UNITED NATIONS UNIVERSITY

UNU-MERIT

Working Paper Series

#2006-030

Absorptive Capacity and Export Diversification in Sub-Saharan African Countries

Alexis Habiyaremye and Thomas Ziesemer

June 2006

United Nations University - Maastricht Economic and social Research and training centre on Innovation and Technology
Keizer Karelplein 19, 6211 TC Maastricht, The Netherlands
Tel: (31) (43) 350 6300, Fax: (31) (43) 350 6399, e-mail: info@merit.unu.edu, URL: http://www.merit.unu.edu

Absorptive Capacity and Export Diversification in Sub-Saharan African Countries

Alexis Habiyaremye* **and Thomas Ziesemer****

Abstract

This paper examines the extent to which dependence on primary commodities in Sub-Saharan African(SSA) countries can be explained by low levels of absorptive capacity (the ability to acquire, internalize and utilize knowledge developed elsewhere). We examine the individual and combined effects of various indicators of absorptive capacity on export diversification. We test the significance of these effects on a sub-sample consisting of SSA countries and a sample of other developing countries. Our results show that the association between higher levels human capital and basic infrastructure -two crucial components of absorptive capacity -with more export diversification is subject to threshold level effects, while the abundance of natural resources turns out to be impeding diversification in SSA. These results imply that SSA countries need to substantially increase their investments in basic infrastructure as well as reinforce the accumulation pace of human and physical capital to allow active technological learning and reduce their dependence on primary commodities.

Keywords: absorptive capacity, human capital, capital accumulation, export diversification, Sub-Saharan Africa.

JEL Classification: O13, O33, O55.

UNU-MERIT Working Papers
ISSN 1871-9872

UNU-MERIT Working Papers intend to disseminate preliminary results of the research carried out at the institute to attract comments

* Corresponding author. Please send your correspondence to : habiyaremye@merit.unu.edu

The authors gratefully acknowledge helpful comments by Semih Akcomak (UNU-MERIT) but are sole responsible for the views expressed here and all remaining errors and omissions.

** Department of Economics, Maastricht University and UNU-MERIT

1. Introduction.

The persistently weak performance of Sub-Saharan African (SSA) economies has often been attributed to the poor infrastructure and the low investment level which has been insufficient to trigger a sizable manufacturing activity (see e.g. Collier, 2002 or Sachs et al., 2004). The continent has remained dependent on the export of a few primary commodities and has had to endure the consequences of all problems resulting from the fluctuation of commodity prices in world markets as well as their deterioration of terms of trade. The combined effects of low investment levels and poor infrastructure, together with dependence on primary commodities, has led to very low productivity levels and a correspondingly low level of capital accumulation that is considered one of the causes of the SSA poverty traps (Sachs et al., 2004).

An influential World Bank study (Collier, 2002) has recently highlighted the serious problems generated by such primary commodity dependence. It presents empirical evidence that link primary commodity export to three major problems:

- The most common problem is dealing with the volatility of world prices and exorcising the so-called "resource curse" when primary commodities are essentially natural resources. Directly related to this is primary commodities' low income elasticity of export demand, resulting in chronic deterioration of terms of trade.
- The second serious problem is the association of primary commodity dependence with various dimensions of poor governance as shown by growing empirical evidence. Some avenues have even 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 is its association with the risk of civil wars. The weightiness of this problem is illustrated by Collier and Hoeffler (2001), who found the risk of civil wars arising from dependence on 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.

Primary commodity dependence is thus highly problematic as it reinforces some of the causes of poverty traps in least developed countries. The serious problems associated with it in many developing countries call for imminent measures to increase economic diversification, especially in SSA countries where poverty traps seem to have most devastating consequences. Although diversification can't be expected to become a panacea for SSA poverty, the accumulated empirical evidence linking export diversification to better growth performance (see e.g. Al Marhubi, 2000, De Ferranti et al., 2002 or Herzer, 2005) puts it in a prime position in the search for structural solutions.

Diversifying the economy to reduce dependence on primary commodities is however a highly demanding challenge: countries seeking to diversify must have sufficient levels of human and physical capital as well as an adequate infrastructure to support the processing of primary commodities or the initiation and expansion of manufacturing activities for export(Lall,1992; Benhabib and Spiegel, 2002; Collier, 2002). They must possess the ability to make effective use of technological knowledge in production, engineering, and innovation in order to achieve and sustain competitiveness. In the absence of such capabilities and the necessary financial resources for investment, developing countries may remain confined in low growth equilibrium if they fail to pay the set up costs needed to bring a more productive technology into use (Barro and Sala-i-Martin, 2003).

This requires active technological learning that enables countries to adopt and successfully apply foreign technologies. Such a technological learning can only succeed when it is based on strong technological capabilities that are anchored in an effective national innovation system (Kim, 1997). For most developing countries, the success of such learning depends essentially 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 exploit external sources of knowledge effectively and generate own innovations. This concept of absorptive capacity pioneered by Cohen and Levinthal (1989) finds its origin in the notion of "social capability" coined by Abramovitz (1986) to refer to skills and technical competences as well as institutions and markets capable of mobilizing resources on large scale.

Considering the multitude of problems linked to primary commodities dependence in many SSA countries and the potential benefits of export diversification, it is pertinent to explore and analyse the adequacy of their absorptive capacity to catalyse the adoption of new technologies and examine the mechanisms though which the diversification comes about. This paper examines the individual and combined effects of human capital stock, physical infrastructure and capital accumulation on economic diversification in the context of developing countries. We test the relationship on a sample of SSA countries in a multiplicative, log linear model, to check whether these effects may help explain the persistently weak growth performance in this part of the world. The rest of the paper is organized as follows: the next section reviews the theoretical and empirical literature relating some components of absorptive capacity -such as human capital and basic infrastructure- to economic performance and that relating natural resources endowment and economic diversification to economic performance. Section 3 presents a model linking elements of absorptive capacity to economic diversification. It specifies a relationship between human capital, physical capital accumulation, and infrastructure on the one hand and export diversification on the other. Section 4 analyses the empirical results while the final section provides a conclusion.

2. Absorptive capacity, primary commodities and economic performance

2.1 Human capital and labour productivity

The role of human capital in supporting economic development and technological change has been extensively studied and its importance can now be considered as axiomatic. Temple (2001) provides a rich and comprehensive review of the growth effects of education and social capital for the OECD countries. However, the precise mechanism through which human capital supports economic development is still not fully unambiguously understood and is still a subject of debate (see e.g. Meier and Rauch 2001).

When educational attainment is used as a proxy for human capital, there are three main views that attempt to explain how education affects the production process and contributes to economic performance. The first view considers education as having the effect of increasing the labour "efficiency units" making an educated worker represent more labour units than an uneducated one in activities where they are perfect substitutes. Keeping the labour force constant, education increases thus the efficiency units of labour available for the production process in an economy and increase output per worker. The second view is that educated workers are able to perform complex tasks and are therefore not substitutable by unskilled workers. Technically skilled workers allow the economy to produce more technologically sophisticated goods and services and help the country to "move up the technology ladder". The third view associates education and skills of workers with learning and creation of new technologies that generate more output keeping constant the level of inputs. Applied to the case of developing countries, this view suggests that educated workers help the country to absorb, implement and diffuse foreign technology, thereby generate more growth.

Benhabib and Spiegel (1994, 2002) used this latter approach to analyse the effects of human capital on technology adoption and found evidence that human capital stock indeed facilitates the adoption of foreign technologies and the creation of appropriate domestic technologies. The evidence linking human capital to economic performance has thus been established so well in micro as in macro level analysis (see e.g. Psacharopoulos, 1985 or Temple, 2001). It clearly shows that the ability of a nation to adopt and implement new technologies from abroad is a function of its stock of human capital. The speed of technological catch up and technology diffusion is thus a positive function of the available human capital.

2.2 Capital investment and economic performance

The strong relationship between gross fixed capital formation (as a percentage of GDP) and subsequent growth rates since WWII has led many authors (like De Long & Summers 1991, 1992) to conclude that the rate of (physical) capital formation determines the rate of a country's economic growth. Such a view is also supported by Eaton and Kortum (2001), who attribute part of cross-country difference in productivity to the access to capital goods as reflected by capital goods prices and barriers inhibiting trade in equipment. Drawing on De Long & Summers' results, Temple and Voth (1998) examined the link between human capital, industrialization and investment. They constructed a model with multiple equilibria, in which the accumulation of human capital triggers investment in equipment and drives industrialization if the market size is sufficiently big to allow firms to cover large fixed costs. Empirical test of this model in stratified regressions reveals a high correlation between growth and equipment investment. This correlation is strongest in developing countries and falls with the extent of initial industrialization.

However, some more recent empirical results rejected the existence of a causal effect between physical capital accumulation and economic growth. For example, following Lipsey and Kravis (1987) who found the growth rate to be more closely associated with the rate of capital formation in succeeding rather than in preceding periods, Blomstrom, Lipsey and Zejan (1994) tested the direction of causality between these two measures on a sample of 101 countries and found past growth to have a significant effect on current capital formation, even after controlling for lagged effects. No evidence of capital formation preceding economic growth was found. For their part, Howit and Aghion (1998) challenged the view presented by many neoclassical growth theorists that "the driving force of growth is the accumulation of knowledge… capital accumulation is not central to growth"[1]. They developed a model linking technological advance to R&D effort, in which R&D are capital intensive and find knowledge and capital to be two complementary state variables determining the level of output at any point of time. For Howit and Aghion, technological progress cannot be sustained indefinitely without capital accumulation.

2.3 Infrastructure and productivity

Basic infrastructure is an important component of a country's absorptive capacity. Narula (2004) identifies the following aspects of basic infrastructure as indicators of absorptive capacity :

- Telephones to provide communication services
- Roads, railways, waterways, ports and airports for transportation facilities
- Basic skilled human capital (primary and secondary education)

[1]Olivier Blanchard, quoted by Howitt and Aghion (1998), p.115.

- Electricity and other energy sources and utilities
- Primary and secondary schools for basic skilled labour
- Hospitals and health centres for a healthy population and its labour force.

In addition to sufficient levels of human and physical capital, countries seeking to sustain their competitiveness must have an adequate industrial infrastructure to make effective use of technological knowledge in production, engineering, and innovation. For developing countries, basic, industrial and technological infrastructure is necessary to support the processing of primary commodities or the initiation and expansion of manufacturing activities (Lall, 1992; Collier, 2002).

2.4. Natural resources endowment, primary commodity dependence and economic performance

The analysis of the impact of natural resource abundance on economic performance has unveiled a seemingly paradoxical phenomenon called the Dutch disease: the low growth performance observed subsequent to booms in revenues from natural resource exports. When the natural resources are abundant, capital and labour that would otherwise be used in the manufacturing sector are pulled in the resources sector and the non tradable goods sector whose demand is increased by the revenues from natural resources. Such booms accompanied by a shift of resources across sectors tend to shrink the tradable manufacturing sector. The economy loses the benefits from externalities or the advantages of increasing return to scale.

If the manufacturing sector has externalities such as forward or backward linkages, shrinkage of the manufacturing tradable goods results in chronic low growth, named the "Dutch disease" after the phenomenon observed in the Netherlands following the discovery of large gas reserves in the north of the country. The view held by many scholars gives support to the assumption that manufacturing has larger externalities than other forms of economic activities. The empirical support for this assumption is based on the observation that countries with more diversified exports do better and that growth tends to be positively correlated with growth in manufacturing production and manufacturing exports rather than on micro-level evidence. It remains therefore somewhat speculative.

Sachs and Warner (1997) analysed the effects of natural resource abundance in 1971 on the growth performance of the countries in the subsequent two decades and found a strong negative association between resources intensity and growth performance. It is interesting to note that in Sachs and Warner (1997), investment rate (average investment to GDP ratio) in their regression is also positively associated with the growth performance of the two decades period but negatively associated with change in human capital accumulation over the same period. The different avenues in which natural resources abundance impede economic performance have been reviewed and discussed in detail by Gylafson (2004).

3. Human capital, infrastructure, physical capital accumulation and economic diversification

3.1. Hypotheses

For developing countries to engage in diversified productive activities, they must possess the necessary absorptive capacity that enables them to identify, select implement and disseminate various foreign technologies in their production processes. Among many other definitions, absorptive capacity at the national level can be defined as "the ability to learn and implement the technologies and associated practices of already developed countries" (Dahlman and Nelson, 1995). According to Narula(2004) national absorptive capacity encompasses basic and advanced infrastructure to provide a platform for industries to operate, firms to carry internalize technology flows, and formal and informal institutions to enable efficient interactions between economic actors and provide incentives for economic activities.

The theoretical and empirical evidence presented in section 2.1 linking human capital to economic performance and the evidence linking diversification to economic growth (De Ferranti, 2000, Herzer, 2005) forms the basis for our hypothesizing a positive correlation between human capital and diversification as a byproduct of technological learning and industrialization. Following Azariadis & Drazen(1990); Xu (2000), and Benhabib & Spiegel(2002), whose results confirm a positive relationship between human capital levels and technological learning and diffusion, and Herzer (2005) who find an empirical association between export diversification and growth performance through learning, we conjecture a positive association between human capital at the disposal of a country and its capacity to diversify its export structure, therefore reduce the dependence on primary commodities.

Likewise, we hypothesize a positive relationship between the level of investment in physical capital accumulation and the diversification potential of a country. However, as expressed in section 2.2, although there is an empirical evidence of a strong association between gross domestic fixed capital formation rates and economic growth, the direction of causality is indeterminate. While growth can create investment opportunities that explain the subsequent expansion in investment and fixed capital formation, the accumulation of capital may also be the cause of labour productivity increase as the capital-labour ratio goes up, and therefore be the source of output growth. The relation between capital accumulation and the subsequent diversification may be expected to follow this latter logic and thus display a positive correlation. A country that invests a bigger proportion of its output in capital formation is likely to accumulate more rapidly the infrastructure and equipment necessary to allow the country to diversify its production basis. Chile and Botswana provide a good example for such reasoning, where the accumulation of capital is related to developing other sectors than the exploitation of primary commodities.

Diversification in developing countries is also dependent on the existence of sufficient basic and industrial infrastructure to provide energy, communication and transportation possibilities as well as skilled and healthy human capital. The more intensive a country can provide basic, advanced or technological infrastructure, the more various firms are likely to make use of it, thereby increasing the diversity of a country' s production. If this diversity of production can be reflected in the export structure, then infrastructure will be positively associated with export diversification. However, countries also develop infrastructure that are specific to the exploitation and the transportation of primary commodities such as natural resources. Especially in developing countries, the provision of basic infrastructure is likely to be more linked to activities in the primary commodity sector than to other forms of industrial production. In SSA countries, where a majority of the population is dependent on agriculture, the importance of this activity must also be reflected in the infrastructure related to it. In that case, infrastructure will be associated with primary sector activities rather than diversification, especially at low level. The overall effect of infrastructure on diversification is thus dependent on its level and the intensity of its use by the various sectors of economic activity.

Obviously, the dependence on primary commodities in the export structure has various other causes that are unrelated to infrastructure or human and physical capital. Natural resources endowment is the most salient reason why an economy may have a large share of primary commodities in its exports. As example, even a high-income, industrialized country such as Norway, with the world highest human development index in 2004, had still 74%of its exports composed of oil and fishing products in 2002 because of its natural endowment in these products. This is valid for most oil exporters and other mineral rich countries such as Botswana, Democratic Republic of Congo, Zambia or Chile with their impressive reserves of diamonds, cobalt, copper and other metal ores. To account for these effects, we include two measures of natural resources endowment represented by an oil variable for countries exporting crude oil, and a mineral variable for countries whose exports in mineral ores represent 30% or more of their total export value.

Other factors that are likely to influence the level of diversification include the level of per capita GDP and the population size. Countries with larger population sizes are more likely to develop varied skills that can be deployed in different fields. Likewise, countries with populations spread over large geographical areas can benefit from distinct regional specialization. We therefore include population size as a control variable to capture these effects. Countries with higher levels of income are more likely to be able to deploy resources in diversified economic activities, while at the same time the benefits of diversification are likely to foster per capita GDP growth. Controlling for the effects of per capita income can thus introduce endogeneity bias and bring the necessity for instrumentation. Moreover, many of the effects of per capital income are hardly to be dissociated from the infrastructure and investment variables effects and therefore do not necessitate any separate control in our opinion since these variables already act partly as a control for them.

In dealing with SSA and other least developed countries, we expect the effect of human capital and infrastructure on diversification to be weak in low-income countries in SSA where the levels of educational attainment may be below the threshold level needed to affect diversification. We test the same relationship on SSA and on a larger sample comprising middle-income countries where the differences in level of human capital are more observable and the effect on diversification likely to be significant.

3.2. Estimation model

In order to analyse the correlation between our components of absorptive capacity and the corresponding diversification, we express the diversification measure to be a multiplicative function of the levels of human capital, investment in physical capital accumulation and the available infrastructure. This means that for a country, the availability of human capital at a given point of time should increase the level of diversification observed at a future time. With a given level of human capital, a country investing more should also proportionally increase its diversification potential, while the availability of more infrastructure facilitate the business contacts and provides facilities and incentives for firms to engage in new activities. Intuitively, diversification should be positively related to each of these three variables.

The simplified specification of this model takes the well known Cobb-Douglass functional form:

$$DIV = C^{*}\ HUMCAP^{\beta_1} * CAPINVEST^{\beta_2} * INFRAST^{\beta_3} \qquad (1)$$

where C, $\beta1$, $\beta2$, and $\beta3$ are constants, while HUMCAP, CAPINVEST and INFRAST are respectively the measures of human capital stock, capital equipment investment and the relative infrastructure density in the period preceding the time at which the measure of diversification is recorded.

The length of the lag time between the measure of each element of absorptive capacity and its corresponding effect on export diversification/concentration can vary as a result of diverse factors. For example, the infrastructure usually changes only gradually and the level of infrastructure available at the beginning of the year of observation can reasonably be estimated to be operational and producing its effects in the same year. The infrastructure variable measure need therefore not be lagged. For human and physical capital to sort effects on productivity and diversification a more or less sizable period of time will be necessary.

This functional form is analogous to the Cobb-Douglas production function without any restriction on the exponent terms. This may be thought of as considering the diversification to be associated with the output produced with available infrastructure, human capital stock and capital accumulation as factor inputs. Taking the logs of both sides of equation (1), and taking stochastic and measurement errors into account, we obtain:

$$ln(\text{DIV}) = \ln(C) + \beta 1 * ln(\text{HUMCAP}) + \beta 2 * ln(\text{INFRAST}) + \beta 3 * ln(\text{CAPINVEST}) + \varepsilon \qquad (2)$$

where ε represent the error term.

To account for the distortion that might be brought in this relationship by natural resources endowment, such as oil, natural gas or mineral ores, since the abundance of such resources tends to increase export concentration *ceteris paribus,* we introduce fuels and mineral variables in the equation, which capture the effects of the endowment of these resources on the export concentration of the corresponding country. Equating ln(C) to $\beta 0$, we can write this as:

$$ln(\text{DIV}) = \beta_0 + \beta 1 * ln(\text{HUMCAP}) + \beta_2 * ln(\text{INFRAST}) + \beta_3 * ln(\text{CAPINVEST}) + \beta_4 * \ln(\text{FUELS}) + \varepsilon \qquad (3)$$

Another source of diversification might be the population in size since as a more populous country is also (ceteris paribus) more likely to have a grater variety of skills and economic activities. We control for this effect by including population in the model:

$$ln(\text{DIV}) = \beta_0 + \beta 1 * ln(\text{HUMCAP}) + \beta_2 * ln(\text{INFRAST}) + \beta_3 * ln(\text{CAPINVEST}) + \beta_4 * ln(\text{FUELS}) + \beta_5 * ln(\text{POPUL}) + \varepsilon \qquad (4)$$

3.3. Variable measurement and data

Diversification: Diversification is a concept that is not directly measurable because it manifests itself under various aspects. It must reflect at the same time the spread of economic activities over various sectors and the degree to which each of these sectors contributes to the overall economy. However, there are measures that can be easily associated with the extent of diversification or conversely, with the extent of export concentration or dependence on primary commodities. We review briefly some indicators and indexes used in empirical literature to measure export diversification. The first and simplest indicator like the one used by Herzer (2005) measures export diversification by taking the number of export sectors (SITC-3digit). An alternative way to this approach is to measure diversification indirectly by the share of primary commodities export in total exports. Primary commodities are the sum of all food items (SITC 0; 1; 22; 4) agricultural raw materials (SITC 2 less 22, 27, 28), fuels (SITC 3) and ores and metals (SITC 27; 28; 68). UNCTAD records data on primary commodities dependence in the export structure and these data are readily available in UNCTAD handbook for statistics. Instead of taking the share of primary commodities in total exports as a measure of primary commodity dependence, measuring the share of manufactured products in total exports provides an indication of the extent to which the country in question has been able to establish forward linkages and reduce its dependence on primary commodities.

Diversification can also be measured with a modified Finger-Kreinin measure[2] of similarity in trade. Such a diversification index is computed by measuring absolute deviation of the country share of trade from world structure and ranges from 0 to 1 reflecting the relative differences between the structure of trade of the country and the world average. However, as a result of its use of absolute value, this index is more difficult to handle in empirical analysis if one does not know exactly which observations have higher or lower shares than the average.

Another way to gain insight in the export diversification structure of a country is to use the Herfindahl concentration index of the exports, such as the normalised index developed by the UNCTAD (1995). It has been normalized to obtain values ranking from 0 to 1 (maximum concentration), according to the following formula:

[2] See Finger, J. M. and M. E. Kreinin (1979), “A measure of ‘export similarity’ and its possible uses”. *The Economic Journal*, 89: 905-12.

$$H_j = \frac{\sqrt{\sum_{i=1}^{239}(\frac{x_{ij}}{X_j})^2} - \sqrt{1/239}}{1-\sqrt{1/239}},$$

where Hj = country j's concentration index;
x_{ij} = value of exports of product i in country j;

$X_j = \sum_1^{239} x_{ij}$ and 239 = number of products (at the three-digit level of SITC, Revision 2) .

The equivalent number (EN) of export sectors is the reciprocal of the Herfindahl concentration index(1/H) and can be directly used as a positive measure of diversification(see e.g. Neff, 1997). The UNCTAD data files contain records of both the Finger-Kreinin diversification index and the Herfindahl index as measure of respectively export diversification and concentration. They also record the shares of manufactured export in total export as well as the degree of dependence on primary commodities.

In this paper, we focus our attention on the dependence on primary commodities and use the normalised Herfindahl index to analyse how it is affected by the various components of basic absorptive capacity. A high share of primary commodities in exports means that the country's diversification is relatively low and is expected to be associated with low levels of human capital and infrastructure. Such a country has a high reliance on products in the sectors of low value-added and low externalities and technological learning takes place only very slowly. Concentration is therefore expected to be decreased by increasing levels of absorptive capacity, at least when the threshold levels have been reached. Looking at the share of manufactured exports to total export inverts the expected signs of the association between the measure of diversification and the independent variables. In our analysis we make use of the normalized Herfindahl index as dependent variable to proxy the (reciprocal of) export diversification. (See appendix A.3 for SSA export diversification data).

For the independent variables, the measurement of the various indicators of absorptive capacity is done as follows:

Human capital: Human capital is a broad concept that does not easily lend itself to measurement, since it is embodied in humans. It comprises, in addition to skills developed through education and formal training, all inherited and acquired skills and abilities, experiences, behaviours and attitudes that contribute to increasing the efficiency of economic activities. In empirical research, the

measure of human capital has usually been a proxy related to educational attainment or literacy, because measures of the other aspects of human capital are more difficult to estimate reliably.
In this paper, we use educational attainment measures proposed by Barro and Lee (2001) in the form of the average number of years of schooling in the population and a measure for literacy as proxies for human capital.

Obviously, a measure of human capital that incorporates aspects of quality to the stock and flow measures given by the educational attainment and enrolment rates would be more attractive. An education measure such as those representing the per capita investment in human capital accumulation can play this role of incorporating quality, following the logic that more resources invested per inhabitant increase not only the number, but also the quality of schools, and therefore the education quality (Hanushek, 1995). However, owing to the lack of reliable data on educational expenditures and their relation to educational quality, such a measure is not used in this paper. Other measures of human capital include the UNDP records of educational attainment based on both literacy and combined gross enrolment rates in the primary, secondary and tertiary educational levels. The educational attainment and literacy data used for SSA countries are reported in appendix A1

Capital formation: Investment in capital accumulation is measured by the ratio of gross fixed capital formation to total GDP. Such a measure has also been used in other studies measuring the role of physical capital accumulation, like Grier (2004). However, in a cross sectional analysis involving countries with a wide range of GDP magnitudes, the ratio may be less informative than the per capita investment. Indeed, a small developing country with a low population may for example be investing the same proportion of its GDP in capital accumulation as a rich, populous industrialised country, but since the outcome of investment in productive facilities is subject to scale economies, the effects of these two investments on diversification may be very different. That is why we use the per capita PPP adjusted investment in capital accumulation here to circumvent this difficulty.

Infrastructure: As a consequence of the multiplicity of its indicators, the measurement of infrastructure is much more complex than the other elements of absorptive capacity. It must take into account diverse aspects related to the public provision of basic facilities that facilitate economic activities in a country. Such basic infrastructures are measured by the density of paved roads and railways to allow transportation, the production of electricity to supply the necessary energy to firms for their production activities, and the telecommunication facilities as measured for instance by the number of main telephone lines available per thousand inhabitants. To circumvent the complexity caused by the diversity of basic infrastructure, we have constructed a measure of basic infrastructure score on the basis of relative density of roads and railways per land area, telephone lines per thousands inhabitants and electricity production in KWH per capita. The infrastructure score has been constructed as follows: for each of the three categories above (transportation, telecommunication, and energy), density has been computed for each country or territory as the total length of roads and railways per land area, total telephone landlines and mobile per thousand inhabitants and total KWH of electricity produced per inhabitant. Then, for each country or territory, a relative score on each category was determined as its categorical density relative to that of the country with the best performance in that category. For example, Germany was found to have the highest density of railways and the relative scores on this category were calculated with respect to the German density. Finally, the country's basic infrastructure provision score was computed as an unweighted average[3] of the different relative scores in each of the categories (see appendix A2 for details about the construction of infrastructure scores, data are reproduced for SSA alone).

Fuels: Finally, the variable related to oil and gas endowment takes the value of the share of fuels in export if the country is crude oil or natural gas exporter and zero otherwise.

Data sources

The data on export diversification, Herfindahl export concentration index and share of oil and other fuels in export were taken from UNCTAD's handbook for statistics in its 2004 and 2005 editions. Data on per capita income are the PPP adjusted per capita GDP reported by UNDP and available in its data files and have sources World Bank income data; educational attainment measures are those developed by Barro and Lee (2001), and were corroborated by UNESCO data from the UIS data files. Data on infrastructure, gross domestic fixed capital formation and land area were collected from the CIA's world fact book in the various yearly editions. Thanks for its extensive networks of information, these data seem highly reliable. All these data have been cross-

[3] The weighting of indicators in a composite index is an unsolvable problem unless one has a good and reliable measure of the underlying phenomenon. Most studies that developed a composite index either gave equal weightings to all indicators or a subjective weighting in simple units(see Arundel, Bordoy and Hollanders (2002), European Innovation Scoreboard 2002, Technical Paper No 6: Methodological Report, p.11)

checked from different sources to increase their reliability and where discrepancies were observed, they were relatively small and these differences could hardly affect the outcome of the regressions.

4. Empirical results

Our empirical analysis begins with the linear model, whose results are analysed in sections 4.1 and 4.2. The model is further extended in section 4.3 with quadratic terms to deepen the analysis of the differences between SSA countries and the rest of the world. In section 4.3 we show that quadratic terms generate threshold effects that can help explain the differences between SSA and other countries.

4.1 Regression results for the log linear model

We begin our data analysis by running various cross-country regressions, distinguishing between SSA countries and non-SSA countries and regressions including the whole sample of 202 countries and territories for which data were available. We start with the sample containing all countries and territories for which we have data to estimate the coefficient of the relationships using the log of the Herfindahl index for the year 2002 as the dependent variable and the Barro & Lee measure of educational attainment for the year 1999 as a proxy for human capital. The score for infrastructure was also calculated for the year 1999 while capital investment was calculated as average gross domestic fixed capital formation per capita over the period 1990-1999. All regressions are performed with White-heteroskedasticity robust standard errors.

Table 1A reports the regression results where regression nr-1 is performed on the full sample cross country data. All coefficients appear with the expected signs and are significant at 1% level, except the coefficient for capital investment, which remains highly insignificant. This is however not surprising since the causality between capital accumulation and diversification could be expected to be ambiguous as in the case of causality between capital accumulation and growth. In the same table 1A, regression nr 3 run on the SSA sub-sample gives a similar picture, though the significance of the coefficients now drops to 5%, except the coefficient for fuels that expresses the dependence on primary commodities that remains highly significant at 1%. Capital accumulation now seems to invert the sign and be positively associated with change in concentration, although its coefficient remains highly insignificant.

Human capital and infrastructure provision seem thus to have a significant correlation with the export diversification. This underscores once again the crucial role played by adequate absorptive capacity in supporting the adoption of technologies that support export diversification. In addition infrastructure is also intensively used by the primary sector itself and is indispensable for its expansion: some countries develop infrastructures that are specific to the exploitation and the transportation of natural resources to the ports for shipment abroad or for the exploitation of agricultural produce.

Such types of infrastructure play therefore a limited role in stimulating the development of other economic activities. A very familiar example of this is the Democratic Republic of Congo where a high electricity production capacity was developed for the exploitation of copper and cobalt mines along with a railway link between the copper (Shaba) province of Katanga in the south east of the country and the port of Matadi on the Atlantic coast for exporting the ores. Moreover, railways are only exploited to a limited extent in many SSA countries and their density very often does not correspond to a proportional economic use relative to other developing and developed countries. In some of the SSA countries, extensive railway networks are often underutilised, if utilised at all in some areas, where seeing a train remains a remarkably rare phenomenon. In some other countries, the roads are also often in very bad maintenance conditions and unpaved ones remain impracticable during the rainy seasons that characterise many SSA countries.

>>>>>>>>>>>>>>>>>Insert table 1A about here<<<<<<<<<<<<<<<<<<

Table 1a : OLS regressions estimates with Barro & Lee measure of educational attainment (average years of education) as a proxy for human capital

The sign and significance of the results come thus to confirm our expectation as they also suggests that the absolute levels of infrastructure and their utilisation, investment and actual capital accumulation as well as educational attainment are still low but have the potential to significantly affect the capabilities of SSA to break through in manufacturing and reduce the heavy dependence on primary commodities.

Another noteworthy result is that population size does not seem to have a sizable influence on explaining diversification differences in SSA countries in contrast to its high significance in explaining global differences and in other developing countries. This may express a somewhat uniform distribution of skills and economic activities across population groups in SSA and a low level of dissemination of specific knowledge and skills. Indeed, when the skills are similar and homogeneously distributed across the population, there are less diversification benefits to be gained from a larger population size in a country.

4.2 Is SSA really different?

Africa is badly endowed with educated labour, and Wood (2000) has suggested that this is part of the explanation for Africa's lack of competitiveness in manufacturing. A comparison of the rate of return to human and physical capital in African manufacturing across five countries finds that the returns to human capital are systematically much lower than to physical capital (Bigsten *et al*., 1998). Low productivity is often attributed to a poorly educated labour force and defective or poor infrastructure.

The differences observed in regression results between the two samples, though small, call for further investigation of the contrast between SSA countries and other parts of the world. We check whether the above claims are supported by empirical evidence by performing the same regression on the sub-sample of only developing countries and removing all SSA countries to allow a comparison. For simplicity in this operation, we take for developing countries in this sample only those whose PPP-adjusted per capita income was below US$ 11,000 in 1999. If the difference is due, as we conjecture, to an overall low level of infrastructure, educational attainment, capital accumulation and a correspondingly low level of diversification, then running the regression on a sub-sample of non-SSA developing countries enables us to observe differences in the significance of the estimated coefficients as well as in the explained variances. This is precisely what happens in regression nr 2 of table 1A, whose adjusted R-square is visibly higher, indicating that more variance is explained by the model in this sub-sample.

The significance of educational attainment vanishes, while that of infrastructure and population size as explanatory variable for diversification pattern increases tremendously as their p-values come again below 1%. This would tend to suggest that differences in diversification pattern in the other developing countries are more explained by the differences in infrastructure provision and population specialisation rather than by differences in educational attainment. We also note the higher and significant coefficient for infrastructure, meaning that if non SSA developing countries could increase their infrastructure level from their average of 0.10% of the most advanced countries to, say, 15%, which is a 50% increase, this would corresponds to a reduction of the export concentration index of 0.21*50%, or about 10% point on the normalised index from their average of 0.38 to almost 0. 34. Coefficients for SSA are somewhat lower.

Consistent with the Dutch disease hypothesis, the presence of natural resources tends to reduce the share of manufactured products in export and thus hamper export diversification. In this regression, coefficient implying a positive relationship between population size and export diversification becomes highly significant again, confirming the idea that some relationships that are unobserved in SSA because of the too low values of the underlying driver of diversification may well be observed elsewhere in countries where the values are higher.

The same regression run on the full sample but now using a different measure for human capital, namely the literacy rate (percentage of population 15 years old and above that can read and write) that was present in 1999 confirms the reasoning above (regression nr 4 in Table 1B). All coefficients come with the expected sign and are all significant at 1% level with the exception of capital accumulation. The regression results confirm our expectation that export diversification recorded in 2002 increased across countries with the increase of the measure of literacy that was present in the country three years earlier, as well as with the relative infrastructure density. If we exclude SSA countries from the sample, the regression results as reported in table 1B (regr. nr 5) show the same picture, be it at a significance level of 5% this time.

>>>>>>>>>>>>>>>>Insert table 1B about here<<<<<<<<<<<<<<<<<<<<

Table 1B: OLS estimates using literacy as proxy for human capital

In the regressions excluding the SSA countries (regressions nr 5 and 6 in table 1B), the coefficient for population becomes again highly significant, meaning that some differences in export diversification for non-SSA countries are attributable to differences in population size. The regression results confirm our expectation that exports concentration recorded in 2002 was a decreasing function of the measure of literacy that was present in the country three years earlier, and of the level of basic infrastructure provision. It is interesting to note that infrastructure coefficients remain significant throughout all regressions. The significance of all three variables is remarkable although the explanatory power measure of the regression decreased somehow.

In contrast, SSA displays a completely different picture since apart from fuels that are significant across regressions, only the infrastructure provision remains significant at 5% (regr nr 7, table IB). The estimated coefficients for human capital, population and capital investment in the SSA sub-sample remain insignificant, which suggests that the relationship between these elements of absorptive capacity and export diversification is not observable when literacy is used to measure human capital. In regression nr 6, we also note the insignificance of the literacy coefficient, implying that diversification differences within developing countries are less explained by differences in literacy than by global differences. The relationships between the various components of absorptive capacity and the resulting potential for export diversification seem to present a different picture in SSA as compared to the rest of the world or to other developing countries irrespective of the measure of human capital we use.

4.3 Quadratic model and threshold level effects

In order to gain a closer view of the contrast between Sub-Saharan African countries and the rest of the developing world in the relationship between its components of absorptive capacity and its export diversification, we investigate whether the relationship displays threshold effects by augmenting the above model with quadratic terms for human capital, infrastructure, investment and population in the regression. The regression equation thus obtained is therefore:

$$\mathit{ln}(\text{DIV}) = \beta_0 + \beta 1 * \mathit{ln}(\text{HUMCAP}) + \beta_2 * \mathit{ln}(\text{INFRAST}) + \beta_3 * \mathit{ln}(\text{CAPINVEST}) + \beta_4 * \mathit{ln}(\text{FUELS})$$
$$+ \beta_5 * \mathit{ln}(\text{POPUL}) + \beta_6 * [\mathit{ln}(\text{HUMCAP})]^2 + \beta_7 * [\mathit{ln}(\text{INFRAST})]^2 + \beta_8 * [\mathit{ln}(\text{CAPINVEST})]^2$$
$$+ \beta_9 + * [\mathit{ln}(\text{POPUL})]^2 + \varepsilon \qquad (5)$$

Table II presents the regression results that allow us to analyse the difference between SSA and the other developing countries. The results in regressions 8 and 9 allow to compare the two sub-samples on the basis of literacy as a measure of human capital and displays remarkably significant quadratic terms for literacy, infrastructure and physical capital accumulation. We note that the log linear and the log quadratic terms have negative coefficient with respect to the log of the Normalized Herfindahl index. From the value of the coefficients in regression 8 for SSA countries, we can compute the constrained maximum for literacy with regard to the concentration index, or, in other words, its minimum value for its association with more export diversification.

>>>>>>>>Insert table II about here<<<<<<<<<<<<<<<<<

Table II: OLS estimates of threshold effects

The partial regression relation with respect to literacy is:

$$\mathit{ln}\ (\mathit{Herfindex}) = \sim + \mathit{constant} + 4.5804 * \mathit{ln}(\mathit{LITERACY}) - 0.6598 * (\mathit{ln}(\mathit{LITERACY}))^2 \qquad (6)$$

where ~ stands for the remaining regressors. Taking the partial derivative with respect to *ln*(LITERACY), for a fixed left-hand side value and setting the partial derivative to zero, we can solve for the maximum value of *ln* (LITERACY) in this comparison or minimum positive association with export diversification of 3.47, corresponding to a literacy rate of approximately 32.17. Only for values above this maximum we get the effect of enhancing diversification. The SSA average is above this value. As can be seen in the literacy data for SSA in appendix A1, some SSA countries still have a literacy rate below this level while many others are around or only slightly above it. However, the maximum value holds for the panel and not necessarily for single countries.

Likewise, looking at the coefficients for infrastructure we can compute the threshold level for infrastructure to be associated with more export diversification. The constrained (partial) extremum is given by differentiating the equation:

$$ln(Herfindex) = -0,1899*[ln(INFRAST)]^2-1,7637*ln(INFRAST)+constant+ \sim \quad (7)$$

with respect to ln(INFRAST) and setting the derivative equal to zero. We obtain a maximum at the point where ln(INFRAST)=-4,64, i.d. where infrastructure score is equal to 0,01. The SSA average of the infrastructure variable is larger than the threshold level, which implies that SSA as a whole could gain diversification benefits from increased infrastructure provision. Again, from the data in appendix A2, we note that although a large number of SSA countries are above this threshold, many SSA countries still have an infrastructure score that is close to or even below this calculated minimum level for diversification, though this minimum obtained for the panel does not necessarily hold for single countries.

By comparison, the same regression run on a the sub-sample of non-SSA developing countries (regr. nr 9 in table II) does not present a significant log quadratic term for literacy, which confirms the earlier highlighted contrast. The significance of both the linear and the quadratic term in infrastructure to the contrary, is visible in both sub-samples and presents the same pattern, though the coefficients are somewhat larger in SSA. The appearance of a significantly positive quadratic term with a negative linear coefficient for the log of capital accumulation also reinforces the impression that countries with a more concentrated export structure tend to invest more in the accumulation of capital, most probably related to the exploitation of abundant resources.

When the Barro & Lee measure of educational attainment in average number of years of schooling is used for human capital variable, the quadratic term loses its significance in any of the SSA or other developing countries sub-samples (regressions 8a and 9a in table II). The adjusted R-squared of this regression also drops considerably, implying a better performance of literacy measure in explaining diversification differences. While we expected these effects to be present irrespective of the used human capital measure, their absence in regression 8a and 9a may suggests that differences in average number of years of schooling, educational attainment are relatively low across low income countries and do not sufficiently reflect human capital differences and therefore fail to explain export diversification differences. The higher adjusted R-squared values for regressions 8 and 9 as compared to 8a and 9a also justify the relative superiority of literacy in explaining cross country differences in diversification.

Before drawing any conclusion about these results, we need to be reasonably assured that they are free from any gross misspecification errors and biases. For example, the independent variables are strongly related to per capita income and failing to include income in the previous regressions could possibly imply a missing variable bias. It is reasonable to expect that, *ceteris paribus*, rich countries in terms of per capita GDP level will tend to have more diversified exports because they export a relatively higher total value of goods and services. Other elements such as openness, trade policies and institutions also have an influence on export diversification. Countries that export more are more likely to be open to trade in terms of trade restrictions, tariff and non-tariff barriers and other impediments. Various measures of trade openness exist which can be used to control for this dimension in the regression. Many other factors[4] such as research and development efforts, market size and institutions like property rights and incentive regimes also play a role in stimulating diversification.

5. Summary and conclusions

Both the problems resulting from dependence on primary commodities in developing countries and the technological learning benefits attributable to diversification form the background of this inquiry into the factors affecting diversification and their effects on reducing primary commodity dependence. In this paper, we have examined some of the factors that affect the level of export diversification and quantified their effect in a cross-sectional analysis. Our empirical results show that human capital stocks, infrastructure and population size significantly explain part of the cross-country differences in export diversification, while the endowment in natural resources constitutes a strong impediment to diversification across all countries. Overall, the level of investment in physical capital accumulation does not seem to significantly explain the observed differences: if

[4] The effect of some of the institutional and policy variables on economic performance have been analysed in previous studies and do not necessitate to be dwelled on again here. Because there are many other factors affecting the diversification that cannot all be included in our specification, our estimated coefficients are likely to be slightly overestimated. However, even the inclusion of per capita GDP as a regressor to control for its effect turned out to lead to insignificant coefficients and has not yielded any additional information. Attempting to include more factors in our model would make it unnecessarily complex and reduce its usefulness.

anything, capital accumulation seems to go in hand with the exploitation of primary commodities in SSA[5].

A comparison of SSA countries with the rest of the world reveals that for human capital and infrastructure to lead to more diversification, some threshold levels in their indicators must be in place. Many SSA countries have levels of infrastructure and human capital stock that are below or around these thresholds, implying their that their absorptive capacity is still too low to materially influence export diversification. Although the density of infrastructure matters in explaining diversification differences among SSA countries, infrastructure and investments are often associated with the exploitation of primary commodities, therefore sometimes barely benefiting the other sectors of the economy. The levels of educational attainment in average years of schooling also do not seem to unambiguously explain intra SSA differences as the measures of human capital stocks remain relatively low overall in the continent. Also in contrast to the rest of the (developing) world, difference in population size do not correspond to differences in diversification, suggesting lower levels of regional or specific specialisation. The low level of basic infrastructure and human capital stock seems thus to be one of the reasons why SSA has continuously been falling behind by all standards of economic, social and technological development.

Deriving useful lessons from empirical observations is therefore often a much more difficult exercise that requires more diligence than that needed for observing and discerning the empirical relationships. Temple and Voth (1998) suggest that a policy of subsidy to equipment investment for stimulating industrialisation may be dominated by other policies. However the deviation in SSA of the relationship between human capital, infrastructure, capital stock investment on the one hand and diversification on the other implies that these three factors deserve a high level of attention. These results are consistent with the idea of threshold levels of human and physical capital for technological learning and technology diffusion. This observed relationship between the

[5] In interpreting the results of the regression, the causality issue is crucial. Finding a statistical association is not enough to derive conclusions about the causality between the dependent and the independent variables. One of the ways to deal with this issue is to examine causality with the Granger method based on the idea that causes precede effects in time. In our cross sectional analysis it is unfortunately not possible to test causality between the dependent and the independent variables with the Granger method. However, we implicitly incorporate this idea of causality by using lagged values of the dependent variable to be explained by the values of the independent that were measured a number of years before, to allow for these effects to take place. For education, a time lag of 3 years was chosen for their effects to manifest themselves while one year of lag was judged sufficient for capital investment. The constraints on consecutive data availability did not allow a panel analysis which would have permitted to better incorporate the time and causality effects.

components of absorptive capacity in SSA and its diversification level needs to be brought in line with that in the rest of the world through a strong investment in human capital accumulation and a significant increase in infrastructure provision so that a strong basis for a diversified production system can be laid.

References

Abramovitz, M. (1986). Catching up, forging ahead, and falling behind. *Journal of Economic History*, 385-406.

Al-Marhubi, F. (2000). "Export Diversification and Growth: An empirical Investigation" *Applied Economics Letters* 7, pp. 559-562

Amin Guitiérrez de Piñeres, S. and M. J. Ferrantino (2000). *Export dynamics and economic growth inLatin America*, Ashgate Publishing Ltd

Auty, R.. (1994). "Industrial Policy Reform in Six Large Newly Industrialising Countries: The Resource Curse Thesis". *World Development 22*, *January 1994, pp.11-26*.

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. and J- W. Lee (2000). "International Data on Education Attainment : Update and Implications". *NBER Working Paper, w7911*

Barro, R. and J-W. Lee (2001). International Data on Educational Attainment, *Oxford Economic Papers* 3, 541-563.

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". FRBSF *working paper2003/02*

Bigsten, A.., P. Collier, S. Dercon, M. Fafchamps, B. Gauthier, J.W. Gunning, A. Isaksson, A.. Oduro, and R.Oostendorp(1998). "Rates of Return on Physical and Human Capital in Africa's Manufacturing Sector ". *The Centre for the Study of African Economies Working Paper Series*. Working Paper 76.

Blomstrom, M., R. Lipsey and M. Zejan (1994). "What explains Growth in Developing Countries?" in: *What Lies Behind Convergence*.

Burnside, C and D. Dollar(1997). "Aid, Policies, and Growth". *World Bank Policy Research Working Paper* No. 569252.

Cohen, W. and D. Levinthal (1989). "Innovation and Learning: the Two Faces of R&D" . Economic Journal,99 pp.569-596

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

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

Collier, P. and J.W. Gunning (1999). "Explaining African Economic Performance". *Journal of Economic Literature*, *vol. 37*.

Collier, P. and C. Pattillo (eds.)(1998). *Investment and Risk in Africa*. London: Macmillan.

Dahlman, C. and R. Nelson (1995). "Social Absorption Capability, National Innovation Systems and Economic Development in Social Capability and Long Term Economic Growth". B. Koo and D. Perkins: 82-122.

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

De Long, J.B. and L. Summers (1991). "Equipment Investment and Economic Growth". *Quarterly Journal of Economics, pp445-502*.

De Long, J.B. and L. Summers (1992). "Equipment Investment and Economic Growth: How Strong is the Nexus?" *Brookings Papers on Economic Activity*.

Eaton,J. and S. Kortum (2001). "Trade in Capital Goods," *European Economic Review* vol. 45(7), pages 1195-1235.

Greene, W. H. (2000). *Econometric Analysis* (4th edition). NJ: Prentice Hall.

Grier, R. (2003). "The Interaction of Human and Physical Capital Accumulation: Evidence from Sub-Saharan Africa". *Working paper, University of Oklahoma, Norman, OK*.

Gylfason, T. (2004). "Natural Resources and Economic Growth: From Dependence To Diversification". *CEPR Discussion Paper No. 4804 December 2004*.

Hanushek, E. (1995). "Interpreting Recent Research on Schooling in Developing Countries". *World Bank Reseanch Observer,10 August1995, pp. 230-244*.

Herzer, D. (2005). "Exportdiversifizierung und Wirtschaftswachstum in Chile: Eine Őkonometrische Analyse". *Jahrbuch fur Nationalöconomie und Statistik. Vol. 225, pp. 163-180.*

Hoff, K. and J. Stiglitz (2002). "Obstacles to the Emergence of the Rule of Law in Post-Communist Societies: Coordination Failures and Conflicts of Interest". *Mimeo*, *World Bank, Washington, D.C.*

Howitt, P and P. Aghion (1998). "Capital Accumulation and Innovation as Complementary Factors in Long-Run Growth". *Journal of Economic Growth,3, june 1998, pp.111-130*

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

Kronenberg, T. (2004). "The Curse of Natural Resources in the Transition Economies". Economics of Transition, Vol. 12, No. 3, pp. 399-426.

Lall, S. (1992). "Technological Capabilities and Industrialization". *World Development, Vol. 20, pp. 165-86.*

Lewis, A. (1969). *Aspects of Tropical Trade 1883-1965.* Almqvist and Wicksell, Stockholm.

Lipsey, R. and Kravis (1987). "Is the U.S. a Spendthrift Nation?" *NBER Working Paper No.* W2274.

Meier, G. M. and J.E. Rauch (2000). *Leading Issues in Economic Development* (7th ed.) Oxford University Press, Oxford.

Neff, T. (1997) " Improving energy security in Pacific Asia: Diversification and Risk Reduction for Fossil and Nuclear Fuels" Project Commissioned by the Pacific Asia Regional Energy Security (PARES) Massachusetts Institute of Technology, Center for International Studies

Psacharopoulos, G. (1985). "Returns to education: A Further International Update and Implications". *Journal of Human Resources,20* (Fall 1985), pp.583-604.

Psacharopoulos, G. (1991). *The economic Impact of Education: lessons for Policymakers.* ICS Press, San Francisco.

Sachs, J. D. and A. M. Warner (1997). "Natural resources Abundance and Economic Growth". *Harvard Institute for International Development, Novemebr 1997, pp.1-25.*

Sachs J. D., J. W. McArthur, G. Schmidt-Traub, M. Kruk, C. Bahadur, M. Faye, and G. McCord1(2004). "Ending Africa's Poverty Traps". *Brookings Papers in Economics.*

Temple, J. (2001). "Growth effects of Education and Social Capital in the OECD Countries". *OECD Economic Studies, no 3, pp. 57-101.*

Temple, J and H-J. Voth (1998). "Human Capital, Equipment Investment and Industrialisation". *European Economic Review 42, pp.1343-1362.*

UNCTAD (2002). Diversification of Production and Export in Commodity Dependent Countries, Including Single Commodity Exporters for Industrialisation and Development Taking into Account the Special Needs of the LDCs. *Background note for expert meeting, Geneva 26-28 June 2002.*

UNCTAD (2004). *UNCTAD Handbook of Statistics 2004*. UNCTAD, Geneva.

UNCTAD (2005). *UNCTAD Handbook of Statistics 2005*. UNCTAD, Geneva.

Wood, A. (2000). "Land vs labour: Diverging paths of export growth". *ID21 Insights Communicating Development Research.*

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

Table IA: OLS regressions estimates for the full sample ,SSA sub sample and non SSA developin countries with Barro&Lee measure of educational attainment (average years of education) as a proxy for human capital.

Dependent variable: normalized Herfindahl index(log)			
Regression nr	***1. All countries***	***2. Non-SSA, developing***	***3. SSA countries***
Variable(log)			
CONSTANT	1.8151**	1.3238**	-0.03682
	(0.8377)	(0.0227)	(1.6473)
EDUC Attainment	-0.3270***	-0.1031	-0.2016**
	(0.1181)	(0.1796)	(0.1084)
INFRAST	-0.1413**	-0.2137***	-0.1911**
	(0.0635)	(0.0764)	(0.1046)
CAPINVEST	-0.0397	-0.0309	0.0229
	(0.0666)	(0.1264)	(0.0806)
FUELS	0.1138***	0.1826***	0.0822***
	(0.0378)	(0.0395)	(0.0302)
POPUL	-0.1606***	-0.1967***	-0.0775
	(0.0190)	(8.67)	(0.0577)
Prob>F-test	0.0000	0.0000	0.0111
Adj. R-squared	0.3335	0.4784	0.2410
Root MSE	0.7058	0.4891	0.4183
No. obs	193	96	41

White-heteroskedastisity robust standard errors in parentheses;
*** = significant at 10%; ** =significant at 5%; *** significant at 1%.**

Table IB: OLS estimates using literacy as proxy for human capital

Dependent variable: normalized Herfindahl index (log)					
	Regression nr	***4: All countries***	***5: Non-SSA countries***	***6: Non-SSA, developing***	***7: SSA countries***
Variable (log)					
CONSTANT		3.5777***	4.7400***	4.1216	-0.3415
		(0.9306)	(1.2593)	(1.4748)	(1.5870)
LITERACY99		-0.4649***	-0.6207**	-0.3016	-0.1921
		(0.1615)	(0.2852)	(0.2522)	(0.2155)
INFRAST		-.1697***	-0.1161**	-0.1489**	-0.2383**
		(0.0514)	(0.0629)	(0.0699)	(0.1044)
CAPINVEST		-0.0462	-0.0628	-0.1266*	0.1742
		(0.0656)	(0.0932)	(0.0731)	(0.0815)
FUELS		0.1220***	0.1317***	0.1899***	0.0903**
		(0.0371)	(0.0513)	(0.0374)	(0.0302)
POPUL		-0.1800***	-0.1924***	-0.2074***	-0.0960
		(0.0190)	(0.0184)	(0.0217)	(0.0615)
Prob>F-test		0.0000	0.000	0.0000	0.0212
Adj. R-squared		0.3303	0.2802	0.4953	0.2190
Root MSE		0.7079	0.1560	0.4835	0.4243
No. obs		194	148	97	46

**White-heteroskedastisity robust standard errors in parentheses; * = significant at 10%;
** = significant at 5%; *** = significant at 1%**

Table II: OLS estimates with quadratic terms for thresholds level effects

Dependent variable: normalized Herfindahl index(log)				
Regr. nr	***8. SSA countries (literacy)***	***8a SSA countries (ed. attainment)***	***9. Non-SSA, dev. countries (literacy),***	***9a . Non-SSA, dev. (ed. attainment)***
Variable (log)				
CONSTANT	16.7827**	1.1365	30.8475*	1.9664
	(7.1577)	(5.1230)	(6.5382)	(1.6623)
EDUC attainm		-0.1477		-1.1697
		(0.1204)		(0.1770)
LITERACY	4.5804***		-9.7233	
	(1.6968)		(6.5382)	
INFRAST	-1.7637***	-0.0690	-0.8327***	-0.6398***
	(0.6064)	(0.5833)	(0.2377)	(0.1982)
CAPINVEST	-3.9008***	0.2272*	-1.5673	-0.1181
	(1.0827)	(0.1185)	(1.7715)	(0.0995)
FUELS	0.0824**	0.0727**	0.1660***	0.1723***
	(0.0376)	(0.0334)	(0.0365)	(0.0397)
POPUL	-1.2211	-0.4725	0.1806	-0.1460
	(0.7722)	(0.7116)	(0.1605)	(0.1814)
EDUC attainm quadratic		-0.0370		0.0366
		(0.0252)		(0.0488)
LITTERACY quadratic	-0.6598***		1.1161	
	(0.2381)		(0.7831)	
INFRAST quadratic	-0.1899**	0.0270	- 0.1105***	-0.0797***
	(0.0801)	(0.0827)	(0.0367)	(0.0272)
CAPINVEST quadratic	0.1949***	-0.005	0.0638	0.0033
	(0.0546)	(0.0045)	(0.0802)	(0.0050)
POPUL quadratic	0.0374	0.0128	-0.0007	0.0010
	(0.0243)	(0.0224)	(0.0051)	(0.0058)
Prob>F-test	0.000	0.014	0.000	0.000
Adj. R-squared	0.4450	0.3112	0.5383	0.5220
Root MSE	0.3770	0.4200	0.4657	0.4558
No. observ	46	41	97	87

White-heteroskedastisity robust standard errors in parentheses; * = significant at 10%; ** = significant at 5%; * significant at 1%.**

APPENDIX A1: SSA countries and their educational attainment

Country	Pop2002	GDP2002	literacy99	Barro&Lee99
Angola	11190786	2130	66.80	n.a
Benin	7162921	1070	33.6	3..32
Botswana	1640115	8170	76.29	6.23
Burkina Faso	13925313	1100	26.60	2.11
Burundi	6370609	630	46.80	1.23
Cameroon	16380005	2000	70.00	4.15
Cape Verde	418224	5000	72.92	n.a
Central African Republic	3799897	1170	45.33	3.42
Chad	9826419	1020	41.00	2.21
Comoros	671247	1690	55.67	na
Congo, Democratic Republic of the	60085804	700	65.50	4.14
Congo, Republic of the	3039126	800	79.49	5.75
Cote d'Ivoire	17298040	1500	47.65	5.16
Djibouti	476703	1990	67.90	2.10
Equatorial Guinea	535881	3130	85.70	2.14
Ethiopia	73053286	780	37.96	1.97
Gabon	1389201	6590	63.20	2.33
Gambia, The	1593256	1720	40.10	3.02
Ghana	21029853	2130	70.32	5.67
Guinea	9467866	2100	35.90	1.86
Guinea-Bissau	1416027	710	42.40	0.95
Kenya	33829590	1020	81.35	4.74
Lesotho	1867035	2420	82.94	3.62
Liberia	3482211	840	52.12	3.35
Madagascar	18040341	740	68.90	2.58
Malawi	12158924	580	59.29	3.63
Mali	12291529	930	24.92	1.20
Mauritania	3086859	2220	39.73	n.a
Mauritius	1230602	10810	84.07	6.45
Mozambique	19406703	1050	42.86	1.38
Namibia	2030692	6210	81.32	7.11
Niger	11665937	800	15.48	1.39
Nigeria	1.29E+08	860	62.51	2.98
Reunion	776948	5700	88.90	na
Rwanda	8440820	1270	65.53	2.98
Senegal	11126832	1580	36.47	3.15
Seychelles	81188	8232	91.90	7.48
Sierra Leone	6017643	520	29.60	3.13
Somalia	8591629	520	37.60	na
Sudan	40187486	1820	56.48	2.65
Swaziland	1173900	4550	78.96	5.78
Tanzania	36766356	670	73.84	3.09
Togo	5681519	1480	55.81	4.62
Uganda	27269482	1390	66.01	4.31
Zambia	11261795	840	77.26	5.97
Zimbabwe	12746990	2400	87.87	5.99

Source: UNDP CD-ROM

APPENDIX A2: Construction of the infrastructure index
(Excerpt for SSA countries)

Country	Area	Pop	Tel	Mob	Roads km	Railw km	Elec Prod kwh	Road density	Raild ensity	Tel density	Electr pc	Road score	Rail score	Tel score	Ener score	Infra score
Angola	1246700	11190786	96300	130000	51429	2761	1.71E+09	0.04	0.00	0.02	152.54	0.01	0.02	0.01	0.01	0.01
Benin	112620	7460025	66500	236200	6787	578	2.85E+08	0.06	0.01	0.04	38.23	0.01	0.04	0.02	0.00	0.02
Botswana	600370	1640115	142400	435000	10217	888	9.3E+08	0.02	0.00	0.35	567.03	0.00	0.01	0.20	0.03	0.06
Burkina Faso	274200	13925313	65400	227000	12506	622	3.61E+08	0.05	0.00	0.02	25.92	0.01	0.02	0.01	0.00	0.01
Burundi	27830	6370609	23900	64000	14480	0	1.32E+08	0.52	0.00	0.01	20.72	0.10	0.00	0.01	0.00	0.03
Cameroon	475440	16380005	110900	1077000	34300	1008	3.57E+09	0.07	0.00	0.07	218.01	0.01	0.02	0.04	0.01	0.02
Cape Verde	4033	418224	71700	53300	1100	0	43080000	0.27	0.00	0.30	103.01	0.05	0.00	0.17	0.01	0.06
Central African Republic	622984	3799897	9000	13000	23810	0	1.06E+08	0.04	0.00	0.01	27.90	0.01	0.00	0.00	0.00	0.00
Chad	1284000	9826419	11800	65000	33400	0	96130000	0.03	0.00	0.01	9.78	0.01	0.00	0.00	0.00	0.00
Comoros	2170	671247	13200	2000	880	0	23840000	0.41	0.00	0.02	35.52	0.08	0.00	0.01	0.00	0.02
Congo, Democratic Republic of the	2345410	60085804	10000	1000000	157000	5138	6.09E+09	0.07	0.00	0.02	101.29	0.01	0.02	0.01	0.01	0.01
Congo, Republic of the	342000	3039126	7000	330000	12800	894	3.48E+08	0.04	0.00	0.11	114.51	0.01	0.02	0.06	0.01	0.02
Cote d'Ivoire	322460	17298040	328000	1236000	50400	660	4.76E+09	0.16	0.00	0.09	275.12	0.03	0.02	0.05	0.02	0.03
Djibouti	23000	476703	9500	23000	2890	100	1.8E+08	0.13	0.00	0.07	377.59	0.02	0.03	0.04	0.02	0.03
Equatorial Guinea	28051	535881	9600	41500	2880	0	26690000	0.10	0.00	0.10	49.81	0.02	0.00	0.05	0.00	0.02
Ethiopia	1127127	73053286	435000	97800	33297	681	2.15E+09	0.03	0.00	0.01	29.42	0.01	0.00	0.00	0.00	0.00
Gabon	267667	1389201	38400	300000	8464	814	1.16E+09	0.03	0.00	0.24	835.73	0.01	0.02	0.14	0.05	0.05
Gambia, The	11300	1593256	38400	100000	2700	0	90310000	0.24	0.00	0.09	56.68	0.05	0.00	0.05	0.00	0.02
Ghana	239460	21029853	302300	799900	46176	953	6.92E+09	0.19	0.00	0.05	329.15	0.04	0.03	0.03	0.02	0.03
Guinea	245857	9467866	26200	111500	30500	837	8.55E+08	0.12	0.00	0.01	90.31	0.02	0.03	0.01	0.01	0.02
Guinea-Bissau	36120	1416027	10600	1300	4400	0	55000000	0.12	0.00	0.01	38.84	0.02	0.00	0.00	0.00	0.01
Kenya	582650	33829590	328400	1590800	63942	2778	4.48E+09	0.11	0.00	0.06	132.28	0.02	0.04	0.03	0.01	0.02
Lesotho	30355	1867035	28600	92000	5940	0	3.14E+08	0.20	0.00	0.06	168.18	0.04	0.00	0.04	0.01	0.02
Liberia	111370	3482211	7000	2000	10600	490	4.89E+08	0.10	0.00	0.00	140.37	0.02	0.03	0.00	0.01	0.02
Madagascar	587040	18040341	59600	279500	49827	732	8.4E+08	0.08	0.00	0.02	46.57	0.02	0.01	0.01	0.00	0.01
Malawi	118480	12158924	85000	135100	28400	797	1.09E+09	0.24	0.01	0.02	89.48	0.05	0.05	0.01	0.01	0.03
Mali	1240000	12291529	56600	250000	15100	729	7E+08	0.01	0.00	0.02	56.95	0.00	0.00	0.01	0.00	0.01

Mauritania	1030700	3086859	31500	300000	7660	0	1.9E+08	0.01	0.00	0.11	61.62	0.00	0.00	0.06	0.00	0.02
Mauritius	2040	1230602	348200	462400	2000	0	1.84E+09	0.98	0.00	0.66	1491.95	0.19	0.00	0.37	0.09	0.16
Mozambique	801590	19406703	83700	428900	30400	3123	8.86E+09	0.04	0.00	0.03	456.49	0.01	0.03	0.01	0.03	0.02
Namibia	825418	2030692	127400	223700	42237	2382	1.17E+09	0.05	0.00	0.17	574.68	0.01	0.02	0.10	0.03	0.04
Niger	1267000	11665937	22400	24000	10100	0	2.66E+08	0.01	0.00	0.00	22.82	0.00	0.00	0.00	0.00	0.00
Nigeria	923768	1.29E+08	853100	3149500	194394	3557	1.99E+10	0.21	0.00	0.03	154.15	0.04	0.03	0.02	0.01	0.02
Reunion	2517	776948	300000	489800	1214	0	1.17E+09	0.48	0.00	1.02	1500.74	0.09	0.00	0.57	0.09	0.19
Rwanda	26338	8440820	23200	134000	12000	0	1.67E+08	0.46	0.00	0.02	19.75	0.09	0.00	0.01	0.00	0.02
Senegal	196190	11126832	228800	575900	14576	906	1.74E+09	0.07	0.00	0.07	156.11	0.01	0.04	0.04	0.01	0.03
Seychelles	455	81188	21700	54500	373	0	2.18E+08	0.82	0.00	0.94	2685.13	0.16	0.00	0.53	0.16	0.21
Sierra Leone	71740	6017643	24000	67000	11300	0	2.55E+08	0.16	0.00	0.02	42.43	0.03	0.00	0.01	0.00	0.01
Somalia	637657	8591629	100000	35000	22100	0	2.36E+08	0.03	0.00	0.02	27.42	0.01	0.00	0.01	0.00	0.00
Sudan	2505810	40187486	900000	650000	11900	5995	2.58E+09	0.00	0.00	0.04	64.22	0.00	0.02	0.02	0.00	0.01
Swaziland	17363	1173900	46200	88000	3107	301	4.02E+08	0.18	0.02	0.11	342.45	0.03	0.13	0.06	0.02	0.06
Tanzania	945087	36766356	149100	891200	88200	3690	2.73E+09	0.09	0.00	0.03	74.17	0.02	0.03	0.02	0.00	0.02
Togo	56785	5681519	60600	220000	7520	568	1.09E+08	0.13	0.01	0.05	19.15	0.03	0.08	0.03	0.00	0.03
Uganda	236040	27269482	61000	776200	27000	1241	1.78E+09	0.11	0.01	0.03	65.09	0.02	0.04	0.02	0.00	0.02
Zambia	752614	11261795	88400	241000	91440	2173	8.17E+09	0.12	0.00	0.03	725.20	0.02	0.02	0.02	0.04	0.03
Zimbabwe	390580	12746990	300900	379100	18338	3077	8.84E+09	0.05	0.01	0.05	693.42	0.01	0.06	0.03	0.04	0.04

Infrastructure score is constructed in the following way: the land area data are the CIA world Factbook data on land mass excluding territorial or inland waters, Population data are also data on total population in the reference year 1999.The columns Tel, Mob, RoadsKM, and RailwaysKm represent respectively the number of total telephone landlines, number of mobile lines, total roads length in kilometres and total railways in kilometres. The next column is the total yearly electricity production in kilowatt hours. Road density and rail density are obtained by respectively dividing the total road length and rail length by the land mass. Telephone density is obtained by dividing the sum of land and mobile lines by the population size, while Electricity pc column representing the per capita electricity production is obtained by dividing the total production of electricity by the population size. Then, for each of the four density columns, the maximum density has been identified, relative to which a density score could be determined for each country. These scores are reported in the columns called road score, rail score tel. score and Enerscore. Finally, the basic infrastructure score was calculated as an unweighted average of these various partial scores.

Appendix A3: Percentage of fuels in total exports, normalised Herfindahl export concentration index and number of export products for SSA countries for the year 2002

Country	*Fuels*	*Herfindahl index*	*Number exp prod*
Angola	93.50	0.89	61.00
Benin	0.40	0.46	42
Botswana	0.10	0.83	113.00
Burkina Faso	0.00	0.60	53.00
Burundi	0.00	0.65	12.00
Cameroon	49.40	0.46	89.00
Cape Verde	48.50	0.48	12
Central African Republic	0.10	0.52	11.00
Chad	0.00	0.74	28.00
Comoros	0.00	0.88	5.00
Congo, Dem. Republic	3.60	0.70	33.00
Congo, Rep. of the	87.60	0.74	50.00
Cote d'Ivoire	12.80	0.43	138.00
Djibouti	0.00	0.13	58.00
Equatorial Guinea	89.00	0.90	20.00
Ethiopia	0.00	0.41	36.00
Gabon	83.30	0.81	58.00
Gambia, The	0.10	0.33	26.00
Ghana	4.90	0.38	127.00
Guinea	0.10	0.55	32.00
Guinea-Bissau	0.00	0.73	13.00
Kenya	19.20	0.30	166.00
Lesotho	0.00	0.35	32.00
Liberia	0.00	0.65	5.00
Madagascar	2.60	0.34	90.00
Malawi	0.00	0.61	50.00
Mali	1.90	0.71	139.00
Mauritania	0.00	0.53	44.00
Mauritius	0.00	0.28	154.00
Mozambique	0.00	0.55	69.00
Namibia	0.70	0.36	162.00
Niger	1.60	0.47	38.00
Nigeria	99.60	0.89	53.00
Reunion	0.20	na	na
Rwanda	6.80	0.50	7.00
Senegal	22.70	0.29	122.00
Seychelles	40.00	0.49	12.00
Sierra Leone	0.00	0.86	12.00
Somalia	0.00	0.43	52.00
Sudan	69.20	0.59	54.00
Swaziland	0.00	0.45	135.00
Tanzania	1.30	0.31	92.00
Togo	0.50	0.32	59.00
Uganda	0.10	0.29	89.00
Zambia	2.10	0.50	103.00
Zimbabwe	1.10	0.14	188.00

Source: UNCTAD Handbook of Statistics, 2004; 2005

The UNU-MERIT WORKING Paper Series

2006-001 *A Knowledge Economy Paradigm and its Consequences* by Luc Soete.

2006-002 *Public-Private Sector Partnerships in an Agricultural System of Innovation: Concepts and Challenges* by Andy Hall.

2006-003 *Capacity Development for Agricultural Biotechnology in Developing Countries: Concepts, Contexts, Case Studies and Operational Challenges of a Systems Perspective* by Andy Hall and Jeroen Dijkman.

2006-004 *Technological Capabilities with Different Degree of Coherence: A Comparative Study of Domestic-Oriented vs. Export-Driven Bulgarian Software Companies* by Rossitza Rousseva.

2006-005 *Small Islands, New Technologies and Globalization: A Case of ICT adoption by SMEs in Mauritius* by Kaushalesh Lal and Aveeraj Sharma Peedoly.

2006-006 *Beyond Unobserved Heterogeneity in Computer Wage Premiums; and Data on Computer use in Germany, 1997-2001*. Double paper by Joan Muysken, Sybrand Schim van der Loeff and Valeria Cheshko.

2006-007 *Learning in Local Systems and Global Links: The Otigba Computer Hardware Cluster in Nigeria* by Banji Oyelaran-Oyeyinka

2006-008 *Breaking the Fence: Patent Rights and Biomedical Innovation in "Technology Followers*" by Padmashree Gehl Sampath

2006-009 *Taxation and Technolgoy Adoption: A Hotelling Approach* by Ben Kriechel and Thomas Ziesemer

2006-010 *Foreign Direct Investment and Technology Spillovers: Evidence from the Indian Manufacturing Sector* by Subash Sasidharan

2006-011 *Persistence of Innovation in Dutch Manufacturing: Is it Spurious?* by Wladimir Raymond, Pierre Mohnen, Franz Palm and Sybrand Schim van der Loeff

2006-012 *Random walks and cointegration relationships in international parity conditions between Germany and USA of the post Bretton-Woods period* by Franco Bevilacqua

2006-013 *On the Persistence of Inequality in the Distribution of Personal Abilities and Income* by Adriaan van Zon and Hannah Kiiver

2006-014 *Foreign Direct Investment, Firm-Level Capabilities and Human Capital Development: Evidence from Kenyan Manufacturing Industry* by Geoffrey Gachino

2006-015 *The Determinants of Pharmaceutical R&D Expenditures: Evidence from Japan* by Jörg C. Mahlich and Thomas Roediger-Schluga

2006-016 *Random walks and cointegration relationships in international parity conditions between Germany and USA for the Bretton-Woods period* by Franco Bevilacqua

2006-017 *Concepts and guidelines for diagnostic assessments of agricultural innovation capacity* by Andy Hall, Lynn Mytelka and Banji Oyeyinka

2006-018 *Buying and Selling Research and Development Services, 1997 to 2002 by* Julio M. Rosa, Antoine Rose and Pierre Mohnen

2006-019 *INDIA's product patent protection regime: Less or more of "pills for the poor"?*by Padmashree Gehl Sampath

2006-020 *Worker Remittances and Growth: The Physical and Human Capital Channels* by Thomas Ziesemer

2006-021 *Creating the Capacity to Benefit from Technological Change in Developing Countries* by Watu Wamae

2006-022 *A Technology Acquisition Model: the role of learning and innovation* by Watu Wamae

2006-023 *Are North-South Technological Spillovers Substantial? A dynamic panel data model estimation* by Watu Wamae

2006-024 *How "black" is the black sheep compared to all others? Turkey and the EU* by İ. Semih Akçomak and Saeed Parto

2006-025 *Diffusion paths for Micro Cogeneration Using Hydrogen in the Netherlands* by Mattijs Taanman, Arend de Groot, René Kemp, & Bart Verspagen.

2006-026 Rough Road to Market: Institutional Barriers to Innovations in Africa by Banji Oyelaran-Oyeyinka and Padmashree Gehl Sampath

2006-027 *Innovativity: a comparison across seven European countries* by Pierre Mohnen, Jacques Mairesse & Marcel Dagenais

2006-028 *Empirical studies of innovation in the knowledge driven economy* by Bronwyn H. Hall and Jacques Mairesse

2006-029 *Information and Intellectual Property: The Global Challenges* by Rishab Ghosh and Luc Soete

2006-030 *Absorptive Capacity and Export Diversification in Sub-Saharan African Countries* by Alexis Habiyaremye & Thomas Ziesemer