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Private and public investment in sub-Saharan Africa: The role of instability risks

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Highlights

- This paper investigates the impact of public investment on private investment in sub-Saharan Africa using the finite mixture model.
- The sample covers 42 countries over the period 1980-2015.
- It incorporates the potential presence of hidden heterogeneity and tries to explain the group membership.
- We find that the impact of public investment on private investment differs across three different groups of countries.
- Moreover, we find that countries with high risk of conflict, terrorism and repatriation of profits are less likely to be in the group where public investment crowds in private investment.

Abstract

This paper explores the impact of public investment on private investment in sub-Saharan Africa using the finite mixture model. We argue that the impact of public investment on private investment differs across groups of countries with similar but unobserved characteristics. Contrary to previous studies, the paper incorporates the potential presence of hidden heterogeneity and tries to explain the group membership. Using a sample of 42 countries, we find that the impact of public investment on private investment differs across three different groups of countries. Moreover, we find that countries with high risk of conflict, terrorism and repatriation of profits are less likely to be in the group where public investment crowds in private investment. The paper underscores the need for sub-Saharan African countries to ensure private investment security by reducing the risks associated with conflicts and terrorism, and preserving contract viability and repatriation of profits.

JEL classification: E22, E62, H41, O16
Keywords: Sub-Saharan Africa, Private investment, Public investment, Finite mixture model

1. Introduction

The relationship between public investment and private investment has come under intense controversy in the scientific literature.

On the one hand, some authors argue that higher public investment can "crowd out" private investment (Blejer and Khan, 1984; Barro, 1989; Bahmani-Oskooee, 1999). Indeed, for these authors, an increase in public investment can only be achieved either directly by raising taxes on individuals and firms or by increasing the level of indebtedness on the market. Thus, if public investment is financed by higher taxes, this leads to a reduction in aggregate demand and reduces profitability as well as business investment. In contrast, if the government finances public investment by borrowing from banks, it culminates in a raise in

interest rates, which consequently affects the cost of capital for the private sector from banks and thereby crowds out (competes away) private investment.

On the other hand, Keynesians provide a counterargument that increasing public investment in infrastructure (such as roads, highways and electricity) and/or health and education can have a complementary impact on private investment by increasing the marginal productivity of private capital. They argue that usually budget deficits result in an increase in public investment, which makes private investors become more optimistic about the future course of the economy and invest more (Bahmani-Oskooee, 1999). This suggests a crowding-in effect of public investment on private investment.

However, the previous empirical analyses focusing on estimates of the "crowding-out" or "crowding-in" effects between public and private investment ignored the conditional role of country risk by exploring only the direct impact (Aschauer, 1989; Greene and Villanueva, 1991; Bahmani-Oskooee, 1999; Ramirez, 1994; Erden and Holcombe, 2005; Annala et al., 2008; Cavallo and Daude, 2011; Xu and Yan, 2014; Abiad et al., 2016, etc). Indeed, the institutional environment can have significant effects on private investment, and countries that protect and secure the business environment are likely to encourage private investment. The risk of instability in countries may alter the impact of public investment on private investment, especially in developing countries such as sub-Saharan Africa. In fact, private investors may be reluctant to invest in a country if the risks to their investments are high. Thus, country risk can prove to be very important in the relationship between public and private investment, particularly in sub-Saharan Africa.

Sub-Saharan Africa is one of the regions facing more risks, such as internal or external instability. We can mention the case of the Democratic Republic of Congo, the Central African Republic, Niger, Liberia, Nigeria, Libya, Burundi, etc. In addition, sub-Saharan Africa is also experiencing an increase in terrorism (Mali, Sudan, Somalia, Burkina Faso,

etc.). This unstable regional situation has led to an increase in military spending in several countries. Such spending is a diversion of resources and is likely to reduce public investment in infrastructure and other sectors. Added to this are costs related to the destruction of production infrastructure (hydroelectric and telecommunication installations, roads, houses, schools, hospitals, etc.), which may discourage private investment. In this sense, Fosu (1992) pointed out that in the presence of political instability, the risk of capital loss increases, which lowers the volume of realized investments. He argued that political instability considerably reduces the time horizon for investment, not only of the investor, but also of the policymaker; the latter is content with the practice of managing and waiting for power, particularly in the economic field. Recently, Drakos and Konstantinou (2014), based on a trivariate panel VAR and in particular Generalized Impulse Responses, showed that terrorism significantly increased the subsequent trajectory of public order and safety spending across European countries during the period 1994-2006. Contrary to previous studies on the relationship between public and private investment in sub-Saharan African countries (Ifeakachukwu et al., 2013; Tchouassi and Ngangue, 2014), this paper takes into account the risk of instability and uses an economic technique that captures the potential heterogeneity in the model.

Previous studies used traditional econometric models (OLS, IV, GMM) that impose a single model in the sample, and thus assume that the effect of public investment is constant across the distribution. Furthermore, these models disregard the possibility that heterogeneity may exist along the distribution of the outcome itself. The objective of this paper is to take a careful look at the relationship between public and private investment in sub-Saharan Africa. The paper differs from previous studies in three ways. First, previous studies employed traditional OLS fixed effects and GMM methods, which impose a single model in the sample. In this paper we use the finite mixture model, which relaxes the single model and allows unobserved heterogeneity in the sample. The finite mixture model incorporates a latent

variable to classify countries into different classes and enables any possible unobserved heterogeneity that may exist to be taken into account. Second, we explore whether the risks associated with civil war, terrorism, cross-border conflicts and a lack of repatriation of profits can help explain the variations between groups. This is very important given that the continent is affected by several conflicts and the risks to investment are high in some countries. Third, we focus on the sub-Saharan African region, which has been less studied in the previous literature.

Using a sample of 42 sub-Saharan African countries over the period 1980-2015, we find that our model is best grouped into three different classes, which apparently is in line with the three different theories on the potential impact of public investment on private investment. In the first class, public investment has no significant effect on private investment, consistent with the Ricardian equivalence theory. In the second class, we find that public investment is positively associated with private investment, confirming the Keynesian view. In the third class, the results show that public investment is negatively associated with private investment, thus confirming the neoclassical theory. Our findings highlight that there is an observed heterogeneity on the impact of public investment on private investment, which the previous literature has failed to incorporate. Moreover, we find that the risks associated with conflicts, terrorism, contract unviability and repatriation of profits help explain the group membership. More precisely, countries with high risk of conflicts, terrorism, contract unviability, and repatriation of profits are less likely to be in the group where public investment crowds in private investment. The paper underscores the need for sub-Saharan African countries to ensure security and reduce the risks associated with private investment.

The rest of the paper is organized as follows. Section 2 presents a brief review of the literature. Section 3 describes the data sources and the variables used in this paper. In Section

4, we specify our empirical estimation strategy, while Section 5 discusses the main results. Finally, we provide some policy implications and conclude in Section 6.

2. Review of literature

The literature on the effect of public investment on private investment has been the subject of a series of studies with some mixed results. First, some studies showed that there is a crowding-in effect of public investment on private investment, while others found a crowding-out effect. Studies in line with the Keynesian view showing a complementarity between public and private investment argue that this crowding-in effect is due to the fact that public investment is generally limited to goods and services that the private sector will not produce in optimal quantities, such as public goods. In this sense, public investment in social and economic infrastructure tends to complement private investment because it facilitates the implementation and realization of private agents' investment plans thanks to the elimination of transportation, communication and educational bottlenecks (Ramirez, 1994; Martinez-Lopez, 2006). Many empirical studies have confirmed the crowding-in effect of public investment on private investment. Using the full information maximum-likelihood statistical technique, Erenburg (1993) found that public investment had a positive impact on private investment in the United States over the period 1925-1985. Ramirez (1994) used a modified accelerator model and found that public investment overall had a positive and significant effect on private investment in Mexico during the 1950-1988 period. Moreover, from a pooled regression model using both cross-section and time series data, Ramirez (2000) found that public investment spending had a positive (lagged) effect on private capital formation in Latin American countries during the 1980-1995 period. Using a simulation model, Abiad et al. (2016) highlighted that increased public investment raises output, both in the short and the long term, and crowds in private investment. Finally, using quarterly data over the period

1956-2010, Blackley (2014) found that public investment had a significant crowding-in effect on private investment in the United States.

However, the neoclassical theory argues that increased public investment undertaken by heavily subsidized and inefficient state-owned enterprises more often than not reduces the investment opportunities for the private sector (Bahmani-Oskooee, 1999; Ramirez, 1994). Thus, public investment could crowd out private investment. Using an 18-sector computable general equilibrium model where money plays a non-neutral role, Pradhan et al. (1990) found that public investment crowds out private investment in India. Moreover, Sahu et al. (2012), using a flexible accelerator model in a VECM framework, showed that government investment crowds out private investment in the long run in India for the period 1970-71 to 2009-10. In the same vein, Serven (1998) revealed that public investments in non-basic infrastructure (investments outside of power systems, water and sewage, and transport) crowd out private investment in India. Exploiting both the time series and GMM methods on a large sample of 116 developing countries during the period 1980-2006, Cavallo and Daude (2011) also found that on average public investment crowds out private investment. Finally, Tchouassi and Ngangue (2014) highlighted that public investment negatively affects private investment on a sample of 14 African countries over the period 1980–2010, using OLS regressions.

Finally, there is a third category of empirical literature for which the results suggest partial crowding-out and crowding-in effects on private investment depending on the structural conditions of countries. Thus, Blejer and Khan (1984) tested whether public investment crowds out or crowds in private investment on a sample of 24 developing countries over the period 1971–1979 using OLS pooled cross-section. They found that public investment in infrastructure is complementary to private investment, while other types of public investment (real sector investment that is not related to infrastructure) leads to

crowding out of private investment. Similarly, Erden and Holcombe (2005) found that while public investment is complementary to private investment in developing countries, the effect is opposite in developed countries. They attributed these results to the structural differences between the two categories of economies. Thus, although public investment may provide the necessary infrastructure facilities in developing countries and hence boost private investment, in developed economies the public sector is already large and may compete with the private sector. In the same vein, using data from 1925 to 1985 for the U.S., Aschauer (1989) stated that "higher public investment may raise the marginal productivity of private capital and, thereby, crowd in private investment". Pereira (2001) employed impulse response analysis with vector auto-regressive (VAR) estimates and showed that, at the aggregate level, public investment crowds in private investment over the period 1956 to 1997 for the U.S. Disaggregating private investment, he also showed that the crowding-in effect of public investment is strong for equipment and only marginal for structures. Thus, he concluded that the crowding-in effect on private equipment is particularly strong in cases of industrial and transportation equipment. Finally, Xu and Yan (2014), using a structured vector auto-regressive method, showed that government investment in public goods in China crowds in private investment significantly, while government investment in private goods, industry and commerce, mainly through state-owned enterprises, crowds out private investment significantly during the period 1980-2011.

However, the literature on the effect of public investment on private investment did not take into account the role of instability risks (Aschauer, 1989; Annala et al., 2008; Cavallo and Daude, 2011; Xu and Yan, 2014; Abiad et al., 2016, among others). This paper fills in this gap and analyzes the potential effect of risks on the relationship between public and private investment. In this paper, we will focus on the risks of conflicts, terrorism, contract unviability, external pressures on governments and the lack of repatriation of profits.

Moreover, contrary to previous studies employing the OLS fixed effects and GMM methods, which impose a single model on the sample, this study uses the finite mixture model, which relaxes the single model and allows unobserved heterogeneity in the sample.

3. Data sources

Our sample covers 42 sub-Saharan African countries over the period 1980-2015. The selection of countries is exclusively based on the availability of data. We extracted the data from several sources. Public and private investment over GDP ratios are from the IMF's Fiscal Affairs Department (FAD). As for the remaining control variables, we extracted the GDP growth series from the IMF's World Economic Outlook (WEO). Real effective exchange rate data, defined as the ratio of prices in the country to prices in the main trade partners adjusted for variations in the nominal effective exchange rate, are from the IMF's WEO. The financial development variable is taken from Svirydzenka (2016). Finally, we include natural resource rents in percentage of GDP to capture the natural endowments of countries. This variable is from the World Bank's World Development Indicators. Trade openness, defined as the sum of imports and exports over GDP, is from the World Bank's World Development Indicators. In this paper, we use the 5-year averages of the data in order to reduce short-term shocks: 1980-1984; 1985-1989; 1990-1994; 1995-1999; 2000-2004; 2005-2009; 2010-2015. Table 1 presents the descriptive statistics of the different series.

<insert Table 1 here>

4. Econometric model

Previous studies typically employed econometric techniques imposing a restriction of homogeneous slope parameters. They assumed that all sampling units face similar constraints

and behave in similar ways. The assumption that all observations can be characterized by a single model can mask critical features of the data (Morduch and Stern, 1997). Therefore, traditional modelling techniques may be incapable of detecting behavioral changes within subgroups. Our paper proposes a different view and fills this gap by using a finite mixture of regression models, a semi-parametric method for modelling unobserved heterogeneity in the sample that allows us to relax the hypothesis of a single model. Finite mixture models have received increasing attention in the healthcare literature (see Deb and Trivedi, 1997; Deb et al., 2011; Conway and Deb, 2005) and other econometric applications (see Heckman and Singer, 1984; Wedel et al., 1993; Geweke and Keane, 1997), but have not yet been applied in studies on the relationship between public and private investment.

The finite mixture model allows an endogenous (data determined) as well as probabilistic assignment of countries across the subgroups. This feature is by far more attractive than an exogenous or ad hoc selection of membership, which could be highly sensitive to arbitrariness, data mining, and sample selection bias (Di Vaio and Enflo, 2011). Rather than splitting the sample based on a priori arbitrary choices, mixture models generate endogenous group membership and permit explaining group membership with several covariates. Countries are hence endogenously allocated to a group, and each has its own probability of belonging to one group or another. Mixture models capture discrete unobserved heterogeneity in the sample based on the intuitive idea that different "types" may correspond to different latent classes or subsamples.

To specify a finite mixture model, assume that each country belongs to one of a set of latent classes j=1,…, C, and that countries are heterogeneous across classes. Conditional on the observed covariates, there is homogeneity within a given class j. Specifically, a mixture model of linear regression is:

$$f(y/x;\Theta) = \sum_{c=1}^{C} \pi_c \phi(y/x;\beta_c,\sigma_c) \qquad (1)$$

where $f(y/x;\Theta)$ is the distribution of private investment conditional on belonging to class c and on covariates x; C is the number of groups; and π_c is the probability of belonging to group c.

The probability of belonging to class *c* is:

$$\pi_c = \frac{\exp(\gamma_c)}{\sum_{c=1}^{C}\exp(\gamma_c)}, \text{ with } 0 < \pi_c < 1 \text{ and } \sum_{c=1}^{C}\pi_c = 1 \qquad (2)$$

The estimation can be carried out using maximum likelihood with the EM algorithm of Dempster et al. (1977).

$$\max_{\pi,\Theta} log\ L = \sum_{i=1}^{N}(\log(\sum_{c=1}^{C}\pi_c f_c\ (y|\Theta_c)) \qquad (3)$$

Furthermore, as recommended by Hawkins (2001) in the case of a mixture of linear regression, we use the Bayesian Information Criterion (BIC) to choose the number of components. The BIC is defined as:

$$BIC = -2\log(L) + K\log(N) \qquad (4)$$

where log(L) is the estimated value of the log-likelihood estimated in (3) and N is the number of observations.

5. Results

5.1 Baseline results

We first focus on the selection of the number of groups by using the information criteria AIC and BIC. Table 1 below reports the results of the AIC and BIC values for each number of classes. Usually, the lower the value of AIC and BIC, the better the econometric specification. Table 2 shows that the AIC and BIC values are high for C=1, which is the case for one group for all countries in the sample. Thus, the traditional econometric models are not adapted to this study. As we can observe, the AIC value is lower when the number of classes

is 4, while the BIC value is lower when the number of classes is 3. Given that the BIC has changed its trend (declining from C=1 to C=3 and then increasing for C=4), while the AIC has not, we will focus on the BIC criteria for the selection of the number of groups. The BIC value is minimized for C=3, so we select the mixture model with three groups.

<insert Table 2 here>

We now turn to the econometric regressions using the finite mixture models with three groups. The results are reported in Table 3. It is worth noting that we control for country and year fixed effects in all regressions. In columns (1) and (2), we present the results by using traditional econometric models including fixed effects OLS and Generalized Methods of Moments. We find that public investment is positively associated with private investment. The coefficient associated with public investment is positive and statistically significant at 10 percent and 5 percent in columns (1) and (2), respectively. An increase of public investment by 1 percent of GDP will result in an increase of private investment by 0.3 percent of GDP and 0.13 percent of GDP when the fixed effects OLS and GMM are used, respectively. However, as explained above, these traditional econometric models do not provide a full view of the potential differential impacts between countries.

Table 3 shows that the impact of public investment on private investment differs in the function of the group of countries (columns 3-5). We find that the coefficient associated with public investment is not statistically significant in Group 1. Thus, public investment does not affect private investment in this group of countries. This finding is consistent with the Ricardian equivalence theory. According to this theory, an increase in budget deficits due to an increase in government spending must be paid either now or later, with the total present value of receipts being equal to the total present value of spending (Barro, 1989; Bahmani-

Oskooee, 1999). Hence, a cut in today's taxes must be matched by an increase in future taxes, leaving interest rates, and thus private investment, unchanged.

Moreover, we find that public investment crowds in private investment in the countries of group 2. The coefficient associated with public investment is positive and strongly significant at the 1 percent level in these countries. An increase in public investment by 1 percent of GDP is associated with a surge of private investment by 0.4 percent of GDP. This finding is consistent with the Keynesian view, according to which public investment is likely to have a complementary relationship with private investment through the multiplier effect. This theory points out that higher public investment may raise the marginal productivity of private capital, thereby crowding in private investment (Aschauer, 1989). The results also confirm previous studies including those by Bahmani-Oskooee (1999), Ramirez (1994), and Erden and Holcombe (2005).

<insert Table 3 here>

Table 3 also shows that the impact of public investment on private investment is negative and statistically significant at the 1 percent level in group 3. An increase of public investment by 1 percent results in a decrease of private investment by 0.54 percent of GDP. The result confirms the neoclassical theory, which highlights that an increase in public investment leads to a direct or indirect crowding-out effect on private investment. When the government borrows from the financial markets, this could lead to an increase in interest rates, which in turn increases the cost of private companies' borrowing and dissuades them from investing. Several previous studies (Pradhan et al., 1990; Cavallo and Daude, 2011; Tchouassi and Ngangue, 2014; Bahal et al., 2015) have also found that public investment crowds out private investment in some countries. In columns 6-8, we also present the results

of the regressions including the lag of private investment as a control variable. The results remain broadly consistent with those of the baseline in columns 3-5.

We now turn to look at the composition of the three groups. As explained in Section 4, we compute the posterior probability that country c belongs to one of the two by using the Bayes rule. Then, we allocate country c to a given group only when the likelihood of being in that group is greater than that of being in the other groups. Table 4 (see below) reports the composition of the countries with their posterior probability of group membership. Group 1 is comprised of 8 countries, group 2 contains 31 countries and group 3 contains 3 countries. At the bottom of Table 4, we present the average values of public and private investment for each group (columns 2, 3 and 4). We observe that private and public investment in percentage of GDP is higher for the countries in group 1 than for those in groups 2 and 3. Furthermore, the main difference between groups 3 and 2 is the level of private sector investment. As can be observed in Table 4, private investment is on average 8 percent of GDP in group 2, while it is on average 20 percent of GDP in group 3. It appears that the crowding-in effect may prevail when private investment is at a very low level. This could be explained by the fact that when the private sector is underdeveloped, the public sector can still play a great role by providing the infrastructure and all necessary inputs for the development of the private sector. Table 4 also reports the posterior probability of belonging to one of the groups. We note that there is a probability of 81.2 percent of the sample to be in group 2. In other words, a sub-Saharan African country has a probability of 81.2 percent to be in the group for which public investment crowds in private investment. On the opposite side, there is a probability of 9 percent to be in the group where public investment crowds out private investment (group 3). Finally, public investment does not affect private investment (group 1) in around 9.8 percent of the sample.

<insert Table 4 here>

5.2 The role of instability risks

After having described the classification of the countries, we need to understand the factors contributing to explaining group membership. Given that the probability of being in group 2 is high we will focus our analysis on this group. Thus, we define a dummy variable taking the value of one if the country is in group 2 and 0 otherwise. We then use the random effects Mundlak model (Mundlak, 1978) to estimate the correlates of being in group 2. The advantage of the random effect Mundlak model is that it takes into account the countries that are not in group 2, while the fixed effects model drops these countries and addresses the issue of incidental parameters. Also, the RE-Mundlak approach controls for all unexplained differences between countries, taking care of all country-specific and time-invariant characteristics that may affect the likelihood of being in group 2. We intend to explore whether fragile countries that face a high risk of civil war or conflicts are likely to be in group 2 or not. To this end, we use some variables from the International Country Risk Guide (ICRG) (Howell, 2013), which provides an assessment of the political and economic risks of countries. We estimate the following equation:

$$Crowdin_{i,t} = \alpha_i + Risks_{i,t} + \pi_{i,t} \quad (5)$$

where $Crowdin_{i,t}$ is a binary variable taking the value of 1 if country i is in group 2 and thus experiences a crowding-in effect at time t, and zero otherwise. $Risks_{i,t}$ represents the risk variable ICRG. $\pi_{i,t}$ is the error term. Regarding the risk variables, we consider the following: (i) variables related to political violence and internal conflict including civil war, terrorism and civil disorder. High values are given to countries embroiled in an ongoing civil war, terrorism and civil disorder; (ii) variables related to the investment profile of countries. They provide an assessment of factors affecting the risk to investment that are not covered by other

political, economic and financial risk components. These factors include contract viability/expropriation, profit repatriation, and payment delays. High values are given to countries with a high risk to investment; (iii) variables related to external conflict including war, cross-border conflict, and foreign pressures. The external conflict measure is an assessment of the risk to the incumbent government from foreign action, ranging from non-violent external pressure (diplomatic pressure, withholding of aid, trade restrictions, territorial disputes, sanctions, etc.) to violent external pressure (cross-border conflicts to all-out war). The results of the regressions are reported in Table 5.

<insert Table 5 here>

We find that risky countries are less likely to be in group 2. Indeed, the results show that the marginal effects associated with civil war, civil disorder and terrorism are negatively associated with the probability of being in group 2. Therefore, countries that face a high risk of internal conflict, including the risk of civil war, terrorism or political violence and civil disorder, are less likely to be in the group of countries where public investment crowds in private investment. This finding can be explained by the fact that when the risk of conflict is high, private investors are worried about the rentability of their investment and therefore may not be encouraged to invest in the country. Moreover, we find that in countries where the risk of expropriation, lack of profit repatriation and payment delays is high, the probability of being in group 2 is low. In fact, when investors feel that their companies can be expropriated, or they cannot repatriate their profits, they will be less likely to invest. Such a situation could result in a reduction of private investment. Finally, we find that countries facing cross-border conflict or any external pressure (diplomatic pressures, trade restrictions, sanctions, etc.) are less likely to be in group 2.

5. Conclusion

In this paper, we investigated the impact of public investment on private investment by taking into account the possibility that countries are grouped into different classes. We used a finite mixture model, which allowed us to relax the single model featured by the traditional OLS fixed effects and GMM estimators. The finite mixture model incorporates a latent variable to classify individuals into different classes and enables any possible unobserved heterogeneity that may exist to be taken into account. Using a sample of 42 sub-Saharan African countries over the period 1980-2015, we found that the impact of public investment on private investment differs across groups. More specifically, public investment does not affect private investment in the first group, while it crowds in and crowds out private investment in the second and third groups, respectively. Moreover, we focused on the risks associated with conflicts, terrorism, contract unviability and repatriation of profits to explain the group membership. The results show that countries where these risks are high are less likely to be in the group where public investment positively affects private investment. Our findings have important policy implications for sub-Saharan African countries. In fact, the results clearly highlight that for African countries to attract private investment, they need to ensure investment security by reducing conflicts and terrorism, and preserving contract viability and repatriation of profits.

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Table 1. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Private investment (% of GDP)	495	11.42	8.88	0.94	57.48
Public investment (% of GDP)	495	6.12	5.69	0.05	50.18
GDP growth	464	4.12	4.81	-12.27	55.67
Financial development	308	0.11	0.08	0.00	0.61
Natural rents	361	12.27	13.72	0.00	80.71
Log (Real exchange rate)	307	4.83	0.62	3.69	9.48
Trade openness	429	69.80	42.51	12.88	440.74

Table 2. Selection of the number of groups

	C=1	C=2	C=3	C=4	C=5
AIC	1656.6	1549.6	1517.8	1501.3	Not concave
BIC	1681.2	1609.4	1609.2	1624.4	Not concave

Table 3. Baseline results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			Finite mixture model					
VARIABLES	Fixed-effects OLS	GMM	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
Lag. Dep. Variable		0.513				0.629***	0.215***	0.049***
		(0.453)				(0.056)	(0.031)	(0.006)
Public investment	0.300**	0.126*	0.0448	0.413***	-0.543***	0.128	0.394***	-0.502***
	(0.131)	(0.0694)	(0.285)	(0.0767)	(0.136)	(0.085)	(0.061)	(0.127)
GDP growth	0.263**	0.304***	-0.940***	0.271***	2.425***	-0.814***	0.529***	0.127***
	(0.110)	(0.103)	(0.212)	(0.0808)	(0.131)	(0.195)	(0.141)	(0.011)
Financial Development	15.32***	8.366	-111.8***	24.40***	30.05***	-27.471***	19.015***	24.402***
	(4.807)	(10.09)	(41.46)	(2.833)	(4.406)	(3.488)	(3.927)	(0.187)
Natural rents	-0.0378	-0.0132	-0.499***	0.00980	0.221***	-0.296***	0.042	0.163***
	(0.0427)	(0.0248)	(0.0863)	(0.0230)	(0.0179)	(0.009)	(0.025)	(0.012)
Log(Real Exchange rate)	0.578	0.533	-14.42***	0.407	10.42***	-4.572***	0.978	9.924***
	(1.037)	(0.944)	(5.266)	(0.663)	(0.690)	(0.423)	(0.791)	-0.885
Trade openness	0.0760***	0.0512***	0.248***	0.0124	0.159***	0.181***	0.021	0.148***
	(0.0232)	(0.0187)	(0.0230)	(0.0120)	(0.009)	(0.008)	(0.028)	(0.008)
Constant	-1.617	-3.586	93.90***	-0.236	-57.36***	28.209***	-4.118	-8.304***
	(5.183)	(3.514)	(32.24)	(3.432)	(4.479)	(3.327)	(4.118)	(0.683)
Observations	249	249	249	249	249	249	249	249
Number of countries	42	42	42	42	42	42	42	42
R^2	0.344							
AR(1)		0.504						
AR(2)		0.291						
Hansen p-value		0.522						

Standard errors in parentheses. * p<0.1 significant at 10 %; ** p<0.05 significant at 5 % ; *** p<0.01 significant at 1 %

Table 4. Country classification

Country	Period	Group membership	Probabilities		
			Group 1	Group 2	Group 3
Angola	1995-1999	3	0.0	0.0	1.0
Angola	2000-2004	2	0.0	1.0	0.0
Angola	2005-2015	1	1.0	0.0	0.0
Burundi	1980-1984	3	0.1	0.4	0.6
Burundi	1985-2015	2	0.1	0.9	0.0
Benin	1985-2009	2	0.0	0.9	0.1
Benin	2010-2015	3	0.0	0.3	0.7
Burkina Faso	1980-2015	2	0.1	0.9	0.0
Botswana	1980-2009	2	0.0	1.0	0.0
Botswana	2010-2015	1	0.5	0.1	0.5
Central African Republic	1980-2015	2	0.0	1.0	0.0
Cote d'Ivoire	1980-2015	2	0.0	1.0	0.0
Cameroon	1980-2004	2	0.1	0.9	0.0
Cameroon	2005-2009	3	0.0	0.5	0.5
Cameroon	2010-2015	2	0.0	1.0	0.0
Congo, Republic of	1980-1984	1	0.7	0.3	0.0
Congo, Republic of	1985-1989	2	0.1	0.9	0.0
Congo, Republic of	1990-1994	3	0.1	0.1	0.8
Congo, Republic of	1995-2015	2	0.0	1.0	0.0
Comoros	1980-2015	2	0.0	1.0	0.0
Cabo Verde	1990-1999	1	1.0	0.0	0.0
Cabo Verde	2000-2004	2	0.0	1.0	0.0
Cabo Verde	2005-2009	3	0.1	0.1	0.8
Cabo Verde	2010-2015	1	0.7	0.3	0.0
Ethiopia	2010-2015	2	0.1	0.9	0.0
Gabon	1980-1989	3	0.0	0.0	1.0
Gabon	1990-1999	2	0.1	0.9	0.0
Gabon	2000-2009	3	0.1	0.0	0.9
Gabon	2010-2015	2	0.1	0.9	0.0
Ghana	1980-2009	2	0.0	1.0	0.0
Ghana	2010-2015	1	0.6	0.4	0.0
Guinea	1985-2015	2	0.0	1.0	0.0
Gambia, The	1980-2015	2	0.0	1.0	0.0
Guinea-Bissau	1985-2015	2	0.0	1.0	0.0
Equatorial Guinea	1985-1994	2	0.0	1.0	0.0
Equatorial Guinea	1995-2004	1	1.0	0.0	0.0
Equatorial Guinea	2005-2015	2	0.0	1.0	0.0
Kenya	1980-2015	2	0.0	1.0	0.0
Liberia	2000-2015	2	0.0	1.0	0.0
Lesotho	2005-2015	2	0.0	1.0	0.0
Madagascar	1980-2015	2	0.0	0.6	0.4

Mali	1980-2015	2	0.0	0.6	0.4
Mozambique	1990-2015	2	0.0	1.0	0.0
Mauritania	1990-2009	2	0.0	1.0	0.0
Mauritania	2010-2015	1	0.8	0.2	0.0
Mauritius	1980-2015	2	0.0	1.0	0.0
Malawi	1980-2004	2	0.2	0.8	0.0
Malawi	2005-2009	3	0.0	0.4	0.6
Malawi	2010-2015	2	0.0	1.0	0.0
Namibia	1990-2004	2	0.0	1.0	0.0
Namibia	2005-2015	3	0.1	0.3	0.6
Niger	1980-1984	1	1.0	0.0	0.0
Niger	1985-2009	2	0.2	0.8	0.0
Niger	2010-2015	3	0.4	0.0	0.5
Nigeria	1990-2015	2	0.1	0.9	0.0
Rwanda	1980-2015	2	0.0	1.0	0.0
Sudan	2010-2015	2	0.2	0.8	0.0
Senegal	1980-1999	2	0.0	1.0	0.0
Senegal	2000-2004	3	0.0	0.3	0.7
Senegal	2005-2015	2	0.0	0.6	0.4
Sierra Leone	1980-2015	2	0.0	1.0	0.0
Swaziland	1980-1999	1	1.0	0.0	0.0
Swaziland	2000-2004	3	0.0	0.0	1.0
Swaziland	2005-2015	2	0.0	1.0	0.0
Seychelles	1990-2015	2	0.1	0.8	0.1
Chad	1980-2015	2	0.2	0.8	0.0
Togo	1980-2015	2	0.0	1.0	0.0
Tanzania	1990-2004	2	0.1	0.9	0.0
Tanzania	2005-2015	1	0.9	0.1	0.0
Uganda	1980-2009	2	0.0	1.0	0.0
Uganda	2010-2015	1	0.7	0.3	0.0
South Africa	1980-2015	2	0.0	1.0	0.0
Zambia	1990-2004	2	0.0	1.0	0.0
Zambia	2005-2009	3	0.0	0.0	1.0
Zambia	2010-2015	1	1.0	0.0	0.0

Means of key variables and posterior probabilities by group

	Group 1	Group 2	Group 3
Private investment	26.60	8.67	20.09
Public investment	8.33	5.28	5.59
Posterior probability	0.10	0.81	0.09

Table 5. The role of instability risks

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Civil war	-0.2623***								
	(0.086)								
Terrorism		-0.3404***							
		(0.110)							
Civil disorder			-0.3539***						
			(0.120)						
Repatriation				-0.3176***					
				(0.108)					
Payment delays					-0.3527***				
					(0.121)				
Contract unviability						-0.3158***			
						(0.110)			
War (external)							-0.2307***		
							(0.078)		
Cross border conflict								-0.3020***	
								(0.095)	
Foreign pressures									-0.2936***
									(0.097)
Constant	1.4135***	1.4627***	1.3773***	1.3982***	1.3412***	1.3715***	1.4091***	1.4522***	1.3741***
	(0.317)	(0.339)	(0.307)	(0.318)	(0.297)	(0.310)	(0.319)	(0.325)	(0.300)
Observations	171	171	171	171	171	171	171	171	171
Number of countries	29	29	29	29	29	29	29	29	29

Standard errors in parentheses. * p<0.1 significant at 10 %; ** p<0.05 significant at 5 % ; *** p<0.01 significant at 1 %