Foreign Aid, Foreign Investment, Remittances and Economic Growth: a Bootstrap Panel Granger Causality Analysis for Sub-Saharan Countries

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Abstract: This paper investigates the potential Granger causality among the economic growth, remittances, foreign direct investment and official development aid in Sub-Saharan countries during the period 1990-2012. We adapt, to our problematic, the bootstrap panel Granger causality approach developed by Kònya (2006), which is based on SUR system and Wald test with country specific bootstrap critical values. Our results show a robust Granger causality between economic growth and foreign investment in seven of the fourteen countries of our survey. Granger causality is also significant between economic growth and remittances but only for four countries whereas there is no Granger causality between economic growth and foreign aid, except for Mali. We also bring significant evidences from the interactions between remittances, foreign investment and foreign aid.

Keywords: Remittances, Foreign direct investment, Official development assistance, Economic growth, Bootstrap panel Granger causality analysis, Heterogeneity, Cross-section dependence, Franc zone.

JEL classification: C33, F21, F22, F24, F41, O55.

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I. Introduction

For many developing countries, Official Development Aid (ODA), Foreign Direct Investment (FDI) and remittances constitute three major sources of funding, which are likely to favor economic development.[2] Indeed, ODA, FDI, and Remittances to developing countries were respectively estimated to US$135 in 2013 (OCDE, 2013), US$778 billion in 2013 (UNCTAD, 2013), US$436 billion in 2014 (World Bank, 2015).

This paper analyzes the relative impact of ODA, FDI and Remittances on economic growth by implementing a Bootstrap Panel Granger Causality test applied to Sub-Saharan countries of the Franc Zone. The econometric methodology developed in this paper allows us to contribute to the literature according to three main issues. Firstly, we estimate simultaneously the impact of ODA, FDI and Remittances taking properly into account the potential simultaneity bias between the economic growth and these three external sources of funding. Secondly, we estimate potential complementary or substitution effects between ODA, FDI and Remittances. Thirdly, we take into account both the cross-sectional dependence as well as the heterogeneity across countries.

INSERT FIGURES 1 & 2

INSERT FIGURES 3 & 4

Many studies intend to estimate separately the impact of ODA, FDI or Remittances on the growth rate of the receiving countries. Nevertheless, many of these do not take properly into account the potential simultaneity bias between the growth rate and the external source of finance they focus on. Yet: concerning Aid, donors could be motivated to give aid to suffering countries or to give Aid to successful recipients. Concerning FDI, they could favor economic growth notably through capital spillover and knowledge transfers whereas FDI could also be attracted by growth in new markets. Concerning Remittances, altruism can motivate migrants to remit in order to avoid poverty of those left behind especially during recessions. Moreover, potential complementary or substitution effects between ODA, FDI or Remittances have also to be taken into account.

The present contribution focuses on the fourteen Sub-Saharan countries of the CFA franc zone. According to the World Bank classification, in 2014, among the 31 countries which are considered as low-income economies (GNI per capita of $1,045 or less), 8 are members of the Franc Zone whereas four countries of the Franc Zone are considered as lower-middle-income

[2] See, for example, Carkovic and Levine (2002), Alfaro et al. (2006) or Driffield and Jones (2013), for empirical findings and literature survey.

economies (GNI per capita of more than $1,045 but less than $4,125) and 2 countries exhibit a substantial higher level GNI per capita mainly because of hydrocarbon and mining resources. Hence, define efficient policy in order to promote development in this especially poor part of the world is obviously a crucial objective. According to this social issue, the present paper intends to understand in which way ODA, FDI and Remittances are likely to contribute to the economic growth of these countries. Indeed, since 1990, ODA, FDI and Remittances to Franc Zone countries have been increasing (Figure 1). The sum of these three external sources of funding grew over 5 times from about $21 billion dollars in 1990 to about $114 billion dollars in 2012. If currently, ODA, FDI and Remittances represent respectively 40%, 35% and 25% of the total amount these relatives' contributions have changed during the two last decades. Between 1990 and 2012, FDI grew over 33 times from $1.2 billion dollars to $40 billion dollars, remittances grew over 16 times from $1.8 billion dollars to $28 billion dollars whereas ODA simply grew over 3 times from $17.8 billion dollars to $46.3 billion dollars. Hence, as shown in Figure 2: the ODA/FDI and ODA/remittances ratios respectively decline from 14.5 to 1.2 and 10 to 1.7 whereas the FDI/REM ratio grew from 0.7 to 1.4. Then the relative contribution of ODA declines over the period. Nevertheless, countries of the sample are a priori heterogeneous and interdependent. Indeed, levels of development as well as the magnitude of the external sources of funding seem to be heterogeneous (Figure 3 and 4). Moreover, these fourteen countries of the Franc zone are former French colonies and are all members of the Central African Economic and Monetary Community (CEMAC)[3] or of the West African Economic and Monetary Unions (WAEMU)[4], both unions which peg their currency to the euro at the same level and which intend to favor economic and financial cooperation with France and to develop their integration in order to coordinate macroeconomic policies and to create a common market. This focus on Franc zone countries induces two econometric issues. Firstly, as these economies are quite integrated, cross-sectional dependence across countries has to be tested. Hence, our econometric methodology based on both the Seemingly Unrelated Regression (SUR) systems and the Wald tests allows us to consider heterogeneity as well as cross-sectional dependence across countries. Secondly, as cultural links between countries favor their exchanges, ODA, FDI or Remittances from the European union (EU) and especially from France to CFA zone are ceteris paribus relatively high with regard to the total ODA, FDI or Remittances received by CFA countries. Thus, as

[3] CEMAC is made up of the following countries: Chad, Central African Republic, Cameroon, Equatorial Guinea, Gabon and Republic of Congo.
[4] WAEMU is made up of the following countries: Niger, Mali, Senegal, Guinea-Bissau, Ivory Coast, Burkina Faso, Togo and Benin.

long as economic conditions in sending countries can impact their capacity to export financial resources, we are in able to test the robustness of our results. The robustness of our results is tested using the investment rate, then the level of development, instead of the real GDP, in order to analyze the impact of external sources of funding on the economic growth.

Our results show a robust Granger causality between economic growth and foreign investment in seven of the fourteen countries of our survey. Granger causality is also significant between economic growth and remittances but only for four countries whereas there is no Granger causality between economic growth and foreign aid, except for Mali. We also bring significant evidences from the interactions between remittances, foreign investment and foreign aid.

The paper is organized as follows. Section 2 surveys the literature on ODA, FDI and Remittances efficiency. Section 3 explains the econometric methodology. Section 4 describes the data. Section 5 reports empirical results and Section 6 concludes.

II. Literature Survey

2.1. Impact of Aid, FDI and Remittances on growth

Most of the existing empirical literature test bivariate causality relations between the economic growth rate and ODA, FDI, and remittances.

A voluminous empirical literature intends to estimate the ODA efficiency. Recent contributions based on cross-countries surveys conclude that this impact is conditional to the quality of the institutions in the recipient countries (Burnside and Dollar, 2000; Hansen and Trap, 2001; Clemens et al., 2004). Nevertheless, as notably shown by Rajan and Subramanian (2008), cross-country regression results are biased because of simultaneity issue between Aid and growth. Indeed, donors could be motivated to give aid to suffering countries or to give Aid to successful recipient. Two possible solutions are likely to limit this bias. On the one hand, an instrumentation strategy can be adopted. Rajan and Subramanian (2008) propose an instrumentation of the supply of aid by taking into account colonial links and commonality of language and population ratio. Concerning France, these instruments are all significant and positive. Nevertheless, their final regressions, which considers more than 70 recipients countries, concludes that the impact of aid on economic growth is on quite small and depending on the time horizons. On the other hand, Panel regressions can address this issue by incorporating country fixed effect or by testing temporal causality between the aid and

growth. For example, Minoiu and Reddy (2009), using a panel approach (OLS and GMM regressions), show that ODA promote economic growth in the short but also in the long term.[5] Number of studies intends to estimate the impact of FDI on growth. The OECD survey on this topic (2002) points out that 11 out of 14 empirical studies conclude that FDI contributes to economic growth. Contributions based on cross-country regressions argue that the FDI is more efficient when the country is sufficiently developed, in term of income per capita or education level of the population, when the country is sufficiently open or when financial markets are sufficiently developed.[6] Nevertheless, concerning Sub-Saharan African (SSA) Countries, Asiedu (2002) indicates that SSA countries have on average received less FDI than in other region. On an empirical study based on OLS regressions, she argues that return on capital, infrastructure and openness have no impact on FDI in SSA whereas they promote FDI in other developing countries. Nevertheless, the major part of studies based on cross-country regressions suffers from a simultaneity bias between FDI and Growth: indeed, as long as FDI could favor growth notably through capital spillover and knowledge transfers (De Mello, 1997), FDI could also be attracted by faster growing markets. Hence, after controlling for the potential biases induces by simultaneity and country specific effects, Carkovic and Levine (2002) conclude that the impact of FDI on growth would be not significant. A recent strand of literature on FDI and growth intend to focus more directly on Granger causality.[7] Although the impact of FDI on growth seems highly heterogeneous across countries, the major part of these contributions concludes in a significant impact of FDI on growth. More precisely concerning countries of the Franc Zone, which are present in his survey, Tekin (2012) estimates evidence that FDI Granger-causing GDP in Benin and Togo, and GDP Granger-causing FDI in Burkina Faso but causality in any direction in Central African Republic.

The literature on the microeconomics of remittances show that in the one hand, altruism motivates migrants to remit in order to avoid poverty of those left behind especially during recessions while in the other hand a part of the remittances can be invested in physical and human capital and then favors growth (Docquier and Rappoport, 2006). Hence, cross-section regressions exhibit correlations between remittances and growth, which cannot be rigorously interpreted in term of causality. Nevertheless, as pointed by Chami et al. (2005) the sign of the impact of remittances on growth is not obvious as remittances are also likely to provide an

[5] See, for example, Mercieca (2010) for a literature review.
[6] For a survey of this literature, see Lipsey (2004).
[7] For a survey of this literature, see Hansen and Rand (2006).

incentive for beneficiaries to reduce their effort on the labor market. Ahamada and Coulibaly (2013) is a notable exception. They adopt a panel Granger causality approach in order to estimate the impact of remittances on economic growth in Sub-Saharan African countries and conclude that there is no causality between remittances and growth as remittances do not contribute to increase physical capital investment.

2.2. Complementarity versus substitutability between ODA, FDI and Remittances

Empirical studies which intend to test potential interactions between ODA, FDI and Remittances all focus on interactions between ODA and FDI. A priori, the relationship between ODA and FDI is ambiguous. Indeed, in the one hand, ODA is likely to raise the productivity of capital by financing complementary input as public infrastructure or human capital whereas in the other hand ODA could crowd out private investment if ODA take the form of physical capital flow (Selaya and Sunesen, 2012). Moreover, Asiedu et al. (2009) show that risk as a negative effect on FDI but that aid mitigates the adverse effect of risk on FDI. Karakaplan et al. (2005) investigate the hypothesis that countries receiving ODA create direct or indirect (signaling) effects in an economy that attracts FDI. Their results suggest that ODA and FDI flow together in the presence of good governance and financial market development. In a side point, the authors provide a control for Sub-Saharan Africa in their regressions, and find that relatively higher GDP per capita appears to be related to less FDI in Africa. Nicholson (2014) test Granger-causality between foreign aid and foreign investment in lower- and middle-income countries between 1990 and 2008. He concludes that if the hypothesis that ODA does not granger-causes FDI can be rejected at 95% for East Asia, Pacific, Europe, Central Asia and 90% for Latin America and Caribbean, this hypothesis can not be rejected for Middle East, North Africa, South Asia and Sub-Saharan Africa.

Our approach is different from that of Driffield and Jones (2013), which analyze the relative contributions of FDI, ODA and remittances to economic growth in developing countries. They used panel system with simultaneous equations. They find that all sources of foreign capital have a positive and significant impact on economic growth. However, if the work of Driffield and Jones (2013) take into account the role of institutions in the interaction between FDI, ODA and remittances, heterogeneity and cross-section dependence is not take into account in order to explain the contributions of FDI, ODA and remittances to economic growth.

III. Econometric Methodology

In panel data framework, three approaches can be employed to test for Granger causality. The first one is based on the generalized method of moments (GMM) that estimates homogenous panel model by removing individual fixed effects. The second one was developed by Hurlin (2008) and Hurlin and Dumistrescu (2012), which accounts for heterogeneity in the panel. The third approach proposed by Kónya (2006) allows the possibility to study both heterogeneity and cross-sectional dependence. The approach of Kónya (2006) appears to be the most appropriate approach to our study because it is based on both the seemingly unrelated regression (SUR) systems and the Wald tests with country specific bootstrap critical values. Following the approach of Kónya (2006), we are enabled to test for Granger causality on each individual country separately, by taking into account the possible cross-sectional dependence across countries.

The panel causality approach by Kónya (2006) examines the relationship between *Y* and *X* using the following bivariate VAR model:

$$\left.\begin{aligned} y_{i,t} &= \alpha_{1,i} + \sum_{l=1}^{ly_i} \beta_{1,i,l} y_{i,t-l} + \sum_{l=1}^{lx_i} \gamma_{1,i,l} x_{i,t-l} + \varepsilon_{1,i,t} \\ x_{i,t} &= \alpha_{2,i} + \sum_{l=1}^{ly_i} \beta_{2,i,l} y_{i,t-l} + \sum_{l=1}^{lx_i} \gamma_{2,i,l} x_{i,t-l} + \varepsilon_{2,i,t} \end{aligned}\right\} \quad (1)$$

where $i = 1, \dots, N$ denotes the country, $t = 1, \dots, T$ the period, *s* the lag and ly_i and lx_i the lag lengths. The error terms, $\varepsilon_{1,i,t}$ and $\varepsilon_{2,i,t}$ are supposed to be white noise (zero mean, constant variances and individually serially uncorrelated).

In the system (1), in country i, there is:

- Unidirectional Granger causality from *X* to *Y* if, in the first equation, not all $\gamma_{1,i}$'s are zero, but, in the second, all $\beta_{2,i}$'s are zero;
- Unidirectional Granger causality from *Y* to *X* if, in th first equation, all $\gamma_{1,i}$'s are zero, but, in the second, not all $\beta_{2,i}$'s are zero;
- Bidirectional Granger causality between *X* and *Y* if neither all $\gamma_{1,i}$'s nor all $\beta_{2,i}$'s are zero;
- No Granger causality between *X* and *Y* if all $\gamma_{1,i}$'s and $\beta_{2,i}$'s are zero.

As the two equations in (1) contain the same predetermined variables, the OLS estimators of the parameters are consistent and asymptotically efficient. So, we can estimate each equation in the system (1) one-by-one, in any preferred order. Following this assumption, we can rewrite the system (1) as follow:

$$\left.\begin{aligned} y_{1,t} &= \alpha_{1,1} + \sum_{l=1}^{ly_i} \beta_{1,1,l} y_{1,t-l} + \sum_{l=1}^{lx_i} \gamma_{1,1,l} x_{1,t-l} + \varepsilon_{1,1,t} \\ &\vdots \\ y_{N,t} &= \alpha_{1,N} + \sum_{l=1}^{ly_i} \beta_{1,N,l} y_{N,t-l} + \sum_{l=1}^{lx_i} \gamma_{1,N,l} x_{N,t-l} + \varepsilon_{1,N,t} \end{aligned}\right\} \quad (2)$$

and

$$\left.\begin{array}{c} x_{1,t} = \alpha_{2,1} + \sum_{l=1}^{ly_i} \beta_{1,2,l} y_{1,t-l} + \sum_{l=1}^{lx_i} \gamma_{1,2,l} x_{1,t-l} + \varepsilon_{2,1,t} \\ \vdots \\ x_{N,t} = \alpha_{2,N} + \sum_{l=1}^{ly_i} \beta_{2,N,l} y_{N,t-l} + \sum_{l=1}^{lx_i} \gamma_{N,i,l} x_{N,t-l} + \varepsilon_{2,N,t} \end{array}\right\} \quad (3)$$

Compared with the system (1), equations (2) and (3) has different predetermined variables. The only possible link among individual regressions is contemporaneous correlation within the systems. Therefore, systems (2) and (3) must be estimated by seemingly unrelated regressions (SUR) methodology to take into account contemporaneous correlation within the systems. In this case, the SUR estimator is more efficient than the OLS estimator. Following Kónya (2006), we use country-specific bootstrap Wald critical values to implement Granger causality test. The main advantage of this procedure is to test for Granger causality on each individual panel member separately.

The framework describes previously is well adapted for testing one-period ahead direct causality relations between two variables. However, bivariate VAR models can omit others potential explanatory variables. We decide to extend the seminal framework of Kónya (2006) to our analysis. Then, we formulate the following multivariate model inspired of the SUR model describe in system (1):

$$\left.\begin{array}{c} GDP_{1,t} = \alpha_{1,1} + \sum_{l=1}^{lgdp_1} \beta_{1,1,l} GDP_{1,t-l} + \sum_{l=1}^{lrem_1} \gamma_{1,1,l} REM_{1,t-l} + \sum_{l=1}^{lfdi_1} \varphi_{1,1,l} FDI_{1,t-l} + \sum_{l=1}^{loda_1} \theta_{1,1,l} ODA_{1,t-l} + \varepsilon_{1,1,t} \\ \vdots \\ GDP_{N,t} = \alpha_{1,N} + \sum_{l=1}^{lgdp_1} \beta_{1,N,l} GDP_{N,t-l} + \sum_{l=1}^{lrem_1} \gamma_{1,N,l} REM_{N,t-l} + \sum_{l=1}^{lfdi_1} \varphi_{1,N,l} FDI_{N,t-l} + \sum_{l=1}^{loda_1} \theta_{1,N,l} ODA_{N,t-l} + \varepsilon_{1,N,t} \end{array}\right\} \quad (4)$$

$$\left.\begin{array}{c} FDI_{1,t} = \alpha_{2,1} + \sum_{l=1}^{lgdp_2} \beta_{2,1,l} GDP_{1,t-l} + \sum_{l=1}^{lrem_2} \gamma_{2,1,l} REM_{1,t-l} + \sum_{l=1}^{lfdi_2} \varphi_{2,1,l} FDI_{1,t-l} + \sum_{l=1}^{loda_2} \theta_{2,1,l} ODA_{1,t-l} + \varepsilon_{2,1,t} \\ \vdots \\ FDI_{N,t} = \alpha_{2,N} + \sum_{l=1}^{lgdp_2} \beta_{2,N,l} GDP_{N,t-l} + \sum_{l=1}^{lrem_2} \gamma_{2,N,l} REM_{N,t-l} + \sum_{l=1}^{lfdi_2} \varphi_{2,N,l} FDI_{N,t-l} + \sum_{l=1}^{loda_2} \theta_{2,N,l} ODA_{N,t-l} + \varepsilon_{2,N,t} \end{array}\right\} \quad (5)$$

$$\left.\begin{array}{c} REM_{1,t} = \alpha_{3,1} + \sum_{l=1}^{lgdp_3} \beta_{3,1,l} GDP_{1,t-l} + \sum_{l=1}^{lrem_3} \gamma_{3,1,l} REM_{1,t-l} + \sum_{l=1}^{lfdi_3} \varphi_{3,1,l} FDI_{1,t-l} + \sum_{l=1}^{loda_3} \theta_{3,1,l} ODA_{1,t-l} + \varepsilon_{3,1,t} \\ \vdots \\ REM_{N,t} = \alpha_{3,N} + \sum_{l=1}^{lgdp_3} \beta_{3,N,l} GDP_{N,t-l} + \sum_{l=1}^{lrem_3} \gamma_{3,N,l} REM_{N,t-l} + \sum_{l=1}^{lfdi_3} \varphi_{3,N,l} FDI_{N,t-l} + \sum_{l=1}^{loda_3} \theta_{3,N,l} ODA_{N,t-l} + \varepsilon_{3,N,t} \end{array}\right\} \quad (6)$$

$$\left.\begin{array}{c} ODA_{1,t} = \alpha_{4,1} + \sum_{l=1}^{lgdp_4} \beta_{4,1,l} GDP_{1,t-l} + \sum_{l=1}^{lrem_4} \gamma_{4,1,l} REM_{1,t-l} + \sum_{l=1}^{lfdi_4} \varphi_{4,1,l} FDI_{1,t-l} + \sum_{l=1}^{loda_4} \theta_{4,1,l} ODA_{1,t-l} + \varepsilon_{4,1,t} \\ \vdots \\ ODA_{N,t} = \alpha_{4,N} + \sum_{l=1}^{lgdp_4} \beta_{4,N,l} GDP_{N,t-l} + \sum_{l=1}^{lrem_4} \gamma_{4,N,l} REM_{N,t-l} + \sum_{l=1}^{lfdi_4} \varphi_{4,N,l} FDI_{N,t-l} + \sum_{l=1}^{loda_4} \theta_{4,N,l} ODA_{N,t-l} + \varepsilon_{4,N,t} \end{array}\right\} \quad (7)$$

In equations (4) to (7), *GDP* refers to the real GDP per capita (in logarithm), *REM* refers to the remittances per capita (in logarithm), *FDI* refers to the foreign direct investment (in logarithm) and *ODA* refers to the official development assistance (in logarithm).

Each equation in (4), (5), (6) and (7) has different predetermined variables. The only possible link among individual regressions is contemporaneous correlation within the systems. Therefore, systems (2), (3), (4) and (5) must be estimated by SUR procedure, rather than OLS procedure, to take contemporaneous correlations into account within the systems. To determine the direction of causality, Wald statistics for Granger causality are compared with country-specific critical values that are obtained from the bootstrap sampling procedure generating bootstrap Wald critical allows *GDP*, *REM*, *FDI* ODA to not be necessarily stationary, they can denote the level, the first difference or some higher difference.

IV. Data and preliminary analysis

In this paper, we used annual data from 1990 to 2013 for the Franc zone. The Franc zone is made up of the following countries: Benin (BEN), Burkina Faso (BFA), Central African Republic (CAF), Ivory Coast (CIV), Cameroon (CMR), Congo (COG), Gabon (GAB), Equatorial Guinea (GNQ), Guinea-Bissau (GNB), Mali (MLI), Niger (NER), Senegal (SEN), Chad (TCD) and Togo (TGO). Data come from the World Bank database (*World Development Indicators*). The variables used in the study include the real GDP per capita, remittances per capita (defined as workers'remittances and compensations of employees), foreign direct investment (defined as the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments), official development assistance (defined as government aid which includes grants, "soft" loans and the provision of technical assistance). We also use the investment rate and the level of development as a proxy of real GDP per capita in robustness tests. All these variables are measured per capita in constant $2005. Table 1 reports summary statistics of variables used in the study.[8]

INSERT TABLE 1

In 2013, the total population, GDP and the average GDP per capita are respectively equal to nearly $161 million, $174 billion and quite $1000 per capita. Nevertheless, the CFA zone is characterized by a great heterogeneity. The GDP of Ivory Coast and Cameroon represent,

[8] Individual statistics for each country in the panel are available upon request from the authors.

respectively, 18% and 17% of the total GDP, 12.6% and 13.8% of the total population (Figures 3 and 4).

INSERT FIGURES 3 & 4

Per capita income range from $333 in Central African Republic to reach respectively $1329, $1529, $3167 and $11571 in Cameroon, Ivory Coast, Congo Republic and Gabon, countries which are petroleum exporters (Figure 5).

INSERT FIGURE 5

Concerning ODA, FDI and Remittances, Franc zone countries are also characterized by a great heterogeneity in absolute as in relative terms (Figures 6 and 7). Gabon and Congo receive an important inflow of FDI mainly because of the investment of foreign multinational firms in domestic oiled and gas fields. Moreover, as usually noticed, small countries receive proportionally higher amounts of ODA. Concerning Remittances, Senegal and Mali exhibit higher relative amount to put in balance with the emigration tradition, especially to France, of their residents.

INSERT FIGURES 6 AND 7

One of the important assumptions in the bootstrap panel causality is the existence of cross-sectional dependency among the countries in the panel. Therefore, testing for cross-sectional dependence is crucial for selecting the appropriate and efficient estimator. To test for cross-sectional dependency, we employ four different tests: Lagrange multiplier (LM) test from Breusch and Pagan (1980), noted as CD_{BP}, two cross-sectional dependence tests statistic of Pesaran (2004, 2006), one based on Lagrange multiplier (noted as CD_{LM}) and the other based on the pairwise correlation coefficients (noted as *CD*). However, the *CD* test has a lower power when the population average pair-wise correlations are zero, as demonstrated by Pesaran and al. (2008). That why, we use a fourth cross-sectional dependency test. The fourth test is proposed by Pesaran and al. (2008), which developed a bias-adjusted test that is a modified version of the LM test. The bias adjusted LM statistic is noted as LM_{adj}.

Table 2 reports the results of these four cross-sectional dependence tests. Our results show that the null hypothesis of no cross-sectional dependence is rejected at the conventional levels of significance, in all cases. These results confirm strong links exist between the Franc Zone countries. These results also show that a shock, which may occur in one of the Franc zone countries, seem to influence other countries. Regarding the strong economic, financial and

trade links between these countries, this result is no surprisingly. Indeed, we can explain these strong links by economic, trade, financial and monetary integration.[9] Consequently, the SUR method is more appropriate that the country-by-country pooled OLS method (Zellner, 1962).

INSERT TABLE 2

Before proceeding to estimation, optimal lag lengths must be determined because results from the causality test are sensitive to the lag structure as indicated by Kónya (2006). Indeed, the lag structure may cause different estimation results. On the one hand, two few lags will cause error specification and incorrect estimation (biased results). On the other hand, too many lags will cause multicolinearity problem and the degree of freedom is reduced, leading to inefficient results. Ideally, the lag structure would vary across countries, variables and equation systems. However, in a relatively large panel system, it can cause a substantial computational burden. To overcome this problem, following Kónya (2006), we allow maximal lags to differ across variables but to be the same across equations. We estimate the system for each possible pair of $ldpg_1$, $lrem_1$, $lfdi_1$, $loda_1$, $lgdp_2$, $lrem_2$, $lfdi_2$, lod_2, $lgdp_3$, $lrem_3$, $lfdi_3$, $loda_3$, $lgdp_4$, $lrem_4$, $lfdi_4$ and $loda_4$. We assume 1 to 4 lags exist and then we choose the combinations that minimize the Schwarz Bayesian criterion.[10]

V. Results

Tables 3 to 5 report the results of Granger causality between economic growth and, respectively, remittances (Table 3), foreign direct investment (Table 4) and official development aid (Table 5).

Table 3 show a strong causality between economic growth and foreign direct investment: causality from economic growth to foreign direct investment for Congo, Niger and Togo; causality from foreign direct investment to economic growth for Central African Republic, Cameroon, Mali, Senegal and Togo. Our results confirm those of Hassan et al. (2011), which provide strong evidence of the role of financial development in accounting for economic growth in a panel of 40 Sub-Saharan African countries. Our results are also confirmed by Alfaro et al. (2006), which demonstrate that financially well-developed economies experience a higher economic growth when FDI increase.

INSERT TABLE 3

[9] See, for example, Galy and Hadjimichael (1997), Fielding (2003) or IMF (2014) for a literature review.
[10] Detailed results are available upon request from the authors.

Table 4 show that there is some causality between economic growth and remittances: causality from economic growth to remittances for Congo; causality from remittances to GDP for Central African Republic, Cameroon and Chad. These results are very interesting. First, they confirmed those obtained by Singh et al. (2010) on a panel of 36 Sub-Saharan African countries. But, Singh et al. (2010) assume the homogeneity of the panel. Our approach takes into account both the heterogeneity and the cross-sectional dependence of the panel. Our results are different from those of Ahamada and Coulibaly (2013), which find no causality between remittances and economic growth. Ahamada and Coulibaly (2013) use a bivariate VAR model with economic growth and remittances.

INSERT TABLE 4

We can explain the relative impact of remittances on economic growth by the link between foreign direct investment and economic growth (Table 4). Indeed, as demonstrated by Mundaca (2009) a well-developed financial system help remittances to influence economic growth. With foreign direct investment, and with the economic integration of countries panel, remittances can influence economic growth.

Table 5 shows that there is no causality between economic growth and ODA except for Mali (causality from ODA to economic growth).

INSERT TABLE 5

These results are very interesting. The impact of ODA on economic growth is a permanent subject of discussion since the 1980s. A large theoretical but also, and essentially, empirical literature indicate that ODA may not always be successful in promoting economic growth. It demonstrates even the opposite. One of the successful factors could be good institutional and policy frameworks in order to enhance aid effectiveness. This remains a paramount requisite for improving the prospects that aid is transformed into economic growth.

VI. Conclusion

This paper examines the causality between economic growth, remittances, foreign direct investment and official development aid for 14 Sub-Saharan Countries (the Franc Zone). We use the panel bootstrap approach developed by Kònya (2006), which is based on SUR system and Wald test with country specific bootstrap critical values. We adapt this methodology to our problematic. Our results show a robust Granger causality between economic growth and foreign direct investment for seven of fourteen countries. Granger causality is also significant

between economic growth and remittances but for less countries (only four of fourteen countries). There is no Granger causality between economic growth and official development aid, except for Mali. Our framework shows that there is an interaction between these four variables and especially the interaction (complementarity and/or substitutability) between remittances, FDI and official development aid. These findings suggest some implications about the role of remittances, FDI and ODA on economic growth in the countries of the Franc zone. First, FDI, ODA and remittances have an impact, strong for FDI, medium for remittances and low for ODA, on economic growth. Second, FDI are attracted by well-development financial system. Third, ODA impact economic growth only if institutions and political stability are promoted. Finally, remittances are in relation with the level of development of the domestic financial system but also with the economic conditions of the country from which the workers are living. Thus, several policy recommendations can be made: promote well-developed financial system and promote institutional and political stability.

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FIGURES AND TABLES

Figure 1: ODA, FDI, Remittances in the Franc Zone (Billions of US$)

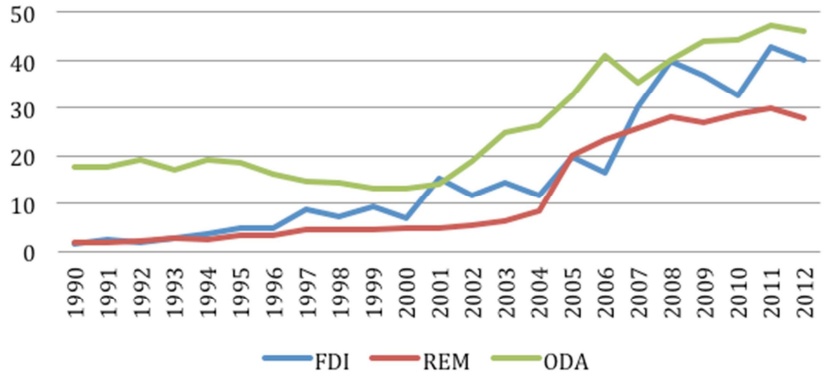

Figure 2: FDI, ODA, Remittances Comparisons in the Franc Zone

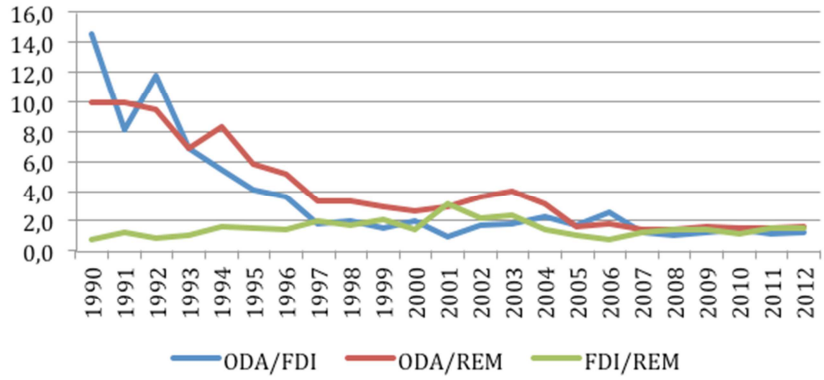

Figure 3: Population in % of the population of the Franc Zone

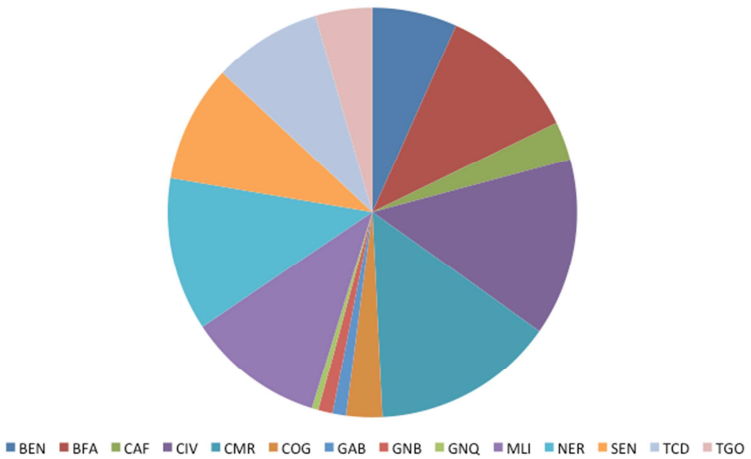

Figure 4: GDP in % of the GDP of the Franc Zone

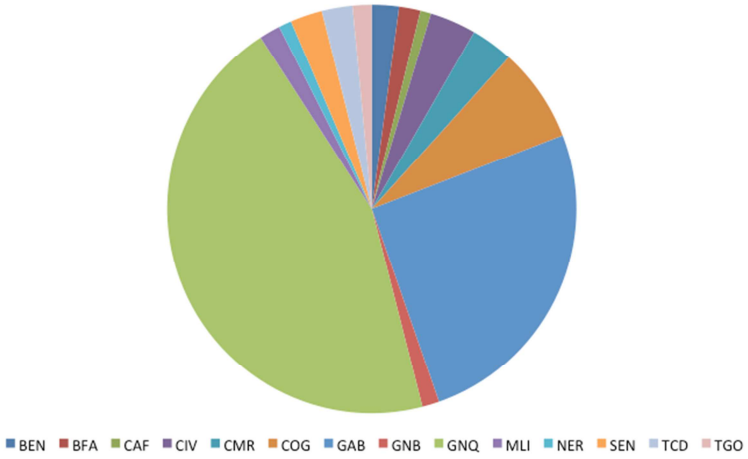

Figure 5: GDP per capita in 2014 (constant US dollar 2005)

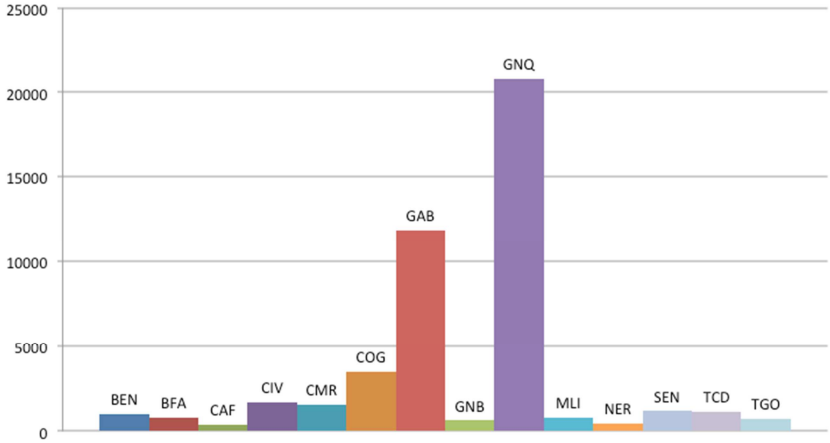

Figure 6: FDI, Remittances en ODA per capita in 2013 (constant US dollar 2005)

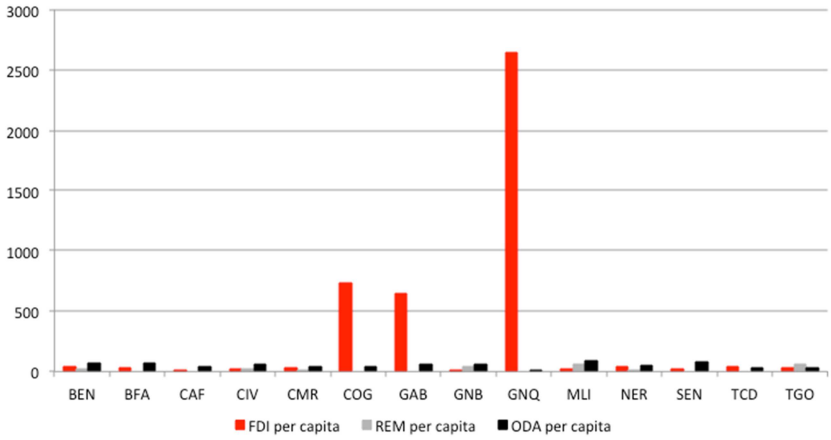

Figure 7: FDI, Remittances and ODA in 2013
(in % of GDP)

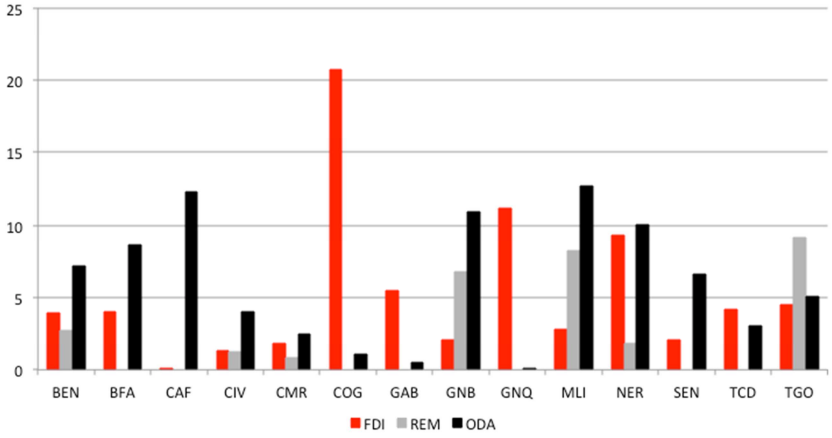

Table 1: Descriptive statistics

	GDP per capita	FDI per capita	REM per capita	ODA per capita
Mean	1768,39	118,34	15,24	58,66
StDev	3826,47	454,54	21,35	42,35
Max	25691,33	4128,45	132,96	447,77
Min	176,30	-1273,00	0,03	-8,82
Nb. of obs.	350	350	257	336

Note: StDev is the Standard Deviation.

Table 2: Cross-sectional dependence tests

Method	Test statistics	p-Value
CD_{BP}	465.4^{***}	0.00
CD_{LM}	19.65^{***}	0.00
CD	14.109^{***}	0.00
LM_{adj}	67.45^{***}	0.00

Note: Significant at 1% (***), 5% (**) and 10% (*).
CD_{BP}, CD_{LM}, CD and LM_{adj}, are, respectively, the cross-sectional dependence tests of Breush and Pagan (1980), Pesaran (2004), Pesaran (2006) and Pesaran and al. (2008).

Table 3: Granger causality tests between GDP and FDI

	H_0: GDP does not cause FDI		H_0: FDI does not cause GDP	
Country	Wald test statistic	P-value	Wald test statistic	P-value
BEN	2.120	0.145	0.942	0.332
BFA	1.874	0.171	2.655	0.103
CAF	0.691	0.406	4.100**	0.043
CIV	0.011	0.917	1.981	0.159
CMR	0.132	0.716	7.185***	0.007
COG	2.680*	0.092	1.231	0.267
GAB	0.762	0.383	1.116	0.291
GNQ	0.018	0.894	0.004	0.950
GNB	0.162	0.687	1.295	0.255
MLI	0.596	0.440	3.544*	0.060
NER	3.742*	0.053	1.275	0.259
SEN	0.081	0.775	5.030**	0.025
TCD	0.768	0.381	0.851	0.356
TGO	2.932*	0.087	3.032*	0.082

Note: significant at 1% (***), 5% (**) or 10% (*). Critical values are based on 1000 bootstrap replications.

Table 4: Granger causality tests between GDP and REM

	H_0: GDP does not cause REM		H_0: REM does not cause GDP	
Country	Wald test statistic	P-value	Wald test statistic	P-value
BEN	0.952	0.329	0.130	0.719
BFA	0.255	0.613	0.419	0.517
CAF	1.235	0.266	11.914***	0.001
CIV	0.292	0.589	0.117	0.732
CMR	2.293	0.130	6.892***	0.009
COG	4.285**	0.038	0.606	0.436
GAB	1.523	0.217	1.965	0.161
GNQ	0.064	0.800	0.005	0.942
GNB	1.560	0.212	1.098	0.295
MLI	2.038	0.153	0.069	0.793
NER	2.179	0.140	0.236	0.627
SEN	0.660	0.417	0.036	0.850
TCD	0.004	0.949	2.646*	0.094
TGO	0.120	0.729	0.001	0.972

Note: significant at 1% (***), 5% (**) or 10% (*). Critical values are based on 1000 bootstrap replications.

Table 5: Granger causality tests between GDP and ODA

	H_0: GDP does not cause ODA		H_0: ODA does not cause GDP	
Country	Wald test statistic	P-value	Wald test statistic	P-value
BEN	0.012	0.912	0.085	0.770
BFA	0.001	0.974	0.000	1.000
CAF	2.576	0.109	0.101	0.750
CIV	0.006	0.940	0.037	0.847
CMR	0.938	0.333	0.850	0.357
COG	0.309	0.578	0.004	0.952
GAB	0.564	0.452	0.018	0.894
GNQ	1.132	0.287	0.016	0.900
GNB	0.009	0.926	1.913	0.167
MLI	0.155	0.693	8.011***	0.005
NER	0.039	0.844	2.111	0.146
SEN	1.720	0.190	0.023	0.879
TCD	1.381	0.240	0.102	0.750
TGO	0.183	0.669	1.690	0.194

Note: significant at 1% (***), 5% (**) or 10% (*). Critical values are based on 1000 bootstrap replications.

Table 6: Granger causality tests between FDI and REM

	H_0: FDI does not cause REM		H_0: REM does not cause FDI	
Country	Wald test statistic	P-value	Wald test statistic	P-value
BEN	0.029	0.864	0.161	0.688
BFA	0.660	0.417	2.572	0.109
CAF	0.155	0.694	0.155	0.694
CIV	13.028***	0.000	0.701	0.402
CMR	2.934*	0.087	0.660	0.416
COG	0.019	0.891	0.327	0.568
GAB	1.404	0.236	0.192	0.662
GNQ	1.240	0.265	3.231*	0.072
GNB	1.075	0.300	1.156	0.282
MLI	0.283	0.595	0.180	0.672
NER	5.449**	0.020	2.523	0.112
SEN	0.136	0.712	0.224	0.636
TCD	1.200	0.273	0.089	0.766
TGO	0.732	0.392	1.679	0.195

Note: significant at 1% (***), 5% (**) or 10% (*). Critical values are based on 1000 bootstrap replications.

Table 7: Granger causality tests between FDI and ODA

	H_0: FDI does not cause ODA		H_0: ODA does not cause FDI	
Country	Wald test statistic	P-value	Wald test statistic	P-value
BEN	0.171	0.679	0.227	0.634
BFA	1.173	0.279	0.892	0.345
CAF	1.268	0.260	1.266	0.260
CIV	0.516	0.473	0.002	0.967
CMR	0.342	0.559	4.668**	0.031
COG	0.337	0.561	1.653	0.199
GAB	0.000	0.985	0.827	0.363
GNQ	0.037	0.848	0.384	0.535
GNB	0.049	0.824	2.353	0.125
MLI	1.277	0.258	1.886	0.170
NER	0.568	0.451	0.000	0.997
SEN	0.280	0.596	0.006	0.936
TCD	4.177**	0.041	0.018	0.892
TGO	0.013	0.909	0.382	0.537

Note: significant at 1% (***), 5% (**) or 10% (*). Critical values are based on 1000 bootstrap replications.

Table 8: Granger causality tests between REM and ODA

	H_0: REM does not cause ODA		H_0: ODA does not cause REM	
Country	Wald test statistic	P-value	Wald test statistic	P-value
BEN	0.736	0.391	1.141	0.285
BFA	0.360	0.548	0.311	0.577
CAF	0.001	0.980	0.057	0.812
CIV	1.221	0.269	0.647	0.421
CMR	0.400	0.527	0.050	0.823
COG	0.024	0.877	1.051	0.305
GAB	0.277	0.599	0.291	0.590
GNQ	4.144**	0.042	0.024	0.877
GNB	0.332	0.565	1.588	0.208
MLI	0.126	0.722	0.965	0.326
NER	1.176	0.278	7.056***	0.008
SEN	0.040	0.841	0.010	0.922
TCD	0.223	0.636	0.007	0.933
TGO	6.411**	0.011	1.161	0.281

Note: significant at 1% (***), 5% (**) or 10% (*). Critical values are based on 1000 bootstrap replications.

Table 9: Direction of Granger causality between Sub-Saharan Countries

Direction of causality	Countries
GDP —› FDI	Congo, Niger, Togo
GDP —› FDI	Central African Republic, Cameroon, Mali, Senegal, Togo
GDP —› REM	Congo
REM —› GDP	Central African Republic, Cameroon, Chad
GDP —› ODA	-
ODA —› GDP	Mali
FDI —› ODA	Chad
ODA —› FDI	Cameroon
FDI —› REM	Ivory Coast, Cameroon, Niger
REM —› FDI	Equatorial Guinea
REM —› ODA	Niger
ODA —› REM	Equatorial Guinea, Togo

Note: GDP, FDI, REM and ODA, denote, respectively, economic growth, foreign direct investment, remittances and official development aid. “—›” represents the causal direction.