

# Do Capital Inflows Boost Growth in Developing Countries?

Evidence from Sub-Saharan Africa

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## Abstract

This paper examines whether domestic output growth helps attract capital inflows and, in turn, capital inflows help boost output growth in a set of 38 Sub-Saharan African countries. Using a two-step approach to address reverse causality and omitted variable issues, the paper finds that output growth in countries in Sub-Saharan

Africa does not attract capital inflows. However, aid and foreign direct investment inflows enhance growth, while sovereign debt inflows do not. A 1 percent increase in the level of real aid inflows raises growth of real output per capita by 0.022 percentage point. For foreign direct investment inflows, the figure is 0.002 percentage point.

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# **DO CAPITAL INFLOWS BOOST GROWTH IN DEVELOPING COUNTRIES?**

## **EVIDENCE FROM SUB-SAHARAN AFRICA**

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JEL: F35, O40

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## I Introduction

Does economic growth in developing countries attract more capital inflows? In turn, do capital inflows foster further economic growth? These are important questions for many developing countries. If the answers are yes for both, this is great news because this implies that economic growth and capital flows can form a positive feedback cycle where one reinforces the other. For Sub-Saharan Africa (SSA), the issue is becoming very important, in light of the stronger economic growth, and capital flows into the region in recent years. For example, FDI has grown from below 1% of GDP in the 1990s to as high as 4% of GDP in recent years, while sovereign debt inflows have grown from almost nothing in the early 2000s to about 1% of GDP in recent years (see Figure 1).

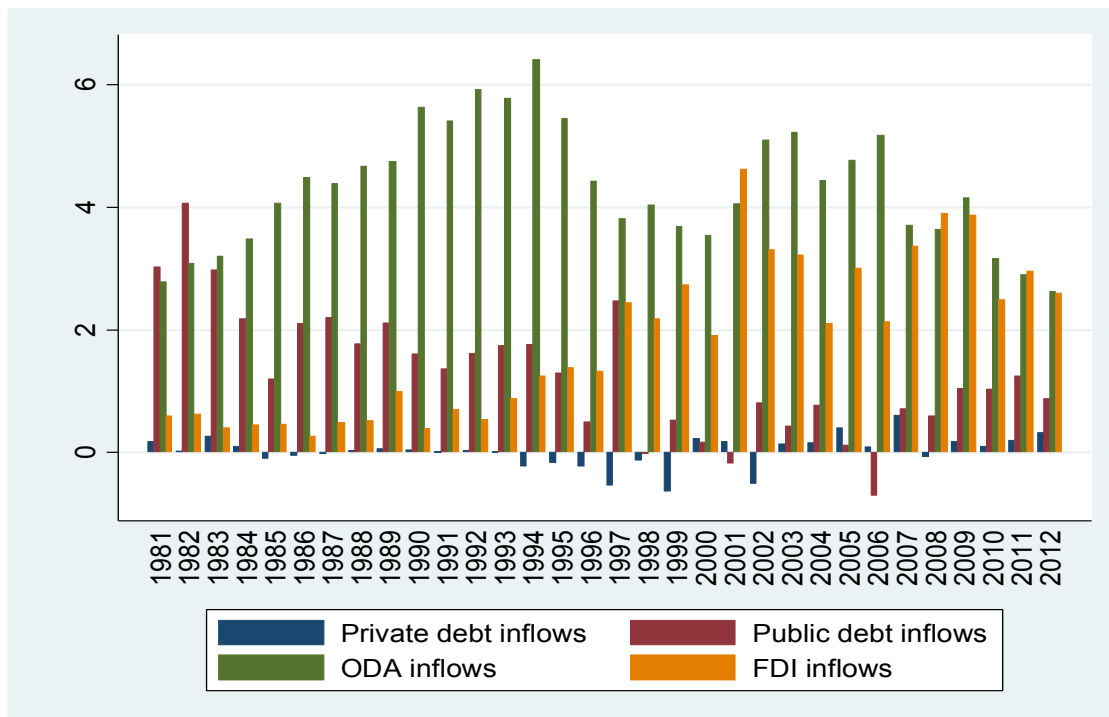


Figure 1: Capital flows to SSA, % of SSA's total GDP

It is commonly believed that longer term inflows such as FDI, aid or sovereign debts have some positive impacts on the receiving economy. Theory suggests that this can be the case, because long-term capital inflows help countries mitigate their capital constraints, and provide capital for investment. FDI or aid inflows could also bring foreign know-how and technologies, or encourage better governance and support human capital development. In addition, long term capital inflows insulate countries from the inherent volatility associated with the short term capital flows (see Lipsey, 2001, and Levchenko and Mauro, 2007 for the evidence regarding the stability of FDI in “sudden stop” periods).

Empirically however, the mutual impacts between capital flows and growth are less clear, because of the endogeneity issues. The first endogeneity bias is reverse causality: we cannot tell a positive relationship between capital inflows and growth means capital inflows cause growth, or growth attracts capital inflows, or both are happening at the same time. The second endogeneity bias comes from omitted variables: we do not know if growth and capital inflows are both driven by a third factor that is not captured, such as global growth, or global interest rates. It is reasonable to believe that global growth provides capital to a developing country and at the same time helps boost the country’s growth, via channels like export.

In this paper, we return to the issue and study the causal relationship between economic growth and three types of capital inflows: aid, FDI and sovereign borrowing. We show that for a set of 38 developing countries in Sub-Saharan Africa (SSA), for the period from 1979 to 2012, economic growth does not attract aid, FDI nor sovereign lending. On the other hand, aid and to a lesser extent, FDI has a positive effect on economic growth. Sovereign borrowing does not. We focus on aid, FDI and sovereign lending because they are the largest types of capital inflows to SSA and to developing countries in general, and because we would like to focus on longer term capital flows. We do not consider private sector equity and debt inflows because for most developing countries, they constitute a much smaller amount compared to the other three categories. This is also true in SSA (see Figure 1).

We examine the causal relationship between capital inflows (aid, FDI and foreign borrowing) and economic growth in two steps. In the first step, we focus on the impact of growth on capital inflows. We use rainfall to instrument for real per capita GDP growth and estimate the impact of instrumented real per capita GDP growth on the three types of capital flows. After instrumented by rainfall, the “exogenous” output growth has no impact on aid, FDI, nor sovereign borrowing.

In the second step, we estimate the impact of capital inflows on output growth, following the approach of Bruckner (2013). After the causal response of capital inflows to real per capita GDP growth is quantified by the IV estimates, we use the residuals in capital inflows that are not driven by GDP per capita growth as an instrument to estimate the effect of capital inflows on GDP growth. As will be clearer in the methodology section, the residuals from the IV estimation in the first step, by construction, are a component of capital inflows that is orthogonal to real GDP per capita growth.

We also make a strong effort to address the issue of omitted variables. Note that Bruckner’s (2013) approach focuses on the simultaneity problem between aid and growth, and does not address the issue of omitted variables. It is however entirely possible that a third factor can drive both capital inflows and economic growth at the same time. As discussed, global factors such as global growth or global interest rates are two obvious candidates. Controlling for global factors is relatively easy because we can use time fixed effects. In addition to global factors, we identify two more factors that are particularly relevant for SSA countries and we control for them. They are growth of export destinations, and a country’s commodity price index.

## **II Literature Review**

The paper is related to a strand of literature on the “Lucas paradox”, which shows that capital flows do not go to countries with the highest economic growth. Prasad et al. (2007) document a negative cross-country correlation between the ratio of capital inflows to GDP and growth. Gourinchas and Jeanne (2013) show that capital flows do not go to developing countries that grow more. On the other hand, Kalemli-Ozcan et al. (2010) show that capital flows between U.S. states are consistent with the neo-

classical framework: capital flows to rich states. They argue that the small size and “wrong” direction of net international capital flows are likely due to frictions associated with national borders rather than to inherent flaws in the neoclassical model. This strand of literature stops short of establishing a causal impact. In our paper we take a step further by identifying an exogenous source of growth, and showing that exogenous growth does not attract long term capital flows. This is true for all the three types of capital considered: aid, FDI, and sovereign borrowing.

Our paper is also related to the aid effectiveness literature, which focuses on examining the impact of aid on growth. The literature is well aware of the endogeneity problem and has tried to address it, with mixed results. Boon (1996) proposes the use of population size, friends of France and friends of U.S. dummies to identify aid flows that are driven by political motives. He finds that aid does not increase investment and does not benefit the poor; aid only increases the size of the government. Burnside and Dollar (2000) use a similar set of instruments and find that aid is good for growth in an environment of good policies—a result that Easterly et al. (2004) did not find robust with additional data. Hansen and Tarp (2001) combine these instruments with lagged aid in a GMM estimation framework to show that aid enhances growth and this is not conditional on policies. Rajan and Subramanian (2008) also use similar instruments but find that aid has no effect on growth. However, as Deaton (2010) notes, the instruments that these papers have used for foreign aid in cross-country growth regressions are unlikely to fulfill the exclusion restriction, for the simple reason that being political a friend of world powers also likely boosts growth. In addition, the use of lagged variables as instruments in a GMM framework is also being cast doubt (see Hauk and Wacziarg, 2009). Most recently, Bruckner (2013) shows that aid has a positive impact on output growth, after removing the reverse causality issue.

There is also a strand of literature that examines the impacts of FDI on growth. It generally supports the view that FDI is good for growth in a favorable environment. Blomstrom, Lipsey, and Zejan (1994) find that growth spillovers from inward FDI are positively correlated with a country’s wealth. Borenstein, de Gregorio, and Lee (1998) find that the effect of FDI on growth depends on the host country’s human

capital. Alfaro et al. (2003) find that spillovers from FDI increase with financial development. However, the literature on FDI also faces the difficulties of separating the causal impacts between growth and FDI inflows. More recently, with the GMM panel estimation approach, Carkovic and Levine (2005) find that FDI does not have a robust, positive impact on growth. Again, the GMM framework is no longer the gold standard.

The literature on the relationship between developing countries' sovereign debt inflows and growth is more limited. Most of the focus is on the association between the *level* of public debt and growth in developed countries, and they have mixed results. Panizza and Presbitero (2013) provide a nice review. They find that many papers have found a negative correlation between debt and growth in advanced countries. However, there is no paper that can make a strong case for a causal relationship going from debt to economic growth. They also find that a non-monotone relationship between debt and growth (Reinhart and Rogoff, 2010) is not robust to small changes in data coverage and empirical techniques (see for example, Herdon, Ash, and Pollin (2013) or Pescatori et al, 2014). Our paper contributes to the literature by investigating the causal impact of sovereign debt inflows to developing countries on growth.

### **III Data and Descriptive Analyses**

#### **III.1 Data**

We analyze the causal relationship between capital inflows and growth in 38 Sub-Saharan African countries<sup>2</sup>, from the period from 1970 to 2012. The data sources are as follows:

*Output:* Real GDP per capita in 2005 US dollars, from the World Development Indicators, for the period from 1960 to 2012.

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<sup>2</sup> The countries are Angola, Benin, Botswana, Burkina Faso, Burundi, Central African Republic, Chad, Congo, Dem. Rep., Congo, Republic of Cote d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, Gambia, The Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe.



*Capital inflows:*

- FDI: net inflows of foreign direction investment, in current US dollars, from the World Development Indicators for the period from 1970 to 2013. Net FDI inflows equal new investment inflows less disinvestment in the reporting economy from foreign investors.
- Aid: net official development assistance and official aid received (ODA), in current US dollars, from the World Development Indicators, for the period from 1970 to 2012. Net ODA consists of disbursements of loans made on concessional terms (net of repayments of principal) and grants by official agencies of the members of the Development Assistance Committee (DAC), by multilateral institutions, and by non-DAC countries to promote economic development and welfare in countries and territories in the DAC list of ODA recipients.
- Public debt flows: Net flows on external debt, public and publicly guaranteed debt in current US dollars, from the International Debt Statistics of the World Bank, for the period from 1970 to 2012. Net flows (or net lending or net disbursements) received by the borrower during the year are disbursements minus principal repayments. Public and publicly guaranteed debt comprises long-term external obligations of public debtors, including the national government, political subdivisions (or an agency of either), and autonomous public bodies, and external obligations of private debtors that are guaranteed for repayment by a public entity. They do not include ODA. Figure 1 shows that they much smaller than ODA.
- All three types of capital inflows are divided by population and deflated by the U.S. consumer price index to obtain real per capita capital inflows in 2010 US dollars. Population and the U.S. CPI are also from the World Development Indicators. The idea is that we would like to examine the relationship between per capita output growth, and per capita capital inflows.

### *Rainfall:*

Our rainfall data come from the GPCP<sup>3</sup> database, which provides rainfall estimates from 1979 to present day, published by the precipitation research group at NASA. This rainfall measure has been used in the literature several times, notably in Miguel (2004) and Bruckner and Ciccone (2011). GPCP provides monthly averages of rainfall in 2.5 degree latitude and longitude intervals. These monthly averages are then multiplied by the number of days in each month to produce an estimate of monthly rainfall. These monthly rainfall estimates are then summed to get an annual rainfall estimate. Since 2.5 degree latitude and longitude intervals do not represent countries accurately, we follow the approach of Miguel (2004) to aggregate rainfall in these intervals to country levels in SSA. The GPCP data set utilizes weather station measures in conjunction with satellite observations of cold cloud cover.

### *Commodity index:*

We assemble a country-specific commodity export price index following the model:

$$ComPI_{i,t} = \prod_{c \in C} ComPrice(t)_{c,t}^{\theta_{i,c}}$$

where  $ComPrice_{c,t}$  is the international price of commodity  $c$  in year  $t$ , and  $\theta_{i,c}$  is the average (time invariant) value of exports of commodity  $c$  in the GDP of country  $i$ . Our commodity data comes from two sources. The first of these is the NBER-UN trade data, which we use for export values. Real commodity price index come from the UNCTAD commodity statistics. We included aluminum, beef, coffee, cocoa, copper, cotton, gold, iron, maize, oil, rice, rubber, sugar, tea, tobacco, wheat, and wood in our index, following Arezki and Bruckner (2014).

## **III.2 Capital Flows to SSA**

Figures 1 and 2 present an overview about total capital inflows to the 38 Sub-Saharan Africa countries, in terms of 38 SSA countries' total GDP (Figure 1, shown in section 1) and current US dollars (Figure 2),

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<sup>3</sup> GPCP rainfall data is publicly available from <http://precip.gsfc.nasa.gov/>

from 1981 to 2012. For the ease of presentation, we did not include data for the early decades. Figure 2 reveals that historically ODA inflows accounted for the most part of capital flows, but in recent years FDI are increasingly important. As of 2012, FDI and ODA are the two largest types of capital inflows to SSA countries, with each of them having the magnitude of around 40 billion dollars. Public debt inflows come third with about 13 billion dollars in 2012. Private debt inflows are of a tiny share compared to the other three. This is not surprising, given most of the countries are poor with underdeveloped financial markets. Since private capital flows constitute a tiny share, we do not analyze their impact on output growth.

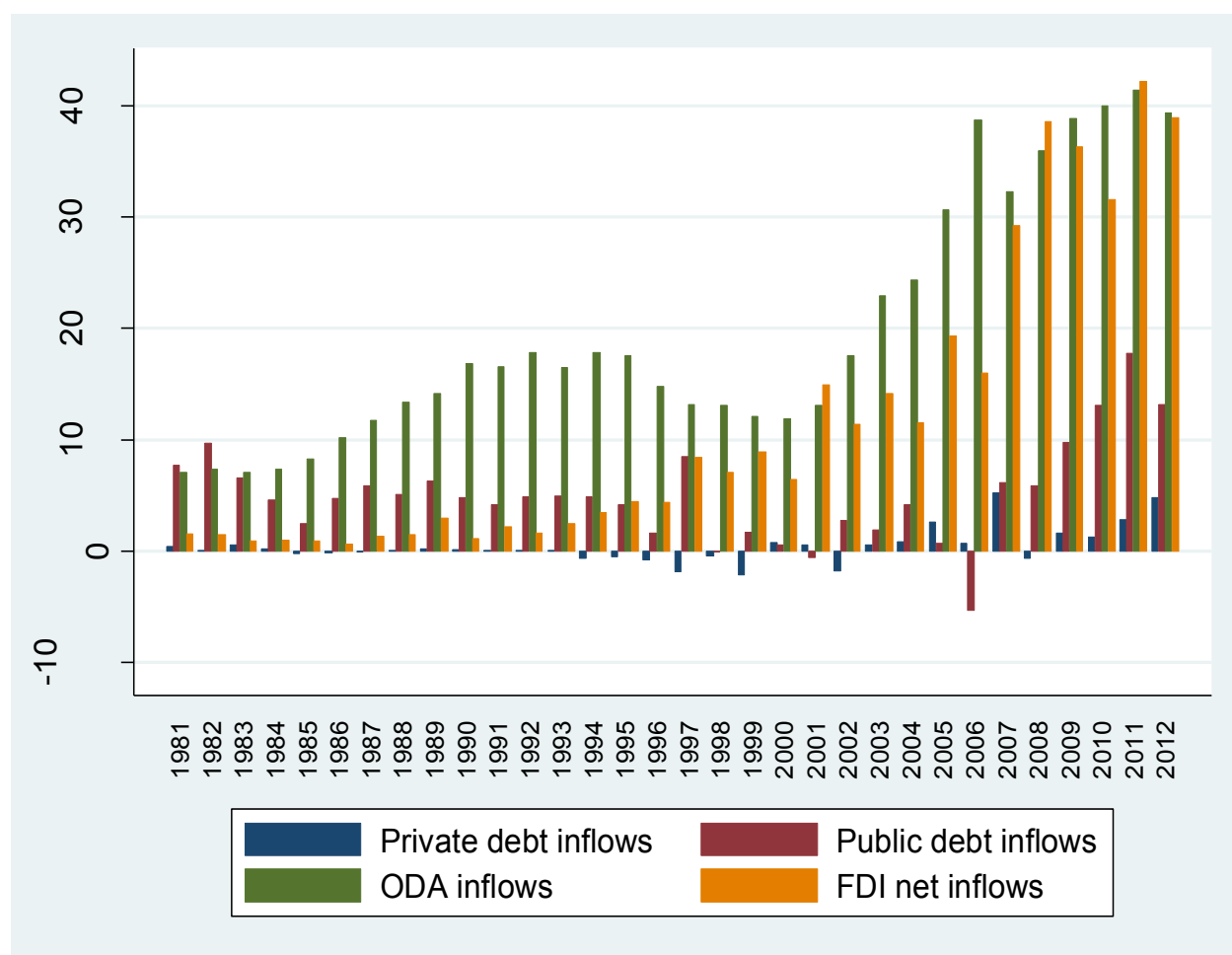


Figure 2: Total nominal capital flows to SSA, current USD (billions)

## IV. Methodology

### IV.1 Conceptual Framework

To understand the approach more easily, consider this system of equations:

$$y_{i,t} = \beta x_{i,t} + \rho z_{i,t} + \epsilon_{i,t} \quad (1)$$

$$x_{i,t} = \gamma y_{i,t} + u_{i,t} \quad (2)$$

$$E[z_{i,t}, u_{i,t}] = 0$$

where  $y_{i,t}$  is output growth of country  $i$  at time  $t$ ;  $x_{i,t}$  is capital flows to country  $i$  at time  $t$  and  $z_{i,t}$  is rainfall in country  $i$  at time  $t$ . The assumption is that any impact rainfall has on capital flows is via output growth, that is,  $E[z_{i,t}, u_{i,t}] = 0$ . Suppose (1) and (2) represent the correct relationship between output growth, capital inflows and rainfall. We are interested in estimating  $\beta$  and  $\gamma$ .

Rearranging the system to solve for growth  $y_{i,t}$  and capital flows  $x_{i,t}$ :

$$y_{i,t} = \frac{1}{1-\gamma\beta} [\beta u_{i,t} + \rho z_{i,t} + \epsilon_{i,t}] \quad (3)$$

$$x_{i,t} = \frac{\gamma}{1-\gamma\beta} [\beta u_{i,t} + \rho z_{i,t} + \epsilon_{i,t}] + u_{i,t} \quad (4)$$

The methodology consists of two steps:

**Step 1:** Estimating  $\gamma$ , the impact of growth on capital flows, using rainfall  $z_{i,t}$  as an instrument.

The estimated value of  $\gamma$  is:

$$\hat{\gamma} = \frac{\text{cov}(x, z)}{\text{cov}(y, z)} = \frac{\frac{p\gamma}{1-\gamma\beta}}{\frac{p}{1-\gamma\beta}} = \gamma$$

where  $\text{cov}(x, z) = \frac{p\gamma}{1-\gamma\beta}$  is from (4) and  $\text{cov}(y, z) = \frac{p}{1-\gamma\beta}$  is from (3). The estimated value of  $\gamma$  is consistent.

After that, we calculate the estimated “residual” capital flows:

$$\hat{u}_{i,t} = x_{i,t} - \hat{\gamma} y_{i,t}$$

**Step 2:** Estimating the impact of the residual capital flows  $\hat{u}_{i,t}$  on output growth  $y_{i,t}$

The estimated value of the impact is:

$$\hat{\beta} = \frac{cov(y, u)}{var(u)} = \frac{\beta}{1 - \gamma\beta} + \frac{1}{1 - \gamma\beta} \frac{cov(\epsilon, u)}{var(u)}$$

The above result reveals that the estimated impact of the residual capital flows  $\hat{u}_{i,t}$  on output growth  $y_{i,t}$

is not the same as  $\beta$ . It consists of two terms:  $\frac{\beta}{1 - \gamma\beta}$  and  $\frac{1}{1 - \gamma\beta} \frac{cov(\epsilon, u)}{var(u)}$ . The second term,  $\frac{1}{1 - \gamma\beta} \frac{cov(\epsilon, u)}{var(u)}$ ,

means that if  $\epsilon_{i,t}$  and  $u_{i,t}$  are correlated, the estimated value  $\hat{\beta}$  will be biased. Specifically,  $\hat{\beta}$  will also capture omitted factors that drive both capital flows and output growth. In our paper, we control for many variables that potentially affect capital flows and output growth.

Even in the case that  $\epsilon_{i,t}$  and  $u_{i,t}$  are not correlated, the first term,  $\frac{\beta}{1 - \gamma\beta}$ , means the estimated impact  $\hat{\beta}$  is not exactly  $\beta$ , but a function of  $\beta$ . If  $\frac{\beta}{1 - \gamma\beta}$  is significantly different to zero,  $\beta$  will also be significantly different to zero.

## IV.2 Extension of the Framework with Multiple Types of Capital Flows

Note that if we would like to separate different types of capital flows and estimate the impact of each source on output growth, the estimation for aggregate capital flows is no longer valid. We need to explicitly take individual types of capital flows into consideration. The new system of equations will be as follows:

$$y_{i,t} = \beta^1 x_{i,t}^1 + \beta^2 x_{i,t}^2 + \rho z_{i,t} + \epsilon_{i,t} \quad (5)$$

$$x_{i,t}^1 = \gamma^1 y_{i,t} + u_{i,t}^1 \quad (6)$$

$$x_{i,t}^2 = \gamma^2 y_{i,t} + u_{i,t}^2 \quad (7)$$

where  $x_{i,t}^1$  and  $x_{i,t}^2$  are two different types of capital flows. We also assume that  $E[z_{i,t}, u_{i,t}^1] = 0$  and  $E[z_{i,t}, u_{i,t}^2] = 0$ .

Rearranging the system to solve for growth  $y_{i,t}$  and capital flows  $x_{i,t}^1$  and  $x_{i,t}^2$ :

$$y_{i,t} = \frac{1}{1-\gamma^1\beta^1-\gamma^2\beta^2} [\beta^1 u_{i,t}^1 + \beta^2 u_{i,t}^2 + \rho z_{i,t} + \epsilon_{i,t}] \quad (8)$$

$$x_{i,t}^1 = \frac{\gamma^1}{1-\gamma^1\beta^1-\gamma^2\beta^2} [\beta^1 u_{i,t}^1 + \beta^2 u_{i,t}^2 + \rho z_{i,t} + \epsilon_{i,t}] + u_{i,t}^1 \quad (9)$$

$$x_{i,t}^2 = \frac{\gamma^2}{1-\gamma^1\beta^1-\gamma^2\beta^2} [\beta^1 u_{i,t}^1 + \beta^2 u_{i,t}^2 + \rho z_{i,t} + \epsilon_{i,t}] + u_{i,t}^2 \quad (10)$$

**Step 1:** Estimating  $\gamma^1$  and  $\gamma^2$ , the impact of growth on capital flows, using rainfall  $z_{i,t}$  as an instrument.

The estimated values  $\hat{\gamma}^1$  and  $\hat{\gamma}^2$  are consistent. Next, we calculate the estimated “residual” capital flows:

$$\hat{u}_{i,t}^1 = x_{i,t}^1 - \hat{\gamma}^1 y_{i,t}$$

$$\hat{u}_{i,t}^2 = x_{i,t}^2 - \hat{\gamma}^2 y_{i,t}$$

Note that  $\hat{u}_{i,t}^1$  and  $\hat{u}_{i,t}^2$  are correlated, but not perfectly so.

**Step 2:** Estimating the impacts of the residual capital flows  $\hat{u}_{i,t}^1$  and  $\hat{u}_{i,t}^2$  on output growth  $y_{i,t}$

If we regress  $y_{i,t}$  on  $\hat{u}_{i,t}^1$  and  $\hat{u}_{i,t}^2$  *separately*, the estimated results suffer from additional biases.

$$\hat{\beta}^1 = \frac{cov(y, u^1)}{var(u^1)} = \frac{\beta^1}{1-\gamma^1\beta^1-\gamma^2\beta^2} + \frac{\beta^2}{1-\gamma^1\beta^1-\gamma^2\beta^2} \frac{cov(u^2, u^1)}{var(u^1)} + \frac{1}{1-\gamma^1\beta^1-\gamma^2\beta^2} \frac{cov(\epsilon, u^1)}{var(u^1)} \quad (11)$$

$$\hat{\beta}^2 = \frac{cov(y, u^2)}{var(u^2)} = \frac{\beta^2}{1-\gamma^1\beta^1-\gamma^2\beta^2} + \frac{\beta^1}{1-\gamma^1\beta^1-\gamma^2\beta^2} \frac{cov(u^2, u^1)}{var(u^2)} + \frac{1}{1-\gamma^1\beta^1-\gamma^2\beta^2} \frac{cov(\epsilon, u^2)}{var(u^2)} \quad (12)$$

$\hat{\beta}^1$  is the estimated value of the impact of  $\hat{u}_{i,t}^1$  on  $y_{i,t}$  if we regress  $y_{i,t}$  on  $\hat{u}_{i,t}^1$  alone. (11) shows that in addition to the correlation between  $\epsilon$  and  $u^1$ ,  $\hat{\beta}^1$  also picks up the correlation between  $\hat{u}_{i,t}^1$  and  $\hat{u}_{i,t}^2$ .

Similarly in (12),  $\hat{\beta}^2$  also picks up the correlation between  $\hat{u}_{i,t}^1$  and  $\hat{u}_{i,t}^2$ . This suggests that we should not separately estimate the impact of one type of capital flows on growth. We should jointly estimate them.

$$\begin{bmatrix} \hat{\beta}^1 \\ \hat{\beta}^2 \end{bmatrix} = (X'X)^{-1}(X'y)$$

where  $X = [\hat{u}_{i,t}^1 \quad \hat{u}_{i,t}^2]$  and  $y = [y_{i,t}]$

In the subsequent sub-sections, we will go in to details the specifications of the regressions.

### IV.3 Estimate of the Impact of Real per Capita GDP Growth on Capital Flows

Estimating the impact of real per capita GDP growth on capital flows requires an exogenous source of variation for real GDP growth. We use rainfall to instrument for real per capita GDP growth and estimate the impact of instrumented real per capita GDP growth on the three types of capital flows. Because rainfall is random, rainfall is arguably exogenous to all other economic factors, including capital flows. On the other hand, rainfall is found to significantly affect output growth in Sub-Saharan Africa, because these countries are often the poorest, and their agriculture's irrigation system is under-developed, leaving the countries dependent on rainfall for their agriculture output. After the influential work of Miguel (2004) and Bruckner and Ciccone (2011), employing rainfall to instrument for economic growth in Sub-Saharan Africa is becoming acceptable in the literature<sup>4</sup>.

We estimate the effect of real per capita GDP growth on real capital flows using an IV estimation:

$$x_{i,t} = a_i + b_t + timetrend_i + \gamma \Delta y_{i,t} + u_{i,t} \quad (13)$$

where  $i$  is for country  $i$ , and  $t$  is for time  $t$ ;  $x_{i,t}$  is the log of real capital inflows (foreign aid, FDI and public debt inflows) per capita<sup>5</sup> to country  $i$  at time  $t$ .  $a_i$  is a set of country fixed effects to capture time-invariant characteristics of country  $i$ .  $b_t$  is a set of time fixed effects to capture global common factors at year  $t$  (such as global growth or global interest rates).  $timetrend_i$  is a set of country-specific time trend (i.e. we allow each country to have a separate coefficient for the time trend).  $\Delta y_{i,t}$  is the log-difference of real per capita GDP.  $\Delta y_{i,t}$  is instrumented by log of rainfall level. The underlying assumption is that any impact that rainfall has aid, FDI and foreign borrowing has to go through the channel of changing output. The assumption is reasonable for FDI and foreign borrowing. Regarding aid, one could argue that aid may responds directly to extreme rainfall events – e.g., emergency aid in response to floods and droughts. However, to the extent that emergency aid responds to the output declines that result from climatic disasters, rather than the disasters themselves, our identification strategy is still valid. In addition, as a

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<sup>4</sup> However the strength of the rainfall instrument becomes weaker in recent years, because SSA countries are less dependent on rainfall for their agricultural activities.

<sup>5</sup> Since the vast majority of capital flows are positive, taking log does not materially affect the sample size.

practical matter, it turns out that we remove extreme rainfall observations from the sample (see section 4.1), hence the concern is mitigated.

The idea of (13) is to investigate how output growth affects the level of capital inflows? A positive  $\gamma$  implies that higher GDP growth will attract a higher level of capital inflows, something one would predict for FDI and sovereign borrowing, because the return for capital is expected to be higher in good times, and because countries have a pro-cyclical access to capital markets (Kaminsky, Reinhart and Vegh, 2004). However, it is more difficult to predict the impact of GDP growth on aid inflows. On the one hand, there is less need for aid in good times. On the other hand, countries can be rewarded with more aid when growth is higher. For instance, Pallage and Robe (2001) find that foreign aid is procyclical. This finding suggests that aid rewards good economic performance. Nevertheless, their paper only examines the correlation between aid and growth, and is silent on the causality between them, a point our paper is trying to address.

#### **IV.4 Estimate of the Impact of Capital Inflows on Real per Capita GDP Growth**

After estimating the impact of real per capita GDP growth on capital flows, we will estimate the impact of capital inflows on GDP growth. Before we do that, consider an OLS regression between real capital inflows and real per capita GDP growth

$$\Delta y_{i,t} = a_i + b_t + timetrend_i + \beta^1 x_{i,t}^1 + \beta^2 x_{i,t}^2 + \beta^3 x_{i,t}^3 + \epsilon_{i,t} \quad (14)$$

where  $a_i$  is a set of country fixed effects,  $b_t$  is a set of time fixed effects, and  $timetrend_i$  is a set of country-specific time trend, and  $x_{i,t}^1, x_{i,t}^2, x_{i,t}^3$  are the log of real aid, FDI and sovereign borrowing capital inflows per capita. The idea is to investigate how each type of capital inflows affects output growth. Theory predicts that foreign aid would help growth because it alleviates capital constraints. On the other hand, foreign aid might have no effect in the presence of bad policies (Burnside and Dollar, 2000). The same argument can apply to FDI and sovereign borrowing. If foreign capital is not effectively used, the negative effects associated with foreign capital might outweigh the positive effects. Note that we use the



levels of real capital inflows, not growth in capital inflows, as the explanatory variable, because neoclassical models such as Burnside and Dollar (2000) give a prediction between levels of capital inflows and growth. In addition, the use of growth in capital flows might be problematic when the levels of capital flows are near zero: a small uptick in capital inflows might cause a large jump in growth of capital flows.

If real per capita GDP growth has an effect on real capital inflows, the OLS regression (14) will be biased. The bias from simultaneity can be corrected if we construct a residual capital flows series where the effect of growth on capital flows are taken out. In other words, we replace  $x_{i,t}^1, x_{i,t}^2, x_{i,t}^3$  in equation (14) by the residuals  $\hat{u}_{i,t}^1, \hat{u}_{i,t}^2, \hat{u}_{i,t}^3$  from equation (13):

$$\Delta y_{i,t} = a_i + b_t + \text{timetrend}_i + \theta^1 \hat{u}_{i,t}^1 + \theta^2 \hat{u}_{i,t}^2 + \theta^3 \hat{u}_{i,t}^3 + \omega_{i,t} \quad (15)$$

As sections 3.1 and 3.2 show,  $\theta^1, \theta^2, \theta^3$  reflect the true impacts of aid, FDI and sovereign debt inflows on economic growth, *provided that there are no omitted variables that drive both economic growth and capital inflows*.

The omitted variable problem is an issue. In this paper, we take a step further to identify common factors that most likely drive both economic growth and capital inflows into SSA countries. As discussed briefly in the introduction, global factors are an important set of factors, and are controlled by the time fixed effects. In addition to global factors, we identify two more country-specific factors that are particularly important for SSA countries. The first one is growth of trade partners. SSA and many developing countries usually have a set of important partners whose economic growth is disproportionately more vital to the countries than general global growth. For example, one can think of the importance of the USA to Mexico, and France to the West Africa Economic and Monetary Union (UEMOA). If this is the case, time fixed effects are not going to address this country specific factor. We build an index to proxy for partners' growth to capture this. The index is the weighted average of the trade partners' growth, where the weights are the share of the country's export to the partner. We argue that export weights are a good quantifiable

approximation of how important a foreign country is. As important export destinations are usually important financial providers and key political allies, key partners' growth can spur a country's growth and at the same time inject capital to the country.

The second factor is the international price index of the country's main commodity. Since many SSA countries are resource rich and commodity exporters, commodity prices greatly affect the countries' export and therefore country's output. On the other hand, it is reasonable to believe that when the international price of a country's main commodity is rising, the country's commodity sector likely attracts foreign investment inflows to take advantage of the commodity boom. Similarly, governments could also borrow more to invest in the sector. For those reasons, a country's commodity prices can both affect growth and capital flows simultaneously. We build a commodity price index to capture this (as described in the Data section).

In summary, the system is rewritten as follows:

$$x_{i,t}^j = a_i + b_t + timetrend_i + \gamma \Delta y_{i,t} + Control_{i,t} + u_{i,t}^j \quad (16)$$

and

$$\Delta y_{i,t} = a_i + b_t + timetrend_i + \theta^1 \hat{u}_{i,t}^1 + \theta^2 \hat{u}_{i,t}^2 + \theta^3 \hat{u}_{i,t}^3 + Control_{i,t} + \omega_{i,t} \quad (17)$$

## V. Results

### V.1 The Effect of Rainfall on Economic Growth

$\Delta \log(y_{i,t})$  is instrumented by log of rainfall level.

$$\Delta \log(y_{i,t}) = a_i + b_t + timetrend_i + \log(rainfall) + r_{i,t}$$

The exclusion restriction states that the instruments (i.e. rainfall) only affects the dependent variables (i.e. real capital inflows per capita) through the effects on per capita GDP growth. This is a reasonable assumption. Rainfall is significantly positively correlated with real per capita output growth in the set of

38 SSA countries. Table 1 shows the results of the regression between real per capita GDP growth and rainfall.

Figure 3 shows the partial correlation between rainfall and growth (i.e. after removing the effect of the set of controlling variables such time fixed effects, country fixed effects and country specific time trend) with the full sample. Overall, there is a positive relationship between rainfall and growth, as the positive sloped fitted line indicates. After removing the outliers, which in this case are extreme rainfall observations (those that have the residuals larger than 0.4 or smaller than -0.4), and extreme growth, the relationship becomes even more significant (Figure 4).

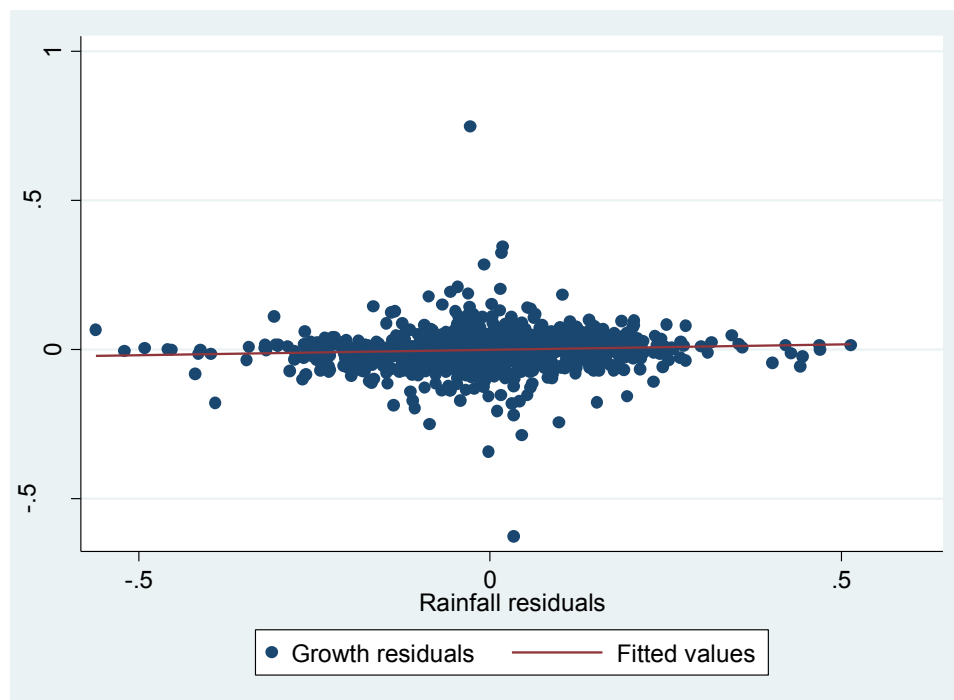


Figure 3: Scatterplot between rainfall residuals (horizontal axis) and growth residual (vertical axis), full sample

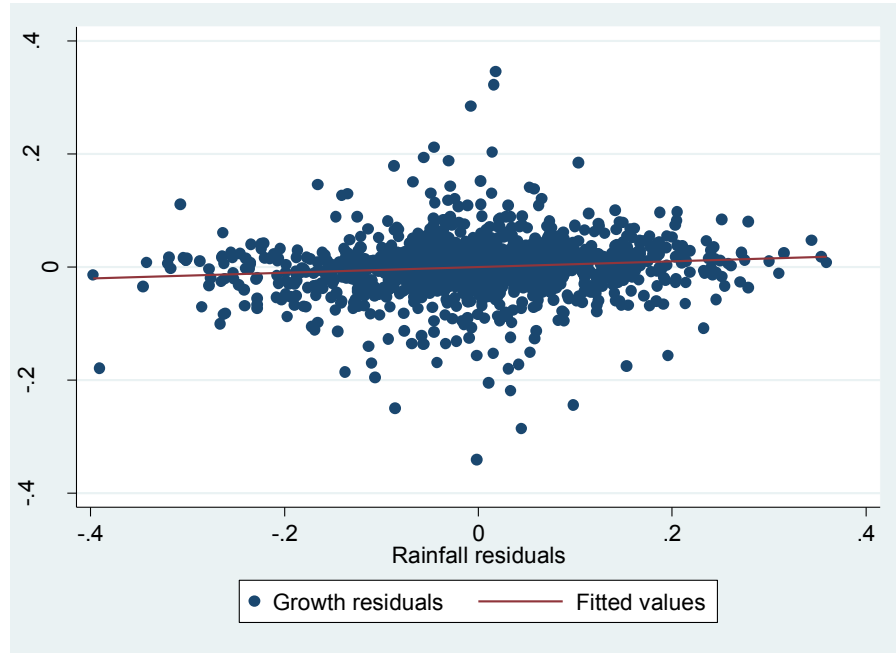


Figure 4: Scatterplot between rainfall residuals (horizontal axis) and growth residual (vertical axis), after removing outliers

After we remove outliers, the relationship becomes more significant (at 1% level). A 1% increase in rainfall leads to an increase of 0.058% in real per capita GDP growth. F-test for rainfall equals 17.26. For the rest of the paper we will work with this sample.

VARIABLES	Full sample	Without outliers
log(rainfall)	0.038*** [2.85]	0.051*** [4.15]
F-test (rainfall)	8.12	17.26
Time fe	Y	Y
Country fe	Y	Y
Country time trend	Y	Y
R2	0.2215	0.2436
No of countries	37	37
No of Obs	1216	1198

Robust standard errors in brackets

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 1: Regression results between real per capita GDP growth and rainfall  
(note: standard errors are clustered at the country level)

## V.2 The Effects of Exogenous Economic Growth on Capital Flows

After obtaining the instrumented per capita output growth, we use it as the main explanatory variable to examine the impact of output growth on different types of capital inflows. Note that we also control for growth of trade partners and commodity index. In addition, country fixed effects, time fixed effects and country-specific time trend are also controlled. The standard errors are clustered as the country level.

Table 2 shows the results of the regressions. The dependent variables *are the log of real ODA, FDI and public debt inflows per capita*. The main explanatory variable is the instrumented change in log of real output per capita. This variable is arguably exogenous to capital inflows.

Table 2 shows that exogenous domestic output growth has no impact on different types of capital inflows. The inflows do not seem to be driven by commodity index or growth of trade partners either.

VARIABLES	log(ODA inflows)	log(FDI inflows)	log(public debt inflows)
Instrumented output growth	-0.413 [1.914]	-9.476 [9.119]	4.997 [4.758]
Growth of trade partners	9.007 [6.105]	4.053 [18.276]	4.417 [22.639]
Commodity Index	-0.395 [0.593]	-0.820 [1.971]	1.711 [1.176]
Time fixed effects	Y	Y	Y
Country fixed effects	Y	Y	Y
Country time trend	Y	Y	Y
F-test	1.13	0.45	1.62
No of countries	34	34	33
Observations	1,065	931	898
Clustered-Robust standard errors in brackets			
*** p<0.01, ** p<0.05, * p<0.1			

Table 2: Impacts of output growth on capital inflows

The results show that from 1979 to 2012, on average, exogenous output growth within a country in Sub-Saharan Africa does not attract capital inflows. This stands in contrast with the capital flows literature, who tends to show that within a country, capital inflows are pro-cyclical (e.g. Broner et al, 2013 and

Pallage and Robe, 2001). However, our finding is different in two ways: first, while the literature is about association between growth and capital flows, we focus on causality. We separate the impact of growth to capital flows from that of capital flows to growth. Our finding here implies that in SSA, any positive relationship between growth and capital flows mostly reflect positive impacts of capital inflows to growth, a point to which we will address in section 4.3.

Another potential explanation is that SSA only becomes under the radar of investors in recent years. In other words, the attraction of capital flows to strong growth in SSA only has materialized recently. In order to check that hypothesis, we re-run the regression but limit the observations to the last two decades (1990-2012). However the coefficients for the instrumented growth are still not significant at the 5% level, and hence the results are not shown here. This implies that the attraction of capital flows to economic growth in SSA is still limited.

In addition, we also split the sample into periods with positive growth and those with negative growth to see if the impacts of growth on capital flows differ between those periods. We find that in both types of economic performance, growth and recession still have no significant impacts on capital inflows in SSA.

### **V.3 The Effects of Capital Flows on Economic Growth**

In this section, we turn around and investigate the impacts of capital flows on growth. In the first set of regressions, we use actual capital flows as the explanatory variables. That is, we do not take the residuals, as shown in equation (15). The reason is that all of the coefficients of the explanatory variables in Table 2 are not significantly different from zero, and the F-tests are all insignificant. Therefore, if one takes the view that the coefficients are zeros, the residuals of capital flows will be the same as the dependent variables. We then regress real output growth on the three types of capital inflows. Table 3 below shows the impacts of capital inflows on real output growth.

Among the three types of capital inflows, aid seems to matter most to output growth. It is significant at 1% level and has the highest magnitude. The coefficient of 0.022 implies that a 1% increase in the level

of ODA inflows increase growth by 0.022 percentage point (note that  $\frac{\beta^1}{1-\gamma^1\beta^1-\gamma^2\beta^2-\gamma^3\beta^3}=\beta^1$  since  $\gamma^1 = \gamma^2 = \gamma^3 = 0$ ) . FDI also seems to support growth, although the magnitude is much smaller and it is only significant at 5% level. Public debt, on the other hand, shows no impact on growth. Commodity index and growth of trade partners have positive signs, but are not significant.

VARIABLES	Growth of real output per capita		
	[1]	[2]	[3]
log ODA inflows	0.022*** [0.007]	0.025** [0.010]	
log FDI inflows	0.002** [0.001]	0.002 [0.001]	
log public debt inflows	-0.002 [0.002]	-0.004 [0.003]	
log ODA inflows (t-1)		-0.011 [0.009]	
log FDI inflows (t-1)		-0.001 [0.002]	
log public debt inflows (t-1)		-0.004 [0.004]	
log ODA inflows (t-2)		-0.008 [0.009]	
log FDI inflows (t-2)		-0.000 [0.001]	
log public debt inflows (t-2)		0.005 [0.003]	
Growth of Trade partners	0.772 [1.142]	-0.558 [0.909]	1.452** [0.627]
Commodity Index	0.125* [0.071]	-0.027 [0.099]	-0.015 [0.103]
Constant	-11.843* [5.939]	-141.735*** [7.351]	-14.233** [6.970]
Observations	770	547	1,080
R-squared	0.287	0.361	0.229
Clustered-Robust standard errors in brackets			
*** p<0.01, ** p<0.05, * p<0.1			

Table 3: Impacts of capital inflows on output growth

The finding helps shed light in the debate on the effectiveness of aid. While existing literature still struggles with the flows-growth endogeneity issue, we strive to isolate an exogenous component of aid flows. We find that “exogenous” foreign aid helps output growth, a result consistent with the findings of

Burnside and Dollar (2000) and Bruckner (2013). The finding confirms the role of aid in assisting poor countries. We also show that “exogenous” FDI inflows help a country’s growth, but the effect is much less significant and the magnitude is much smaller than that of aid. Nevertheless, the result is consistent with the finding of the existing literature that FDI inflows are generally good for growth.

On the other hand, we find that “exogenous” sovereign borrowing does not help growth at all. The results are quite striking. Developing countries are often praised about being able to raise money from the international financial market. This is considered as a new way to help finance countries’ need of investment without depending on foreign aid. The finding cast a doubt on this belief. It suggests that sovereign borrowing might not be deployed most effectively and hence does not have any effect on growth. Unlike foreign aid which comes with clear purposes and stricter monitoring, capital raised from foreign borrowing is usually more freely spent. Speculatively, they can be more prone to corruption, vested interests, and irresponsible investment decisions.

Since the impacts of aid, FDI and sovereign borrowing can be of longer term, we test if they have any impact in the subsequent years (see column (2) in Table 3). We find that capital flows with two lags have no impact, probably because they are overwhelmed by the impacts of contemporaneous capital inflows. Similarly, we also regress capital flows with longer lags (up to five year lag) on output, but we do not observe a significant effect. Hence we do not report the results here. In addition, in columns [1] and [2], the impacts of growth of trade partners and commodity index are not significant. When we remove capital flows (equation [3]), the growth of trade partners become significant. This implies that one channel through which the growth of trade partners affects a country is via capital flows.

As a robustness check, in the second set of regressions, we calculate the residuals components of capital flows, strictly following equation (13), no matter if the coefficients in Table 2 are not significantly different to zero. The results are basically unchanged (see Table 4).



VARIABLES	Growth of real output per capita		
	[1]	[2]	[3]
log ODA inflows (residual)	0.022*** [0.007]	0.025** [0.010]	
log FDI inflows (residual)	0.003** [0.001]	0.002* [0.001]	
log public debt inflows (residual)	-0.003 [0.002]	-0.005* [0.003]	
log ODA inflows (residual) (t-1)		-0.010 [0.009]	
log FDI inflows (residual) (t-1)		-0.001 [0.002]	
log public debt inflows (residual) (t-1)		-0.004 [0.005]	
log ODA inflows (residual) (t-2)		-0.008 [0.009]	
log FDI inflows (residual) (t-2)		-0.000 [0.001]	
log public debt inflows (residual) (t-2)		0.005 [0.003]	
Growth of Trade partners	0.905 [1.161]	-0.482 [0.919]	1.452** [0.627]
Commodity Index	0.111 [0.072]	-0.041 [0.096]	-0.015 [0.103]
Constant	-10.954* [5.890]	-139.496*** [7.435]	-14.233** [6.970]
Observations	770	547	1,080
R-squared	0.288	0.363	0.229
Clustered-Robust standard errors in brackets			
*** p<0.01, ** p<0.05, * p<0.1			

Table 4: Impacts of capital inflows on output growth

## VI. Conclusion

This paper investigates the causal impacts of economic growth on capital flows and of capital flows on growth in a set of 38 Sub-Saharan African countries. Using a two-step approach to address reverse causality and omitted variable issues, we find two sets of results. First, contrary to popular belief, economic growth in Sub-Saharan Africa has not managed to attract capital inflows. Second, we find that “exogenous” capital flows have positive impacts on economic growth. Among the three measures of

capital flows, i.e. aid, FDI and sovereign borrowing, we find that aid and FDI have significant positive impacts on economic growth of the same year, while sovereign borrowing does not.

The findings reinforce the notion that foreign aid can be effective. On the other hand, the findings cast doubt on the role of sovereign borrowing. While having access to financial markets is conventionally believed to help countries mitigate capital constraints and grow, the results from 38 SSA countries show that sovereign borrowing has no immediate or future growth impacts.

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