma et al., 2001). Since our objective here is to apply the NSI analytical framework to the development problem of SSA countries, we focus our attention on the latter strand.

According to Dutrenit (2004), this later strand of literature has focused on analysing the learning processes involved in the gradual building up of a minimum base of technological knowledge to be able to carry out innovative activities. Applied on the catching-up' processes of the new industrialised countries of East and South -East Asia, this literature has identified different stages of accumulation from the acquisition of foreign technology to the gradual building up of innovative technological capabilities that allowed some firms from these then developing countries to reach the technological frontier, and even develop technological leadership in certain areas (Amsden 1989; Kim 1997, 2000; Dutrenit, 2004). In this literature, technological capabilities are understood as the ability to use technological knowledge efficiently to assimilate, use, adapt and change existing technologies; and also as the ability to create new technologies and to develop new products and processes (Kim 1997). This literature starts from the idea that firms that are technologically immature learn over time, accumulate knowledge, and, on these bases, are able to progressively carry out new activities and acquire new technological capabilities.

Much of the focus on capacity building has been on enhancing scientific and technical skills, capabilities, and institutions in developing countries as a pre-condition for assessing, adapting, managing, and developing technologies (UNCTAD, 1995). But the need for enhanced skills and capabilities can also occur in the areas of technology selection, financing, marketing,

maintenance, service, information dissemination, utility regulation, policy development, technology transfer, market intermediation, tax policies, macroeconomic policies, and property rights. Many studies have recognised that capacity building can vary greatly from country to country, depending on the particular circumstances and needs of each country.

One of the arguments in favour of specific approach to NSI in developing countries that NSI is more at odds with neoclassical theories of growth in developing countries as indicated by Lundvall (1997). This has led Edquist (2001) to propose the concept of Systems of Innovation for Development (SID), which has a number of key differences with the NIS approach taken in developed countries: In the SID:

- Product innovations are more important than process innovations because of effect on the product structure
- Small, incremental innovation are more important and more attainable than radical ones
- Absorption(diffusion) is more important than development of innovation that are new to the world
- Innovations in low and medium technology are more attainable than those in high technology systems.

This explains why development scholars have put emphasis on the building of absorptive capacity by developing nations or their ability to acquire, learn and implement the technologies and associated practices already in use in developed countries (Dahlman and Nelson 1995). The promotion of learning and national absorptive capacity through various components of the national systems of innovation is indispensable for long-term industrial and economic development. As a consequence, the focus of absorptive capacity shifts the emphasis for developing countries from innovation to learning, both passive and active.

Passive learners absorb the technological capabilities for production, using a kind of black- box approach, while active learners master technology and its improvements through a deliberate learning effort (Juma et al., 2001). The choice of passive or active learning has therefore profound implications on a country' s ability to achieve the type of growth that will ultimately improve the living standards and well being of its citizens. Juma et al (2001) stress that passive learners are doomed to remain underdeveloped in the long run because they depend on spurious competitiveness such as low wages, natural resources depletion or state protection. Though not sufficient alone, active learning is a necessary condition to achieve long term, sustainable development. Analysis of development problems should be understood in this context.

4.4. Applying the NSI framework to development strategy

Science and technology are central to the development process of poor countries. Science and technology provide the tools that help solve or reduce the problems that afflict many poor countries and impede their economic development prospects. Economically successful countries are those that have been able to transform scientific knowledge and technical innovation into profitable economic productivity. Such economies are successful in transforming knowledge into innovation because they possess a complex, integrated system of human capital, infrastructures and institutions for translating new knowledge and innovation into economically viable new products and processes.

In essence, successful economic development is intimately linked to the nation's capacity to acquire, absorb apply and disseminate modern technologies in its economic activities. This capacity is embodied in a nation's NSI, the complex system of regulations, institutions, human capital, firms and government programs involved in the process of linking science and technology to the economy. The recognition of the importance of national innovation systems has provided both an alternative and an adjunct to standard macroeconomic perspective on development. As Bozeman et al.(2004) rightly pointed out, macroeconomic theory and policy alone are simply not sufficient for guiding development. Innovation policy is necessary as well, even though policy to support innovation systems may sometimes be in conflict with standard macroeconomic dogmas. The use of NIS as a framework to innovation policy gives a crucial insight in the thinking about developing countries: it views innovation efforts as intimately linked to broader macroeconomic and human capital policies.

For many, if not most developing countries, catching up technologically depends on the extent to which they are able to position their national systems of innovation and environment to best take advantage of knowledge flows from developed as well as other developing countries. In this respects, Juma et al.(2001) notes that many of developing countries will have to move from natural resources extraction economies to knowledge based ventures that add value to these natural resources. He observes that all these changes require a shift in public policy at the national and global level because domestic innovation will not be possible without access to international markets and likewise, access to international markets cannot be achieved without domestic technological innovation.

Empirical evidence shows that the realisation of technological improvements in developing countries is closely related to their level of human capital (Nelson and Phelps, 1966; Abramovitz,1986; Benhabib and Spiegel, 1994, 2002; Xu, 2000). The amount and degree of sophistication of technology those countries can adopt and efficiently utilise depend, among other factors, on their supply of technical and managerial skills. This implies that development

policy targeting technology acquisition and the reduction of the technology gap must be aimed at facilitating the interaction between technology flows and human skills. Indeed some developing countries in East Asia and Latin America have been successful in narrowing the technology gap in a few decades, and their educational attainment is credited for much of this achievement (Lall, 1992; Kim et al., 1987; Jomo, K.S., 2000, Rasiah, 1998).

Both empirical evidence and the role of substantial investments in human capital by East Asian NICs in the periods of their rapid growth indicate that, for absorptive capacity at country level to affect productivity growth in a significant way, its components must reach some threshold levels or "critical masses" (Azariadis & Drazen, 1990; Borensztein et al., 1998; Xu, 2000;). We argue that the mass effects in accumulation of adequate levels of human capital and absorptive capacity is an important explanation of the difference of development experiences between African and East Asian countries in their decades of spectacular economic growth for the latter

To date, African poverty, economic stagnation and dependence on primary commodities have mainly been analysed through traditional vision of development economics, neoclassical trade and growth theories. While the limitations of the applicability of neoclassical growth and trade theories to SSA have been elaborated upon supra, the limitations of development economics in analyzing and proposing workable solutions to problems of undeveloped countries has been recognized by such prominent economists as Amartya Sen. As Pakdaman(1994) explains, after admitting that traditional development economics insufficiently recognised that economic growth was no more than a means to some other objective, Sen proposed a new line of thinking in this discipline based on what people " can or cannot do" and how "*the domination of circumstance and chance over individuals can be replaced by the domination of individuals over chances and circumstances"* .

These limitations of traditional approaches justify the need of applying the NSI as an alternative analytical framework for SSA development problems. Whereas technology is treated as freely available and applicable in the neoclassical theories, in practice, technology is neither costless nor easy to absorb and utilise. Its acquisition can require substantial investments and its absorption and application often require complex skills and competences that are not always freely available in many developing countries. The use and assimilation of new technologies presuppose the existence of a minimum of technological capabilities in developing countries to choose, acquire, generate, and apply technologies that are suited to their development objectives. Such capabilities on national level eventually determine the rates and patterns of development and industrialization (Bhalla, 1994). Development strategies in the SSA context need to be measured not only against this dimension but also against other dimensions of the NSI and must be continually evaluated on their systemic adequacy. For these reasons,

developing countries, and SSA countries in particular must frame their development strategies within robust SID tailored to their development needs and priorities.

4.5. Devising development strategies with SID approach

4.5.1. Appropriate SID: the necessary conditions

In order to be able to devise a sustainable and successful development strategy, a set of minimum conditions regarding the NSI must be fulfilled. As the famous Chinese strategist Sun ZU once wrote, a general who does not know himself and does not know his enemy is doomed to loose all his battles. Likewise, a country that does not know its capabilities nor the challenges it must face on its development path will most probably lose the battle for technological and economic development. Knowing oneself supposes having developed the capabilities to correctly asses what one can achieve and the forces and resources needed to achieve it. For the purpose of industrialization, the OECD provides the tools to asses the existence of development conditions.

> *Over the longer term, economic growth arises from the interplay of incentives and capabilities. The capabilities define the best that can be achieved; while the incentives guide the use of capabilities and indeed stimulate their expansion, renewal or disappearance. In the advanced economies, the capabilities refer primarily to the supply of human capital, of savings and of the existing capital stock, as well as to the technical and organisational skills required for their use; the incentives originate largely in product markets and are then more or less reflected in markets for factor supply, thereby determining the efficiency with which capabilities are used. Both incentives and capabilities operate within an institutional framework. Institutions set the rules of the game and intervene directly in the play; They act to alter capabilities and change incentives and they can modify behaviour by changing attitudes and expectations (OECD 1987).*

Lall (1992) uses these three pronged approaches involving the interplay of incentives, capabilities and institutions to analyse numerous factors that influence the national technological capabilities in developing countries. He groups technological **capabilities** at the national level under three broad headings: **physical investment, human capital and technological effort**. According to him, these three are strongly intertwined in ways that make it difficult to identify their separate contribution to national technological performance, but they do not go automatically together. If physical capital is accumulated without the skills or the technology needed to operate it efficiently, national technologic capability will not develop adequately. Likewise, if formal skills are created but not combined with technological effort and

supported by a financial system that provides needed financial resources, efficiency will not increase in a dynamic way.

Human capital here is meant to include, not only the skills generated by the formal education and training, but also those created by the on-the-job training and experience of technological activity and the legacy of inherited skills attitudes and abilities that aid industrial development. Literacy at primary and secondary education is essential for any efficient form of industrialisation and may be largely sufficient for early industrialisation effort utilising simple technologies. However, as more sophisticated technologies are adopted, the need for more advanced, specialised skills on the part of both the workforce and management emerges.

Moreover, even trained labour force and physical capital are only fully productive when they can be combined with effort by productive enterprises to assimilate and improve upon the relevant technologies. Such efforts comprise a broad spectrum of production design and research work with firms backed up by a technological infrastructure that provides information standards, basic scientific knowledge and various facilities too large to be owned by a private firm (Lall, 1992). Technological effort is therefore equally crucial to the development of efficient industrial capabilities.

Incentives

Both physical and human capital are necessary for industrial development, but they will not be effectively utilised in the absence of an appropriate structure of incentives for investment and production. Incentives arising from market forces, institutional functioning and government policies affect the pace of accumulation of capital and skills, the types of capital purchased and the types of skills learnt and the extent to which existing endowments are exploited in the production system. They determine the choices made by firms, other NSI actors and all economic entities about where to commit resources and how much of the resources to commit in the pursuit of their strategies.

Lall (1992) points out that incentives comprise both the neoclassical prescription of export orientation as well as internal competition and sufficient selective protection to allow diversification and deepening to take place. In most developing countries, the role of government policies assumes a great importance because structural and market failure call for remedial actions, but care must be exercised to avoid excessive or misjudged intervention; even justifiable interventions must be judiciously administered.

Three broad sets of incentives

Macroeconomic incentives: GNP growth rate and stability price change, interest rates exchange rates, credit and foreign exchange availability as well as political stability and

exogenous shocks like sudden deterioration of terms of trade. They shape the climate within which all other incentives interact to optimize resource allocation.

Competition

While acknowledging the benefits of free market competition, economic theories accept that interventions in the incentive framework of free trade in the form of infant industry protection or promotion are needed to overcome many market failures affecting resource allocation. Such interventions must be selective, requiring that policy identifies specific sectors activities or even firms for promotion over others to exploit their superior growth potential linkages or externalities. Authorities in charge of development policy should be able to identify suitable activities for protection. Protection should not be too widespread, indiscriminate or prolonged, and should be offset by other incentives for increased efficiency. Competent authorities should be able to correct protection mistakes if they occur and they must be given resources and political strength to do that.

Incentives from factor markets

For an efficient resources allocation, properly functioning of capital markets, labour markets and technology markets with relative factor prices reflecting the scarcity of factors are indispensable. Some selective market intervention by the government to optimise social returns, such as guiding education and training towards certain industry needs, may be necessary or even inevitable.

Institutions

The development of capabilities and the play of incentives express themselves only through specific market and non-market institutions that emerge naturally from the functioning of markets. As a result of market failure or rigidities in the existing systems appropriate institution may fail to emerge. If they do not emerge by themselves the development of a proper institutional framework must become a priority.

4.5.2. Investing in human capital

Adequate human capacity is needed to assess, select, import, develop and adapt appropriate technologies. As noted in the previous section, there is considerable evidence showing that for any strategy regarding technology acquisition diffusion, adaptation and improvement sufficient levels of human capital are needed. If capabilities for active learning and integrating the new knowledge are deficient, they may result in unsuccessful application of purchased technologies and unforeseen technology adoption problems. Since human capital is essentially accumulated through the channels of education, training, experience and learning by doing, policy aimed at fostering formal education, skills training and other avenues of human capital accumulation are

important in building adequate human capabilities. Indeed, research has demonstrated that an economy's absorptive capacity, which forms the basis for successful technology transfer, depend heavily on the level of education and training (Mytelka, 2001).

Dahlman and Nelson(1995) note that a key input in achieving a successful technology acquisition is a technical human capital base able to assess and decide on technology matters, requiring a well developed level of educational system that lays the necessary foundation at all levels. They distinguish two levels at which investment in human capital should be aimed: the university level and the primary/ secondary education level. According to Dahlman and Nelson, while university level forms qualified personnel to assess technology and develop strategy to take advantage of technological changes, the primary/ secondary level provides critical components to speed up the diffusion and adoption of new technologies. This means that there is a need for strong scientific, engineering and socio-economic capabilities as abase for policy making as well as for skilled labour force that makes adaptation and improvement of foreign technologies on the shop floor and increase the awareness and ability to take advantage of technological opportunities.

4.5.3. Acquiring foreign technology

Developing countries can acquire foreign technology in various ways, such as reverse engineering of foreign capital goods, technology transfer through foreign direct investment (FDI) or foreign licensing. As a prominent actor in the NSI, the government has the responsibility to contribute to the formation of human and social capital needed to evaluate, choose, implement and modify foreign technologies. Since a great deal of technological information is embodied in foreign capital goods, the easiest way for developing countries to acquire technology is by importing those capital goods from developed countries and reverse-engineering them domestically and adapting them to local conditions. However, this type of technology acquisition does not include the transfer of theoretical or practical knowledge; it is therefore of limited use if it takes place without an already existing solid base of human capital capable of filling these lacunae.

Obviously, trade and tariffs laws and regulations, as well as intellectual property regimes, are powerful instrument to guide this avenue of acquisition. As Mansfield et al. (1981) suggested, imitation costs can be high where the levels of human capita are low, and the loose intellectual property rights regime that would be needed to maintain such a system might be prohibitively damaging to foreign trade relations. The alternative way of acquiring technologies through FDI is not less sinuous. In many cases the technology remains totally controlled by the foreign investor, but local firms can benefit from the establishment of foreign firms through linkages and spillovers. Foreign licensing on the other hand the foreign firm can provide some assistance

in implementing the new technology. Here the government has also a whole host of policy tools to influence technology acquisition. Developing countries might for example regulate the amount of domestic ownership in foreign firms because more local ownership is likely to increase the network and linkages available for spillovers to other domestic firms.

The engineering and management skills required in acquiring the capacity to optimize resources and innovate are not trivial. Various kinds of high quality training are needed to embody in personnel of the receiving firm the skills, knowledge and expertise applicable to particular products and processes. Such training, both generic and specific, should be an important part of any technology transfer package and deliberately planned as a learning vehicle for the work force of the recipient firm (Imai, 1994). The transfer should not only be of specific know-how, but also of related systemic knowledge of the relevant technologies so that recipients can add value. As Brooks (1995) points out, this is an important consideration for developing countries, because it implies that the work force must experience continual cumulative learning, both from experience and formal training, in order to remain competitive.

4.5.4. Using and diffusing technologies

Nations with a low rate of literacy and weak higher education systems have a great deal of difficulties assimilating and implementing foreign technology because they lack essential levels of human capital. Technical competences and skills at the university-education level are needed to monitor and assess international technology development and implement any needed adaptation and changes. Strong education is also necessary at the primary and secondary levels to increase the general literacy level of the population and create a labour force with human skills necessary to understand the working of technology and make improvements on the shop floor.

For developing countries to take full advantage of acquired technology, government needs to enact policies that help domestic firms in using and diffusing these technologies throughout the economy. This can be done by establishing institutions and networks that disseminate the tacit and codified knowledge present in new technological systems. These networks and institutions do not develop by themselves; they need to be initiated and stimulated as an essential part of a nation's social absorptive capacity which is embedded in the National systems of innovation. With the help of government incentives, developing countries can create various formal and informal networks to facilitate the diffusion of the technology. Subcontracting is one of the effective instruments to create such close contacts that support knowledge transfer while conducting business. To ensure that domestic subcontractors produce products of equal or similar quality, it is important to establish an organization that implements standards, testing and quality control. Standardisation systems require collaboration between public and private

sectors and are part of the institutional system of national system of innovation administered by the public sector because of their character of "public goods".

4.5.5. Adapting and improving technologies

Transferred technology is typically used by firms to improve upon their productive capabilities. Technology adaptation and improvements take thus place at the firm level. The role of firms' innovations strategies is particularly important in the adaptation and improvement of the transferred technologies. Many of incremental change in process inputs or equipments that characterize constant technology change do not occur in formal R&D labs but rather on the shop floor. Developing countries firms' ability to absorb and use new technology effectively also improves their ability to develop innovations themselves.

However, if international competitiveness is the goal, then research labs are necessary to conduct reverse engineering or adapt technologies to fit specific needs of customers or simply to keep up with the international industry trends. Developing countries should concentrate their efforts on the industrial R&D expenditures that focus on the support for the acquisition, assimilation and improvement of foreign technology (Dahlman and Nelson, 1995). Fundamental change requires thus an autonomous capacity to innovate, acquire and adapt technologies.

5. SUMMARY AND CONCLUSIONS

In this paper, we have examined the problem of SSA's poverty traps in their structural symptoms of marginalisation from the world economy, dependence on primary commodities in its international trade relations and weak technological capabilities. We have attempted to show some of the reasons explaining how traditional approaches to fostering growth and reducing poverty on the basis of neoclassical wisdom failed in the African context. We presented the NSI in its developing countries version (SID) as an alternative approach to diagnosing the poverty problem by looking at its roots: lack of human capital physical infrastructure, technological efforts, appropriate incentives and institution necessary for a country to grow in the long run. Even though there is no deterministic (or one-to-one) relationship between growth and poverty reduction it is reasonable to state that for a country to be able to reduce the poverty of its population, it must find means to achieve economic growth and put in place policies to use the benefits of economic growth to alleviate poverty.

Growth in SSA has been impeded in general by the marginalisation of Africa in the world trade, dependence on a few primary commodities and the decline of its terms of trade since the mid-1980s. The combined effects of these factors have been devastating for the African population, whose poor living conditions have turned into poverty traps characterised by too low saving rates, too low capital stock and too low human capital to effect growth.

We have explored how this seemingly inextricable poverty trap can be overcome by shifting the attention on the utilisation of imported technologies. These technology however can only be successfully acquired, utilised and diffused if the acquiring country has developed sufficient social absorptive capacity in the form of human capital, physical infrastructure and institutions organised in systems of innovation for development. Analysing SSA poverty and dependence on primary commodities within such a framework has allowed us to identify the main issues to be addressed by SSA governments and their donors in their development strategies.

One of the major issues to be tackled by the governments is the reduction of primary commodity dependence of SSA economies. Through its revenue stabilisation effects and its direct impact on problems inherent to the dependence on primary commodities, successful economic diversification can be the key to growth and thus to disentangling the poverty traps in SSA. Fundamental change in the export structure can be achieved if African governments set their minds on developing an autonomous capacity to innovate, acquire and adapt technologies.

Capacity-building is required at all stages in the process of technology transfer. In the beginning, basic level of technological capability should be built via the establishment of institutes that provide training in the fundamentals of technology assessment and management. Capacity for technology assessment and negotiation by African countries at the agreement stage of technology acquisition is crucial in order to overcome the disadvantages of information asymmetry that characterises the technology market. However, capacity alone is of limited use without the appropriate blend of incentives and institutions to foster technology utilisation and productivity increase.

Increasingly, there is a consensus amongst both analysts and African actors themselves that local involvement, in the form of traditional institutions, local organisations and individuals is critical to increasing national capacity. Unfortunately even the financial assets saved by Africans in most cases migrate to developed countries and are thus not used to invest in activities that could help Africa exit the poverty traps. Collier, Hoeffler and Pattillo have estimated that the proportion of African private wealth held abroad, even by 1990 was 40% (Collier, 2002). The political economy consequence of this mobility is that capital has strong bargaining power relative to the immobile factors such as land and labour. Hence, the burden of poor governance is shifted more or less fully to these immobile factors.

In Sub-Saharan Africa, existing capabilities are weak in almost all technology areas. Many political leaders in SSA have rarely been interested in nurturing the development of the capacity to innovate and to be competitive in international markets. Bilateral and multilateral donors have also shown too little readiness to provide assistance aimed at nurturing the local innovative capabilities. Where efforts to build up technological capabilities have been undertaken, the link between science and technology on one side and the industry on the other, has been minimal, resulting in brain drain of African scientists and shortages of competent manpower coexisting with unemployed qualified personnel. Should SSA countries succeed in building basic technological capabilities, their recipe for escaping poverty traps will also have to include the essential ingredients of an increased role for agriculture productivity, political stability, independent competent bureaucracy, expansion of education and finding an engine of growth.

REFERENCES

Abramovitz, M. (1986). "Catching up, forging ahead, and falling behind", in *Journal of Economic History*, June, Vol. 46(2), pp. 385-406.

Adeoti, J. (2002). "Building Technological Capability in Less developed Countries: The Role of National Systems of Innovation". *Science and public Policy*, april 2002

Addison, T., G. Mavrotas and M. McGillivray (2003). **"**Aid, Alternative Sources of Finance and the Millennium Development Goals". Paper prepared for presentation at the "Development Financing: Global Policy Agendas"session at Development Studies Association Annual Conference, London, November 2004.

African Development Bank (2004). Africa in the Global Trading system. *African Development report 2004.*

Amsden, A.H. (1989). *Asia's Next Giant: South Korea and Late Industrialisation*. New York: Oxford University Press.

Auty, R. (2001). *Resource abundance and economic development*. Oxford University Press.

Azariadis, C. & A. Drazen (1990). "Thresholds Externalities in Economic Development". *Quarterly Journal of Economics, vol. 105 No2, pp. 501-526*

Barro, R. J. and Jong Wha Lee. (2000). "International Data on Education Attainment : Update and Implications", *NBER Working Paper*, w7911

Barro, R.J. and X. Sala-i-Martin (2003) *Economic Growth,* The MIT Press

Benhabib, J. and M. Spiegel. (1994), "The Role of Human Capital in Economic Development: Evidence from Aggregate Cross-Country Data". *Journal of Monetary Economics, 34, 143-173.*

Benhabib, J. and M. Spiegel (2002). "Human Capital and Technology Diffusion". *Mimeo. Federal Reserve Bank of San Francisco.*

Beynon, J.(2001). "Policy implications for aid allocations of recent research on aid effectiveness and selectivity". Paper presented at the joint Development Centre/DAC experts seminar on "Aid effectiveness", OECD Paris, January 2001.

Bhalla, G.S., (ed.) (1994). Economic Liberalization and Indian Agriculture, New Delhi, Institute for Studies in Industrial Development.

Borensztein, E., J. De Gregorio and J.W. Lee (1998). How does FDI affect economic growth? *Journal of International Economics*, vol 45, p. 115-135.

Burnside, C., and D. Dollar (2000). "Aid, policies, and growth". *American Economic Review*, 90, pp 847-69.

Burnside, C. and D. Dollar (2004). "Aid, policies, and growth: revisiting the evidence". *World Bank Policy Research Working Paper 3251, March 2004*

Collier, P. (1995). "The Marginalization of Africa". *International Labour Review* 134 (No. 4-5), pp. 541-557.

Collier, P.(2002). "Primary Commodity Dependence and Africa's Future*" World Bank April 2002*

Collier, P. and D. Dollar (2001). "Globalization, Growth and Poverty" . *World Bank.*

Collier, P. and A. Hoeffler(2001). "On the Incidence of Civil War in Africa". *Journal of Conflict Resolution* 46(1):13-28.

Criscuolo, P. and R. Narula (2002). "A novel approach to national technological

accumulation and absorptive capacity: Aggregating Cohen and Levinthal". *MERIT Research Memorandum 2002-16*.

Cummings, R.J.(1992). "A historical Perspective on the Lagos Plan of Action". in Nyang' oro, J. and T. Shaw, eds. *Beyond Structural Adjustment in Africa. PRAEGER, New York,*1992.

Dahlman, C. and R. Nelson (1995). "Social absorption capability, national innovation systems and economic development". in D.H. Perkins, and B.H. Koo (eds.), *Social capability and long-term growth*, Basingstoke, Macmillan Press.

Dalgaard, C-J., and H. Hansen (2001). "On aid, growth and good policies", *Journal of Development Studies*, 37, 2001, 17-41.

Dayton-Johnson, J. and J. Hoddinott (2003). "Aid, Policies, and Growth, Redux." Unpublished manuscript, Dalhousie University, April 2003.

De Ferranti, D., G.E. Perry, D. Leerman and W.F. Maloney(2002). "From Natural Resources to the Knowledge Economy". *The World Bank, Washington D.C*.

Delgado, R.(1994). *Failed Revolutions: Social Reform and the Limits of Legal Imagination* (Westview Press, 1994)

Dutrénit, G. (2000). *Learning and Knowledge Management in the Firm: From Knowledge Accumulation to Strategic Capabilities*. Cheltenham: Edward Elgar.

Dutrenit G. (2004). "Building Technological capabilities in Latecomer Firms". *Science, Technology & Society 9:2 (2004)* SAGE PUBLICATIONS

Edquist, C., ed. (1997). *Systems of Innovation: Technologies, Institutions and Organization*. London: Cassell Academic.

Edquist C. (2001). "Systems of Innovation for Development". *World Industrial Development Report (WIDR) 2001.*

Freeman, C. (1987), *Technology Policy and Economic Performance: Lessons from Japan*. London: Francis Pinter.

Easterly, W. , R. Levine, and D. Roodman (2003). "New Data, New Doubts: A Comment on Burnside and Dollar's "Aids, Policies and Growth(2000)."

Enos, J.(1995). In pursuit of Science and Technology in Sub-Saharan Africa. Impact of Structural Adjustment Programmes UNU INTECH Studies in New Technology. Routledge.

Fagerberg, J. (1994). "Technology and international differences in growth rates', in *Journal of Economic Literature*, Vol. 32, pp. 1147-75.

Feinson S. (2003). Knowledge Flows, Innovation and Learning in Developing Countries. A project for the Global inclusion Program of the Rockefeller Foundation.

Gerschenkron, A. (1962). *Economic backwardness in historical perspective*. Cambridge, Belknap Press of Harvard University Press.

Habiyaremye, A. (2003). "Authoritarianism and Economic Development: the Example of Korea's Park Chung Hee". *Samenhang- Urugwiro, n°3, june 2003*

Hekkert, M., R. Suurs, H. van Lente and S. Kuhlman (2005). "Functions of Innovation Systems: A New Approach for Analysing Socio-economic Transformations". Draft paper, University of Utrecht.

Herzer, D.(2005). Exportdiversifizierung und Wirtschaftswachstum in Chile: Eine Ökonometrische Analyse. *Jahrbuch fur Nationaloconomie und Statistik. Vol225 pp.163-180.*

Jomo, K.S. (2002). Southeast Asia's ersatz miracle.introdiction in Jomo K.S ed.,(2002).Southeast Asian Developmental States in Comparative East-Asian Perspective.

Jonkers, E.(1951). *Keur uit de werken van Cicero*, tweede druk. E.J Brill, Leiden.

Juma, C., K.Fang, ., D. Honca, , J. Huette-Perez, V. Konde, and S. Lee,(2001). "Global Governance of Technology : Meeting the Needs of Developing Countries". *International Journal of Technology Management. Vol.22 no 7.*

Katz, J.(1994). “Technology, Economics and Late Industrialisation”. Chapter 7 in Salomon, J.-J., F. Sagasti and C. Sachs-Janet, (eds). *The Uncertain Quest: Science, Technology and Development.* UNU Press.

Khor, M. (2000). “Globalization and the South: Some Critical Issues”. *UNCTAD Discussion Papers, No147, April 2000*

Kim, L. (1997), *From Imitation to Innovation. The Dynamics of Korea’s Technological Learning*. Boston, MA: Harvard Business School Press.

Kim,L., J.Lee and J.Lee(1987). Korea’s entry into the computer industry and its acquisition of Technological Capability”. *Technovation, 6,. pp.277-293*

Lall, S, *(1992a).*Technological Capabilities and Industrialization*. World Development, Vol. 20, No. 2 (1992), pp. 165-86.*

Lall, S. (1992b). "Structural Problems of African Industry," in F. Stewart, S. Lall and S. Wangwe, (eds). *Alternative Development Strategies in Sub-Saharan Africa.* (London: Macmillan).

Lamuse, R. (1995). Chapter on Mauritius. in Wangwe S. (ed.). *Exporing Africa. Technology, Trade and Industrialisation in Sub-Saharan Africa.* UNU-INTECH Studies in New Technology. Routledge.

Leith, J. Cl.(1999). “Botswana: A Case Study of Economic Policy Prudence and Growth” . *The World Bank Publications*.

Lewis, W.A. (1955). *The Theory of Economic Growth.* (Homewood, IL: R. D. Irwin)

Liu, X. and S. White (2001). “Comparing Innovation Systems: a Framework and Application to China’s Transnational Context”. *Research Policy, Vol 30, pp.1091-1114.*

Lundvall, B.-Å., *Product Innovation and User-Producer Interaction*, Aalborg: Aalborg University Press, 1985.

Lundvall, B.-A., ed. (1992). *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. London: Pinter Publishers.

Lundvall, B.-Å., ed.(1992). *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. London: Pinter Publishers, 1992.

Lundvall, B.-Å.(1997). “Information Technology in the Learning Economy”. *Communications & Strategies*, No. 28, pp 117-192, 1997.

Lundvall, B.-Å.(1999) “National Business Systems and National Systems of Innovation”. Special Issue on Business Systems, *International Studies of Management and Organization*, Summer 1999.

Mansfield, E., M. Schwartz and S. Wagner(1981). “Imitation Costs and Patent: An Empirical Study”. *Economic Journal* 91: pp.907-918

Muchie, M.(2005). “Towards AfricanSystems of Innovation: Reframing Development Theory to ProvideReal Answer to the African Dilemma”. Paper presented in UNU-INTECH Seminar March 2005.

Muchie M., P. Gammeltoft and B-A. Lundvall (2003). *Putting Africa First: The Making of African Innovation Systems.* Aalborg. Alborg University Press

Mytelka,L.(2001). Promoting Scientific and Technological Knowledge for Sustainable Development. UNU- INTECH Working Paper

Narula, R. (2004). Understanding absorptive capacities in an “innovation systems” context: consequences for economic and employment growth. *MERIT Infonomics Research Memoranda Series.*

Nelson, R. (1993), *National Innovation Systems*. New York: Oxford University Press

Nelson, R. R. and E. S. Phelps (1966). “Investment in Humans, Technological Diffusion, and Economic Growth”. *American Economic Review, 56, pp. 69-75.*

Ng, F. and A. Yeats (1996). “Open economies work better: did Africa’s protectionist policies cause its marginalisation in world trade?” *World Bank Policy Research Working Paper no 1636*

Nyang' oro, J. E.(1992). "The Evolving Role of the African State Under the Structural Adjustment". in Nyang' oro, J. and T. Shaw, (eds). *Beyond Structural Adjustment in Africa. PRAEGER, New York,*1992.

OECD, (1987): *Structural Adjustment and Economic Performance*. Paris: OECD 1987

Oxfam (2005) ""Hypocritical" international aid system fails world's poorest". Press Release 28 February 2005 also available on: http://www.oxfam.org/eng/pr050228_MDGs_paris.htm accessed last on 06-06-2005

Oyelaran-Oyeyinka, B. (2004). "Learning and Local Knowledge Institutions in African Industry". *UNU-INTECH Discussion Paper Series 2004-2*.

Pritchett, L. (1996). "Where has all the education gone?", *World Bank Policy Research Working Paper #1581*

Przeworsky, A. And, J.R Vreeland (2000). "The Effect of IMF Programs on Economic Growth". *Journal of Development Economics, Vol. 62, No 2, 2000*

Rasiah, R.(1998). "The export manufacturing experience of Indonesia, Malaysia and Thailand: Lessons for Africa". *UNCTAD Discussion Papers.*

Romer, P. (1990). "Endogenous Technical Change". *Journal of Political Economy, 98, S71-S102.*

Sachs, J. D. and A. M. Warner (1997). "Fundamental Sources of Long-Run Growth". *American Economic Review, May, 87(2), 184-188.*

Sachs J. D., J. McArthur, G. Schmidt-Traub, M. Kruk, C. Bahadur, M. Faye, and G. McCord (2004). "Ending Africa's Poverty Traps". *Brookings Papers in Economics.*

Sarraf, M. and M. Jiwanji (2001). "Beating the Resource Curse: The Case of Botswana". *World Bank Publications, The World Bank, Washinton DC, 2001.*

Stein, H.(1999). "Globalisation, Adjustment and the Structural Transformation of African Economies: The Role of International Financial Institutions". *CSGR working Paper no 32/99 University of Warwick.*

Stewart, J. B. (2004). "The best of Times or the worst of Times: Alternative Visions of Africa in the 21st Century". *The Great Lakes Research Journal _ Vol. 1_ December 2004.*

Stokke, H. E. (2004). "Technology adoption and Multiple Growth Paths: An intertemporal general equilibrium analysis of the catch-up process in Thailand". *Working Paper, Norwegian University of Science and Technology.*

Wangwe, S. (1995). Introductory chapter in Wangwe S. (ed). *Exporting Africa. Technology, Trade and Industrialisation in Sub-Saharan Africa.* UNU-INTECH Studies in New Technology. Routledge.

Weeks, S.G. (2002). "Pre-vocational Secondary Education in Botswana: An Historical and Comparative Perspective 1966 to 2002". Paper prepared for the Regional Vocational Skills Development Review, Human Development Africa Region, World Bank.

Wignarajan, G.(2001). "Firm size, Technological Capabilities and Market-Oriented Policies in Mauritius". *UNU-INTECh Discussion Paper Series.*

Wolf, M. (2001). "Is Today's Globalisation Different from What Has Gone Before?"

Wolf, M. (2004). Why Globalization Works.

World Bank(1993). The East Asian Miracle. *World Bank Publications, Washington D.C.1993*

World Bank (1995). *Workers in an Integrating World. WorldDevelopment Report 1995.* (New York: Oxford University Press).

World Bank(1998). *Assessing Aid*, The World Bank, Washington, DC, 1998.

World Bank (1989). *Sub-Saharan Africa: From Crisis to Sustainable Development*. Washington D.C.: World Bank.

Xu, B. (2000). "Multinational enterprises, technology diffusion, and host country productivity growth". *Journal of Development Economics*, Vol. 62, pp. 477-93.

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