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# The African Growth Gap and the Realization of the MDGs

Tobias Knedlik and Eva Reinowski\*

To be presented at the Annual Conference of Verein für Socialpolitik, Research Committee Development Economics hosted by the Center for International and Comparative Studies, CIS (University of Zurich and ETH Zurich) and the Institute for Environmental Decisions, IED (ETH Zurich) in Zurich, Switzerland, May 30-31, 2008.

## Abstract

Earlier literature on economic growth models identified Africa specific determinates of economic growth. In standard models of economic growth Africa dummies were significant. A more recent strand of literature attributes the significance of Africa dummies to inappropriate estimation techniques. If growth models were appropriately estimated, the Africa dummy would disappear. The analysis of this paper reproduces the Systems-GMM approach, which was found to be appropriate, with an extended sample. It turns out that an Africa dummy appears to be significant. The analysis is extended by the search for potential explanations of an Africa dummy. The analysis finds that infrastructure, access to high tech, R&D, and business environment are factors that explain part of the anomaly of African growth processes. The MDGs reflect the specifics of African growth processes only partially. They should therefore not be the sole focus of growth oriented economic policy.

**Key words:** economic growth models, Africa dummy, MDGs

**JEL:** C3, O1, O4

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## 1. Introduction

It is undisputed that strong economic growth is a necessary, although not sufficient, condition to reach the ambitious Millennium Development Goals (MDGs). The UN's Economic Commission for Africa estimates that the average annual growth rates need to exceed seven percent to reach the MDGs.<sup>1</sup> Most of the African Economies reach far lower economic growth rates even though the developments on world markets for primary commodities show large price increases and therefore present favourable conditions for many African countries.

It is known in the empirical literature on economic growth since the early 1990s that African economies tend to grow slower than the rest of the world even when considering standard determinants of economic growth.<sup>2</sup> Barro (1991), Levine & Renelt (1992) found significant "Africa dummies" when estimating standard or extended economic growth models of Solow style. The conclusions drawn from this finding are that African growth seems to be somehow different from the growth in the rest of the world. An extensive literature was then searching for reasons of the differences and sometimes found plausible explanations. In the early 2000s a new strand of literature was trying to explain that the phenomenon might not be due to African specifics but due to inappropriate estimation methods. It was concluded that, if the correct estimation method is used, the Africa dummy disappeared. This seemed to be the end of the discussion.

The motivation for this study was the observation of fast growing Asian countries and the still slow economic growth of African countries; there might still be a difference in economic growth between African and non-African countries. The database is now larger as compared to the early 2000s and it seems worthwhile to investigate whether or not the Africa dummy would still disappear using the appropriate estimation method and on the basis of an enlarged sample. If we were able to identify an Africa dummy, it would then be interesting to know what the reasons for the different growth performance of the African economies are and how development policy could incorporate this knowledge into policies and programmes to reach the MDGs.

The rest of the paper is structured as follows. Section 2 provides a brief summary of the literature on economic growth models including the Africa dummy. In section 3 the

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<sup>1</sup> Economic Commission for Africa (2003: 1).

<sup>2</sup> The African growth performance of most recent years is an exception to this general finding.

estimation model that is regarded as appropriate in the literature is reconstructed and estimated with different data sets. Possible explanations of the Africa dummy are presented in section 4. Section 5 deals with the implication of the empirical finding for development policy, while section 6 concludes the paper.

## **2. The Africa dummy in the literature**

Basic economic growth models of the Solow style (Solow, 1956) posit that long-term economic growth depends on initial GDP, the initial level of technology, technological progress, the savings rate, the growth of the labour force, the depreciation rate, the output share of capital, and the rate of convergence to steady state.<sup>3</sup> Similar models were used in the empirical analysis of economic growth and were found to explain economic growth well in different countries and across countries. Barro (1991) was the first to include an Africa dummy in the estimated equations and found it to be significant. He noted that “There appear to be adverse effects on growth from being in Sub-Saharan Africa”.<sup>4</sup> He also provided a figure for the African growth gap: -1.14 percent GDP growth. Since Barro’s seminal, paper various other authors have found significant Africa dummies.<sup>5</sup>

With the “discovery” of the Africa dummy, several efforts have been made to explain the phenomenon started with varying degree of success. Some authors failed to explain the dummy using other measures. Mauro (1995) for example could not explain the dummy by a bureaucratic efficiency index; Easterly & Levin (1997) failed to show that ethno-linguistic heterogeneity is a plausible explanation of the dummy; Temple & Johnson (1998) could not replace the Africa dummy by social arrangements. However, other papers established sets of variables that could render the Africa dummy to become insignificant. These include Sachs & Warner (1997), who replaced the dummy by a mixture of structural and policy variables (landlocked, climate, openness, government savings, institutional quality); Barro (1997) found government consumption to be significant; while Englebert (2000) saw state legitimacy as explanation for the Africa dummy.

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<sup>3</sup> See Mankiw et al. (1992: 409).

<sup>4</sup> Barro (1991: 436).

A later strand of literature tried to explain the existence of the Africa dummy in empirical growth models by econometric shortcomings and argued that there is no significant dummy once the appropriate estimation technique is used.<sup>6</sup> The authors argue that the single cross-section analysis, as employed by most of the previous papers, is not able to capture the dynamic nature of economic growth. Additionally, cross-section approaches do not make use of all data available. They also point out that standard panel data approaches such as Ordinary Least Square (OLS) and within group estimations fail to account for unobserved country specifics and endogeneity of explanatory variables. The estimations using OLS or within group estimations are therefore biased.

One method, which takes these shortcomings into account, is the two-step approach consisting of Systems-General Method of Moments (Sys-GMM) approach to estimate the dynamic panel economic growth model and the regression of the Africa dummy on the residuals of the first step estimation. Using this approach, the authors are unable to estimate a significant coefficient on the Africa dummy. Following this strand of literature it seems that economic growth in Africa can be explained the same way as economic growth in the rest of the world. The Africa dummy disappears. This Sys-GMM is explained and employed in the next section of this paper.

### 3. Reconstructing the Sys-GMM-approach

In this section the Sys-GMM-approach as outlined in Hoeffler (2002) is reconstructed in order to scrutinise the results of her paper regarding the insignificance of the Africa dummy.<sup>7</sup> The starting point of the derivation of the estimation equations is a basic economic growth model of the Solow style:

$$(1) \quad \ln y_t - \ln y_0 = -(1 - e^{-\lambda t}) \ln y_0 + (1 - e^{-\lambda t}) \ln A_0 + g_t + (1 - e^{-\lambda t}) \frac{\alpha}{1 - \alpha} \ln(s) - (1 - e^{-\lambda t}) \frac{\alpha}{1 - \alpha} \ln(n + g + \delta)$$

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<sup>5</sup> See e.g Barro (1991: 435-436), Easterly & Levine (1997: 1210-1211), Levine & Renelt (1992: 950), Sala-i-Martin (1997: 181).

<sup>6</sup> See Hoeffler (2002: 155), Du Plessis & Keller (2002: section 5).

<sup>7</sup> See Hoeffler (2002: 139-143) and for more details Hoeffler (1998: 80ff).

Where  $y_t$  is current GDP,  $y_0$  initial GDP,  $A_0$  the initial level of technology,  $g_t$  technological progress,  $s$  the savings rate,  $n$  the growth of the labour force,  $\delta$  the depreciation rate,  $\alpha$  the output share of capital, and  $\lambda$  is the rate of convergence to steady state.

This equation can be translated into a dynamic panel data context:

$$(2) \quad y_{it} - y_{i,t-1} = \alpha + \beta y_{i,t-1} + \gamma x_{it} + \eta_i + v_{it}$$

Here  $\alpha$  is a constant term,  $\beta$  the coefficient of the lagged dependent variable,  $\gamma$  the vector of coefficients of a set of other explanatory variables  $x_{it}$  which are observed for country  $i$  at time  $t$ .  $\eta_i$  specifies time invariant unobserved country characteristics and  $v_{it}$  are the residuals. By adding  $y_{i,t-1}$  to both sides of the equation, equation (2) can easily be transformed into:

$$(3) \quad y_{it} = \alpha + \beta^* y_{i,t-1} + \gamma x_{it} + \eta_i + v_{it}$$

Thus  $\beta^* = \beta + 1$ .

Hoeffler (2002) argues that using such an OLS approach to panel data might cause a bias of the estimator of  $\beta^*$  since the lagged dependent variable is correlated with the country effects. To avoid problems of endogeneity the GMM-approach uses first differences of the variables. This approach eliminates the time invariant country effects:

$$(4) \quad y_{it} - y_{i,t-1} = \beta^* (y_{i,t-1} - y_{i,t-2}) + \gamma (x_{it} - x_{i,t-1}) + (v_{it} - v_{i,t-1})$$

In order to ensure unbiased and consistent estimates of  $\beta^*$ , instruments have to be used to estimate equation (4). Appropriate instruments are two or more periods lagged values of  $y_{it}$  and  $x_{it}$ .

However, as outlined by Hoeffler (2002), this approach suffers from performing poorly if the time series are close to random walk and it is additionally biased if the sample is small. To solve these problems the Sys-GMM-approach estimates a set of equations consisting of equations of the type of equation (4) using differently lagged variables as instruments and a set of level estimations of the style of equation (3) using differenced variables as instruments.

Hoeffler (2002) then discusses the treatment of country characteristics such as an Africa dummy in the models. The inclusion of an Africa dummy  $w_i$  in equation (3) would result in equation (5), whereas the extensions of equation (3) are shown in bold letters:

$$(5) y_{it} = \alpha + \beta^* y_{i,t-1} + \gamma x_{it} + \delta w_i + \eta_i + v_{it}$$

Since the Africa dummy might be correlated with the unobserved country characteristics or the error term, Hoeffler (2002) suggests a two-step approach where equation (5) is first estimated without the Africa dummy, resulting in inclusion of the effects of the dummy in the unobserved country characteristics:

$$(6) y_{it} = \alpha + \beta^* y_{i,t-1} + \gamma x_{it} + \eta_i^* + v_{it}, \text{ where } \delta w_i + \eta_i = \eta_i^*$$

Equation (6) provides consistent estimates of the coefficients. In the second step, we estimate the influence of the Africa dummy on the residuals of equation (6).

$$(7) (y_{it} - \hat{\alpha} - \hat{\beta}^* y_{i,t-1} - \hat{\gamma} x_{it}) = \delta w_i + (\eta_i + v_{it})$$

A significant coefficient  $\delta$  would indicate that the Africa dummy explains part of the unobserved country characteristics.

To run the Sys-GMM-approach and the two-step approach of Hoeffler (2002) we use data obtained from Pen World Tables (version 6.2). In line with Hoeffler (2002) we use real GDP per capita (PPP, chain index) as dependent variable. As explanatory variables we include investment to GDP, population growth rates, and average years of schooling. The last one is an extension to the classical Solow model to account for human capital formation. The technical progress plus the rate of depreciation are assumed to be 0.05 for all times and all countries. As done by Hoeffler (2002) we include time dummies to account for period specific effects. Data is present for the period from 1960 to 2000 in five year intervals, where, if applicable, five-year averages (1960-1964, 1965-1969, ..., 2000-2004) are calculated. Thus, the time dimension comprises 9 periods. The panel includes observations for 188 countries. We also use two sub-samples, 142 developing countries and the countries used in the paper by Hoeffler (2002). Due to missing data points the panel is unbalanced. To estimate the Sys-GMM model we use the `xtdpdsys` procedure of STATA 10.

The regression analysis starts with estimating the Sys-GMM model including the country sample of Hoeffler (2002) and then regressing the residuals of the estimation on the Africa dummy, which takes the value of one if countries are situated in Sub-Saharan Africa and zero otherwise. The results are displayed in table 1 in the appendix. The main result from the regression analysis is that the coefficient of the Africa dummy is not significantly different from zero. This confirms the findings of Hoeffler (2002).

To check whether the results hold to be true in other samples, the country sample is extended to all 188 countries of our database and to the sub-sample of developing countries only. The results are presented in tables 2 and 3 in the appendix respectively. It turns out that for both samples the coefficient of the Africa dummy is significant at the 1%-level. In these samples the Africa dummy helps to explain part of the unobserved country characteristics, which are reflected in the residuals of the Sys-GMM estimation. This finding suggests that, in line with the early literature on the Africa dummy, growth processes in Africa seem to be different from the rest of the world. The insignificance of the Africa dummy in the Hoeffler (2002) sample might be due to a sample bias and cannot be confirmed by using two other (larger) samples.

Thus, using a Sys-GMM and the two-step approach of Hoeffler (2002) does not necessarily lead to the disappearance of the Africa dummy. It is still possible to identify the specificity of African growth processes. To enlighten the “mystery” of the Africa dummy various possible explanations are tested.

#### **4. What determines the Africa dummy?**

Latest growth theory suggests that a range of factors, such as innovation and institutions, play an important role in explaining economic growth but are not reflected in the classical growth models of the Solow type. While human capital was included in the above estimations, which extended the narrow model already, other factors were left outside the model.

This section looks at seven groups of possible explanatory variables. These are Business Perception (consisting of management perception indicators for main hindrances for business: corruption, courts, crime, electricity, finance, labour regulation, labour skills), Business Environment (ease of doing business index, time to start a business), Infrastructure (electrical outages, paved roads as percent of total roads), Access to High Tech (fixed line and mobile phone subscribers, PCs per 1000 inhabitants), Banking and Finance (domestic credit to GDP, market capitalisation, stocks traded), Research and Development (R&D expenditure per GDP), Conflict (military personnel as percent of total labour force)<sup>8</sup>, Health System (infant

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<sup>8</sup> We use military personal as percent of total labour force as a proxy for conflict by assuming that in conflict times military personal is expected to remain constant or increase, whilst total labour force is expected to decrease.



mortality, HIV, TBC), Land (arable land). All row data is obtained from World Bank's World Development Indicators. By calculating country averages, dummy variables for all 22 variables were constructed. In a first step a univariate analysis of the dummies identified the individual contribution to the explanation of growth processes in general. In a second step group members were used together in order to identify group representatives with highest significance. These group representatives are in the group of Business perception: electricity as hindrance for doing business, Business Environment: ease of doing business index, Access to High Tech: PCs per 1000 inhabitants, Banking and Finance: market capitalisation, Research and Development: R&D expenditure per GDP, Conflict: military personnel as percent of total labour force, Health System: infant mortality, Land: arable land.<sup>9</sup> In a third step all group representatives were used to see their combined impact on the residuals from the Sys-GMM. The Africa dummy was included in this regression as well.

In the case the Africa dummy is rendered insignificant by inclusion of other variables, it can be concluded that this set of variables might explain large part of the Africa specific growth process. The results are presented in the appendix in tables 4 and 5 for all countries and developing countries.

The results show that in both samples, the Africa dummy becomes insignificant if the set of group dummies is included in the estimation model. In both samples the Infrastructure and the Access to High Tech dummies are significant at the 5%-level, while the R&D dummy is significant on the 10%-level. In the developing country sample additionally the Business Environment is a significant explanatory variable (5%-level). However, differences between the two samples are low and the results are relatively robust. Thus, it turns out that the four groups of indices for Infrastructure, Access to High Tech, R&D, and Business Environment are important in explaining African growth specifics. The indices for Health System, Banking and Finance, as well as Business Perception are significant in the univariate analysis, but turn out to be insignificant in the group estimations. Hence, these factors can explain part of the unobserved influences on growth but are probably not Africa specific. The groups Land and Conflict are insignificant in the one-to-one estimation. These influences seem to be appropriately captured by the growth model, e.g. by low initial GDP or low investment.

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<sup>9</sup> The choice of group representatives based on the level of significance in the group estimations was not always easy since in several cases other group members were also highly significant. In the Health System group HIV and TBC were also highly significant, in the Banking and Finance group domestic credit to GDP was also highly significant, the same counts for phone subscribers in the group of Access to High Tech.

## **5. Implications for Development Policy and the MDGs**

The Millennium Development Goals (MDGs) consist of 8 groups of goals, which are then defined in 18 more specific and measurable targets. The groups include I. eradicate extreme poverty and hunger (1. halve, between 1990 and 2015, the proportion of people whose income is less than \$1 a day, 2. halve, between 1990 and 2015, the proportion of people who suffer from hunger), II. achieve universal primary education (3. ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling), III. promote gender equality and empower women (4. Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015), IV. reduce child mortality (5. reduce by two-thirds, between 1990 and 2015, the under-five mortality rate), V. improve maternal health (6. reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio), VI. combat HIV/AIDS, malaria, and other diseases (7. have halted by 2015 and begun to reverse the spread of HIV/AIDS, 8. have halted by 2015 and begun to reverse the incidence of malaria and other major diseases), VII. ensure environmental sustainability (9. integrate the principles of sustainable development into country policies and programs and reverse the loss of environmental resources, 10. halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation, 11. have achieved by 2020 a significant improvement in the lives of at least 100 million slum dwellers), VIII. develop a global partnership for development (12. develop further an open, rule-based, predictable, non-discriminatory trading and financial system (includes a commitment to good governance, development, and poverty reduction, both nationally and internationally), 13. address the special needs of the Least Developed Countries (LDCs) (includes tariff- and quota-free access for LDCs' exports, enhanced program of debt relief for heavily indebted poor countries (HIPC) and cancellation of official bilateral debt, and a more generous official development assistance for countries committed to poverty reduction), 14. address the special needs of landlocked developing countries and small island developing states (through the Program of Action for the Sustainable Development of Small Island Developing States and 22nd General Assembly provisions), 15. deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term. Additional targets for LDCs, landlocked and small island countries include 16. cooperation with developing

countries, develop and implement strategies for decent and productive work for youth, 17. in cooperation with pharmaceutical companies, provide access to affordable essential drugs in developing countries, 18. in cooperation with the private sector, make available the benefits of new technologies, especially information and communications technologies.

Keeping in mind that strong economic growth is regarded as a pre-condition for reaching the MDGs and as well the empirical findings as outlined above about which factors, besides the classical factors, account for economic growth, it is clear that there is no one-way causality between economic growth and reaching the MDGs. It is rather obvious that both targets are strongly interrelated. That means economic growth might not accelerate as long as there is no success in approaching the MDGs and that the MDGs might not be reached if economic growth does not kick off. Often development aid is referred to as being the driver that might turn the wheel from a downward spiral to an upward movement of both measures. This idea is not unquestioned.<sup>10</sup> From the above analysis it is, however, clear that development policy needs to target – besides the classical determinates of growth – several development needs directly in order to achieve sustainable economic growth. While the empirical analysis has shown that various factors including Health System (in line with MDGs IV-VI.), Banking and Finance (MDG VIII.), and Business Perception (MDG VIII.) are of general importance, Infrastructure (not part of the MDGs), Access to High Tech (target 18.), R&D (not part of the MDGs), and Business Environment (MDG VIII.) are of specific importance for African countries.

The first MDG, to eradicate extreme poverty and hunger, is related to economic growth but the interrelations have not been analysed here. The second MDG, to achieve universal primary education, is essential for strengthening economic growth. That is why human capital, as measured by average years of schooling, is already included in the extended growth model. Schooling is a particular important driver of economic growth among developing countries (compare table 3 in the appendix). The third MDG, of promoting gender equality, was not analysed in this paper, while it seems to be evident that, for example, the full exploitation of human capital of an economy, as could be achieved by full involvement of both genders in human capital upgrading as well as by full integration of both genders in the formal economy, is important to extend production possibilities and, therefore, economic growth. The fourth, fifth and sixth MDGs refer to the health system and turned out to be an important explanation of the residuals of the growth model, and could thus explain part of the

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<sup>10</sup> See Knedlik & Kronthaler (2006).

unexplained rest of classical economic growth models. The seventh MDG, of environmental sustainability, was not considered here. Of outstanding importance to achieve higher economic growth rates is the eighth MDG and in particular target 12, which refers to various factors of institutional development. In our empirical exercises we used the ease of doing business index as group representative for the group Business Environment. The index, which is collected by the World Bank, is a summative information tool that comprises various indicators regarding starting a business, dealing with licenses, hiring and firing workers, registering property, getting credit, protecting investors, paying taxes, trading across borders, enforcing contracts, and closing a business. All these important institutions might be subsumed under the commitment to good governance as outlined in MDG VIII but are not spelled out in detail. Also for that reason, to approach the MDGs might not be sufficient to accelerate economic growth. Other factors, such as the importance of local institutions, infrastructure improvements, and R&D support, should not be forgotten. The strengthening of local institutions to ease business might also increase the willingness to invest more in research and development. The number of electrical outages approximated Infrastructure in our empirical analysis. The group Business Perception was represented by the hindrances to business by lack of power supply. Thus, it turned out that electrical power supply is one of the crucial factors of economic growth in Africa.

## **6. Conclusions**

It was shown that the specifics of African economic growth processes do not relate to misspecified empirical models. Using broader samples leads to a significant African dummy in economic growth models. With other potential explanatory variables added to the model, the African dummy is rendered insignificant. This means that these variables help to explain the specifics of African growth processes. These groups of variables are Infrastructure, Access to High Tech, R&D, and the Business Environment. Development policy should address these Africa specific determinants of the growth process, without leaving the classical drivers of economic growth, such as investment and human capital formation, out of consideration. The MDGs might help to address parts of the hindrances for economic growth in Africa but are far from being comprehensive in what is needed to speed up economic growth and enhance development. The improvement of local infrastructure, the support of

research and development activities, and the creation of institutions to ease business should be on top of the agenda of growth enhancing policy.

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## Appendix

**Table 1: Hoeffler (2002) sample**

Sys-GMM				Number of observations = 563		
Group variable: id				Number of groups = 75		
Time variable: year_id				Observations per group: min = 4 average = 7.506667 max = 8		
Number of instruments = 46				Wald chi2(11) = 62.18 Prob > chi2 = 0.0000		
GDP growth	Coefficient	Std. Err.	z	P>z	[95% Conf. Interval]	
GDP growth (-1)	.0162722	.0150759	1.08	0.280	-.0132761	.0458205
Investment	.0737625	.0345975	2.13	0.033	.0059527	.1415724
Population, technology, depreciation	-.0412051	.0882921	-0.47	0.641	-.2142544	.1318442
Schooling	.011856	.0487462	0.24	0.808	-.0836848	.1073968
time3	-.0071378	.0279261	-0.26	0.798	-.061872	.0475965
time4	-.0690488	.0300811	-2.30	0.022	-.1280067	-.0100908
time5	-.0592567	.0325377	-1.82	0.069	-.1230294	.004516
time6	-.145381	.0360014	-4.04	0.000	-.2159424	-.0748197
time7	-.1120039	.0374897	-2.99	0.003	-.1854824	-.0385255
time8	-.1340055	.0411985	-3.25	0.001	-.214753	-.053258
time9	-.0563794	.0435448	-1.29	0.195	-.1417256	.0289668
constant	-.152178	.2482735	-0.61	0.540	-.638785	.334429



Dummy regression (Random effects $u_i \sim$ Gaussian)				Wald $\chi^2(1) = 0.94$		
corr( $u_i, X$ ) = 0 (assumed)				Prob > $\chi^2 = 0.3320$		
Residuals	Coefficient	Std. Err.	z	P>z	[95% Conf. Interval]	
Africa	-.0178207	.0183708	-0.97	0.332	-.0538268	.0181854
constant	.0050093	.0100159	0.50	0.617	-.0146216	.0246402
sigma_u	.04919361					
sigma_e	.14693305					
rho	.10079463 (fraction of variance due to $u_i$ )					

Source: Own calculations.

**Table 2: All countries**

Sys-GMM				Number of observations = 774		
Group variable: id				Number of groups = 118		
Time variable: year_id				Observations per group: min = 1 average = 6.559322 max = 8		
Number of instruments = 46				Wald chi2(11) = 87.12 Prob > chi2 = 0.0000		
GDP growth	Coef.	Std. Err.	z	P>z	[95% Conf.Interval]	
GDP growth (-1)	.0068539	.0141244	0.49	0.627	-.0208295	.0345373
Investment	.1177928	.0309801	3.80	0.000	.0570729	.1785126
Population, technology, depreciation	-.0814706	.0838138	-0.97	0.331	-.2457426	.0828013
Schooling	.0651559	.0472728	1.38	0.168	-.0274972	.1578089
time3	.004827	.0255379	0.19	0.850	-.0452263	.0548804
time4	-.0638882	.0251239	-2.54	0.011	-.1131302	-.0146462
time5	-.0589023	.0276875	-2.13	0.033	-.1131688	-.0046359
time6	-.1559152	.0310532	-5.02	0.000	-.2167783	-.0950521
time7	-.1274107	.0352939	-3.61	0.000	-.1965855	-.058236
time8	-.1615012	.0373685	-4.32	0.000	-.2347421	-.0882603
time9	-.0899566	.0398723	-2.26	0.024	-.1681048	-.0118083
constant	-.4422162	.2432899	-1.82	0.069	-.9190558	.0346233

Dummy regression (Random effects $u_i \sim$ Gaussian)				Wald $\chi^2(1) = 13.00$		
corr( $u_i, X$ ) = 0 (assumed)				Prob > $\chi^2 = 0.0003$		
Residuals	Coeff.	Std. Err.	z	P>z	[95% Conf.	Interval]
Africa	.0690531	.0191489	3.61	0.000	.0315219	.1065843
constant	-.0164345	.0096868	-1.70	0.090	-.0354202	.0025512
sigma_u	.06343954					
sigma_e	.15698816					
rho	.14037652 (fraction of variance due to $u_i$ )					

Source: Own calculations.

**Table 3: Developing countries sub-sample**

Sys-GMM				Number of observations = 536		
Group variable: id				Number of groups = 84		
Time variable: year_id				Observations per group: min = 1 average = 6.380952 max = 8		
Number of instruments = 46				Wald chi2(11) = 54.36 Prob > chi2 = 0.0000		
GDP growth	Coefficient	Std. Err.	z	P>z	[95% Conf. Interval]	
GDP growth (-1)	.01037	.0193392	0.54	0.592	-.027534	.0482741
Investment	.0839623	.0369358	2.27	0.023	.0115696	.1563551
Population, technology, depreciation	-.0934636	.1010187	-0.93	0.355	-.2914565	.1045294
Schooling	.130338	.0686449	1.90	0.058	-.0042036	.2648795
time3	-.0117964	.0378471	-0.31	0.755	-.0859754	.0623825
time4	-.0746254	.0419265	-1.78	0.075	-.1567999	.0075492
time5	-.0861076	.0466093	-1.85	0.065	-.1774602	.005245
time6	-.1945024	.0519343	-3.75	0.000	-.2962918	-.0927129
time7	-.2033619	.0589871	-3.45	0.001	-.3189745	-.0877492
time8	-.233309	.0620595	-3.76	0.000	-.3549434	-.1116746
time9	-.143951	.0657254	-2.19	0.029	-.2727705	-.0151315
constant	-.4058321	.2873448	-1.41	0.158	-.9690175	.1573533

Dummy regression (Random effects $u_i \sim$ Gaussian)				Wald $\chi^2(1) = 10.50$		
corr( $u_i, X$ ) = 0 (assumed)				Prob > $\chi^2 = 0.0012$		
Residuals	Coeff.	Std. Err.	z	P>z	[95% Conf.	Interval]
Africa	.0736371	.0227242	3.24	0.001	.0290984	.1181758
constant	-.0268846	.0137367	-1.96	0.050	-.0538081	.0000389
sigma_u	.06749101					
sigma_e	.17583169					
rho	.12841281 (fraction of variance due to $u_i$ )					

Source: Own calculations.

**Table 4: All countries**

Dummy regression (Random effects $u_i \sim$ Gaussian)		Number of observations = 254 Number of groups = 38				
Group variable: id		Observations per group: min = 1 average = 6.7 max = 8				
		Wald chi2(8) = 18.09				
corr( $u_i$ , X) = 0 (assumed)		Prob > chi2 = 0.0205				
Residuals	Coefficient	Std. Err.	z	P>z	[95% Conf. Interval]	
Africa	.0366279	.0340021	1.08	0.281	-.030015	.1032708
Health System	-.0127621	.0343406	-0.37	0.710	-.0800684	.0545442
Infrastructure	.0629774	.0294511	2.14	0.032	.0052543	.1207006
Business Environment	-.0378948	.0258562	-1.47	0.143	-.0885721	.0127825
Banking and Finance	.0012341	.0251149	0.05	0.961	-.0479902	.0504584
R&D	.0400862	.0239955	1.67	0.095	-.0069442	.0871165
Access to High Tech	-.0937152	.040383	-2.32	0.020	-.1728644	-.014566
Business Perception	-.0267101	.0346248	-0.77	0.440	-.0945734	.0411532
Constant	.0314137	.0412729	0.76	0.447	-.0494797	.1123071

Source: Own calculations.

**Table 5: Developing countries**

Dummy regression (Random effects $u_i \sim$ Gaussian)		Number of observations = 215 Number of groups = 31				
Group variable: id		Observations per group: min = 1 average = 6.9 max = 8				
		Wald $\chi^2(8) = 25.68$				
corr( $u_i, X$ ) = 0 (assumed)		Prob > $\chi^2 = 0.0012$				
Residuals	Coeff.	Std. Err.	z	P>z	[95% Conf.	Interval]
Africa	.0265221	.0351474	0.75	0.450	-.0423656	.0954098
Health System	.0007495	.0354998	0.02	0.983	-.0688288	.0703277
Infrastructure	.0835048	.0304519	2.74	0.006	.0238202	.1431895
Business environment	-.0559117	.0267414	-2.09	0.037	-.1083239	-.0034995
Banking and Finance	.0103969	.0259803	0.40	0.689	-.0405237	.0613174
R&D	.0442111	.0248263	1.78	0.075	-.0044476	.0928698
Access to High Tech	-.1172455	.0417474	-2.81	0.005	-.199069	-.035422
Business Perception	-.0299297	.0357921	-0.84	0.403	-.1000809	.0402216
Constant	-.0084377	.0426644	-0.20	0.843	-.0920585	.0751831

Source: Own calculations.