Openness, investment and growth in Sub Saharan Africa*

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Abstract

This paper revisits the determinants of economic growth in Sub Saharan Africa by looking at conditional and unconditional convergence, and by focusing on the growth incidence of globalisation, domestic investment (DI), and foreign direct investment (FDI). We use annual time-series to estimate panel data models which are: (i) dynamic; and (ii) where the time dimension is larger than the cross-section dimension (i.e., $T > N$). We find the rate of conditional convergence to be around 4%, and the growth impact of FDI and DI to be greater the greater is the change in the degree of economic openness. We also find a net crowding out effect between both types of capital so that larger amounts of FDI reduce the impact of DI on economic growth (and vice-versa). These results are obtained through the estimation of multiplicative interaction models which allows us to evaluate the interactions between changes in openness, DI, and the net flows of FDI. This constitutes a novelty in the appraisal of the globalisation and investment impact on economic growth.

JEL Codes: O55, O47, F43, E22.

Keywords: Africa, Economic Growth, Globalisation, Foreign Direct Investment, Domestic Investment.

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1 Introduction

This paper revisits the determinants of economic growth in Sub Saharan Africa (SSA) by looking at conditional and unconditional convergence, and by focusing on the growth incidence of two critical factors driving today's economic changes: globalisation and investment. Our analysis is based on the estimation of multiplicative interaction models to account for the changing relationship between the degree of openness, domestic investment (DI) and foreign direct investment (FDI) with respect to growth.

Significant studies concerned with the gruesome performance of Africa have outlined, directly or indirectly, the relevance of DI. Although in the seminal study by Sachs and Werner (1997) no role is given to investment,[1] a reexamination of their model by Hoeffler (2001) shows that neglecting unobserved fixed-effects and endogeneity problems is the reason why investment appears to be insignificant. In a subsequent study, Hoeffler (2002) shows that the Solow model provides useful insights to understand the poor growth performance of SSA countries, and states that it may be "worthwhile to focus on the continent's low investment ratios and high population growth rates, which we found to be sufficient to explain Africa's low growth rates" [Hoeffler, 2002, p. 156]. Tsangarides (2002) differs and finds the Solow model inconsistent with the growth evidence on Africa. However, he coincides in signalling investment (among other factors) as relevant. Bosker and Garretsen (2012) consider physical geography as key for economic performance, and focus on the importance of market access. They find that market access positively affects income levels and, despite they see remoteness of many African economies as an important burden, they also state that there is room for policies fostering, for example, infrastructure investment. In the same vein, Calderón and Servén (2011) use quantity and quality indicators of infrastructure, and show that infrastructure development has a positive impact on long-run growth (and a negative one on income inequality). This evidence points to DI as a strategic factor for Africa's development and growth.

Another stream of literature is directly concerned with the growth effects of FDI. Lipsey (2004) surveys empirical macro research on this issue. Even if there is no clear consensus, the literature tends to favor the positive impact of FDI on the exports and growth of the host countries. On the contrary, Herzer (2012) finds that FDI has negative effects on growth, on average, although he also acknowledges large differences in its effect across the 44 developing countries examined. Regarding Africa, Adams (2009) examines

[1] According to Sachs and Warner (1997), poor economic policies are critical. Easterly and Levine (1997) examine the hypothesis that the failure of public policies in SSA is substantially explained by ethnic diversity. They find that the fundamental role exerted by ethnic division on the poor performance of this region works indirectly through public policies, political stability, and other economic forces. This line of reasoning has been endorsed by Fosu *et al.* (2006), in clear contrast with Cinyabugumaa and Puttermanb (2010) who find opposite results.

the impact of FDI and DI on economic growth in SSA, finds both to be significant, and uncovers a net crowding out effect between the two. As in our study, he estimates a dynamic fixed-effects panel data model, and controls for the degree of openness. However, he works with a short sample period (1990-2003) and his results are based on OLS estimates liable to endogeneity problems.

The empirical strategy used this paper, as well as in Adams (2009), is at odds with the usual methodology consisting on the estimation of static models with five year averages. We exploit all available information and use annual time-series to estimate panel data models which are (i) dynamic; and (ii) where the time dimension is larger than the cross-section dimension (i.e., $T > N$). In addition, we contribute to the literature by providing new evidence based on the estimation of multiplicative interaction models (Brambor *et al.*, 2006). Rodríguez (2007) discusses empirical evidence regarding the link between openness and growth in cross-country regressions. He concludes that standard measures of trade policy are basically uncorrelated with growth, although he clearly states that this does not imply that openness is irrelevant for growth because the problem is related to the oversimplification of growth regressions.[2] In this paper we take a step forward by estimating standard growth equations using multiplicative interaction models. As explained in Brambor *et al.* (2006), this is the appropriate tool whenever the hypothesis being tested is conditional in nature as it is the case here (see Section 4).

Turning to our findings, and regarding the absolute convergence of per capita GDP, we confirm and update the well known SSA's growth struggle. Economic catch-up towards the US (which is taken as the reference economy) is only perceived in exceptional cases. When we classify the 43 SSA economies into the ones that have increased or reduced their international exposure to trade, we find no significant differences in their performance. In the 1980s, the "globalisers" grew substantially less than the "non globalisers", but these differences are reverted and reduced in the 1990s, and virtually vanish in the 2000s. Moreover, when we compute the correlation coefficient between each country's per capita GDP normalized by the US one (as indicator of convergence) and the degree of openness (as indicator of economic globalisation) we find no patterns. About half the SSA economies display positive (negative) correlations, but these are not forcefully related with a positive (negative) incidence of globalisation since a positive correlation may arise from a situation of a widening GDP gap and a falling degree of openness. We conclude that there is no relationship between absolute convergence and globalisation.

Regarding conditional convergence, we find that per capita incomes (in a sample of 21 economies having enough time-series data) converge to their steady-state levels at a

[2] Along the same lines, Crafts (2004) concludes that the discussion on the relationship between globalisation and growth is less than conclusive in many respects.

rate of approximately 4% per year. The key drivers of economic growth are DI, FDI, and the change in the degree of openness. Inflation and the current account are also found significant, whereas the impact of other standard variables, such as the terms of trade, population growth or life expectancy, are not robust to different estimation procedures. When FDI is at its average level, a 1 percentage point increase in the ratio of domestic investment to GDP generates between 0.14 and 0.34 extra percentage points of per capita growth depending on the acceleration in the globalisation process. When there is no change in globalisation, the relevant value is 0.14, when the change in degree of openness is 27, then the relevant value is 0.34. Beyond 27, this impact ceases to be significant. Another important result is that this sequence of growth impacts is progressively diminished the larger the net flows of FDI. This reflects the existence of substitutabilities between these two types of investment, and provides evidence of significant crowding-out effects of FDI on DI in terms of its effects on economic growth. Conversely, when DI is at its average level, a 1 percentage point increase in FDI generates between 0.41 and 1.67 extra percentage points increase of per capita growth depending, respectively, whether the change in the degree of openness is 0 or is 50. The crowding-out effect is also confirmed, but from the other side of the relationship: the larger the ratio of domestic investment to GDP, the smaller becomes the growth impact of FDI, which is eventually null for sufficiently large values of DI. In other words, economic growth in the SSA economies is more sensitive to FDI than to DI, but FDI may also become irrelevant if governments devote enough income to investment.

A central implication of these findings is that the effects of domestic policies and the domestic consequences of foreign affairs are closely intertwined. Domestic policies cannot be designed in isolation for the same reason that foreign affairs need to be managed by fully attending national needs and not following generic indications. Globalisation, FDI flows, and expanding efforts in DI will have successful consequences if carefully driven from national authorities according to a thoughtful agreed agenda. Given that these three variables have long-term consequences on growth and, thus, on the living standard of one of the world's poorest regions, short-termism and improvisation should be by all means avoided.[3]

Next Section briefly reviews the main theoretical and methodological issues underlying economic growth regressions. Section 3 documents the poor results achieved by Sub Saharan countries in terms of absolute convergence. Section 4 examines conditional convergence. Section 5 concludes.

[3] A key feature of these variables' time series is the wide oscillatory pattern they follow in many SSA economies. Of course, this may be due to wars or natural disasters, but, if they are not, they may also be a reflection of difficulties in the implementation of long-term plans or strategic structural policies.

2 Background: key issues in the analysis of growth

2.1 Theoretical underpinnings

Two crucial concepts of economic convergence refer to *unconditional* (or absolute) convergence and *conditional* (or relative) convergence.[4] Unconditional convergence implies that poor economies grow faster than wealthy economies independently of the particular political and socioeconomic structure of each particular country. Conditional convergence, in turn, refers to the catching-up process of any economy (or group of economies) to its own steady-state, which is determined by the political and socioeconomic structure of that economy (or group of economies).

The existence of unconditional convergence can be empirically tested by checking whether the coefficient of initial income is negative in a univariate regression of the form

$$\Delta y_{i,t} = \alpha_{i,t} + \beta y_{i,t-1} + \epsilon_{i,t}, \tag{1}$$

where $\Delta y_{i,t}$ is the log difference of real GDP per capita, and $y_{i,t-1}$ is the lagged logarithm of real GDP per capita. Unconditional convergence is captured by the estimate of the β coefficient. A significant negative sign in this coefficient implies the existence of significant unconditional convergence. The reason is that the annual growth rate $\Delta y_{i,t}$ is inversely related to $y_{i,t}$ and, therefore, a larger estimate of β corresponds to a greater tendency for convergence. The estimation of this equation is generally disregarded in empirical studies due to the inherent problem of omitted-variables bias. Here we will try to approach this issue from a rough descriptive perspective that tries to relate unconditional convergence with economic globalisation.

Conditional convergence is generally estimated on the basis of a multivariate regression analysis with two basic ingredients: (i) the presence of dynamics or an initial measure of income –$y_{i,t-1}$ in equation (2) or $y_{i,0}$ (where the subscript 0 denotes the initial value of the 5-years period) in equation (4)–; and (ii) a set of conditioning variables that control for the steady state or long-run per capita income towards which the economy eventually converges. This may be augmented with cross-section and/or period fixed-effects so that the standard model ends up taking the form:[5]

$$\Delta y_{i,t} = \alpha + \beta y_{i,t-1} + \delta \mathbf{X}_{i,t} + \eta_i + \xi_t + \epsilon_{i,t}, \tag{2}$$

[4] The analysis of this concepts are known as β-convergence (see Sala-i-Martin, 1996). Other studies, however, focus on the the fall over time in the dispersion of per capita income across countries, which is known as σ-convergence (for a recent example see Young *et al.*, 2008).

[5] As the goal of this paper is mainly empirical, we do not enter into well-known theoretical details that can be found, for example, in Mankiw *et al.* (1992), and Barro and Sala-i-Martin (1995).

where β and δ are parameters to be estimated, $\mathbf{X}_{i,t}$ is a row vector of determinants of economic growth, η_i is a vector of country fixed-effects controlling for time-invariant differences across countries that are not controlled by $\mathbf{X}_{i,t}$, ξ_t are time fixed-effects controlling for temporary shocks common across countries, and $\epsilon_{i,t}$ is a vector of zero-mean white-noise residuals. Control variables in $\mathbf{X}_{i,t}$ may include, to name a few, foreign direct investment, domestic investment, the degree of openness, population growth, life expectancy, and inflation.

Equation (2) may be reparameterised and written as:

$$y_{i,t} = \alpha + (1 - \beta)\, y_{i,t-1} + \delta \mathbf{X}_{i,t} + \eta_i + \xi_t + \epsilon_{i,t}. \tag{3}$$

This clearly shows that what we actually estimate is a level equation even it is usually expressed in differences. There are two important remarks surrounding the interpretation of standard growth equations.

First, a significant negative sign in the β coefficient implies the existence of significant conditional convergence. Because the dependent variables is expressed as a growth rate, the estimated value of β indicates the rate at which the economies in the sample period converge to their steady-state. For example, a rate of 2% indicates that each year these economies get 2% closer to their steady state. As stated in Sala-i-Martín (1996, pp. 1028) "This does not mean that poor economies grow faster or that the world distribution of income is shrinking. These are phenomena captured by the concepts of absolute- β -convergence and σ-convergence".

Second, it has become common practice to work with five-year averages to avoid short-term business cycle fluctuations. In that case, equation (2) changes to:

$$\Delta y_{i,t} = \alpha + \beta_0 y_{i,0} + \delta \mathbf{X}_{i,t} + \eta_i + \xi_t + \epsilon_{i,t}, \tag{4}$$

where, as noted before, $y_{0,i}$ is the initial value of per capita income (of each five-years period).

In Section 4 we present estimates of both equations (2) and (4). We next clarify the methodological implications of these alternative econometric procedures.

2.2 Methodological discussion

2.2.1 Econometric considerations

The estimation of growth models was initially developed within a cross-section context –for example, the seminal paper by Barro (1991) among the many others that followed. This practice, however, entailed a twofold problem related to the potential endogeneity of the regressors, and to the existence of country-specific effects. A second wave of studies (for example, those of Beck *et al.*, 2000, and Barro, 2000) switched to the estimation of panel data models so that the unobserved country-specificities could be accounted for by the estimated fixed-effects. Common to both methodologies, the standard practice consisted in working with five-years averages to allow for the use of some variables only available at this frequency (human capital, for example) and to clean the information from business cycle noise and, therefore, to focus only in long-run relationships. These two advantages, however, can be put into perspective on the following grounds. First of all, variables only available for five-years periods are quite often indicators that proxy the true unobserved variable (for example institutional-related variables). Second, the concept of "business cycle" is defined ad hoc, as five-years usually start at the begin or in the middle of the decade or, due to their availability from a particular year, they just condition the initial year of the five-years period. This method also implies relying on the assumption that the length of the business cycle is always the same and, as a consequence, business cycles are considered identical (in time and length) across countries.

Here we follow a different strategy. One of the historical limitations that studies on SSA had to face was the lack of sufficient data, both in quantity and quality. This limitation has become progressively less binding and it is fair to make full use of the current information at hand. Moreover, business cycles are inherently part of the economic behaviour: to understand how the different economic forces affect growth we cannot neglect the role of the former. Finally, making full use of the long time series available is helpful for the precise identification of the estimated coefficients. This is what leads us to use available yearly data as individual observations.

The advantages of using panel data are well-known. As shown by equation (2), we control for cross-section and time fixed effects to avoid as much as possible omitted variable biases that could arise, for example, from country-specific factors (institutional settings, for example) that might be correlated with the explanatory variables. Cross-section fixed effects control for time-invariant differences across countries that are not controlled by the explanatory variables, whereas time dummies control for shocks that are common across countries (e.g. the Great Recession).

However, as we estimate a dynamic model and the lagged dependent variable appears as an explanatory variable, the use of a standard fixed-effects model could yield inconsistent coefficients even if the residuals were not serially correlated. For simplicity, and without loss of generality, let us explain this potential inconsistency through the following simple fixed-effects model:

$$y_{i,t} = \gamma y_{i,t-1} + \delta \mathbf{X}_{i,t} + \eta_i + \epsilon_{i,t}, \tag{5}$$

where $y_{i,t}$ is the dependent variable, $y_{i,t-1}$ is the lagged dependent variable, $\mathbf{X}_{i,t}$ is a row vector of explanatory variables, η_i is a fixed-effect term, γ and δ are parameters to be estimated, and $\epsilon_{i,t}$ is a disturbance (i and t represent the cross-section and time dimensions respectively).

Estimate of equation (5) by OLS yields an inconsistent estimation of γ and δ, given that $y_{i,t-1}$ is correlated with the fixed-effect term.[6] One way to overcome this inconsistency is suppressing the fixed-effect term by expressing model (5) as a first-differences model:

$$y_{i,t} - y_{i,t.1} = \gamma(y_{i,t-1} - y_{i,t-2}) + (\mathbf{X}_{i,t} - \mathbf{X}_{i,t-1})'\delta + (\epsilon_{i,t} - \epsilon_{i,t-1}). \quad (6)$$

However, as $y_{i,t-1}$ is correlated with $\epsilon_{i,t-1}$, estimation by OLS still yields inconsistent estimators.

To overcome this result Arellano and Bond (1991) developed the Difference GMM method, which consists in estimating equation (6) using as instruments the levels of the explanatory variables lagged two and more periods.

Some authors, however, considered that this method could have problems for persistent variables such as many of the ones generally used in economic growth models. This additional concern can be addressed through the use of the System GMM method, which was developed by Arellano and Bover (1995) and Blundell and Bond (1998) and deals better than the better than the Difference GMM with the presence of persistent variables.[7] The System GMM method consists in the estimation of two equations, one in differences and one levels such as:

$$\begin{aligned} \Delta y_{i,t} &= \gamma \Delta y_{i,t-1} + \delta \Delta \mathbf{X}_{i,t} + \Delta \epsilon_{i,t}, \\ y_{i,t} &= \gamma y_{i,t-1} + \delta \mathbf{X}_{i,t} + \eta_i + \epsilon_{i,t}. \end{aligned} \quad (7)$$

The key contribution of this method is that it uses further moment conditions than the Difference GMM estimator. Not only the levels of the variables lagged twice and more are used, as in the Difference GMM method, but also the lags of the variables in differences which are now added as instruments in the level equation of the system.

2.2.2 The addition of interactions

Beyond the choice of the econometric technique, one of the contributions of this paper is the estimation of multiplicative interaction models, which hopefully will allow us to better

[6]Lagging equation (5) leads to $y_{i,t-1} = \gamma y_{it-2} + \delta \mathbf{X}_{i,t-1} + \eta_i + \epsilon_{i,t-1}$ so that it is easy to see that $y_{i,t-1}$ is correlated with η_i.

[7]For details on System GMM and its advantages over Difference GMM, see Bond *et al.* (2006) and Roodman (2009). For their aplication on economic growth models, see Castelló-Climent (2010).

disentangle the relationship between DI, FDI, and the degree of economic openness. Next we explain how the estimated coefficients need to be interpreted in this context.

A simple linear additive model can be expressed as follows:

$$\hat{Y} = \alpha_0 + \alpha_1 X + \alpha_2 Z \tag{8}$$

where $\hat{Y}$ is the estimated value of the dependant variable, X and Z are the explanatory variables, and the α's are estimated parameters. In turn, a simple multiplicative interaction model takes the form:

$$\hat{Y} = \beta_0 + \beta_1 X + \beta_2 Z + \beta_3 XZ, \tag{9}$$

where the β's are estimated parameters, and XZ is an interactive term (for details see Aiken and West, 1991, and Brambor *et al.*, 2006).

The presence of the interactive term alters the interpretation of the estimated parameters in a fundamental way. The reason is that in model (8) X and Z are considered independent of one another, whereas in model (9) X and Z are not. In other words, in the additive model the effect of X on Y is considered to be constant while, in the multiplicative interaction model, this effect depends on the values taken by variable Z. Therefore:

- α_1 is the *unconditional* marginal effect of X on Y, while β_1 is the *conditional* marginal effect of X on Y when $Z = 0$.

  (The same interpretation holds for α_2 and β_2 regarding Z).

- β_3 captures the impact of X on Y for different values of the modifying variable Z and allows this impact to vary. That is, the overall conditional marginal effect of X on Y is:

$$\frac{\partial Y}{\partial X} = \beta_1 + \beta_3 Z. \tag{10}$$

Most of the literature uses linear additive models and disregard the possibility that the explanatory variables may be conditioned by one another. Moreover, Brambor *et al.* (2006) show that most of the literature considering multiplicative interaction models is subject to one (or both) of the following problems: omitted constitutive terms, and lack of computation of "marginal effects and standard errors across a substantively meaningful range of the modifying variable" [Brambor *et al.* (2006), p. 78].

To minimise the possibility of omitted constitutive terms, in this study we specify a richer multiplicative interaction model with three interactive terms (details on the empirical justification of this procedure are provided below). This implies an augmented version of model (9) such that

$$\hat{Y} = \beta_0 + \beta_1 X + \beta_2 Z + \beta_3 W + \beta_4 XZ + \beta_5 XW + \beta_6 ZW + \beta_7 XZW, \tag{11}$$

in which case the overall conditional marginal effect of X on Y is

$$\frac{\partial Y}{\partial X} = \beta_1 + \beta_4 Z + \beta_5 W + \beta_7 ZW. \tag{12}$$

This specification is used in Section 4 to compute marginal effects and standard errors of X (in our case, domestic or foreign direct investment) across a substantively meaningful range of the modifying variable Z (changes in the degree of openness) for given values of W (foreign direct or domestic investment).

3 Unconditional convergence

Table 1 displays information on the economic catching-up process of Sub Saharan economies between 1980 and 2009. The first block in the table shows income per capita in each country relative to the US one. For example, real GDP per head in 1980 in Angola was 8.3% of the US one and progressed to 11.6% in 2009. This implies that Angola has tended to converge and in the last three decades has shortened its gap by 3.3 percentage points (of US real per capita GDP in PPP).

Table 1. Economic catching-up in Sub Saharan Africa. 1980-2009.
Real GDP per capita in PPP as % of US real GDP per capita in PPP

	Levels				**Differences (percentage points)**			
	1980	**1990**	**2000**	**2009**	**80-90**	**90-00**	**00-09**	**80-09**
Angola	8.3	7.4	6.0	11.6	-0.9	-1.5	5.6	3.3
Benin	3.8	3.39	2.94	2.71	-0.45	-0.45	-0.22	-1.1
Botswana	11.9	18.34	21.89	21.58	6.4	3.56	-0.32	9.7
Burkina Faso	2.65	2.08	2.03	2.20	-0.56	-0.05	0.17	-0.45
Burundi	1.47	1.41	1.01	0.90	-0.05	-0.41	-0.11	-0.6
Cameroon	7.89	6.00	4.31	4.41	-1.89	-1.69	0.10	-3.5
Cape Verde	4.43	5.11	6.33	9.19	0.69	1.22	2.86	4.8
CAF	3.58	2.34	1.62	1.58	-1.24	-0.72	-0.04	-2.0
Chad	2.31	2.35	1.87	3.11	0.04	-0.48	1.24	0.8
Comoros	5.59	4.11	2.50	2.23	-1.47	-1.62	-0.27	-3.4
D.R. Congo	3.07	2.29	0.30	0.56	-0.78	-1.99	0.26	-2.5
R.Congo	7.00	7.70	5.84	5.40	0.70	-1.86	-0.44	-1.6

Table 1. Continuation...

	Levels				Differences (percentage points)			
	1980	**1990**	**2000**	**2009**	**80-90**	**90-00**	**00-09**	**80-09**
Côte d'Ivore	6.15	5.11	3.86	3.27	-1.04	-1.26	-0.59	-2.9
Equatorial Guinea	2.97	1.98	14.88	53.57	-0.99	12.89	38.69	50.6
Eritrea	n.a.	n.a.	2.1	1.4	n.a.	n.a.	-0.7	n.a.
Gabon	52.1	34.5	28.2	25.0	-17.67	-6.28	-3.18	-27.1
The Gambia	3.4	2.7	2.05	3.6	-0.69	-0.63	1.52	0.2
Ghana	3.2	2.7	2.6	3.0	-0.55	-0.40	0.75	-0.2
Guinea	3.5	2.7	1.9	2.0	-0.78	-0.79	0.08	-1.5
Guinea-Bissau	1.5	1.35	1.2	2.0	-0.16	-0.19	0.83	0.5
Kenya	4.58	3.75	2.89	2.9	-0.82	-0.86	0.04	-1.6
Lesotho	3.13	2.87	2.82	3.2	-0.26	-0.05	0.37	0.1
Liberia	7.04	1.64	1.34	1.0	-5.40	-0.30	-0.38	-6.1
Madagascar	3.23	2.90	2.07	1.8	-0.33	-0.83	-0.24	-1.4
Malawi	3.64	1.88	1.46	1.6	-1.76	-0.41	0.12	-2.05
Mali	2.25	2.18	1.91	2.4	-0.07	-0.27	0.52	0.2
Mauritius	11.86	15.84	19.20	23.07	3.98	3.35	3.88	11.2
Mozambique	1.87	1.28	1.12	1.85	-0.59	-0.16	0.73	-0.0
Namibia	17.84	12.13	10.18	11.52	-5.70	-1.96	1.34	-6.3
Niger	2.74	1.60	1.21	1.30	-1.14	-0.38	0.09	-1.4
Nigeria	5.79	3.73	2.90	4.95	-2.06	-0.83	2.05	-0.8
Rwanda	3.14	2.44	1.69	2.51	-0.69	-0.76	0.82	-0.6
Sao Tomé and P.	6.08	3.26	2.59	4.09	-2.81	-0.67	1.50	-2.0
Senegal	4.52	3.56	3.38	3.63	-0.96	-0.18	0.25	-0.9
Seychelles	39.09	41.19	44.66	57.91	2.11	3.47	13.24	18.8
Sierra Leone	4.10	3.31	1.35	2.12	-0.79	-1.95	0.77	-2.0
South Africa	24.42	17.04	15.04	18.46	-7.38	-1.99	3.42	-5.95
Swaziland	8.88	9.74	8.10	8.37	0.85	-1.63	0.27	-0.5
Tanzania	2.69	2.10	1.84	2.89	-0.59	-0.26	1.06	0.2
Togo	5.32	3.32	2.14	1.79	-2.00	-1.18	-0.35	-3.5
Uganda	2.16	1.75	2.09	2.80	-0.41	0.35	0.71	0.6
Zambia	6.62	3.81	2.12	4.29	-2.80	-1.70	2.18	-2.3
Zimbabwe	1.41	1.16	0.94	0.35	-0.25	-0.22	-0.60	-1.1

Source: Penn World Table 7.0.

The conclusion we obtain from reading this table is twofold. First of all, per capita income in the vast majority of economies is less than 15% of the US one and in many of them it is below 5%. Among the 43 Sub Saharan countries, the exceptions are Botswana (close to 22% in 2009), Equatorial Guinea (near 54%), Gabon (25%), Mauritius (23%), Seychelles (almost 58%), and South Africa (above 18%). Second, only in exceptional cases there has been some economic catch-up. For example in some of the "rich" countries just mentioned –but not in Gabon, and South Africa–, and also in Angola and Cape Verde. Overall, the African experience in last three decades is certainly not successful.

Table 2 classifies our set of countries into two groups, one where international exposure has increased in the last decades, and another one where it has fallen. International exposure is measured by the trade ratio over GDP (i.e., exports+imports/GDP). We call the former "globalisers" and the later "non-globalisers".

Table 2. Economic growth in Sub Saharan Africa.[8] 1980-2009.

Yearly average growth of real GDP per capita in PPP

	1980s	1990s	2000s	$\frac{\text{Exports+Imports}}{\text{GDP}}*100$
Globalisers	-2.4	3.5	30.0	34.8
Non-globalisers	10.5	-2.3	28.3	-21.2
All	3.5	0.8	29.2	8.9

Source: Penn World Table 7.0.

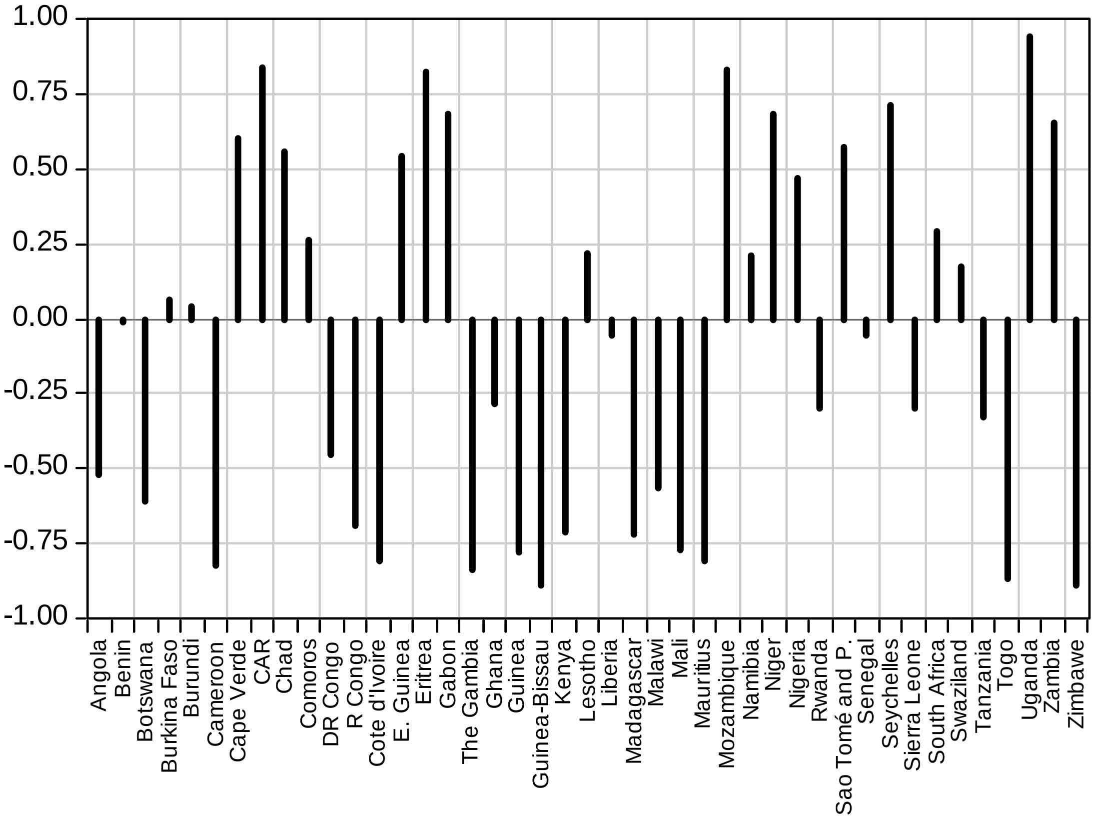
There are significant differences in the 1980s, when the non-globalisers increased per capita income by 10.5% while the globalisers lost 2.5% of it. The 1990s, on the contrary, show little differences between the two groups, with the globalisers growing (at 3.5%) and the non-globalisers loosing track (-2.5%). No differences, either, characterized the 2000s in spite of this being the most successful period in terms of economic growth with a rise in per capita GDP close to 30%.

The connection between per capita GDP and the degree of openness can be further explored by examining the relationship between the two country by country. Figure 1 shows the correlation coefficient between per capita real GDP of each country, as a ratio of the US one, and the degree of openness (measured as imports plus exports of goods and services over domestic output). Normalization with respect to the US GDP provides a synthetic indication of convergence, which we connect with the degree of international exposure. In this way, countries with a positive correlation are successful in the sense that they have been capable to manage the inexorable globalisation process without harming economic growth. On the contrary, countries with a negative correlation are unsuccessful in the sense that changes in their exposure to international markets are negatively

[8] Equatorial Guinea and Eritrea are not considered. Equatorial Guinea is an outlier whose inclusion totally distorts the picture. Eritrea due to lack of data.

correlated with their economic progress.[9]

Figure 1. Correlation between per capita GDP (as % of the US one) and openness.



Note: per capita GDP expressed in per cent with respect to US per capita GDP.

Source: Penn World Table 7.0.

Figure 1 shows a clear ambiguous relationship, where approximately half of the countries display positive and negative correlation coefficients. We conclude that openness does not exert a clear influence on absolute convergence and is thus not able, at least at a first glance, to explain the poor performance of Sub Saharan countries in terms of absolute convergence. Next we carefully explore this issue when applied to conditional convergence.

4 Conditional convergence

4.1 Data

We use annual data running from 1980 to 2009 collected from different sources. Per capita GDP, domestic investment and the degree of economic integration (openness) are obtained

[9]Note that both groups of countries may display this correlation irrespective of the signs taken by both variables. For example, an economy with a widening GDP gap with respect to the US and a falling degree of openness with have a positive correlation coefficient.

from the Penn World Table; current account, prices inflation and population growth from the IMF World Development Outlook; and net inflows of foreign direct investment, terms of trade, and life expectancy from World Bank's Africa Development Indicators.

Table 3. Definitions of variables.

	Variables	Sources	Subindices
y_{it}	Real per capita GDP in PPP	PWT	$i = 1, ..., 21$ countries
y_{i0}	Initial real per capita GDP in PPP	PWT	$t = 1, ..., 30$ years
di_{it}	Domestic investment (% GDP)	PWT	
fdi_t	Net foreign direct investment (% GDP)	WB	
op_t	Openness $\left(\frac{\text{exports + imports}}{\text{GDP}} * 100\right)$	PWT	
ca_{it}	Current account balance (% GDP)	IMF	
tot_{it}	Terms of trade: $\log\left(\frac{\text{price exports}}{\text{price imports}}\right)$	WB	
π_{it}	Price inflation (GDP deflator growth rate)	IMF	
Δpo_{it}	Population growth	IMF	
lex_{it}	Life expectancy (log)	WB	

Note: PPP=Purchase Power Parity; PWT = Penn World Table; WB = World Bank;
IMF = International Monetary Found.

Only 21 of the 43 SSA economies have enough time-series data to conduct our dynamic panel estimation. The rest cannot be taken into account for different reasons depending on the country –for example, Angola has no data on the terms of trade, Zimbawe on the current account, and São Tomé and Príncipe on FDI.

4.2 Estimated equations

We present results broken down on a three-fold dimension: (i) based on the estimation of a standard linear additive model –where all explanatory variables are considered independent– and of a multiplicative interaction model –where some explanatory variables are considered dependent among them; (ii) based on the estimation of a two-way fixed-effects model through OLS and System GMM; and (iii) based on estimates using five-years averages and yearly data. Our reference results will be those obtained through the estimation of a multiplicative interaction model on yearly data by System GMM.

4.2.1 Models with no interactions

Table 4 shows the results from the standard linear additive economic growth model. The first two columns present the two-way fixed effect estimates by OLS (using five-years and yearly data), whereas the last two columns show the analogous System GMM estimates.

The first noteworthy result is the existence of conditional convergence since the estimated coefficient of y_{t-1} is negative and significant across all regressions. The speed of the catching up process ranges from 13% to 6%, depending the methodology, indicating that convergence of these countries towards their steady-state progresses at these rates per year. Regarding the role played by the explanatory variables, the results are also diverse depending on the econometric methodology and the specification of the database in five-years or annual frequencies. One significant feature, however, is that a number of growth factors appear to be non-significant. This may be due to the inherent limitations (and imposed restrictions) of the estimation methodology, and/or to cross-country heterogeneity resulting on an average null effect (the latter would be consistent, for example, with Herzer's, 2012, finding of heterogeneous FDI effects in developing countries).

Table 4. Dynamic two-way fixed effects models without interactions.

Dependent Variable: Δy_{it}

	OLS				**System GMM**			
	Five-years		Yearly		Five-years		Yearly	
	Coeff.	[Prob.]	Coeff.	[Prob.]	Coeff.	[Prob.]	Coeff.	[Prob.]
c	1.01	[0.002]	1.01	[0.010]	2.53	[0.276]	0.30	[0.514]
y_{t-1}	-0.11	[0.000]	-0.12	[0.000]	-0.13	[0.020]	-0.06	[0.018]
Di_t	0.07	[0.018]	0.23	[0.005]	0.69	[0.142]	0.13	[0.284]
fdi_t	0.12	[0.340]	0.17	[0.102]	1.16	[0.259]	0.13	[0.504]
op_t	-0.02	[0.183]	-0.10	[0.177]	-0.45	[0.007]	-0.12	[0.039]
op_{t-1}	0.04	[0.051]	0.10	[0.102]	0.36	[0.060]	0.15	[0.009]
tot_{t-1}	-0.03	[0.121]	-0.02	[0.225]	-0.07	[0.733]	-0.03	[0.384]
ca_t	-0.02	[0.616]	0.10	[0.017]	0.99	[0.177]	0.03	[0.674]
pop_t	-0.17	[0.151]	-0.35	[0.058]	-1.84	[0.011]	-1.03	[0.121]
pop_{t-1}	0.07	[0.524]	0.18	[0.259]	1.90	[0.009]	1.02	[0.126]
π_{t-1}	-0.02	[0.000]	-0.05	[0.047]	-0.20	[0.003]	-0.03	[0.160]
lex_{t-1}	0.02	[0.783]	0.03	[0.604]	-0.25	[0.483]	0.07	[0.372]
R^2		0.52		0.23				
$AR(1)$						0.30		0.00
$AR(2)$						0.07		0.66
$Hansen$						0.99		1.00
Obs		101		522		101		522
N		21		21		21		21

Endogenous variables: $di_t, fdi_t, op_t, pop_t, ca_t$. Predetermined variables: $y_{t-1}, tot_{t-1}, \pi_{t-1}, lex_{t-1}$

In contrast with the diversity of results on DI, current account, the terms of trade, and life expectancy, we find robust results across regressions for the degree of openness (although in OLS estimations the current value is only marginally significant). This gives, to some extent and along the lines of the results in Greenaway *et al.* (1998), empirical support for SSA to a $J-$curve type response of openness to growth, with a current negative impact of openness on growth, and a subsequent positive effect. Inflation, in turn, exerts the expected significant negative influence.

4.2.2 Models with interactions

Estimation of the multiplicative interaction model yields more conclusive results. This is due to the improvement in the model's specification that occurs when unconditional marginal effects have been estimated in the presence of cross-dependencies among explanatory variables that require the estimation of conditional marginal effects (i.e., the impact of some explanatory variables on the dependent variable depend on the value of other explanatory variable). We argue that FDI, DI and openness are not independent from one another and, therefore, their growth impact needs to be assessed through the correct estimation of the conditional marginal effect of these variables on economic growth. This is the reason why estimate a multiplicative interaction model (extensive details on this procedure are provided in Brambor *et al.*, 2006).

We directly focus on the results displayed in the last column, which are obtained through the estimation of the multiplicative interaction model on yearly data by System GMM. The first salient outcome of this regression is that the speed of conditional convergence is reduced with respect to previous estimations and placed at a rate of 4%. The second one is that di and fdi appear as the most important conditional driving forces of economic growth in SSA countries. In addition, the estimated coefficients on openness are robust and significant at a standard 10% critical value. They enter, though, as a difference as we expose in Table 6. This new set of results also show that the current account has a positive marginal effect on growth, whereas the demographic variables (population and life expectancy), the terms of trade, and the inflation are not significant once we control for endogeneity (to see this it is enough to compare these results to the ones in column 2).

The economic interpretation of the interaction coefficients and their standard errors deserves especial attention.

Table 5. Dynamic two-way fixed effects models with interactions.

Dependent Variable: Δy_{it}

	OLS				**System GMM**			
	Five-years		Yearly		Five-years		Yearly	
	Coeff.	[Prob.]	Coeff.	[Prob.]	Coeff.	[Prob.]	Coeff.	[Prob.]
c	0.85	[0.004]	1.03	[0.004]	3.65	[0.002]	0.19	[0.565]
y_{t-1}	-0.10	[0.000]	-0.12	[0.000]	-0.14	[0.000]	-0.04	[0.008]
di_t	0.08	[0.106]	0.29	[0.000]	0.45	[0.124]	0.22	[0.017]
fdi_t	0.24	[0.291]	0.63	[0.012]	-1.42	[0.569]	0.59	[0.025]
op_t	-0.11	[0.241]	-0.37	[0.098]	-0.14	[0.730]	-0.40	[0.107]
op_{t-1}	0.12	[0.247]	0.38	[0.081]	-0.04	[0.899]	0.44	[0.080]
tot_{t-1}	-0.03	[0.115]	-0.02	[0.116]	-0.16	[0.107]	-0.03	[0.234]
ca_t	-0.01	[0.928]	0.09	[0.036]	0.09	[0.095]	0.06	[0.123]
pop_t	-0.20	[0.063]	-0.40	[0.017]	-2.78	[0.056]	-0.29	[0.440]
pop_{t-1}	0.14	[0.152]	0.22	[0.114]	2.78	[0.247]	0.29	[0.443]
π_{t-1}	-0.02	[0.001]	-0.04	[0.069]	-0.22	[0.000]	-0.02	[0.221]
lex_{t-1}	0.03	[0.527]	0.02	[0.680]	-0.32	[0.119]	0.04	[0.417]
$ki_t * \Delta op_t$	0.26	[0.571]	0.81	[0.140]	-3.35	[0.087]	0.92	[0.129]
$fdi_t * \Delta op_t$	3.06	[0.350]	5.27	[0.126]	28.3	[0.132]	5.38	[0.160]
$ki_t * fdi_t$	-0.48	[0.446]	-1.27	[0.033]	4.59	[0.521]	-1.26	[0.033]
$ki_t * fdi_t * \Delta op_t$	-5.48	[0.645]	-11.8	[0.181]	-45.3	[0.350]	-11.5	[0.275]
R^2		0.57		0.26				
$AR(1)$						0.515		0.002
$AR(2)$						0.075		0.714
$Hansen$						1.00		1.00
$Obvs.$		101		522		101		522
N		21		21		21		21

Endogenous variables: $di_t, fdi_t, op_t, pop_t, ca_t, di_t * \Delta op_t, fdi_t * \Delta op_t, di_t * fdi_t, di_t * fdi_t * \Delta op_t$.

Predetermined variables: $y_{t-1}, tot_{t-1}, \pi_{t-1}, lex_{t-1}$

4.2.3 Interpreting the interactions

Table 6 documents the changes in the relevant estimated coefficients when different interactions are considered. The Base-run 1 estimates correspond to the model presented in the last column of Table 5. Base-Run 2 is the same model with openness (and population) entering as a difference. Note that imposition of this restriction does not significantly alter the estimated coefficients. Note, in turn, that the Base-run 2 model is exactly the specification we reach once all interactions are included in the model. This is the one that will be used to compute the marginal effects.

Table 6. Estimated interactions. System GMM.

	di_t	fdi_t	op_t	op_{t-1}	Δop_t	$di_t{*}\Delta op_t$	$fdi_t{*}\Delta op_t$	$di_t{*}fdi_t$	$di_t{*}fdi_t{*}\Delta op_t$
Base-run 1	0.22 [0.017]	0.59 [0.025]	-0.40 [0.107]	0.44 [0.080]		0.92 [0.129]	5.38 [0.160]	-1.26 [0.033]	-11.5 [0.275]
Base-run 2	0.18 [0.016]	0.75 [0.003]			-0.38 [0.111]	0.83 [0.147]	5.02 [0.183]	-1.50 [0.013]	-11.0 [0.318]
Interactions 1	0.22 [0.017]	0.22 [0.191]			-0.32 [0.130]	0.77 [0.073]			
Interactions 2	0.19 [0.081]	0.09 [0.543]			-0.15 [0.057]		0.27 [0.763]		
Interactions 3	0.17 [0.059]	0.78 [0.052]			-0.09 [0.254]			-1.80 [0.048]	
Interactions 4	0.21 [0.009]	0.23 [0.099]			-0.33 [0.117]	0.70 [0.110]	0.65 [0.419]		
Interactions 5	0.18 [0.016]	0.75 [0.003]			-0.38 [0.111]	0.83 [0.147]	5.02 [0.183]	-1.50 [0.013]	-11.0 [0.318]

Notes: BR=Base Run model.
with Δop_t instead of op_t and op_{t-1}.

The interpretation of the scenarios considered is the following. In *Interactions 1*, with $di_t * \Delta op_t$, the effect of domestic investment on growth is considered to be dependent of changes in the degree of openness, but independent of FDI (which is also independent of the change in the degree of openness). The marginal effect of domestic investment (di) on growth (Δy) is thus:

$$\frac{\partial \Delta y}{\partial di} = \underset{[0.017]}{0.22} + \left[\underset{[0.073]}{0.77} * \Delta op\right].$$

This implies that when $\Delta op = 0$, the marginal effect is 0.22 and reflects, on account of the positive sign if the interaction, that there is a complementarity between di and Δop. In turn, Figure A1.a in the Appendix shows the marginal effect of di on Δy for a range of values of Δop between 0 and 50, and the corresponding 95% confidence intervals.[10]

In *Interactions 2*, with $fdi_t{*}\Delta op_t$, the effect of FDI on growth is considered to be dependent of changes in the degree of openness, but independent of DI (which is also independent of the change in the degree of openness). The marginal effect of FDI (fdi) on growth (Δy) is thus:

$$\frac{\partial \Delta y}{\partial fdi} = \underset{[0.543]}{0.09} + \left[\underset{[0.763]}{0.27} * \Delta op\right].$$

[10] This range of values between 0 and 50 implies that our exercise considers situations in which the degree of openness does not change (value 0) or increases by as much as 50 percentage points.

This implies that when $\Delta op = 0$, the marginal effect is null (the estimated coefficient is non-significant). However, we cannot conclude, by the same token, that the marginal effect is also null. This needs to be evaluated for each value of Δop as in Figure A1.b in the Appendix. Note that the marginal effect of fdi on Δy (for the same range of values of Δop than before) is indeed non-significant.

In *Interactions* 3, with $di_t * fdi_t$, the effect of domestic investment is considered to be dependent on FDI (and vice-versa), and both kinds of investment are independent of changes in the degree of openness. The marginal effect of domestic investment (di) on growth (Δy) is thus:

$$\frac{\partial \Delta y}{\partial di} = \underset{[0.059]}{0.17} - \left[\underset{[0.048]}{1.80} * fdi \right].$$

This implies that when $fdi = 0$, the marginal effect is 0.17 (significant at the 6% critical value). Following Figure A1.c in the Appendix, the marginal effect of fdi on di (for a range of values of fdi between 0 and 50) is non-significant.

Interactions 4 contains two interactive terms, $di_t * \Delta op_t$ and $fdi_t * \Delta op_t$. Therefore, the effect of domestic investment on growth is considered to be dependent of changes in the degree of openness, but independent of FDI; whereas the one of FDI depends on changes in the degree of openness, but not on DI. The marginal effects of domestic investment (di) and FDI (fdi) on growth (Δy) are, respectively:

$$\begin{aligned} \frac{\partial \Delta y}{\partial di} &= \underset{[0.009]}{0.21} + \left[\underset{[0.110]}{0.70} * \Delta op \right]; \\ \frac{\partial \Delta y}{\partial fdi} &= \underset{[0.099]}{0.23} + \left[\underset{[0.419]}{0.65} * \Delta op \right]. \end{aligned}$$

This implies that when $\Delta op = 0$, the marginal effect of di on economic growth is 0.21, while the one of fdi is 0.23 (significant at the 10% critical value). In addition, both are positively correlated with changes in the degree of openness. The marginal effects of these growth drivers for different values of Δop are given in Figure A1.d in the Appendix. Note that the marginal effect of di is significant for all considered values of Δop, whereas the one of fdi is significant only in the range of 5-30 percentage points increase in the degree of openness.

Overall, this set of interactions show that di and fdi exert a significant positive effect on economic growth. Nevertheless, our results are not yet conclusive about the possible crowding out effect on growth of these two types of capital. For this purpose, we use a model with all interactions considered –*Interactions* 5– which provides the central result of our analysis.

4.3 Marginal effects

The last scenario in Table 6 considers a situation of multiple interactive terms comprising $di * \Delta op$, $fdi * \Delta op$, $di_t * fdi$, and $di_t * fdi_t * \Delta op$. This corresponds to equation (11). The analysis of the conditional marginal effects is equivalent to the one presented in equation (12) for a variable X. Here, however, we have two variables to be considered: domestic and foreign direct investment.

4.3.1 Case 1: domestic investment

When domestic investment is examined, the empirical version of equation (12) is the following (note that X denotes di, Z denotes Δop, and W denotes fdi):

$$\frac{\partial \Delta y}{\partial di} = \underset{[0.016]}{0.18} + \left[\underset{[0.147]}{0.83} * \Delta op - \underset{[0.013]}{1.50} * fdi - \underset{[0.318]}{11.0} * (\Delta op * fdi) \right].$$

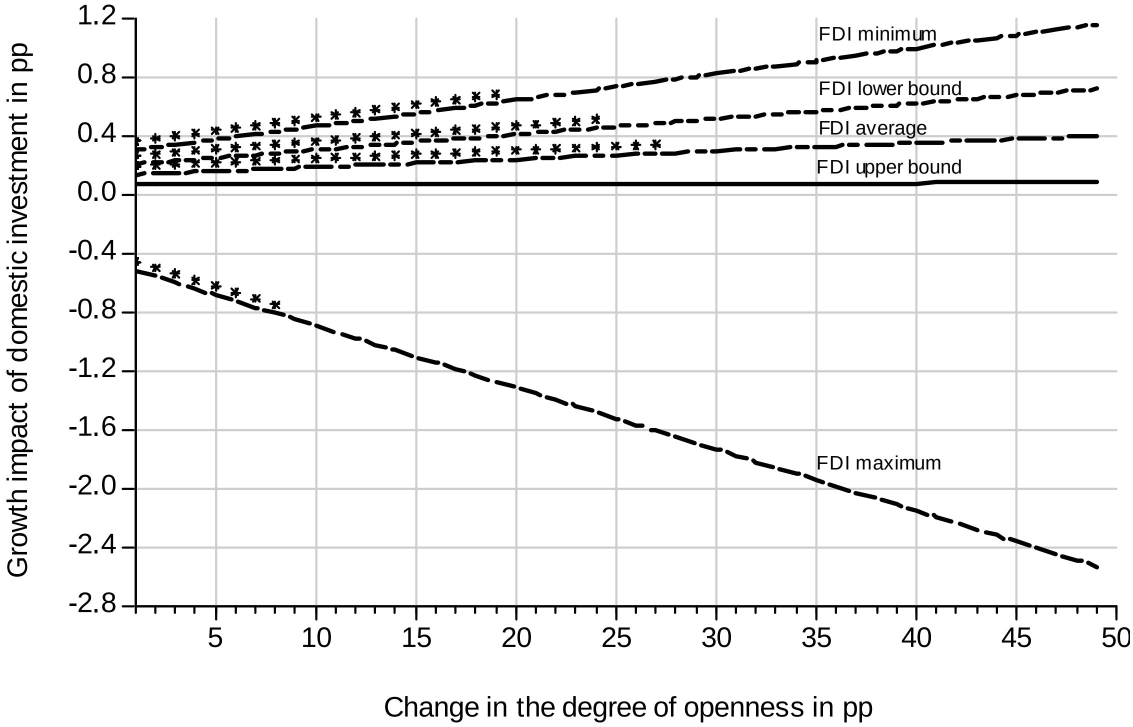
In this case, we consider that both domestic and foreign direct investment depend on changes in globalisation and, also, that the two types of investment depend on each other.

As we have three different variables, what we study now is the conditional marginal effect of domestic investment on economic growth across a range of changes in openness, and for given values of fdi. In the absence of changes in the degree of openness and foreign direct investment, the impact of domestic investment is positive, with a coefficient of 0.18 (this is the case in which $\Delta op = fdi = 0$, and the terms within the brackets are null). In turn, when $\Delta op > 0$, $fdi > 0$, or both, the terms in brackets become relevant. In particular, the impact of domestic investment on economic growth is enhanced in the presence of changes in the degree of openness, but is reduced by larger amounts of fdi. The extent to which this impact is significant across the different values of Δop and fdi is plotted in Figure 2.

As noted before, the range of values for Δop is 0-50, as presented in the horizontal axis. For this range, we simulate the impact of di on growth using five different trajectories of fdi comprising, on one hand, its minimum, maximum, and average values computed over the 21 countries in the sample; and, on the other hand, the upper and lower bounds of the 95% confidence intervals. These sets of values are denoted, respectively, FDI minimum, FDI maximum, FDI average, FDI upper bound, FDI lower bound.

Figure 2 shows that domestic investment exerts a positive impact on economic growth. The reference case is the one in which fdi takes the average value. Given this average value, the larger the change in the degree of openness the larger the impact of di on growth. This impact is significant for changes in openness between 0 and 27 percentage points, and ceases to be significant afterwards.[11] Quantitatively, this impact goes from 0.14 (when $\Delta op = 0$ and $fdi = 2.6$) to 0.34 (when $\Delta op = 27$ and $fdi = 2.6$) implying that a 1 percentage point increase in the ratio of domestic investment to GDP generates between 0.14 and 0.34 extra percentage points of per capita growth depending on the acceleration in the globalisation process (always evaluated at average levels of fdi).

Figure 2. Marginal effects of DI on economic growth. System GMM.



The upper and lower bound lines represent the effects of DI on growth (for a given change in openness) when fdi takes values at the end of the 95% confidence interval. In the upper bound case, $fdi = 7.3$ and the effect of DI on economic growth is not significant for any value of Δop. In contrast, in the lower bound case, fdi = -2.1[12] and the growth impact of DI is larger than for the average value of fdi. This larger impact is significant for changes in openness between 0 and 24 percentage points, and ranges from 0.20 (when $\Delta op = 0$ and fdi =-2.1) to 0.45 (when $\Delta op = 24$ and fdi =-2.1).

There is extensive literature on the crowding out effects between DI and FDI (for recent examples, see Adams, 2009; and Morrissey and Udomkerdmongkol, 2012). In general, however, these effects are not evaluated with respect to their direct influence on economic growth as our analysis allows us to do. In particular, observe that the sequence

[11] Larger changes in short periods of time as the ones begin evaluated are not realistic. For example, the most important change in the degree of openness in a single year occurred in Botswana and attained 30 percentage points (from 138.07 in 1988 to 108.85 in 1989).

[12] Recall that the variable fdi accounts for the net inflows of FDI. Therefore, a negative value in this variable implies that the outflows of FDI have become larger than the inflows.

of effects of di on growth (i.e., the continuous lines in Figure 2) is progressively shifted downwards with higher values of fdi. This reveals the existence of substitutabilities between the two types of investment or, in other words, a significant crowding out effect from larger flows of foreign direct investment on domestic investment.

Let us refer, also, to the fact that when fdi takes maximum values (that is, the highest fdi value of the country with the highest fdi), and for small changes in openness (between 0 and 8 percentage points), the impact of domestic investment on growth can be significantly negative. Of course, this result should be seen as a highly unrealistic extreme case, but it is reported because it reinforces the pattern just described regarding the relationship between di and fdi in their effect on growth. What this extreme case shows is that, for extremely high levels of FDI, there would be no point in detracting resources from consumption or other uses to be invested nationally (of course, our is an aggregate analysis, and we do not control for the always existing scope for domestic targeted policies).

4.3.2 Case 2: foreign direct investment

When foreign direct investment is examined, the empirical version of equation (12) takes the form (note that now X denotes fdi, Z denotes Δop, and W denotes di):

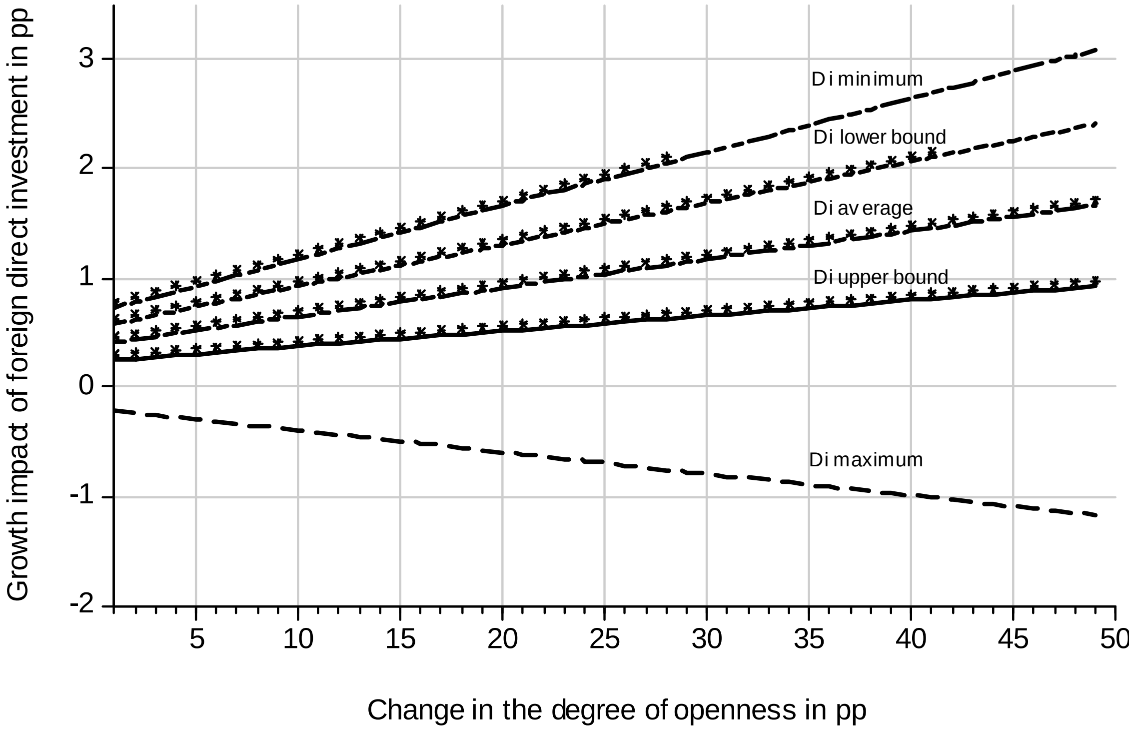
$$\frac{\partial \Delta y}{\partial fdi} = \underset{[0.003]}{0.75} + \left[\underset{[0.183]}{5.02} * \Delta op - \underset{[0.013]}{1.50} * di - \underset{[0.318]}{11.0} * (\Delta op * di) \right].$$

As before, both domestic and foreign direct investment depend on changes in globalisation, and the two types of investment depend on each other. Now, however, we examine the conditional marginal effect of foreign direct investment on economic growth across a range of changes in openness, and for given values of di.

In the absence of changes in the degree of openness and domestic investment, the impact of foreign direct investment is positive, with a coefficient of 0.75 (i.e., $\Delta op = di = 0$, and the terms within the brackets are null). In turn, when $\Delta op > 0$, $di > 0$, or both, the terms in brackets become relevant. In particular, the impact of foreign investment on economic growth is enhanced in the presence of changes in the degree of openness, but is reduced by larger amounts of di. The extent to which this impact is significant across the different values of Δop and di is plotted in Figure 3. As before, we distinguish five different trajectories of fdi comprising the minimum, maximum, and average values computed over the 21 countries in the sample, and the upper and lower bounds of the 95% confidence intervals (denoted, respectively, as DI minimum, DI maximum, DI average, DI upper bound, DI lower bound).

Figure 3 shows that FDI exerts a positive impact on economic growth. As before, the reference case is the one in which di takes the average value. Given this average value, the larger the change in the degree of openness the larger the impact of fdi on growth. This impact is significant for all values of Δop considered (i.e., between 0 and 50 percentage points). Quantitatively, this impact goes from 0.41 (when $\Delta op = 0$ and $di = 21.5$) to 1.67 (when $\Delta op = 50$ and $di = 21.5$) implying that a 1 percentage point increase in the ratio of foreign direct investment to GDP generates between 0.41 and 1.67 extra percentage points of per capita growth depending on the acceleration in the globalisation process (as usual, evaluated at average levels of di).

Figure 3. Marginal effects of FDI on economic growth. System GMM.



In this case, the upper and lower bound lines represent the effects of fdi on growth for a given change in openness when di takes the values at the end of the 95% confidence interval. In the upper bound case, $di = 32.4$ and the growth effect of FDI is smaller than for the average value of di. This smaller impact is significant for the whole range of values in Δop, and goes from 0.25 (when $\Delta op = 0$ and $di = 32.4$) to 0.92 (when $\Delta op = 50$ and $di = 32.4$). In contrast, in the lower bound case, $di = 10.5$ and the growth impact of fdi is larger than for average value of di. This smaller impact is significant for changes in openness between 0 and 41 percentage points, and ranges from 0.58 (when $\Delta op = 0$ and $di = 10.5$) to 2.10 (when $\Delta op = 41$ and $di = 10.5$).

Regarding the substitutabilities between di and fdi, Figure 3 shows an analogous relationship than Figure 2, and confirms –from the other side of the analysis– the existence of significant crowding effects between these two types of investment. More precisely, the sequence of effects of fdi on growth (as before di in Figure 2) is progressively shifted downwards with higher values of di. Moreover, extremely large values of di (that is, an evaluation of this impact at the highest di value of the country with the highest di) imply that the impact of fdi on economic growth is not significant no matter the change in openness (observe that the bottom dotted line shows no significant marginal effects). What this extreme case shows is that, when domestic investment takes place so intensively, smaller or bigger flows of fdi are irrelevant in terms of growth. This reinforces the idea of full-crowding between these two types of investment.

5 Conclusions

We have examined the growth pattern of SSA economies across the last three decades. In terms of unconditional convergence, we have shown that most countries have not progressed and its situation today is worse, in relative terms, than three decades ago. We have tried to establish some pattern that connects their evolution in per capita output to their degree of economic openness, but no clear conclusion could be reached.

In view of this result, we study the conditional convergence of a selection of 21 SSA economies through the estimation of a multiplicative interaction model. Conditional convergence is found significant and progressing at an average rate of around 4%, whereas DI, FDI and the change in the degree of openness are identified as crucial drivers of this process. Interaction models allow the assessment of the cross-dependencies among explanatory factors. We find that the impact of FDI and DI on growth is greater the greater is the change in the degree of economic openness, but we also find a net crowding out effect between both types of capital: larger amounts of FDI reduce the impact of DI on economic growth, and vice-versa.

These new insights on the substitutabilities between different types of capital need to be interpreted with caution. First of all, neither DI nor FDI are negative for economic growth by themselves. Second, SSA economies need a careful design of growth policies so that their precise effect in terms of complementarities or substitutabilities between capitals can be defined. For example, FDI inflows in SSA are mainly oriented towards the primary sector, while there is a general scarcity of infrastructures and skilled human capital. Economic policies will have to be defined, therefore, taking into account the extent to which these features are more or less stringent.

This requires an active role from governments in deciding which flows of FDI are more desirable. Some countries may be receiving FDI inflows in sectors where domestic investment is enough, but some others may be lacking investment in those sectors. Governments have to look careful at their available resources, its possibilities of growth, and the targets they want to reach. What we learn from this paper is that the key to success does not lie in arbitrarily opening the economy, in attracting as much FDI as possible, or in rising generically domestic investment. The potential success of any country, and especially of developing economies, relies very much on their ability to combine correctly all these factors (and, of course, others). This does not seem to be happening at the moment in most SSA economies.

Future research should aim at a more accurate establishment of the specific relationship between globalisation and investment forces. Conditioned on available data, country-specific analyses should lead to precise policy measures helping to transform capital crowding-out effects on crowding-in effects; all in all, helping the countries use FDI and economic openness to complement their domestic investment so that economic growth is boosted as efficiently as possible.

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Appendix: Individual marginal effects and robustness checks.

Figure A1. Individual marginal effects on economic growth.

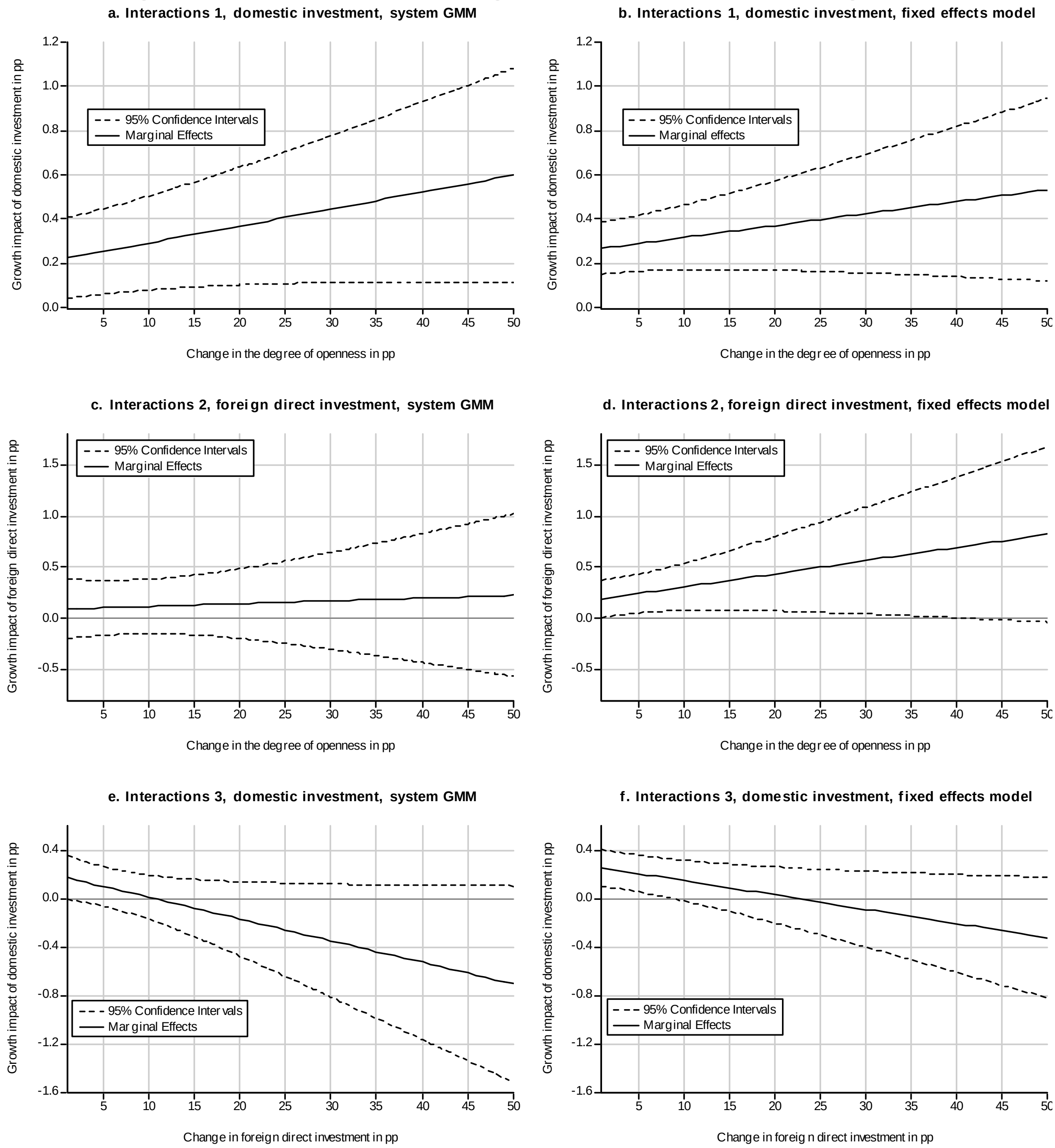

Figure A2. Marginal effects of ki and fdi on economic growth.

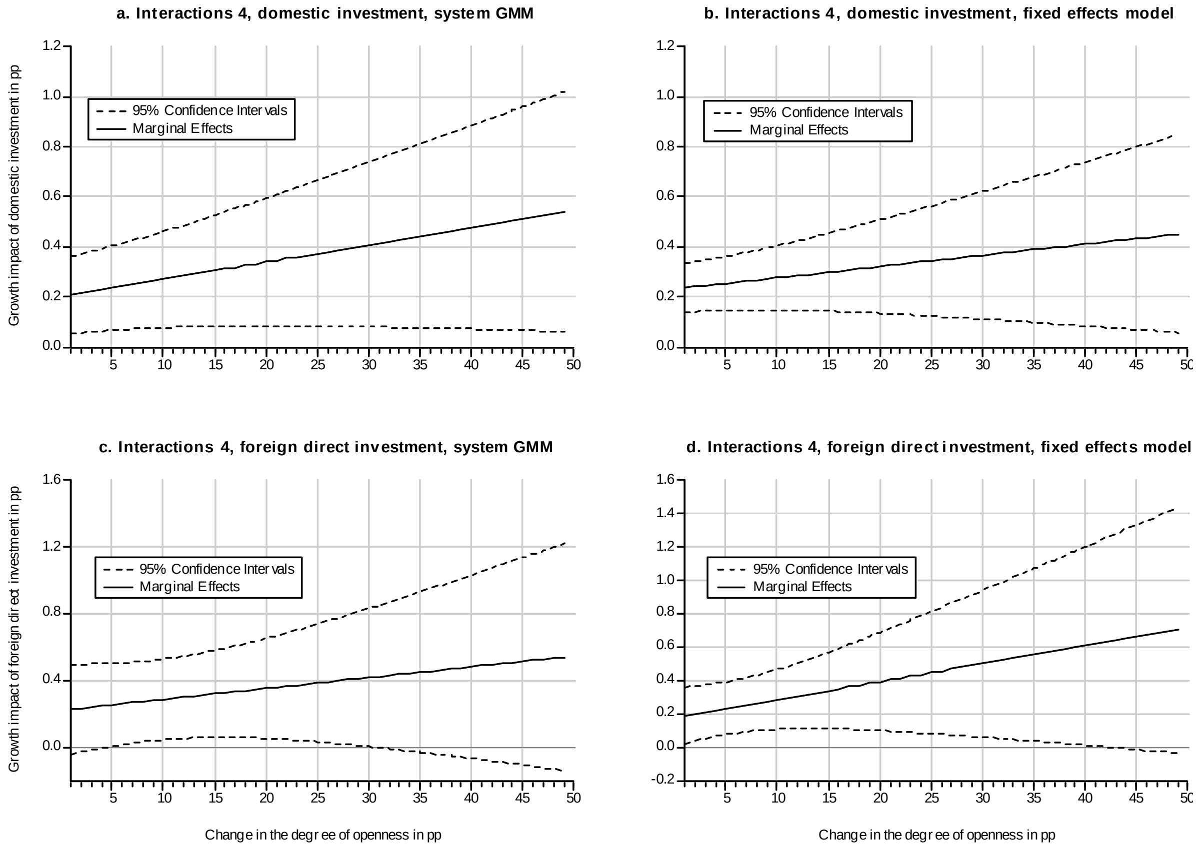

Figure A3. Marginal effects of di on economic growth. Fixed effects model.

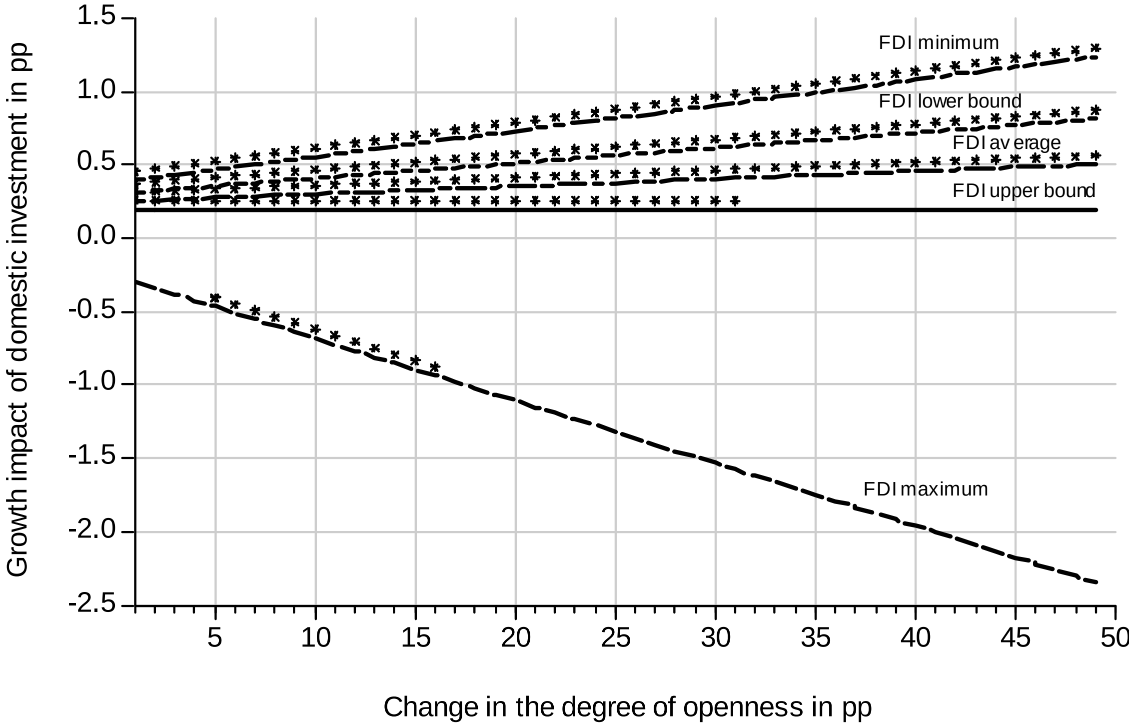

Figure A4. Marginal effects of fdi on economic growth. Fixed effects model.