THE IMPACT OF CHINA'S FDI ON ECONOMIC GROWTH: EVIDENCE FROM FIVE AFRICAN COUNTRIES WITH A LONG MEMORY APPROACH

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ABSTRACT

This paper deals with the relationship between Foreign Direct Investment from China in Africa and the growth level in five African countries. Based on the high degrees of persistence observed in the data, we use techniques based on long memory models, and our results indicate that of the five countries examined, namely Kenya, Zimbabwe, Zambia, Nigeria and South Africa, only for Nigeria do we find a significant positive relationship between the two variables though under some assumptions, this evidence is also found in the cases of Kenya and South Africa. Several arguments are put forward at the end of the article to justify these results.

Keywords: Foreign Direct Investment; China; Africa; growth rate

JEL Classification: C22; F21, F34, F43, O55

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1. Introduction

The ties between modern China and Africa can be traced back to the Bandung Conference in Indonesia—the first significant meeting of Asian and African states held in April 1955. Ever since, China's engagement in Africa has been growing in terms of trade, aid and investment, so that by 2019 the People's Republic of China (PRC) had established a formal diplomatic relationship and has direct investments in nearly all African countries[1].

This paper deals with the analysis of the Foreign Direct Investment (FDI) in five African countries and its influence on the GDP. Investment has played a key role in the growth of Africa's fastest growing economies but up until recent years China's contribution was not so relevant because Chinese investment-share in total FDI was quite low in several African countries (Brautigham et al., 2017). In addition, the Sino-Africa investment flow pattern was somewhat unidirectional, with the exceptions of Mauritius and South Africa (Ajakaiye, 2006; Wang, 2007).

The European Union dominates FDI in Africa (40% of total FDI stock), with the UK and France as major investors. Quite far from the EU, the United States still appears in second place (7% of total FDI stock), but China is getting closer (5% of total FDI stock) as investments more than doubled from 2011 to 2016, up to 40,000 US$ million (UNCTAD, 2018). This steep upward trend responds to China's strategy of obtaining resources and strengthening links with Africa. Several Chinese Presidents have visited Africa (President Jiang Zemin in 1996, President Hu Jintao in 2004), to promote China's 'win-win' approach (Alden, 2005).

The relevance of China's FDI stock in several African economies remains relatively small in comparison to the USA and the EU. Nevertheless, considering the upwards trend in China's investment flows, we think that the topic of our research is crucially important,

[1] Ministry of Foreign Affairs of the People's Republic of China https://www.fmprc.gov.cn/mfa_eng/gjhdq_665435/2913_665441/ (accessed 24 May 2019).

particularly in a global context in which COVID-19 has raised concerns about the availability of international financing in developing economies (Kose et al., 2020).

Africa has the second highest exponential growth of inward FDI among world regions over the 2003-2016 period and is clearly an emerging global FDI destination. However, evidence of negative investment growth in Northern Africa (commonly perceived as the best performing region) puts African FDI growth into perspective (UN-Habitat and IHS-Erasmus University Rotterdam, 2018), particularly considering that the COVID-19 pandemic has strongly impacted on different spheres of the economies that affect FDI flows, such as stock markets (Salisu and Sikiru, 2020; Gil-Alana and Claudio-Quiroga, 2020), oil markets (Devpura and Narayan, 2020; Gil-Alana and Monge, 2020; Narayan, 2020; Prabheesh et al., 2020), global trade and insurance markets (Vidya and Prabheesh, 2020; Wang et al., 2020), and global politics (Apergis and Apergis, 2020).

Based on the above comments, this paper deals with the analysis of the Foreign Direct Investment (FDI) in Africa and its influence on the GDP. We focus on a selected group of five countries, namely, Kenya, Zimbabwe, Zambia, Nigeria and South Africa[2], investigating the level of persistence of the series using updated time series techniques.

We use an econometric approach based on the concept of fractional integration, which is very useful in the analysis of data with high degrees of persistence and that permits us to determine if shocks in the series have transitory or permanent effects. The main contributions of the paper are the following: First, we show that the series under examination are all highly persistent, with orders of integration in all cases significantly above 1. These large orders of integration imply that random shocks in the series will have permanent effects and strong policy measures have to be adopted if we want the series to return to their original paths in the future. Second, we do not observe long equilibrium

[2] The reason for the choice of these countries is explained in detail in the fourth section of the paper.

relationships between the two variables in any of the countries; however, if FDI is taken as an exogenous variable to explain growth, we find a significant positive relationship in the case of Nigeria, and also under some assumptions in the cases of Kenya and South Africa. We analyse several factors in the paper that may explain these results, namely the destination sector of FDI flows and the identity of Chinese investors, but also the characteristics of host economies.

The paper is structured as follows. Section 2 presents a literature review on the FDI in Africa and its influence on GDP. Section 3 is devoted to the methodology used in the paper. Section 4 describes the data. Section 5 presents the main results, while Section 6 concludes the paper.

2. Literature review

The impact of capital and international investment on economic growth has been long discussed in the literature. Development economists, including Rosenstein-Rodan (1943) and Myrdal (1957), defended inward-oriented import substitution policies, aiming at self-sufficiency and without international investment. Solow's neoclassical model of economic growth (Solow, 1956) predicted that FDI could not alter the growth rate of output in the long run. The model defends that the economy tends to converge towards a value for a capital-output ratio consistent with steady-state growth.

Much of the intuition that economists had about long-run growth until the 80's was based on the aggregate growth model (Ramsey, 1928; Cass, 1965; Koopmans, 1965). According to this model the rate of return on investment and the rate of growth of per capita output were "expected to be decreasing functions of the level of the per capita capital stock" (Romer, 1986, page 1002).

The seminal contribution of Romer (1986) changed the dominant paradigm. Romer and subsequent research envisage a positive growth rate of real GDP per capita that arises endogenously in the economy (Lucas, 1988; Romer, 1990; Barro, 1990). In the context of the new theory of economic growth, FDI may potentially enhance the growth rate of per capita income in the host country through several mechanisms. Several hypotheses have been analysed to explain this positive impact, with a relevant focus on the role of the transmission of advanced technology (Borenzstein et al., 1998).

Nowadays, there is a widespread belief among policymakers that FDI generates positive productivity externalities for host countries. FDI impacts positively on growth through capital accumulation, and the incorporation of new inputs and foreign technologies in the production function of the host country. Nevertheless, empirically the relationship between FDI and growth is still unclear (Lall, 1978; de Mello, 1997; Amin and Khalid, 2014).[3]

Some researchers have found evidence of a strong causal link between FDI inflows and GDP growth (Agosin and Mayer, 2000; Li and Liu, 2005; Hansen and Rand, 2006; Mehic et al., 2013; Wu et al., 2019). Moreover, some authors determined that the estimated growth effect of FDI is several times higher than the estimated growth effect of domestic investment (De Gregorio, 1992; Oliva and Rivera-Batiz, 2002). However, some other authors have concluded that the relationship between FDI and growth is not robust (Carkovic and Levine, 2002), and some others have found that the impact could even be negative (Fry, 1993; Agosin and Mayer, 2000; Alfaro, 2003).

Interestingly, several studies have reported that FDI promotes growth when host countries meet a number of conditions: a strong financial sector (Alfaro et al., 2004; Alfaro

[3] The reasons for these mixed results include sample selection, estimation techniques (e.g. Granger causality, cointegration, error correction models), the time period examined, the estimation methodology (i.e. time series versus cross- section), etc.

et al., 2010), a minimum education threshold (Borensztein et al., 1998), economic stability, liberalized capital markets and human capital (Bengoa and Sanchez-Robles, 2003), the adoption of export promotion trade policies (Bhagwati, 1978), etc. Additionally, foreign investment flows are more growth-enhancing when they complement local investment and production (de Mello, 1999; Alfaro et al. 2010), when it can be considered 'quality FDI' taking into account the destination sector, skill intensity and the preferences expressed by the receiving countries (Alfaro and Charlton, 2007), etc.

The characteristics that attract FDI are heterogeneous (Behera and Ranjan-Mishra, 2020), and overall, we have detected a high level of consensus in the literature about the fact that the particular characteristics of host countries influence the final effect of FDI. This is relevant for our research. Since more fragile African states present a serious deficit in several of the aforementioned conditions (education, infrastructure, economic stability, etc.), we could expect a less positive or even negative FDI contribution to growth in these countries.

With regard to Sino-African FDI flows, there is a considerable section of empirical literature discussing the reasons that attract these flows and particularly whether gaining access to natural resources is the main motive for China's investment (Cai, 1999; Deng 2004; Gelb, 2005; Asiedu, 2006; Hong and Sun 2006; Bukley et al. 2007; Frynas and Paolo, 2007; Morck et al., 2008; Biggeri and Sanfilippo, 2009; Bhaumik and Co, 2011; Kolstad and Wiig, 2012; Cheung et. al, 2012; Ramasamy et al. 2012; Milelli and Sindzingre, 2013; Sindzingre, 2016; Reis, 2018, etc.). Brautigham et al. (2017) and He and Zhu (2018) sum up the results pointing out that whereas in the early 2000s FDI by China in Africa was attracted to countries with abundant natural resources -the Democratic Republic of the Congo (DRC), Nigeria, South Africa, Sudan and Zambia-, since 2008-2010 Chinese FDI in Africa has started to move into some of Africa's most promising, high-growth, and economically diverse nations, including Kenya and Ethiopia.

There are fewer studies analysing the impact of FDI on the economic growth of African countries. Some authors find that, in effect, the impact of FDI on Africa depends on the country's initial conditions (Adams, 2009), including the development of the financial market (Hermes and Lensink, 2003; Otchere et al., 2016) and the quality of institutions in host countries (Kamal et al., 2019). Nonetheless, contrary to the idea that least developed African countries do not benefit from FDI and the so called 'natural resource curse', several researchers have found evidence of a positive contribution of FDI over growth and poverty reduction (Soumaré, 2015; Fowowe and Shuaibu, 2014, Gohou and Soumaré, 2012; Fauzel et al., 2015). Admittedly, these studies also recognize that reaping the benefits that accrue from FDI may be more difficult than attracting FDI.

Concerning the impact of China's investment in African countries, empirical results are not conclusive. Several authors are positive about the impact of Chinese FDI (Whalley and Weisbrod, 2012; Chakrabarti and Ghosh, 2014; Megbowon et al., 2019, etc.). Klaver and Trebilcock (2011) conclude that if African economies are growing at unprecedented rates it is partly due to Chinese investment. Donou-Adonsou and Lim (2018) determine that Chinese FDI improves income in Africa, concluding that China's 'win-win approach' may hold good, even though U.S. and German investments raised income per capita more than that of China. Doku et al. (2017) conclude that a 1 per cent increase in China's FDI stock in Africa significantly increases Africa's gross domestic product (GDP) growth by 0.607 per cent. Nevertheless, a few authors find that for many African countries the negative effects may outweigh the positive ones (Oyejide et al., 2009), or determine that Chinese foreign investment in Africa does not appear to have a significant impact on growth (Busse et al. (2016). Interestingly, some others conclude that the impacts of Chinese FDI on economic growth remain contingent upon institutional quality of African countries and the synergies between both partners (Miao et al., 2020), that is to say, host country conditions.

To summarize this section, we point out two main conclusions: first, FDI flows have been theoretically argued to be imperative for economic prosperity, but evidence from empirical literature indicate that its impact have not been equal across economies of the world; and second, most researchers find a positive impact of Chinese FDI in African countries, even though a deficit in education, infrastructure, institutional quality, economic stability, etc. could hinder the FDI contribution to growth in some African countries.

We are confident that this paper contributes to the existing literature through an in-depth analysis of evidence corresponding to five African countries. Our analysis uses a methodology (fractional integration) that has not been much used in the analysis of economic data, in spite of being more general and flexible than the standard methods that are based exclusively on integer degrees of differentiation. This methodology is described in the following section.

3. Methodology

As mentioned earlier we use techniques which are based on the concept of long memory or long range dependence. This is a very general concept that allows us to examine data persistence in a very flexible way. To start with, we say that a given process $\{x_t, t = 0, \pm 1, \ldots\}$ displays the property of long memory if the infinite sum of the autocovariances (or pseudo autocovariances) is infinite, i.e.,

$$\lim_{T \to \infty} \sum_{u=-T}^{u=T} |\gamma_u| = \infty,$$

where $\gamma_u = E[(x_t - Ex_t)(x_{t+u} - Ex_{t+u})]$. Alternatively, assuming that x_t has an absolutely continuous spectral distribution function, with a spectral density function, $f(\lambda)$, given as the Fourier transform of the autocovariances, i.e.,

$$f(\lambda) = \frac{1}{2\pi} \sum_{u=-\infty}^{u=\infty} \gamma_u \cos \lambda u, \qquad -\pi \leq \lambda < \pi,$$

we can provide another definition of long memory based on the frequency domain. Then, we say that $\{x_t, t = 0, \pm 1, \ldots\}$ is long memory (or long range dependent) if the spectral density has at least one pole or singularity at a given frequency in the spectrum (see McLeod and Hipel, 1978).

Within this class of processes, we have a battery of models, but one very popular in econometrics is the one based on fractional integration or I(d, d > 0) processes, which is represented as:

$$(1 - L)^d x_t = u_t, \qquad t = 0, \pm 1, \ldots, \qquad (1)$$

with $x_t = 0$ for $t \leq 0$, and $d > 0$, where L is the lag-operator ($Lx_t = x_{t-1}$) and u_t is I(0) or short memory, defined as a covariance stationary process where the infinite sum of the autocovariances is finite, or alternatively, in the frequency domain, if the spectral density function is positive and bounded at all frequencies,

$$0 < f(\lambda) < \infty. \qquad -\pi \leq \lambda < \pi.$$

Note that the specification in (1) is very general, and u_t can be a weakly autocorrelated ARMA-class of models. Then, if u_t is ARMA(p, q), x_t is said to be a fractionally integrated ARMA (ARFIMA(p,d,q)) model. Thus, our general I(d) specification includes the two standard cases of stationarity I(0) and nonstationarity I(1) if d = 0 and 1 respectively. Robinson (1978) and Granger (1980) justified the use of these models in macro series by means of the aggregation of heterogeneous AR processes, and the same argument of aggregation was used later by many other authors (Linden, 1999; Parke, 1999; Oppenheim and Viano, 2004; Zaffaroni, 2004; Beran et al., 2010; Candelpergher et al., 2015; etc.). Moreover, these processes became very popular in macro modelling in the late 90s. with the influential paper by Gil-Alana and Robinson (1997).

These authors examined an extended version of Nelson and Plosser's (1982) dataset,[5] and came to the conclusion that most of the fourteen US series examined by these authors were in fact I(d) with d constrained between 0 and 1. Other applications using I(d) models in macro series are Diebold and Rudebush (1989), Sowell (1992), Baillie (1996), Mayoral (2006), Baillie et al. (2007); Christensen et al. (2010); Martins and Rodrigues (2012); Gil-Alana and Moreno (2012); Hassler et al. (2014); Cavaliere et al. (2015); Abbritti et al. (2017); etc.

We estimate the differencing parameter d by using a variety of both parametric and semiparametric techniques. In doing so we can have a more complete picture of the results from a robustness viewpoint. Dealing with the parametric methods we use the Whittle function in the frequency domain as proposed in Dahlhaus (1989) and we implement it through the tests of Robinson (1994). This method is very convenient in the sense that it remains valid even in nonstationary contexts (as is the case in our work) and thus, it does not require preliminary differences to render the series stationary. Moreover, it has a standard normal null and local limit distributions and this behaviour holds independently of the inclusion of deterministic components such as intercepts and/or time trends. In addition, semiparametric methods, based on local Whittle methods (Robinson, 1995, Shimotsu and Phillips, 2006; Abadir et al., 2007) will also be implemented in the paper.

It is important to note that the estimation of d is crucial from a policy perspective. Thus, if d is smaller than 1, shocks will have a transitory nature and their effects will disappear by themselves in the long run, contrary to what happens if $d \geq 1$ where shocks are not mean reverting and persist forever. Thus, d can be viewed as an indicator of the

[5] Nelson and Plosser (1982) examined fourteen US macro series testing for stationarity I(0) versus nonstationarity I(1) by using ADF (Dickey and Fuller, 1979) unit root tests. They obtained evidence of unit roots or I(1) behaviour in all except one of the series.

degree of persistence, the higher its value is, the higher the degree of persistence is in the data. In the same way, the lower the value of d is, faster the recovery of the shocks is.

In the multivariate setting, we start by looking at the possibility of cointegration between the two variables (FDI and GDP) and consider the two step approach of Engle and Granger (1987) but from a fractional perspective. In the first step, the order of integration of the two series is examined and, if both series are nonstationary with the same order of integration, we conduct in the second step the regression of one of the variables against the other, checking if the order of integration of the errors is smaller than that of the individual series.

Based on the lack of cointegration in the results obtained in the following section, we also conduct another approach, which basically imposes that the previous values of FDI are weakly exogenous in the analysis of GPD. In other works, we will examine the following model,

$$\log GDP_t \;=\; \alpha + \beta \log FDI_{t-k} \;+\; x_t\,; \quad (1-L)^{d_o} x_t \;=\; u_t, \quad t \;=\; 1, 2, ..., \qquad (2)$$

and, unlike the previous case, we estimate now simultaneously all the parameters in the model. As a final approach, and based on the nonstationary nature of the two series, and also given the large values for the estimated orders of integration of the errors in (2), we conduct the regression model based this time on the first differenced (logged) data, i.e.,

$$(1-L)\log GDP_t = \alpha + \beta(1-L)\log FDI_{t-k} \;+\; x_t\,; \quad (1-L)^{d_o} x_t \;=\; u_t, \qquad (3)$$

testing for the significance on the slope coefficient in the above regression, which is based on the growth rates series. For the analysis of the equations based on (2) and (3) we rely on a version of Robinson (1994) that is specifically designed for this purpose.

4. Data

The difficulty of compiling reliable macroeconomic data from developing African countries is a limitation that always arises in research, having to face the poor quality of economic statistics in some countries (Jerven, 2013, 2015). For these reasons we have decided to work with the Thomson Reuters Eikon database, since it offers a comprehensive platform of data for our selected group of African countries. Eikon merges data from different sources into a single platform and that allows us to analyse data and apply econometric methods.

The Eikon database collects annual outward Chinese investment flows from the Ministry of Commerce of the PRC and African countries' GDP from each country's national bureau of statistics.[6] We use the Interpolated (Q) quarterly data corresponding to Outward Investment from China for the time period from 2003Q4 until 2018Q4. Besides, for GDP, we use quarterly data corresponding to the real GDP local currency, the real GDP US $, the real GDP per capita local currency and the real GDP per capita US$ (2005 prices). The sample size is 61 observations for each series.

We focus on Kenya, Zimbabwe, Zambia, Nigeria and South Africa firstly because of data availability; the Eikon database provides Chinese outward investment data for 25 African countries. Secondly, we use this 'Africa 5' group because of robustness reasons. South Africa, Zambia and Nigeria are the three countries with the highest total volumes of China FDI investment in 2003-2018, and volumes are also relevant in Zimbabwe and Kenya (6th and 9th, respectively). Apart from the three top destinations, we have selected Zimbabwe and Kenya because, following Brautingham et. al (2017), in this research we want to contrast the impact of FDI in a country that has received significant FDI flows in recent years in more industrialized sectors (Kenya), with the impact in a country that is

[6] Kenya National Bureau of Statistics, the Zimbabwe National Statistics Agency, the Central Statistical Office from Zambia, the National Bureau of Statistics from Nigeria and the Statistics South Africa Bureau.

consistent with the traditional profile of Chinese investment during the 90's and early 2000's in mining and raw materials (Zimbabwe). Thus, as we can see in Table 1, our 'Africa 5' selection receive more than 10 US$ billion from 2010 onwards, which is a significant amount compared to the 40-50US$ billion total annual FDI net inflows calculated in the Balance of Payments by the World Bank for the whole Africa in the same period.

[Table 1 about here]

As we can see in Table 2, Nigeria is the most populated and densely populated country within this group of countries, while Zambia and Zimbabwe are the least populated. However, regarding the level of economic development, South Africa clearly occupies the first place very far ahead of the other four.

[Table 2 about here]

5. Results

5.1. Empirical results

The first thing we do in this section is to look at the statistical properties of the individual series, i.e., FDI and the four types of GDP series by looking at the order of integration of the series. We start by considering the following model,

$$y_t = \beta_0 + \beta_1 t + x_t; \qquad (1 - L)^d x_t = u_t, \qquad t = 1, 2, \ldots, T, \qquad (4)$$

where y_t refers to each of the observed series (in logs); β_0 and β_1 are unknown coefficients dealing with an intercept and a time trend; and x_t is supposed to be I(d) implying then that u_t is I(0). We jointly estimate the parameters in the model for the three classical cases of i) no regressors (i.e., β_0 and β_1 are assumed to be zero a priori in (4)); ii) an intercept (β_0 is unknown and β_1 is equal to zero), and iii) an intercept with a linear time trend (both coefficients are estimated from the data). For the disturbances u_t, we consider two potential set-ups: 1) uncorrelation (white noise) errors, and 2) autocorrelation. In the latter case, we employ a non-parametric method proposed by Bloomfield (1973) which approximates ARMA models with very few parameters. It is non-parametric in the sense that it is exclusively defined in terms of its spectral density function, which is:

$$f(\lambda) = \frac{\sigma^2}{2\pi} \exp\left(2 \sum_{r=1}^{m} \tau_r \cos(\lambda r) \right), \qquad (5)$$

where σ^2 is the variance of the error term and m indicates the last of the Fourier frequencies which is associated with the short-run dynamics. Bloomfield (1973) showed that the spectral density function of a highly parameterized ARMA process can be well approximated by the equation in (5), with this model producing autocorrelations which decay exponentially as in the AR(MA) case. Another advantage of this model is that it is stationary for all its range of values unlike the AR models.[7]

Across Tables 3 and 4 we display the estimates of d (and their associated 95% confidence bands) respectively for the two cases of uncorrelated and autocorrelated (Bloomfield) errors, and we have marked in bold in the tables the most appropriate specification for each series, with respect to the three selected cases for the deterministic terms (intercept and/or a time trend).[8]

Starting with the case of white noise errors, and focussing first on the FDI (Panel A), we observe that the time trend is significant for the case of Nigeria. For the remaining countries, the intercept seems to be sufficient to describe this deterministic part. Looking at the estimates of d, we observe that all them are significantly higher than 1, ranging from 1.57 (Zimbabwe) to 1.83 (Zambia). Focussing now on the four different measures for GDP, we see that the estimates are also very high, and significantly higher than 1 in all cases. In fact, the I(2) hypothesis cannot be rejected in any single case. According to these results,

[7] Moreover, it has been shown that this model of Bloomfield (1973) accommodates extremely well in the context of fractional integration (Gil-Alana, 2004, 2008).
[8] This is based on the t-values of the corresponding coefficients of the deterministic terms on the d-differenced processes.

shocks to any of the above series will have permanent effects and strong actions should be taken to recover the original trends (levels) in the series. Nevertheless, this high degree of persistence can be a consequence of the lack of autocorrelation in the error term.

[Table 3 and 4 about here]

Table 4 displays the estimates under the assumption of autocorrelated errors by using the model of Bloomfield (1973) described above. Starting again with the FDI, the only evidence of unit roots is found in the case of Kenya; all the other estimates are significantly higher than 1. For the GDP series, the estimates are also smaller than in the previous table (referring to the white noise case) but the I(2) hypothesis cannot be rejected in many series. Evidence of unit roots is found in a number of cases for the series corresponding to Kenya, Zambia and South Africa. However, for Zimbabwe and Nigeria, the I(2) hypothesis cannot be rejected in any single case. Thus, once more, all individual series appear to be highly persistent, with the effects of the shocks lasting forever.[9]

The above results based on fractional integration might be criticised based on the small number of observations used in the analysis. Nevertheless, the main consequence of that is the wide confidence bands obtained for the values of d, and several Monte Carlo experiments conducted in Robinson (1994) showed that his tests perform relatively well in finite samples; in fact, various empirical applications based on this method have been conducted even with fewer observations.[10]

Next we move to the multivariate case, looking at the relationship between the two variables, FDI and GDP, and the first thing we do is to look at the possibility of cointegration by using the two step approach of Engle and Granger (1987) that basically

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[9] Though not reported, the same evidence in favour of large degrees of integration was obtained in all cases when using semiparametric methods (Robinson, 1995; Shimotsu and Phillips, 2006, and Abadir et al., 2007) where no assumption is made on the error term.

[10] Using finite sample critical values computed in Gil-Alana (2000), the results were almost identical to those reported here based on the asymptotic values.

consists of testing the order of integration of the individual series, and, if it is the same, testing the degree of integration in the errors of the regression of one of the variables (e.g. FDI) against the other (GDP). If the order of integration in the errors is smaller than that of the parent series and show mean reversion we could conclude that the two series move together in the long run (Gil-Alana, 2003). The results using this approach are reported in Table 5 and based on the similarities across the four measures of GDP we display the results only for the GDP and GDP per capita based on the local currencies.

[Table 5 about here]

We observe in this table that the intercept and the slope coefficients are significant in all cases; moreover, the slope is significantly positive implying a positive influence of FDI on GDP. However, if we look at the estimated orders of integration, we observe that all them produce estimates which are significantly higher than 1 implying lack of mean reversion and thus lack of cointegration, and more importantly, potentially producing spurious relations across the variables. Therefore, the significance of the slope coefficient reported in this table should be taken as irrelevant, and we need to look at alternative approaches.

The first alternative approach is to consider the regression model in (2) and estimate the order of integration, d, along with the other parameters under the assumption that FDI is weakly exogenous in the explanation of GDP. We use the methodology described in Robinson (1994) which is specifically designed for this purpose. We try with alternative values of k = 1, 2, 3 and 4. We report in Table 6 the results only for k = 1, with the remaining cases being very similar.

[Table 6 about here]

Starting with the real GDP results, the first thing we observe in Table 6 is that the slope coefficient is statistically significant and positive in a number of cases: Nigeria, under both specifications of the error term (uncorrelated and autocorrelated errors), South Africa with no autocorrelation, and Kenya with autocorrelated disturbances.[11] However, we also observe that the estimated value of d is, in all cases, extremely large, and even for the smallest value (Kenya, d = 0.81) the confidence interval is so wide that we cannot reject either the I(1) or the I(2) hypothesis. The same happens with the real GDP per capita (Panel ii) Table 6) with the same countries displaying significantly positive slopes and large estimates of d, though, here, the confidence intervals for the estimates of d are even wider.

As a final approach, we look at the relationship between the variables in terms of the first differences, working then with the growth rate series. We estimate the parameters in the regression model (3) again for the two cases of uncorrelated and autocorrelated errors. Table 7 reproduces the results with k = 0 though very similar values are obtained with positive values of k.

[Table 7 about here]

We see that the slope coefficients are now statistically insignificant in all cases and, as we should expect, the estimated orders of integration are much smaller than in the previous case. Nevertheless, the confidence intervals are very wide and the I(1) hypothesis cannot be rejected in any single case.

We can summarize our results by saying that the two variables (FDI and GDP) are very persistent, with large orders of integration, implying permanency of shocks and lack of mean reversion behaviour. When looking at the relationship between GDP and FDI, we found very little evidence of any relationship, finding only some positive relationship in the case of Nigeria, and partially for Kenya and South Africa. Nevertheless, very few conclusions can be drawn based on the extremely wide confidence intervals obtained,

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[11] Since the analysis with autocorrelation is based on a non-parametric approach (Bloomfield, 1973) we cannot directly compare this case with the one based on no autocorrelation. Nevertheless, we believe it is important to report the results based on the two cases.

which is clearly a consequence of the small number of observations involved in the application, which is a fact that we have to face when we deal with much African macro data.

5.2. Discussion of the results: stylized facts of China and Africa 5 countries

We find two main explanations for the fact that only Nigeria, and to some extent South Africa and Kenya display a positive relationship between Chinese FDI and growth. The first of these explanations may be related to the characteristics of host economies. Some authors have determined that knowledge spillovers are stronger in countries with higher levels of absorptive capacity. Our results are consistent with the studies that conclude that many African countries have difficulties to fully benefit from foreign technologies because of their limited absorptive capacity and insufficient human development (Borenzstein et al., 1998; Falvey et al. 2005; Malikane and Chitambara, 2017). In our Africa 5 group, South Africa and Nigeria display the highest productivity ratios (see Table 8), and the comparative technological backwardness of Kenya, Zambia and Zimbabwe could be a factor hindering the contribution of China's investment.

[Table 8 about here]

The second explanation concerns the nature and the destination of FDI flows (see Table 9). On the one hand, natural resources account for the lion's share of China's FDI in the case of Zambia and Zimbabwe (Kärkkäinen, 2016; Haglund, 2009); on the other, Chinese investment is comparatively more concentrated in manufacturing, transport, commercial and financial services, and technology in South Africa, Nigeria and Kenya. In our research, we find very little evidence of any relationship between GDP and FDI in Zambia and Zimbabwe, which would be consistent with the natural resource curse. As a matter of fact, Haglund (2009) questioned the contribution of investments in the copper sector to long-term development in Zambia given their short-term strategies.

[Table 9 about here]

In contrast, Nigeria case-studies conclude that Chinese investment has great potential for growth thanks to the transfer of technology through technical partnerships between companies if the right policies and institutions are implemented (Chen et al., 2015; Kayode and Pheng, 2013). As for Kenya, China's investment in road construction projects indicates that China views Kenya as a gateway to the East African region (Ombaba et al., 2012). Finally, South Africa is a relatively developed country that enjoys political stability, and the share of financial services in total Chinese investment is noteworthy.[12]

Thus, the results of this research confirm the findings of previous empirical literature: first, we find that the Chinese FDI impact has been heterogeneous in our Africa 5 group; and second, our results hint to some positive impact of Chinese FDI in better equipped and more advanced countries (Nigeria, South Africa and Kenya), and to no impact in natural resource dependent countries (Zambia and Zimbabwe). The additional evidence obtained in this paper through fractional integration, a methodology scarcely used in the analysis of economic data, contributes to a relevant discussion that needs to be investigated further in future research, especially when more and better data are available in African countries.

6. Concluding comments

We have examined in this work the relation between the Chinese FDI and GDP in a group of five African countries, namely, Kenya, South Africa, Nigeria, Zambia and Zimbabwe, and given the high degree of persistence observed in the data, we use techniques based on long memory and fractional integration.

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[12] In October 2007 the Industrial and Commercial Bank of China (ICBC) acquired 20 percent of Standard Bank of South Africa in a deal with a reported value of US$5.5 billion.

Looking at the orders of integration of the individual series, the first thing we observe is that the estimated values of d are higher than 1 in practically all cases (in fact, in some of the series we cannot reject the hypothesis of I(2) processes). Thus, according to our results, random exogenous shocks in the series will have permanent effects, lasting forever, and requiring strong measures to recover the original trends. This is good in the case of positive shocks since the series will move to a new trend but negative in the context of a negative shock caused for example by climate, pandemics, wars, etc.

In a multivariate context, we find no evidence of cointegration between the variables. However, if we assume that FDI is exogenous for GDP, a positive relationship is found in the case of Nigeria, and partially (depending on the assumptions made on the disturbance term) for Kenya and South Africa. For Zambia and Zimbabwe we do not find statistically significant relationships between the two variables. Several arguments can be put forward to explain this result, including the higher productivity ratios in Nigeria and South Africa, and the higher share of investments in manufacturing and services in Nigeria, Kenya, and South Africa. Nevertheless, if data were available, further research should be conducted to corroborate the findings obtained in this work and the conclusions derived.

In 2020 we have witnessed massive changes in the China-Africa relationship due to COVID-19. The pandemic has induced a debt crisis and Chinese financing in Africa has undergone rapid shifts. This paper opens new avenues for future research on this and related topics and the possibility should be considered of looking at more African countries and the development of international trade between these countries and China to tie it together for investment purposes and obtain a synergistic effect from both.

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Table 1: Outward investment from China to 'Africa 5'

(Millions, US $)

	Kenya	Nigeria	South Africa	Zambia	Zimbabwe	'Africa 5'
2003	25.53	31.98	44.77	143.7	36.74	282.72
2004	28.46	75.61	58.87	147.75	38.06	348.75
2005	58.25	94.11	112.28	160.31	41.63	466.58
2006	46.23	215.94	167.62	267.86	46.15	743.80
2007	55.13	630.32	702.37	429.36	59.15	1,876.33
2008	78.36	795.91	3,048.62	651.33	60.01	4,634.23
2009	120.36	1,025.96	2,306.86	843.97	99.75	4,396.90
2010	221.58	1,210.85	4,152.98	943.73	134.54	6,663.68
2011	308.83	1,415.61	4,059.73	1,199.84	576.44	7,560.45
2012	402.73	1,949.87	4,775.07	1,998.11	874.67	10,000.45
2013	635.9	2,146.07	4,400.40	2,164.32	1,520.83	10,867.52
2014	853.71	2,323.01	5,954.02	2,271.99	1,695.58	13,098.31
2015	1,099.04	2,376.76	4,722.97	2,338.02	1,798.92	12,335.71
2016	1102.7	2,541.68	6,500.84	2,687.16	1,839.00	14,671.38
2017	1,543.45	2,861.53	7,472.77	2,963.44	1,748.34	16,589.53
2018	1,755.88	2,453.49	6,531.68	3,523.02	1,766.25	16,030.32

Source: EIKON database. Ttotal annual FDI net inflows calculated in the Balance of Payments by the World Bank.

Table 2: Some descriptive statistics of the five countries examined

	Population	Surface area	Population density	Gross national income, Atlas method	Gross national income per capita, Atlas method
	Millions	**sq. km thousands**	**people per sq. km**	**$ billions**	**$**
	2017	**2017**	**2017**	**2017**	**2017**
Kenya	49.7	580.4	87	72.7	1,46
Nigeria	190.9	923.8	210	400.7	2,1
South Africa	56.7	1,219.1	47	308.0	5,43
Zambia	17.1	752.6	23	22.1	1,29
Zimbabwe	16.5	390.8	43	19.3	1,17

Source: World Bank. World Development Indicators. Own elaboration. Accessed 26 May 2019.

Table 3: Estimates of d based on a model with no autocorrelation

i) Foreign Direct Investment (FDI)			
	No terms	An intercept	A linear time trend
KENYA	0.91 (0.71, 1.18)	**1.74 (1.47, 2.09)**	1.71 (1.42, 2.09)
ZIMBABWE	0.87 (0.66, 1.15)	**1.57 (1.41, 1.83)**	1.57 (1.42, 1.83)
ZAMBIA	0.90 (0.71, 1.16)	**1.83 (1.67, 2.08)**	1.83 (1.65, 2.08)
NIGERIA	1.03 (0.85, 1.26)	1.76 (1.57, 2.07)	**1.63 (1.44, 1.98)**
SOUTH AFRICA	0.98 (0.81, 1.21)	**1.59 (1.42, 1.86)**	1.56 (1.38, 1.85)
ii) ReaLGDP local currency			
	No terms	An intercept	A linear time trend
KENYA	0.94 (0.77, 1.18)	1.96 (1.73, 2.25)	**1.85 (1.59, 2.17)**
ZIMBABWE	0.92 (0.74, 1.17)	**1.92 (1.74, 2.18)**	1.90 (1.73, 2.16)
ZAMBIA	0.93 (0.76, 1.17)	2.11 (1.93, 2.39)	**1.88 (1.72, 2.16)**
NIGERIA	0.93 (0.77, 1.17)	2.07 (1.85, 2.37)	**1.90 (1.71, 2.19)**
SOUTH AFRICA	0.94 (0.77, 1.18)	2.00 (1.81, 2.28)	**1.87 (1.68, 2.16)**
ii) Real GDP US dollar			
	No terms	An intercept	A linear time trend
KENYA	0.95 (0.79, 1.18)	**1.80 (1.52, 2.16)**	1.78 (1.47, 2.16)
ZIMBABWE	0.92 (0.74, 1.18)	**1.92 (1.75, 2.18)**	1.90 (1.73, 2.16)
ZAMBIA	1.03 (0.88, 1.27)	**1.72 (1.43, 2.12)**	1.71 (1.42, 2.12)
NIGERIA	0.92 (0.75, 1.17)	**1.82 (1.63, 2.17)**	1.80 (1.60, 2.15)
SOUTH AFRICA	0.98 (0.82, 1.21)	**1.82 (1.56, 2.16)**	1.79 (1.55, 2.13)
ii) Real GDP per capita local currency			
	No terms	An intercept	A linear time trend
KENYA	0.94 (0.77, 1.18)	**1.89 (1.64, 2.20)**	1.86 (1.60, 2.18)
ZIMBABWE	0.93 (0.76, 1.17)	**1.92 (1.74, 2.19)**	1.90 (1.72, 2.16)
ZAMBIA	0.93 (0.77, 1.16)	2.03 (1.86, 2.28)	**1.88 (1.73, 2.17)**
NIGERIA	0.94 (0.77, 1.17)	2.01 (1.81, 2.30)	**1.90 (1.71, 2.18)**
SOUTH AFRICA	0.94 (0.77, 1.18)	1.96 (1.78, 2.24)	**1.88 (1.69, 2.18)**
ii) Real GDP per capitaUS dollar			
	No terms	An intercept	A linear time trend
KENYA	0.94 (0.78, 1.18)	**1.78 (1.49, 2.16)**	1.76 (1.49, 2.15)
ZIMBABWE	0.93 (0.76, 1.17)	**1.92 (1.75, 2.19)**	1.90 (1.73, 2.17)
ZAMBIA	0.95 (0.78, 1.18)	**1.72 (1.42, 2.11)**	1.72 (1.41, 2.11)
NIGERIA	0.93 (0.76, 1.17)	**1.80 (1.59, 2.15)**	1.80 (1.56, 2.15)
SOUTH AFRICA	0.96 (0.80, 1.20)	**1.80 (1.56, 2.15)**	1.78 (1.52, 2.13)

The values in bold refers to the selected models according to the deterministic terms. In parenthesis, the 95% confidence bands for the values of d.

Table 4: Estimates of d based on a model with autocorrelation

i) Foreign Direct Investment (FDI)			
	No terms	An intercept	A linear time trend
KENYA	0.68 (0.39, 1.24)	1.03 (0.83, 1.84)	**1.03 (0.64, 1.77)**
ZIMBABWE	0.57 (0.42, 1.13)	**1.39 (1.13, 1.75)**	1.40 (1.15, 1.77)
ZAMBIA	0.71 (0.36, 1.20)	**1.66 (1.34, 2.12)**	1.64 (1.26, 2.11)
NIGERIA	0.92 (0.44, 1.37)	1.44 (1.18, 1.86)	**1.35 (1.12, 1.88)**
SOUTH AFRICA	0.90 (0.36, 1.30)	1.39 (1.09, 1.79)	**1.33 (1.07, 1.75)**
ii) ReaLGDP local currency			
	No terms	An intercept	A linear time trend
KENYA	0.82 (0.48, 1.24)	1.47 (0.83, 2.33)	**1.17 (0.59, 2.11)**
ZIMBABWE	0.73 (0.41, 1.22)	**1.75 (1.41, 2.21)**	1.69 (1.40, 2.21)
ZAMBIA	0.80 (0.38, 1.23)	1.89 (1.63, 2.29)	**1.70 (1.49, 2.06)**
NIGERIA	0.81 (0.47, 1.24)	1.69 (1.41, 2.14)	**1.63 (1.38, 2.22)**
SOUTH AFRICA	0.82 (0.49, 1.21)	1.72 (1.37, 2.26)	**1.54 (1.23, 2.17)**
iii) Real GDP US dollar			
	No terms	An intercept	A linear time trend
KENYA	0.84 (0.49, 1.27)	1.05 (0.40, 1.84)	**1.05 (0.65, 1.77)**
ZIMBABWE	0.73 (0.41, 1.23)	**1.74 (1.38, 2.25)**	1.70 (1.40, 2.21)
ZAMBIA	0.94 (0.59, 1.37)	**1.09 (0.79, 1.66)**	1.08 (0.79, 1.62)
NIGERIA	0.77 (0.38, 1.20)	**1.49 (1.21, 2.16)**	1.47 (1.22, 2.00)
SOUTH AFRICA	0.90 (0.56, 1.32)	**1.22 (0.79, 1.91)**	1.20 (0.74, 1.92)
iv) Real GDP per capita local currency			
	No terms	An intercept	A linear time trend
KENYA	0.81 (0.46, 1.22)	1.05 (0.77, 2.24)	**1.14 (0.50, 2.15)**
ZIMBABWE	0.83 (0.44, 1.26)	**1.72 (1.33, 2.25)**	1.68 (1.35, 2.20)
ZAMBIA	0.82 (0.46, 1.23)	1.87 (1-60, 2.26)	**1.70 (1.51, 2.05)**
NIGERIA	0.81 (0.49, 1.22)	1.67 (1.38, 2.13)	**1.63 (1.37, 2.22)**
SOUTH AFRICA	0.82 (0.49, 1.24)	1.69 (1.31, 2.24)	**1.56 (1.28, 2.15)**
v) Real GDP per capita US dollar			
	No terms	An intercept	A linear time trend
KENYA	0.83 (0.49, 1.26)	**1.04 (0.63, 1.81)**	1.04 (0.64, 1.76)
ZIMBABWE	0.81 (0.45, 1.23)	**1.69 (1.39, 2.21)**	1.69 (1.38, 2.22)
ZAMBIA	0.84 (0.48, 1.26)	**1.07 (0.82, 1.64)**	1.08 (0.80, 1.65)
NIGERIA	0.80 (0.45, 1.22)	**1.45 (1.21, 2.04)**	1.47 (1.22, 2.03)
SOUTH AFRICA	0.85 (0.55, 1.29)	**1.21 (0.82, 1.90)**	1.21 (0.76, 1.88)

The values in bold refers to the selected models according to the deterministic terms. In parenthesis, the 95% confidence bands for the values of d.

Table 5: Estimates in a regression model of GDP against FDI: Two-step approach

i) real GDP local currency / FDI				
	Estimated coefficients		d (White noise)	d (Autocorr.)
KENYA	**5.8564 (365.99)**	**0.1571 (53.64)**	1.73 (1.43, 2.11)	0.94 (0.32, 1.63)
ZIMBABWE	**0.4087 (9.56)**	**0.1122 (15.16)**	1.66 (1.46, 1.99)	1.26 (0.96, 1.73)
ZAMBIA	**1.4417 (53.50)**	**0.2564 (64.69)**	1.77 (1.55, 2.08)	1.26 (0.58, 1.89)
NIGERIA	**8.3174 (190.93)**	**0.1771 (27.51)**	1.68 (1.48, 1.98)	1.35 (1.04, 1.84)
S. AFRICA	**6.1216 (315.38)**	**0.0567 (21.93)**	1.56 (1.38, 1.82)	1.38 (0.98, 1.93)
ii) real GDP per capita local currency / FDI				
	Estimated coefficients		d (White noise)	d (Autocorr.)
KENYA	**1.7083 (193.69)**	**0.0748 (46.37)**	1.76 (1.47, 2.14)	0.86 (0.32, 1.77)
ZIMBABWE	**6.4087 (147.65)**	**0.0653 (8.67)**	1.78 (1.59, 2.06)	1.47 (1.13, 1.98)
ZAMBIA	**7.8513 (475.25)**	**0.1423 (58.58)**	1.76 (1.53, 2.07)	1.17 (0.58, 1.85)
NIGERIA	**12.0705 (509.77)**	**0.0983 (28.11)**	1.72 (1.53, 2.00)	1.45 (1.14, 1.90)
S. AFRICA	**10.6960 (1032.64)**	**0.0268 (19.39)**	1.67 (1.50, 1.90)	1.64 (1.14, 2.25)

In parenthesis in columns 2 and 3, t-values. In bold, significant coefficients at the 5% level.

Table 6: Estimates in a regression model of GDP against FDI in a unified treatment

i) real GDP_t local currency / FDI_{t-1}						
	No autocorrelation			With autocorrelation		
	Constant	Slope	d	Constant	Slope	d
KENYA	**6.344** **(216.22)**	-0.00017 (-0.02)	1.92 (1.74, 2.18)	**5.894** **(273.69)**	**0.1425** **(23.56)**	0.81 (0.13, 2.21)
ZIMBABWE	**1.015** **(16.00)**	0.00053 (0.03)	1.92 (1.74, 2.19)	**0.999** **(15.16)**	0.0051 (0.28)	1.71 (1.19, 2.17)
ZAMBIA	**2.686** **(45.70)**	-0.00165 (-0.13)	2.13 (1.95, 2.42)	**2.650** **(43.95)**	0.0056 (0.46)	1.80 (1.41, 2.33)
NIGERIA	**8.982** **(330.93)**	**0.0179** **(2.20)**	1.96 (1.77, 2.23)	**8.975** **(327.09)**	**0.0198** **(2.42)**	1.82 (1.43, 2.26)
S. AFRICA	**6.291** **(599.47)**	**0.0055** **(1.98)**	2.10 (1.86, 2.40)	**6.296** **(553.55)**	0.0041 (1.38)	1.61 (0.81, 2.13)
ii) real GDP_t per capita local currency / FDI_{t-1}						
	No autocorrelation			With autocorrelation		
	Constant	Slope	d	Constant	Slope	d
KENYA	11.155 (374.78)	-0.00027 (-0.03)	1.90 (1.64, 2.21)	**10.921** **(1123.89)**	**0.0742** **(31.16)**	0.65 (-0.22, 2.22)
ZIMBABWE	6.829 (107.66)	0.0062 (0.35)	1.92 (1.74, 2.20)	**6.818** **(103.46)**	0.0094 (0.52)	1.67 (1.21, 2.23)
ZAMBIA	8.515 (161.61)	0.00109 (0.09)	2.04 (1.86, 2.30)	**8.494** **(159.32)**	0.0053 (0.40)	1.83 (1.52, 2.24)
NIGERIA	**12.410** **(488.40)**	**0.0142** **(1.86)**	1.92 (1.71, 2.18)	**12.406** **(484.18)**	**0.0155** **(2.02)**	1.77 (1.40, 2.23)
S. AFRICA	**107.39** **(1045.36)**	**0.0053** **(1.98)**	2.06 (1.82, 2.41)	**10.745** **(972.30)**	0.0037 (1.29)	1.58 (0.93, 2.10)

In parenthesis in columns 2 and 3, t-values. In bold, significant coefficients at the 5% level.

Table 7: Estimates in a regression model of GDP against FDI in first differences

i) (1 – L) real GDP_t local currency / (1 – L) FDI_t						
	No autocorrelation			With autocorrelation		
	Constant	Slope	d	Constant	Slope	D
KENYA	**0.0115** **(3.78)**	-0.0013 (-0.14)	0.86 (0.59, 1.17)	**0.0127** **(15.11)**	0.0020 (0.27)	0.14 (-0.49, 1.12)
ZIMBABWE	-0.0160 (-1.51)	0.0021 (0.12)	0.90 (0.73, 1.18)	-0.0127 (-1.40)	0.0113 (0.62)	0.66 (-0.32, 1.16)
ZAMBIA	**0.0168** **(8.44)**	-0.00008 (0.009)	0.88 (0.71, 1.16)	**0.0166** **(9.58)**	0.0044 (0.46)	0.67 (0.43, 1.07)
NIGERIA	**0.0234** **(6.11)**	0.0018 (0.24)	0.90 (0.71, 1.19)	**0.0184** **(6.14)**	0.0077 (1.00)	0.62 (0.35, 1.19)
S. AFRICA	**0.0108** **(4.67)**	0.0024 (0.87)	0.86 (0.65, 1.17)	**0.0095** **(5.25)**	0.0036 (1.26)	0.57 (0.32, 1.20)
ii) (1 – L) real GDP_t per capita local currency / (1 – L) FDI_t						
	No autocorrelation			With autocorrelation		
	Constant	Slope	d	Constant	Slope	d
KENYA	0.0047 (1.47)	-0.0005 (-0.06)	0.86 (0.60, 1.19)	**0.0057** **(6.92)**	0.0046 (0.60)	0.11 (-0.57, 1.15)
ZIMBABWE	**-0.0180** **(-1.71)**	0.0050 (0.29)	0.99 (0.71, 1.15)	**-0.0153** **(-1.69)**	0.0141 (0.78)	0.66 (-0.30, 1.15)
ZAMBIA	**0.0104** **(5.27)**	0.0016 (0.16)	0.88 (0.70, 1.14)	**0.0100** **(5.82)**	0.0057 (0.61)	0.67 (0.44, 1.04)
NIGERIA	**0.0165** **(4.31)**	0.0024 (0.30)	0.89 (0.68, 1.19)	**0.0122** **(3.92)**	0.0075 (0.97)	0.64 (0.35, 1.16)
S. AFRICA	**0.0078** **(3.37)**	0.0025 (0.92)	0.86 (0.66, 1.16)	**0.0064** **(3.47)**	0.0037 (1.31)	0.59 (0.24, 1.16)

In parenthesis in columns 2 and 3, t-values. In bold, significant coefficients at the 5% level.

Table 8: Productivity ratios

GDP per capita employed (constant 2011 PPP $)			
	90s	00s	10s*
KENYA	6,402	6,597	7,920
NIGERIA	9,552	13,016	18,435
SOUTH AFRICA	36,770	40,043	43,416
ZAMBIA	6,004	6,803	9,489
ZIMBABWE	6,138	4,127	3,959
Productivity in industry (including construction) (value added per worker, constant 2010 US$)			
	90s	00s	10s*
KENYA	3,749	6,266	7,926
NIGERIA	18,384	17,605	17,113
SOUTH AFRICA	27,000	26,241	29,420
ZAMBIA	11,197	12,488	12,953
ZIMBABWE	5,003	3,824	5,546
*2010 to 2017. Source: World Bank. World Development Indicators. Own elaboration. Accessed 26 May 2019.			

Table 9: Sectoral distribution of Chinese investments and contracts. 2005-2018.

	Kenya	**Nigeria**	**South Africa**	**Zambia**	**Zimbabwe**
Agriculture	3,81	0,64	0,00	3,61	2,11
Metals	0,00	0,00	22,26	9,68	6,34
n.a.	0,00	0,00	8,34	0,00	5,29
Copper	0,00	0,00	12,30	9,68	0,00
Steel	0,00	0,00	1,63	0,00	1,06
Energy	30,08	37,13	13,57	27,66	63,21
n.a.	10,07	7,43	0,00	8,00	1,59
Alternative	4,29	0,00	2,69	0,00	7,72
Coal	0,00	0,00	1,48	0,00	27,38
Gas	0,77	8,57	0,00	0,00	10,36
Hydro	12,57	14,17	0,00	19,66	16,17
Oil	2,38	6,97	9,40	0,00	0,00
Utilities	1,79	0,00	0,00	3,61	1,48
Utilities	1,79	0,00	0,00	3,61	1,48
SUBTOTAL 1	**35,68**	**37,77**	**35,83**	**44,56**	**73,15**
Real estate	4,88	9,81	10,32	14,13	22,62
Construction	2,32	5,98	9,54	14,13	22,62
Property	2,56	3,82	0,78	0,00	0,00
SUBTOTAL 2	**4,88**	**9,81**	**10,32**	**14,13**	**22,62**
Transport	46,16	47,66	9,82	37,88	3,17
Autos	19,30	7,37	9,82	19,54	0,00
Aviation	0,00	1,36	0,00	4,75	3,17
Rail	24,00	36,39	0,00	13,59	0,00
Shipping	2,86	2,54	0,00	0,00	0,00
Other	11,55	0,40	0,00	1,80	0,00
n.a.	0,00	0,00	0,00	1,80	0,00
Industry	11,55	0,00	0,00	0,00	0,00
Textiles	0,00	0,40	0,00	0,00	0,00
SUBTOTAL 3	**57,71**	**48,06**	**9,82**	**39,69**	**3,17**
Entertainment	0,00	0,00	0,00	1,62	0,00
Finance	0,00	0,00	41,34	0,00	0,00
Banking	0,00	0,00	39,58	0,00	0,00
Investment	0,00	0,00	1,77	0,00	0,00
Health	1,73	0,00	0,00	0,00	1,06
Health	1,73	0,00	0,00	0,00	1,06
Technology	0,00	4,36	2,69	0,00	0,00
Telecom	0,00	4,36	2,69	0,00	0,00
SUBTOTAL 4	**1,73**	**4,36**	**44,03**	**1,62**	**1,06**
TOTAL	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**
TOTAL (US $ M.)	**16,790**	**49,960**	**14,150**	**16,630**	**9,460**

Source: China Global Investment Tracker. Accessed 28 May 2018.