Foreign direct investment, economic growth and structural transformation: The case of West African Economies and Monetary Union Countries

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Abstract: *This article examines the long run relationship and the causality between the growth of GDP per capita and FDI in WAEMU countries. Thereafter, it measures the impact of FDI on Total Factor of Productivity (TFP) in the short and long run, for different values of the depreciation of capital stock. Using observation between 1970 and 2012, the econometric analysis provides three key results. First, there is a strong evidence of long run relationship between the growth of GDP per capita and the ratio of FDI inflows. Second, there is bidirectional causality between these two variables. Third, there is a positive and significant effect of FDI on TFP in the long run, conditional on low level of depreciation of capital stock. Therefore, for policy implications, WAEMU countries should intensify their investment in education and health in order to boost the quality of human capital stock and sufficient absorptive capacity necessary to acquire technological transfer from FDI. They should also strengthen their openness, to attract FDI inflows, and invest in infrastructure to better control the depreciation of physical capital stock.*

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1. Introduction

Convergence towards high levels of productivity is a prerequisite to trigger structural transformation of Africa. This structural transformation will be much stronger the more growth generated is inclusive and sustainable, to address challenges related to poverty, youth unemployment, inequality and protection of environment (ECA and AUC, 2013). Indeed, despite a slowdown from 5.7 per cent in 2012 to 4.1 per cent in 2013, growth in Africa remains strong and is equivalent to twice the global growth (ECA and AUC, 2014). However, this growth is largely dependent on exports of commodities, whose prices are vulnerable to exogenous shocks. In West Africa, growth remained stable at 6.7 percent in 2013 compared to 2012, mainly due to investment in minerals and oil sector (ECA and AUC, 2014). In Côte d'Ivoire, for example, growth has improved significantly compared to 2012, reaching 8.8 per cent in 2013.

However, this growth is not translating into the creation of decent jobs and a significant reduction of poverty and inequality. In effect, Africa's growth elasticity of poverty remains marginal compared to other regions of the world. For example, a 1 per cent increase of growth has led to a decline of 2.48 per cent of poverty in East Asia and the Pacific, 3.08 per cent in Latin America and only 1.39 per cent in Africa (Armah, 2013). Therefore, to make this growth more inclusive, Africa and WAEMU countries in particular must industrialize. However, to achieve this industrialization, certain conditions are required. In particular, the availability of high quality of human capital stock (Borensztein et al, 1998; Bengoa et, 2003; Xiaoying et al, 2005), political stability, development of local financial market (Alfaro, 2004, 2006), fiscal policy, the degree of openness (Abdallah et al, 2011; Dabla-Norris et al, 2010, Arbatli, 2011; Anyanwu, 2011), a dynamic industrial policy framework, innovation technology transfer, and research and development. Foreign Direct Investment (FDI) is therefore an opportunity and can help to bridge the technological gap, increase productivity and enhance inclusive growth.

Despite the international financial crisis, FDI flows to WAEMU have increased steadily since 2002. From an average annual growth of 3.5 per cent between 2000 and 2005, FDI flows rose to 18.8 per cent between 2006 and 2011(BCEAO, 2013). The ratio of FDI flows to GDP increased from 1.9 per cent in 2000 to 2.9 per cent in 2011 mainly due to the dynamism of extractive sector, telecommunication and banking. Niger (30.2), Côte d'Ivoire (20), Mali (14.8) and Senegal (14.3), are the main destinations (BCEAO, 2013). However, the sectoral distribution of FDI inflows in WAEMU is unequal. For example, between 2007 and 2011, FDI inflows were mainly oriented on mining and oil sector which represent 49.9 per cent of the volume of FDI inflows followed by transport (14.8), telecommunication (11.9), manufacturing industries and banking (9.4).

This slight increase of FDI inflows in WAEMU, is concentrated in the extractive industries rather than in the manufacturing sector. Extractive industries have limited prospects for inclusive growth and employment creation because of their weak linkage to the economy and their capital-intensive nature. The need for WAEMU countries to select and redirect FDI inflows into sectors with high anchor to all the economy is therefore imperative. Evidences from the contribution of foreign firms in research and development show that FDI have had

positive spillovers in knowledge accumulation for Indonesian domestic industries (Todo et al, 2006).

A good orientation of FDI inflows into industries and manufacturing in particular, might increase the productivity of labor force driving a positive and significant impact on the value added of those industries (Takii, 2005). On the technological aspects, FDI inflows might trigger technology accumulation process in the domestic manufacturing industries. This accumulation will be more significant if technological gap between domestic and multinational firms is higher (Todo et al, 2006). This indeed is the situation for Africa, in general, and for WAEMU countries, in particular. Fauzel (2012), for example, shows that FDI inflows have had positive and significant effects on the productivity of manufacturing sector for Eastern and Southern Africa.

Empirical evidence on the impact of FDI inflows on structural transformation of WAEMU countries remains limited. Most studies in this African region focused on the determinants of FDI (Koukpo, 2005; Udo et al, 2006), or the impact of FDI inflows on poverty reduction (Gohou et al, 2009), regional integration (Elie, 2012).

This paper, aims to contribute to the literature on FDI in twofold: First, it analyzes the causality between FDI inflows and GDP for each countries in the WAEMU using a robust econometric analysis, based on the Toda-Yamamoto (1995) test, and the Unrestricted Error Correction Model (UECM) in an attempt to establish if there is any long term relationship between FDI inflows and GDP. Second, it fills the gap in the literature by estimating the effects of FDI inflows on the structural transformation of WAEMU countries, which is less addressed in this African region. The approach to measuring structural transformation is based on the estimation of total factor of productivity, analogous to Levisohn and Petrin semi-parametric approach.

The case of WAEMU is important for two main reasons. First, this region contains predominantly agricultural countries such as Cote d'Ivoire which is one of the world's leading producers of cocoa and coffee, as well as Mali, one of the first world producer of cotton. Second, the existence of structural geographical constraints for some countries such as Mali, Burkina Faso and Niger, reduces their degree of openness and their competitiveness. FDI inflows are therefore, an opportunity for those countries, to increase their productivity through imitation and learning, to offer differentiated products, driving to an intensification of their trade and competitiveness. Furthermore, a key innovation in this paper comes from, the importance of depreciation of physical capital stock on the absorption capacity of FDI, specifically in the short run.

The rest of this paper is organized as follows: section 2 deals with the literature review and stylized fact. Section 3 presents the empirical methodology, data description and the variables used in the econometric estimations. The results are presented and discussed in section 4 while section 5 concludes with key policy recommendations.

2. Literature review

2.1. Theoretical and Empirical review

Growth is essential for Africa as it leads to an increase in resources. However, this growth has meaning only when it is inclusive. This is possible if in upstream, occurs structural transformation (ECA and AUC, 2014). Indeed, structural transformation is the reorientation of economic activity from less productive sectors to more productive ones (Herrendorf et al, 2011), and can be assessed from three ways:

First, structural transformation happens in a country, when the share of its manufacturing value added in GDP increases. If growth of African countries and WAEMU ones in particular has improved in recent years, it was however driven by the export of commodities, whose prices are vulnerable to exogenous shocks, thus leading to a high exposure to growth volatility. The creation of manufacturing industries and industrial value chains will result into strengthening this growth and reducing the volatility (Elhiraika, 2014). Second, structural transformation of an economy occurs when labor gradually shifts from primary sector to secondary sector and from secondary sector to tertiary sector. In other words, it is the displacement of labor from sectors with low productivity to sector with high-productivity, both in urban than rural areas. This movement of labor is necessary for improvement in the standards of living as well as poverty reduction (ECA et al, 2013). Finally, structural transformation takes place when total factor of productivity (TFP) increases. Although it is difficult to determine the factors explaining a higher increase in TFP, there is an agreement on the fact that there is a positive correlation between institutions, policies and productivity growth (ECA and AUC, 2014).

If Africa has recorded highest growth in recent years, this remains fragile. In addition, the achievement of MDGs remains a challenge (ECA, AUC, 2013)[2]. Inclusive and sustainable growth is therefore important to fill the gap and reduce inequalities. Key factors for the improvement of productivity are essential in boosting and enhancing this growth (Aghion and Howit, 2009). Improved total factor of productivity will result into an increase in production and wage hence, leading to higher standards of leaving. To achieve this, FDI is an opportunity despite the fact that in empirical literature, its contribution leads to controversies. Attracting FDI is important for two main reasons:

First, FDI inflows fill the savings gap, necessary to finance development's projects. Indeed, building a bridge, a dam, a gas plant or a power plant requires a lot of funds. These funds are not generally available, particularly in African countries given the low level of savings. Therefore, FDI inflows, by filling the savings gap, facilitate the financing and development of infrastructure. Second, the presence of foreign firms generates positive externalities on host country through five main channels: technology transfer and know-how; the development and restructuring of local companies through privatization; increased international trade; competition between firms which force them to operate more efficiently; and human capital formation in host country(Todo 2003; Basu and Guariglia, 2007).

[2] See MDG reports 2013

With regards to the relationship between FDI inflows and growth, empirical studies have led to many controversies both at macro and microeconomic level. While some estimate that FDI has a positive impact on growth (see, for example, Bitzer & Gorg, 2009; Liu et al. 2000; Woo, 2009, Li and Liu, 2005), others argue that FDI negatively affect growth (Alfaro et al, 2004; Ang, 2009; Azman-Saini et al, 2010). In effect, existence of absorption capacity is essential in attracting FDI. Building human capital stock is obtained by investing in education and health. Increase in human capital stock will therefore lead to a better acquisition of FDI resulting to positive effects on growth.

Through efficient financial system, FDI contribute significantly to growth (Alfaro et al, 2004). Efficient financial system, lead to a better allocation of resources from less lucrative to more lucrative sectors. Therefore, it guarantees a better monitoring of investments and reduces asymmetries information (Shen and Lee, 2006). The more efficient financial system is, the more it will be able to mobilize savings to finance investment, help to monitor, evaluate and allocate resources efficiently, leading to the strengthening of growth.

Acquisition of new technology through FDI requires important resources since credit rationing in financial markets is a major constraint for entrepreneurs. Efficient financial system, by increasing the amount of resources, reduces this constraint and contributes to increased growth (Alfaro et al, 2004). In addition, the development of financial system is a key indicator for foreign firms, on the existence of opportunities to borrow in order to increase their innovation capacity in host country. Therefore, technological diffusion from FDI will be higher if financial system in the host country is efficient (Hermes et al, 2003).

Similarly, the degree of openness facilitates the mobilization of capital from one country to another thereby positively affecting growth. The more a country is open, the higher is the possibility of attracting FDI to finance lucrative projects, resulting to an increase in growth (Azman-Saini et al, 2010).

Theoretically, the more technological gap between multinational and local firms, the more are spillovers (Wang and Blomstrom, 1992). However, empirical studies do not lead to a consensus. For example, Liu (2005) shows that there is no evidence of positive effects from FDI on growth from the technology gap between MNCs and local firms. This result is confirmed by Herzer et al. (2008) and more recently by Blalock et al (2009). If the effect of FDI on growth are mitigated, what about its effect on TFP?

Studies of the impact of FDI started with Corden (1967) who focused theoretically, on the effect of FDI on the "optimum tariff policy" and Caves (1974) who examined the effect of FDI on welfare and industrial structure. Both studies, Consider the presence of foreign companies as a competitive force, reducing profits, while improving productivity and production efficiency. The overall objectives of both studies were to identify the costs and benefits of FDI, where technological spillovers lead to potential positive indirect effects particularly through productivity. More recently, these technology transfers through FDI will be incorporated in the new theoretical models, developed by Wang and Blomstrom (1992) and resulting from the strategic interaction between multinationals and local companies. Their contribution highlights the importance of competition between domestic firms, to increase their rates of technology

transfer, and force laggard companies with higher technological gap, to operate efficiently and remain competitive.

Empirically, assuming labor mobility from MNCs subsidiaries to domestic firms, spillovers deriving from MNCs staff's training through FDI, will lead to accumulation of skills and human capital in the host country (Haithem, 2010; Fosfuri, 2001). In addition, domestic firms can learn from multinational companies through imitation. This imitation will be more effective if there is a "physical" and continuous contact with the holder technology partner.

FDI are therefore an important channel to ensure technology transfer and strengthen research for development. Interestingly, it improves efficiency and effectiveness of domestic enterprises, leading to an increase in total factor of productivity in the long run (Baldwin el al, 2005). Multinationals can contribute to improvement in productivity and efficiency of local firms through: assisting potential suppliers to obtain new production equipment, the provision of technical assistance in order to improve the quality of suppliers' products and to facilitate their innovation, and finally, access to training and support in terms of managerial know how and organizational.

However, based on microeconomic data consisting of a panel of 17,675 Chinese manufacturing firms, and observed between 1995 and 1999, in the short term, it is proved that FDI had negative effects on productivity of these firms and positive effect on the productivity growth in the long-run (Zhiqiang, 2008).

While some authors argue that FDI have a positive impact on TFP (Woo 2009; Bitzer et al, 2009; Botirjan, 2014), others believe that these impacts are not significant especially in the manufacturing sector (Blalock et al, 2009). The literature also shows that there is a significant spillover effects from multinational firm through FDI, on the productivity of domestic firms. These multinationals can contribute to the effectiveness of local firms by training local workers who will be recruited in the future by local firm and then will transfer their management techniques, and know-how to their local suppliers, making domestics firms increase their management. However, other studies have not supported this view.

In WAEMU, FDI had positive effect, especially to countries with greater technological backwardness like Burkina Faso, Mali, and Niger. In Burkina Faso, FDI inflows have had a positive impact as they generate employment in formal sector and increased local value added. For example, in the telecommunications sector, FDI inflows have led to strengthening competitiveness on mobile and internet services at the regional level (UNCTAD, 2009). On the 8 countries that account for WAEMU, 3 are landlocked[3]. This structural geographical constraint, yield to an increase of additional costs in trade with the rest of the world. As a result, this situation makes them less competitive. Attracting FDI is therefore, important to acquire technology and know-how, yielding to an increase in their productivity. This increase in productivity adds value to their exports making them more competitive. However, this requires considerable efforts from government including education, infrastructure, security, an

[3] Niger, Burkina Faso and Mali

attractive legislative framework, governance improvement, in order to guarantee a sufficient capacity of absorption (UNCTAD, 2009).

Recent studies on the impact of FDI on growth and TFP led to controversies making difficult the convergence towards a consensus. While some estimate that FDI has a positive impact on growth through total factor of productivity, others argue against that the effects of FDI are ambiguous depending on whether economy is in the short or long run. However, econometric modeling technique used and the problem of endogeneity of some variable such as labor in measuring the productivity and the difficulty to measure FDI, can explain such divergences obtained empirically.

Measuring FDI is an important issue in this context of financial globalization in developing countries in general and Africa countries in particular. These shortcomings, could lead to underestimate or overestimate FDI flow and stock to these countries. This could justify the controversy observed empirically concerning the impact of FDI on growth and TFP. Moreover, the use of FDI stocks or flows in different empirical studies could justify these controversies

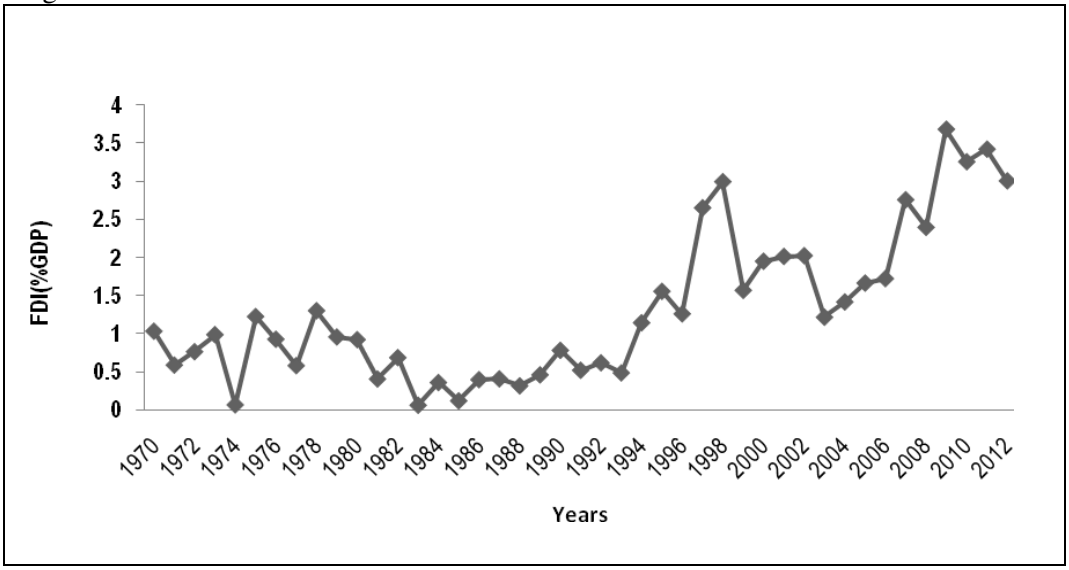
It is therefore difficult empirically to have a consensus on the relationship between spillovers from FDI, growth and productivity of hosting countries.

This paper will therefore, contribute to the empirical debate on the relationship between FDI, growth and productivity by trying to examine these relationships based on macroeconomic data in the specific case of WAEMU countries. It will then try to answer the following question: given the technology transfer from FDI and its positive effects on labor productivity, did FDI inflows to West Africa in general and WAEMU countries in particular contributed to an improvement in growth and TFP?

2.2. Stylized fact

The share of FDI inflows over GDP in WAEMU has increased since 1970. From 1.03 in 1970, it raised to 2.99 in 2012, an increase of around 2.5 per cent average per year (Figure 1). However, the slowdown between 1999 and 2002 could be the consequence of the Ivorian crisis, which started in 1999. The discovery of mineral in Niger, and oil in the region, boosted FDI inflows after 2002.

Figure 1 : Evolution of FDI inflows GDP in WAEMU from 1970 to 2012



Source: Author's Calculation from UNTACD database (2014)

3. Methodology and Data

The methodology is divided as follows: The first step examines the existence of a long run relationship between FDI and GDP per capita for each country and in the sub-region. This is done using Bounds testing cointegration test based on an Unrestricted Error Correction Model (UECM). The second step examines the causality link between GDP per capita and FDI inflows using the Toda-Yamamoto test. The third step involves estimating the total factor of productivity (TFP) which is a proxy for structural transformation. TFP will be obtained using a semi-parametric estimation following the Levinshon and Petrin (2003) methodology. After estimating TFP, the final step estimates the effect of FDI inflows on TFP in the short and the long run.

3.1. Estimating the long run relationship between GDP per capita and FDI inflows

Following Loesse Esso (2010), the long term relationship between GDP and FDI inflows, is estimated using the cointegration test of Bounds suggested by Pesaran and al (2001). The UECM estimated is denoted as;

$$\Delta \ln(g_t) = \alpha_0 + \alpha_1 \ln(g_{t-1}) + \alpha_2 \ln(FDI_{t-1}) + \sum_{i=1}^{p} \beta_i \Delta \ln(g_{t-i}) + \sum_{j=1}^{p} \gamma_j \Delta \ln(FDI_{t-i}) + \varepsilon_t \quad \textbf{(1)}$$

Where g_t is the GDP per capita, FDI is the ratio of FDI inflows over GDP, ε_t is the error component following a Gaussian white noise, $\alpha_i \in \{0,1,2,3\}$; $\beta_i \in \{0,1,2,....p\}$ and

$\gamma_j \in \{0,1,2,....p\}$ are parameters to be estimate. P is the maximum lag of the model minimizing the Akaike, Schwarz and Hannan-Quinn (HQ) information criteria.

3.2. Examining the causality between GDP per capita and FDI inflows.

The causality between GDP per capita and the ratio of FDI inflows over GDP is examined using the Toda-Yamamoto (1995) test. This test is motivated by the fact that, the sequential procedure of causality test proposed by Engel and Granger could introduce potential bias in each step of the procedure and therefore make uncertain the causal inference. Indeed, the power unit root test is low in small samples and nothing guarantees that a linear combination of integrated variable eliminates any bias (Keho, 2008) .In addition, the differentiation of variables to obtain stationary series induces loss of important information and therefore reduces the dynamism of the model. The cointegration test of Johansen is sensitive to the choice of the number of lags and the presence of deterministic trend in the cointegration space and in the VAR (Keho, 2008). This conduces to a risk of sub-parameterization of the VAR and the loosing of degree of freedom introduce distortion and weakens the efficiency of the cointegration test.

The Toda-Yamamoto (1995) test is implemented by first estimating an "Augmented" VAR of order $P = m + d_{\max}$ **(2).** Where $d_{\max}$ is the maximum order of integration of the VAR's series.

For each country of the union, the model to be estimate is as follows:

$$\begin{cases} y_t = \varphi_0 + \sum_{i=1}^{m} \pi_i y_{t-i} + \sum_{i=m+1}^{m+d_{\max}} \pi_i y_{t-i} + \sum_{i=1}^{m} \varphi_i F_{t-i} + \sum_{i=m+1}^{m+d_{\max}} \varphi_i F_{t-i} + \upsilon_{1t} \\ F_t = \tau_0 + \sum_{i=1}^{m} \omega_i F_{t-i} + \sum_{i=m+1}^{m+d_{\max}} \omega_i F_{t-i} + \sum_{i=1}^{m} \tau_i y_{t-i} + \sum_{i=m+1}^{m+d_{\max}} \tau_i y_{t-i} + \upsilon_{2t} \end{cases} \quad \textbf{(3)}$$

Where $y_t = \ln(g_t)$ and $F_t = \ln(FDI_t)$. $\varphi_i, \pi_i, \tau_i, \omega_i$ are the parameters to be estimated and $d_{\max}$ the maximum order of integration among series and is obtain by using the Augmented Dickey-Fuller (ADF) statistics. υ_{it} are residual following a normal distribution.
To test the causality between FDI and GDP the following test is formulated.

$H_0 : \varphi_i = 0..\forall i = 1,....,m$. Under H_0, the statistic of the test is given as:

$$W = N(\hat{\varphi} R'(R \hat{\Sigma}_{\upsilon} R')^{-1} R \hat{\varphi}) \quad \textbf{(4)}$$

Where $\hat{\Sigma}_{\upsilon}$ is the variance covariance matrix of υ_{it}, following a chi-square with m degree of freedom.

3.3. Estimating Total Factor of Productivity (TFP)[4]

This section presents the methodology to estimate the TFP based on the LP (2003) approach. Following Amil (2004), a key issue in the estimation of production functions is the correlation between unobservable productivity shocks and inputs level. A positive productivity shock leads to an increase in the production within the profit-maximizing firm and then requires additional inputs. Therefore, estimating production function using the Ordinary Least Square (OLS), lead to biased estimates of productivity. According to Olley and Pakes (1996), to deal with the problem of unobservable productivity, there is need to develop an estimator that uses investment as a proxy. Levinsohn and Petrin (2003), more recently demonstrate that the use of investment as a proxy of unobservable shock may not smoothly respond to productivity shock as there exist substantial adjustment cost. In addition, investment proxy is only valid for plants reporting nonzero investment. They propose to use intermediate input (electricity or materials) proxies instead of investment to avoids truncating all zero investment firms because at least firms always report positive use of these intermediate input.

For the purpose of this methodology, the production technology is assumed to be a Cobb-Douglas $$y_t = \beta_0 + \beta_l l_t + \beta_k k_t + \beta_m m_t + \omega_t + \eta_t \quad \textbf{(5)}$$

Where y_t is the logarithm of the firm's output, measured in this paper as the logarithm of gross domestic product, l_t and m_t are the logarithm of freely variable inputs labor and intermediate input (energy or materials) and k_t is the logarithm of the state variable capital[5]. ω_t is the transmitted productivity component and η_t is an error component uncorrelated with input choices. ω_t is also an error component but the difference with η_t is that it is a state variable and hence, it impacts the firm's decision rules. In addition, it is unobserved by the econometrician but it can impact on the choices of inputs leading to a simultaneity problem in production function estimation. This is why the use of OLS to deal with this issue yields to inconsistence results and biases the estimates of productivity shocks.

The demand of intermediate input, m_t , is assumed to depend on the firm's state variable k_t and ω_t. $$m_t = m_t(k_t, \omega_t) \quad \textbf{(6).}$$

LP (2003a, Appendix A) show that m_t is monotonically increasing in ω_t. Therefore, inverting m_t, ω_t can be written as

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[4] This paper used the Amil and al (2004) notation. TFP is the Solow residual and is equal to $TFP_{it} = \frac{y_{it}}{l_{it}^{\beta_l} k_{it}^{\beta_k}}$

[5] Following closely the method used by Chow (1993), Li (1997), Zhiqiang (2001 and 2008) this paper uses the perpetual inventory method to obtain the real capital stock in year t: $K_{it} = (1-\delta)K_{it-1} + I_{it}$ and $K_0 = \frac{I_0}{\delta + g}$ in the Solow model steady state relationship. g is the geometric average annual growth rate of investment $g = \sqrt[n]{\frac{I_n}{I_0}} - 1$.

As the annual depreciation rate of capital stock is unknown for WAEMU countries, following Young(2000) and Zhiqiang (2008) this paper assumes that δ=7% and 10%. The use of these different values will help to measure if an increase or decrease of the annual depreciation rate of capital is significant (negatively and positively) on the Total factor productivity within the presence of foreign firms.

$$\omega_t = m_t^{-1}(k_t, m_t) = \omega_t(k_t, m_t) \quad \textbf{(7)}.$$

This equation then shows that the unobserved productivity is expressed as a function of two observed inputs. Following Olley and Pakes (1996), LP (2003) assume that ω_t follows a first-order Markov process $\omega_t = E(\omega_t / \omega_{t-1}) + \xi_t$ **(8)**

Where ξ_t is an innovation to productivity, uncorrelated with k_t but not necessary with l_t. To estimate the productivity shocks, Eq 5 can be rewritten as

$$y_t = \beta_l l_t + \phi_t(k_t, m_t) + \eta_t \quad \textbf{(9)}$$

Where $\phi_t(k_t, m_t) = \beta_0 + \beta_k k_t + \beta_m m_t + \omega_t(k_t, m_t)$ **(10).**

Coefficients of equation 9 are estimate using OLS assuming that $\phi_t(k_t, m_t)$ follows a third order polynomial approximation. The bootstrap approach is finally used to construct standard errors for $\hat{\beta}_l$, $\hat{\beta}_k$ and $\hat{\beta}_m$.

3.4. Estimating the impact of FDI inflows on the TFP

Following Zhiqiang (2008), the panel model to be estimated is:

$$\log(TFP_{it}) = \alpha_1 \log(FDI_{it}) + \alpha_2 \log(W_{it}) + \alpha_3 \log(Z_{it}) + \alpha_4 Q_{it} + \alpha_5 \log(FDI_{it}) * DTF_{it} + \alpha_6 HK_{it} + \alpha_7 Time * \log(FDI_{it}) + \varepsilon_{it}$$
(11)

Where TFP represents total factor of productivity, which is a proxy for structural transformation. W, Z and Q are three groups of controls variables denoting: economic policy, business environment and political risk. DTF[6] is the distance technological frontier which is derived as the US labor productivity divided by the labor productivity of the country under consideration (Botirjan, 2014). DTF captures autonomous technological transfer from advanced countries to technologically laggard ones (Griffith and al., 2004; Madsen et al., 2010; Botirjan, 2014). This paper includes the first lag of DTF to account for the fact that it might take time to imitate technologies developed abroad (Botirjan, 2014). The positive sign of the coefficient α_5, implies that laggard countries have more potential to absorb technology from FDI.

HK is the stock of human capital measured as the average years of schooling for the population over 15 years of age[7](Inklaar and Timmer, 2013). Higher levels of human capital can help countries to develop their technologies as well as increasing countries' ability to absorb technologies developed elsewhere (Kneller, 2005; Nelson & Phelps, 1966). In addition, it could also be an important R&D input for innovation and therefore increase productivity

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[6] $DTF_{it} = (\frac{Max(A_j)}{A_{it}})_{t-1}$, Where $Max(A_j)$ is the Maximum level of US labor productivity and A_{it} is the labor productivity of country i at time t.

[7] $HK = e^{\phi(S_{it})}$ where
$\phi(s) = 0.134 * S1_{\{S \le 4\}} + 0.134 * 4 + 0.0101(S-4)1_{\{4 < S \le 8\}} + 0.134 * 4 + 0.101 * 4 + 0.068(S-8)1_{\{S > 8\}}$ (Inklaar and Timmer, 2013); Caselli(2005), Psacharopoulos(1994)

(Romer, 1990). It is therefore expected that the sign of the coefficient related to this variable is positive. α_1 captures the effect of FDI on the short-term level of productivity, while α_7 captures the effect of FDI on the long-term rate on total factor productivity (Zhiqiang, 2008). The two coefficients are expected to be positive.

Following Gohou et al (2009), the ratio of total debt over GDP, inflation and openness will be used as proxies for economic policy. The coefficients of debt over GDP and inflation are expected to be negative while the coefficient of openness is expected to be positive as openness to trade can give a country better access to technologies developed abroad and enhance their catching-up process through adaptation of advanced foreign technologies (Keller, 2004). Trade openness also positively affects total factor productivity (Miller and Upadhyay, 2000).

The total credit by financial intermediaries to private sector over GDP is used as proxies for business environment with a positive impact expected as an increase of banks credit to private sector increase the amount of investment to avoid aging capital and therefore increase the total factor productivity. Political right rating and civil liberty rating will be used as proxies for political risk with positive sign expected.

Before estimating the panel model (Eq. 11), a poolability test based on Hsiao (1986) will be implemented in order to guarantee that a panel model is applicable for the WAEMU countries. This is a homogeneity test based on the hypothesis that regression coefficients for each country are the same and equal to a constant even if each country might present specificities.

To deal with the problem of endogeneity, a GMM system method is used to estimate **Eq 11** where exogenous variables and lags of order 2 and more of independent variables will serve as instruments. The estimates will be conducted over different sub period to examine whether the significance and the sign of different coefficients shift from one sub period to another.

3.5. Data

The empirical analyses[8] in this paper are based on a balanced panel of 7 countries of WAEMU excluding Guinea Bissau, due to higher level of missing data for this country, and cover the period 1980 to 2011. (Table 1, See Appendix).

4. Results

4.1. Results of unit root tests

Implementing Bounds test is conditional to the fact that, the maximum order of integration of variable of the system is one. Results of unit root test show that none of the variables is integrated to an order greater than one (Table 2). GDP per capita is integrated of order 1 in all WAEMU countries except in Mali where it is stationary in level at 5 per cent significance level.

[8] Eq 11 in particular

However, the ratio of FDI over GDP is integrated of order 1 in countries such as Benin, Cote d'Ivoire, Guinea Bissau, Niger, Senegal, and Togo and in WAEMU in general, while it is level stationary in Burkina Faso and Mali (Table 2, see Appendix).

4.2. Long run cointegration relationship between GDP per capita and the ratio of FDI over GDP

There is a cointegration relationship between the growth of GDP per capita and the growth of the ratio FDI over GDP in Benin, Guinea Bissau, Mali, and WAEMU at 5 per cent significant level and 10 per cent significant level in Côte d'Ivoire (Table 3). However, there is no evidence of cointegration at 5 per cent significant level between the growth of GDP per capita and the growth of the FDI over GDP in Burkina Faso, Niger, Senegal and Togo.

Table 3: Bounds Test F-Statistics: sample 1970-2012(ΔGDP per capita as endogenous variable)

Countries	Lags	F-stat	Outcome
Benin	3	5.74	Cointegration at 5%
Burkina Faso	2	0.78	No cointegration
Cote d'Ivoire	4	5.74	Cointegration at 10%
Guinea Bissau	3	4.58	Cointegration at 5%
Mali	4	9.27	Cointegration at 5%
Niger	3	3.22	No cointegration
Senegal	2	3.50	No cointegration
Togo	3	2.90	No cointegration
WAEMU	3	5.77	Cointegration at 5%

Source: Author's calculation from UNCTAD database, access April 2014

4.3. Causality analysis

The results of the Toda-Yamamoto test show that there is a bi-directional causality between GDP per capita and the ratio of FDI over GDP in WAEMU (Table 4). This is consistent with the results of Hansen and Rand (2006) who used data on 31 countries including Côte d'Ivoire, showed the existence of a bi-directional causality between GDP and FDI. However, at a country level, FDI cause GDP, only in Guinea Bissau and GDP causes FDI only in Niger. In the others countries, there is no evidence of causality, despite the existence of a long-run relationship between these two variables.

The Toda analysis of causality therefore demonstrates that, in WAEMU in general, FDI affect GDP with lags and vice versa. This confirms the fact that, the effect of FDI on growth requires time. Indeed, it takes time to build up a stock of human capital, to invest in infrastructure, to attract FDI, and time for FDI to spread and produce positive effects on GDP. An average of two years is therefore necessary in WAEMU, to obtain a significant effect of FDI on GDP (Table 4). Studies of FDI on GDP which does not take into account this aspect of long run, might lead to an erroneous conclusion that, FDI has no effect on GDP. Similarly, growth is also important for attracting FDI (Table 4).

Table 4: Toda and Yamamoto non causality test results, sample 1970-2012

Countries	Lags	FDI doesn't cause GDP per capita		GDP per capita doesn't cause FDI	
		Wald statistics	P-value	Wald statistics	P-value
Benin	2	0.005	0.94	0.35	0.55
Burkina Faso	2	0.59	0.44	1.06	0.3
Cote d'Ivoire	4	0.22	0.89	0.06	0.8
Guinea Bissau	2	6.02	0.01***	0.46	0.49
Mali	2	0.03	0.86	0.14	0.71
Niger	2	0.33	0.56	31.65	0.00***
Senegal	2	1.78	0.182	0.076	0.78
Togo	2	1.82	0.17	2.52	0.11
WAEMU	2	6.71	0.00***	3.71	0.054*

Source: Author's Estimation from UNCTAD database, access April 2014, *** indicates rejection of null hypothesis for p<0.01, * indicates rejection of null hypothesis for p<0.1.

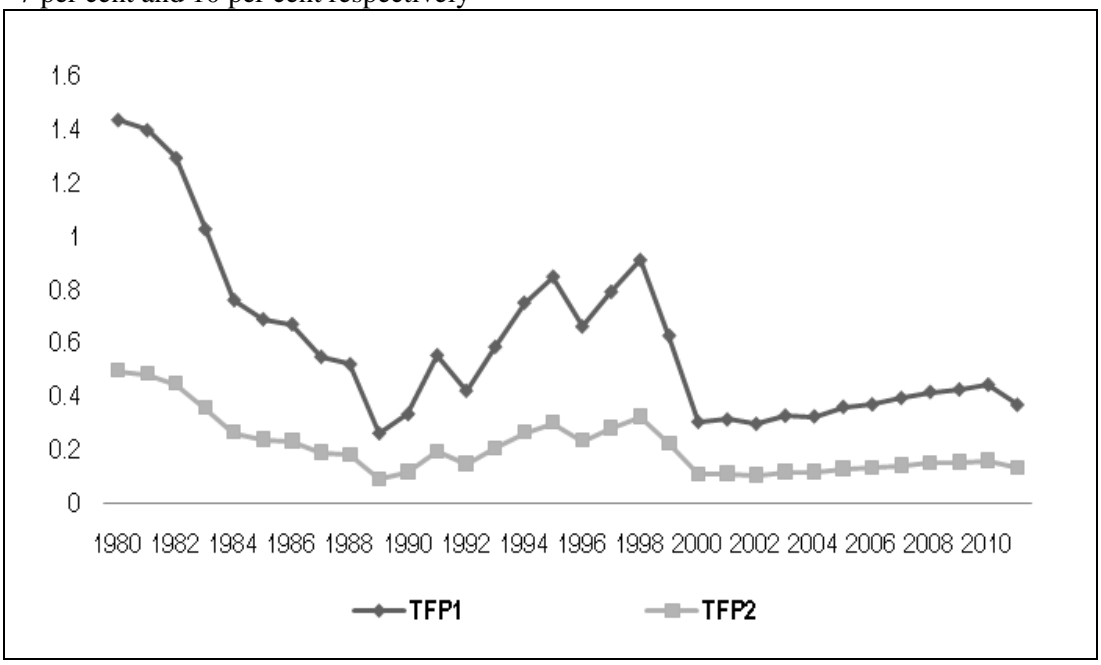
4.4. Result of the estimation of factors elasticities according to LP (2003)

Before estimating the total factor of productivity, this study determines the elasticity of labor and capital inputs. For different values of the depreciation of capital, factor elasticities are estimated using the semi-parametric method of LP assuming constant return to scale. Robust standard errors are derived from using 250 replications bootstrap of the sum of square residual. Results presented show that coefficients related to production factors are all significant at 5 percent and 10 percent when the depreciation of capital stock is 7 percent and 10 percent respectively (Table 5). However, the coefficient of energy is not significant at 10 per cent significant level (Table 5, see Appendix).

4.5. TFP trend in WAEMU and country's contribution

TFP in WAEMU recorded a sharp decline between 1980 and 1990 (Figure 2). Despite the recovery that took place in the early 1990s, the drop of productivity at the beginning of 1999 coincided with the beginning of the Ivorian crisis. In addition, the TFP is higher when the depreciation of capital is low. This result proves that, depreciation of capital, by reducing the stock of capital, reduce the level of TFP.

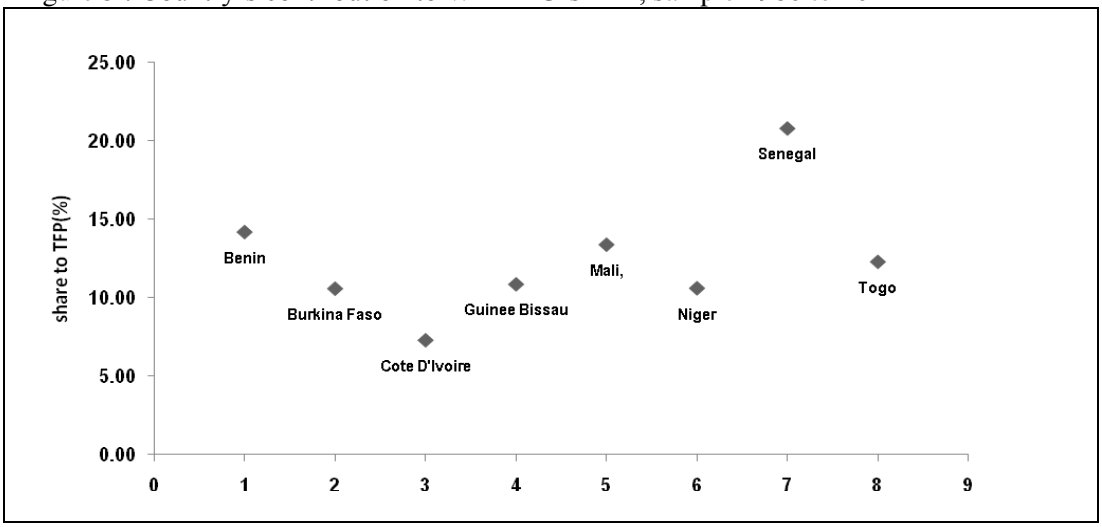
Figure 2 : Evolution of TFP in WAEMU from 1980 to 2011, when the depreciation of capital is equal to 7 per cent and 10 per cent respectively



Source: Author's Calculation from UNTACD database (2014). TFP1 and TFP2 is the TFP assuming that the depreciation of capital is equal to 7 per cent and 10 per cent respectively.

In terms of contribution, Senegal has recorded the highest TFP in the region between 1980 and 2011 (Figure 3). However, after more than 10 years of instability, Cote d'Ivoire, has less contributed to the TFP of the region.

Figure 3 : Country's contribution to WAEMU's TFP, sample 1980 to 2011



Source: Author's Calculation from UNTACD database (2014).

4.6. Result of poolability test Hsiao (1996)

The poolability results test shows that a panel model is suitable to fit our model although there are specificities for each country. Indeed, the p-value of the second F-statistic is 0.38 which is above the 5 per cent critical value. This leads to the non-rejection of the null hypothesis that the coefficients of the regression of each individual are identical to a given constant. However, the p-value of the last F-statistic is 0.00 and less than the 5 per cent critical value leading to rejection of the null hypothesis of non-existence of specific country effects (Table 6, see Appendix).

4.7. Effect of FDI on TFP when capital depreciates at 10 per cent every year

When the depreciation of capital is 10 percent, FDI have no significant positive effects on total factor productivity, whatever the period in short-run and long-run. The explanation is due to the fact that when capital depreciates at 10 per cent every year, the volume of investments devoted to the maintenance and replacement of aging equipment is higher. Thus, the share of spending to accumulate human capital stock in the short term in order to remain competitive decreased significantly so that the decline of working time allocated to current production is not significant and therefore not translating into a significant decrease in productivity in the short term. In addition, in the long-term productivity decline persists given the low stock of capital accumulated in the short term to compensate for the loss of productivity in the short term but this remains in marginal proportions.

With regards to control variables, a one percent increase in inflation results in a decrease of total factor productivity by 0.1 per cent, while a one percent increase of openness causes a 0.17 per cent increase of total factor of productivity (column 4). In addition, an increase in population growth and debt by one per cent leads to a decrease of total factor productivity by 0.69 and 0.14 per cent respectively. Moreover, increasing the stock of human capital by one per cent boosts total factor productivity by 0.425 per cent.

Table 7: Estimating the effect of FDI on TFP assuming Delta is equal to 10 per cent

Variables	(1)	(2)	(3)	(4)
Log(FDI)	-0.082	-0.054	-0.09	-0.177
	-0.9	-0.36	-0.51	-1.46
Log(FDI*TREND)	0.003	0.001	0.002	-0.005
	0.68	0.37	0.29	-1.47
Log(Inflation)	-0.375	-0.038	-0.279	-0.104
	(-2.01)*	-0.46	(-3.10)**	(-2.97)**
Log(Openness)	0.008	-0.031	0.047	0.178
	0.04	-0.16	0.28	(2.83)**
Log(Population growth)	-0.721	-0.516	0.3	-0.691
	(-4.33)***	(-8.62)***	1.22	(-8.41)***
Log(Debt over GDP)	-0.081	-0.13	0.066	-0.145
	-0.49	-1.58	1.67	(-3.91)***
Log(Bank Credit over GDP)	-0.081	-0.124	0.291	-0.001
	-1.23	(-2.01)*	(2.14)*	-0.01
Log (FDI *DTF)	0.019	0.018	0.001	0.017
	(-2.22)*	(-2.42)*	0.13	(2.66)**
Log(Human Capital Stock)	0.817	0.312	0.178	0.425
	(3.08)**	(2.3)*	1.86	(2.67)**
Civil Liberty	0.623	0.054	0.032	0.029
	0.62	1.05	1.35	0.76
Political Right	0.919	0.006	-0.072	0.003
	(7.44)***	0.05	-1.64	0.03
Observations	60	60	72	192
F-Test (P-value)	0.009	0.0421	0.007	0.0518
Sargan P-value	0.001	0.00	0.00	0.00
AR(1) P-value	0.058	0.0104	0.0202	0.0192
AR(2) P-value	0.73	0.836	0.064	0.179

Source: Authors Estimations. Robust t-statistics in parentheses, whereby significant is denoted * for p<0.1, ** for p<0.05; *** for p<0.01. Dependant variable is ltfp for column (1) to column (4). Column (1), (2), (3) and (4) estimates the level effect of FDI on tfp between 1980-1989, 1990-1999, 2000-2011 and 1980-2011 respectively.

4.8. Effect of FDI on TFP when capital depreciates at 7 per cent every year

If the depreciation of capital decreases from 10 per cent to 7 percent[9], the presence of foreign firms is reflected in the short term by a decline in total factor of productivity by 0.24 per cent and an increase in the long-term by 0007 percent (column 4). The explanation for this mechanism arises from the fact that the decrease in depreciation of capital leads to a reallocation in short-term of the volume of investment which would have served for the replacement and maintenance of aging equipment, to the constitution and the accumulation of human capital stock necessary to acquire technology in the long term and to remain competitive, thereby reducing in the short-term the number of hours allocated to current production and yield to a decline in productivity in the short term. However, in the long term, the combination of the human capital stock and the know-how accumulation in the short term will make more efficient and productive different units of production, resulting in an increase of total factor of productivity. Zhiqiang (2008) obtained the same result by using data from 17,675 China manufacturing firms observed over 5 years between 1995 and 1999.

[9] This result remains robust when the depreciation of capital decreases from 7 per cent to 5 per cent.

Regarding the control variables, despite inflation keeping the expected sign; it is not significant when the depreciation of the capital stock is 7 per cent. Similarly, an increase of one per cent in the level of debt leads to a decline in total factor productivity by 0.145 per cent. However, a one per cent increase of openness yields to an increase of total factor of productivity by 0.134 per cent at 10 per cent significance level. In the same order, an increase of the human capital stock by one percent will drive up the total factor productivity by 0.43 per cent at 10 per cent significance.

Moreover, the isolated effect of the increase of human capital stock (0.43 percent) is much higher on the total factor of productivity than the sum of the effects of FDI (0.007 per cent) and openness (0.134 per cent). This result shows that if WAEMU countries want to converge to a structural transformation of their economies in the long term, they must create propitious conditions to get there by investing in education and health in order to accumulate a good quality of human capital stock able to increase total factor productivity leading to an increase in production and employment.

Table 8: Estimating the effect of FDI on TFP assuming Delta is equal to 7 per cent

Variables	**(1)**	**(2)**	**(3)**	**(4)**
Log(FDI)	-0.059	-0.004	-0.025	-0.247
	-0.58	-0.03	-0.2	(-2.14)*
Log(FDI*TREND)	0.001	0.001	0.002	0.007
	0.1	0.3	0.3	(2.54)**
Log(Inflation)	-0.422	-0.112	-0.287	-0.013
	-1.74	-1.37	(-3.02)**	-0.31
Log(Openness)	-0.057	-0.07	-0.019	0.134
	-0.26	-0.34	-0.12	(2.09)*
Log(Population growth)	-0.753	-0.58	-0.45	-0.666
	(-3.77)***	(-12.65)***	-1.16	(-7.73)***
Log(Debt over GDP)	-0.055	-0.243	-0.036	-0.191
	-0.27	(-3.03)*	-1.14	(-5.12)**
Log(Bank Credit over GDP)	0.065	0.109	0.406	0.017
	0.8	1.83	(3.70)**	0.26
Log (FDI *DTF)	0.02	0.017	-0.001	0.018
	(2.04)*	(2.61)**	-0.12	(2.46)**
Log(Human Capital Stock)	0.825	0.229	0.24	0.435
	(2.83)**	(2.15)*	(2.17)*	(2.26)*
Civil Liberty	1.362	0.087	0.09	0.067
	1.08	1.65	(3.92)***	1.65
Political Right	0.942	-0.015	-0.06	-0.012
	(6.33)***	-0.11	-1.15	-0.1
Observations	60	60	72	192
F-Test (P-value)	0.011	0.0615	0.004	0.033
Sargan P-value	0.00	0.00	0.00	0.00
AR(1) P-value	0.054	0.087	0.0234	0.0153
AR(2) P-value	0.633	0.841	0.098	0.132

Source: Authors Estimations. Robust t-statistics in parentheses, whereby significant is denoted * for p<0.1, ** for p<0.05; *** for p<0.01. Dependant variable is ltfp for column (1) to column (4). Column (1), (2), (3) and (4) estimates the level effect of FDI on tfp between 1980-1989, 1990-1999, 2000-2011 and 1980-2011 respectively.

5. Conclusion and policy implication

This study demonstrates, on the basis of robust econometric modeling, the importance of FDI on economic growth in WAEMU countries. The empirical results show a long-run convergence between GDP per capita and FDI. In addition, the bidirectional causality obtained between FDI and growth confirms the convergence of this long-run relationship and the simultaneous importance of these two.

This study also highlights the impact of FDI on total factor of productivity own to the importance of the depreciation of capital on firm's decisions and choices, to accumulate human capital in the short run through the allocation of investment and the time devoted to current production. As demonstrated by the theory of endogenous growth, this paper shows that high quality of human capital stock leads to positive and significant effects on productivity. Similarly, the existence of absorptive capacity in terms of the distance to the technology leader, of receiving countries, is important to acquire technology provided by multinational firms through FDI, and boost the productivity of these countries.

In summary, if WAEMU countries want to converge in the long run to inclusive growth, significant and collective efforts are required to attract FDI inflows. In addition, they must intensify their investment on health and education in order to boost the quality of human capital stock and sufficient absorptive capacity necessary to acquire technological transfer from FDI. They should also strengthen their openness, to encourage massive FDI inflows to the region. Finally, investing in infrastructure is important and reducing depreciation of physical capital stock is fundamental to increase TFP in the long run.

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The usual disclaimer applies.

Appendix: Tables of results

Table 1: Definition and summary statistics of key variables used

Variable	Definition	source
g	GDP per capita	UNCTAD
L	labor	UNCTAD
Investment	Gross formation capital	UNCTAD
FDI	Foreign direct investment inflows	UNCTAD
K	Stock of capital	Estimate by the author
TFP	Total Factor Productivity	Estimate by the author
Infl	Inflation	World Development Indicator-World Bank-Access January 2014
openness	Sum of exports and imports over GDP	UNCTAD
PR	Political Right rating	Freedom House-www.freedomhouse.org
CL	Civil Liberty	Freedom House-www.freedomhouse.org
Debt	Government debt over GDP	
HKS	average year of schooling for the population aged 15 and older	Barro and Lee database, access April, 2014
Credit	Total credit by financial intermediaries to private sector over GDP	Financial Development and Structure Dataset(World Bank)
Energy[10]	Total Electricity Net Consumption (Billion Kilowatt-hours)	US Energy Information Administration (Independent Statistics and Analysis)
DTF[11]	Distance to Technological frontier	PWT6.3 database
Popg	Population growth	World Development Indicator-World Bank-Access January 2014

Table 2: Results for unit root test: sample 1970-2012

Countries/Region	Level		First difference		d_{max}
	GDP	FDI	GDP	FDI	
Benin	-	-	I(1)	I(1)	1
Burkina Faso	-	I(0)	I(1)	-	1
Cote d'Ivoire	-	-	I(1)	I(1)	1
Guinea Bissau	-	-	I(1)	I(1)	1
Mali	I(0)	I(0)	-	-	0
Niger	-	-	I(1)	I(1)	1
Senegal	-	-	I(1)	I(1)	1
Togo	-	-	I(1)	I(1)	1
WAEMU	-	-	I(1)	I(1)	1

Source: Author's calculation from UNCTAD database, access April 2014

[10] http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=2&pid=2&aid=2&cid=BN,UV,IV,PU, ML,NG,SG,TO,&syid=1980&eyid=2012&unit=BKWH

[11] https://pwt.sas.upenn.edu/php_site/pwt63/pwt63_form.php; access April 2014

Table 5: Levinsohn and Petrin (LP) estimation of labor, capital and energy elasticity's, dependant variable is a log of production (GDP)

Parameters	Delta=7%	Delta=10%
	LP	LP
Lnl	0.421** (0.045)	0.373* (0.087)
Lnk	0.490** (0.046)	0.621* (0.079)
Lne	0.380*** (0.015)	0.35 (0.317)

Source: Author's Estimation from UNCTAD database, access April 2014, whereby significant is denoted * for p<0.1, ** for p<0.05; *** for p<0.01. 250 replications bootstrap to estimate the standard error.

Table 6: Poolability test

Hypothesis	F-stat	P-value	Decision
Pool panel data	18.40	0.00	Reject H_0
Panel data	1.06	0.38	Don't reject H_0
Country specificity	138.11	0.00	Reject H_0

Source: Author's Estimation

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