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Effects of Foreign Direct Investment on Total Factor Productivity in CEMAC

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Abstract: *This article aims to analyse the effects of foreign direct investment (IDE) on total factor productivity (PTF) in the Economic and Monetary Community of Central Africa (CEMAC). Using annual data for the period 1990-2020, the methodology was based on the Generalised Moments Method (MMG). The results of this research indicate that three variables positively influence total factor production. These are total factor productivity lagged one period, foreign direct investment and human capital. On the other hand, trade openness, labor force, gross fixed capital formation and political stability negatively explain total factor production. This suggests a series of policy recommendations.*

Keywords*: Foreign direct investment, total factor productivity, spillovers, MMG, CEMAC.*

JEL classification*: F23, O4, F21.*

1. Introduction

The issue of the impacts of foreign direct investment (IDE) on total factor productivity (PTF) has become a national and international concern. According to the work of Solow (1988) and Ozyurt (2008), the entry of IDE into host countries improves total factor productivity and thus facilitates these countries' access to advanced technologies. For the World Bank (2017), IDE brings technical know-how, improves the qualifications of the workforce, creates activity for local businesses and strengthens productivity.

In sub-Saharan Africa, the question of the effects of IDE on total factor productivity is acute. According to Calderon (2021), in this continent, economic activities are faced with panoply of shocks linked, in particular, to natural disasters, political instability, epidemics, wars and deteriorations in the terms of trade. Added to this, are the gaps between economic activity sectors and production units. This results in a poor allocation of resources between the different countries.

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In the Economic and Monetary Community of Central Africa (CEMAC), the work of the World Bank (2021) studied the impact of IDE on TFP over the period from 2010 to 2018. Their results revealed an improvement in IDE incoming followed by an increase in productivity. In Cameroon, this improvement in IDE and productivity was estimated at 0.54% in 2010 against 3.06% in 2018. In Congo, it was -1.8% in 2010 against 12.9% in 2018. In Gabon, the country recorded in 2010 a drop in IDE and PTF of around 9.67% against a slight change of 1.74% in 2018. In the Central African Republic, economic activities recorded a decrease of 9.7% in 2010 against an increase of 4.16%. In Chad, they were -10.4% in 2010 with an increase of 1.96% in 2018. In contrast, in Equatorial Guinea, FDI and productivity increased by 1.98% in 2010 against a decrease -2.05% in 2018.

In contrast, in 2020, the growth rate of total factor productivity in CEMAC was estimated at -11.71%. This decline in total factor productivity had spread to all the countries of the sub-region. Thus, in Congo, Chad, Gabon, RCA, Equatorial Guinea and Cameroon, this rate was 1.13%, 1.41%, 2.14%, 2.15%, 2.21% and 2.65%, respectively.

Faced with this drop in the PTF, the CEMAC countries and their financial technical partners have taken the initiative to set up the African Continental Free Trade Area (ZLECAF). The objective of this initiative is to promote the deal in Africa's internal and external trade relations, and also, to improve the conditions of intra-regional trade, to promote total factor productivity and to diversify the economic activities of CEMAC through the establishment of an efficient institution and a business climate favourable to the attractiveness of IDE.

Within this community, research by Ngongang (2013) and Ekodo *et al*. (2020) analysed the issue of the impacts of IDE on the PTF. Thus, Ngongang (2013) by treating the impact of foreign direct investment on the level of productivity of companies in the CEMAC over the period 1984-2008, finds that IDE positively and significantly impact the productivity of the factors of companies. On the other hand, Ekodo *et al*. (2020) using the generalised method of moments (MMG) in dynamic panel over the period from 1996 to 2016 find an absence of effects between the two variables.

In this paper, the impacts of foreign direct investment on total factor productivity have been studied. This was done by an empirical estimate that combines quantitative variables with the aim of analysing more broadly how IDE can contribute to improving total factor productivity. It will be a question in the context of the CEMAC countries, whether IDE and its determinants can be favorable to the improvement of factor productivity. Where again, if IDE can facilitate the access of these countries to advanced technologies.

The remainder of this article is organised as follows. In the next section, we present the literature review. In the third section, we will present the methodology chosen to estimate the influence of foreign direct investment on total factor productivity. The fourth section will present and discuss the obtained results. The fifth section will present the conclusions of our research.

2. Literature review

2.1. Theoretical review

The economic literature on the effects of IDE on PTF has been marked by authors such as Romer (1986), Cohen and Levinthal (1990), Grossman and Helpman (1991), Aghion and Howitt (1992), Wang and Blomström (1992), DeMello (1997), Borensztein *et al*., (1998), Feldstein (2000) and Stiglitz (2000). In his work on the impacts of IDE on PTF, Romer (1986) shows that IDE is a privileged channel for technology transfer, accumulation of knowledge and know-how. Cohen and Levinthal (1990) explore the relationship between IDE and PTF. They insist on the absorptive capacity and note that this represents the basis of technological transfers and the development of internal innovations. For Grossman and Helpman (1991) as well as Aghion and Howitt (1992), the emphasis is on the hypothesis of technological progress. For these authors, the implementation in underdeveloped countries of openness policies would allow these countries to produce goods similar to those of developed countries. This would result in the acquisition of know-how and a high rate of investment.

Wang and Blomström (1992) developed a model of international technology transfer for IDE where they rely on the role that the supervisory authorities of the host countries should play on the learning effort of domestic firms. They find that the foreign firm maintains a higher level of technology than the local firm. This implies a technological race between the two firms: the multinational firm which seeks to widen the technological gap and the local firm which seeks to reduce this gap. For these authors, developing countries wishing to host FMNs must maximise the rate of transfer of new technologies and assist domestic firms in their learning effort. This implies that the process of technology transfer depends on the performance of local firms in terms of absorptive capacity.

DeMello (1997), Borensztein *et al.*, (1998), Feldstein (2000) and Stiglitz (2000) go further by emphasising local capital, foreign capital, new types of fixed capital inputs from countries of reception and access to markets and vocational training. For DeMello (1997), the stock of technology in the host

country is a function of local capital and foreign capital or even of the substitution of the two. Thus, the presence of IDE in host countries provides access to a series of non-tradable intangible assets that lead to increasing returns to scale and boost productivity. According to Borensztein *et al.*, (1998) and Feldstein (2000), the gains from IDE to developing countries lie in the transfer of technology in the form of new types of fixed capital inputs that contribute to the development of human resources. On the other hand, Stiglitz (2000) finds that IDE brings with it not only resources, but also technology, access to markets and vocational training. They thus improve the quality of human capital in the host countries.

2.2. Empirical review

Much empirical work has been done on the impacts of IDE on PTF in a number of developed and developing countries. Bertschek (1995), for example, analyses the relationship between IDE inflows and product and process innovations in Germany. They use a sample of 1270 manufacturing companies over the period 1948-1988 and find that IDE inflows positively affect local companies.

Blundell and Bond (1996) discussed the impact of IDE on the productivity of German and Italian firms. They used the technological gap between local firms and foreign firms as well as the generalised moments model. Their results revealed a positive and significant impact of IDE on business productivity.

Barrios and Strobl (2002) studied the effect of foreign direct investment on productivity spillovers in Spain over the period from 1990-1998. They conducted this study on panel data from manufacturing companies and used the semi-parametric regression technique. These authors arrived at the results according to which IDE has a positive impact on the productivity of companies with sufficient levels of capacity.

Using UK data, Driffield (2002) attempted to test the hypothesis of the effects of IDE on domestic productivity growth. The results obtained suggest that foreign direct investment stimulates productivity growth in the domestic sector by about 0.75% per year.

Arnold *et al.*, (2011) conducted a study on the link between the presence of IDE and total factor productivity in the Czech Republic. Their analysis was carried out on company data from 21 industrial sectors between 1998 and 2003. They highlighted a positive relationship between IDE and productivity. But they also found that the presence of IDE in companies improves the range and quality of industrial services. This translates into an improvement in the performance of manufacturing companies.

The work of Alam *et al.,* (2013) studied the relationship between economic growth, foreign direct investment and labour productivity of nineteen (19) OECD member countries over the period from 1980 to 2009. They used the technique of causality, the error correction mechanism and the generalised method of moments. The authors found that foreign direct investment causes long-term productivity growth.

In developing countries, several works have analysed the effects of IDE on the total productivity of companies, notably those of Haddad and Harrison (1993), Bielschowsky (1994) and Kokko *et al., (*1996), Harrison (1996) and Javorcik (2004), Aitken and Harrison (1999), Sadik and Bolbol (2001), Bouoiyour and Toufik (2009) and Hanchane and Mouhoud (2009). Indeed, Haddad and Harrison (1993) looked at the impact of IDE on total factor productivity in Morocco. Using panel data from manufacturing industries covering the period from 1985 to 1989, the authors obtained a lack of significant relationship between the increase in high productivity in domestic firms and foreign presence in the manufacturing sector. According to these authors, the importance of the technological gap limits the effects of IDE on productivity in this country.

Bielschowsky (1994) and Kokko *et al.,* (1996) conducted an econometric study in Brazil and Uruguay in which they attempted to analyse the effects of IDE on the productivity of manufacturing industries in these countries. They found that IDE positively and significantly impacts labour productivity and growth in these industries.

Harrison (1996) and Javorcik (2004) studied the effects of foreign direct investment on the productivity at the local market level of domestic firms in underdeveloped countries. Their results showed that in the short term, IDE has negative effects on total factor productivity. These results could be explained by the consequences of the loss of local market share of domestic firms.

In a study published in 1999, Aitken and Harrison questioned the impact of IDE on total factor productivity in Venezuela over the period 1976-1989. They used data from 4.000 companies belonging to processing industries and the correlation method. The authors obtained mixed results: in the context of small firms, IDE positively affects productivity. For domestic firms, they have adverse effects on productivity. As for the presence of foreign capital, it negatively affects the productivity of totally domestic firms. These results can be justified by the tendency of multinationals to operate in the most productive sectors.

Sadik and Bolbol (2001), placed in the context of six (6) Arab countries (Saudi Arabia, Oman, Morocco, Jordan, Tunisia, Egypt) treated the effect of

IDE on total factor productivity over the period 1978 - 1998. They found in Saudi Arabia, Tunisia and Egypt, a detrimental effect of IDE on total factor productivity. On the other hand, in Jordan, they obtained an insignificant impact of IDE on PTF and, in Morocco and Oman, they found no impact. For these last results, the great vulnerability of the growth rates of these two countries to external factors explains the results.

Bouoiyour and Toufik (2009) in the context of Morocco explored the impact of IDE on the total factor productivity of local firms for eighteen (18) sectors of the manufacturing industry over the period 1987-1996. They used the approach of endogenisation of technological spillovers which is based on the accumulation of human capital as a factor of attraction of foreign capital and on the contribution of the entry of IDE flows to the increase in productivity of host countries. These authors attest that trade openness and IDE have a positive and significant impact on the productivity of firms if they are accompanied by the development of a skilled workforce.

Hanchane and Mouhoud (2009) examined the relationship between foreign direct investment flows and total factor productivity in developing countries, particularly in the countries of the Middle East and North Africa (meda-9) over the period 1960-2004. They used the within estimator and generalised least squares. Their results indicate that IDE has no impact on productivity in a sample of 63 countries in the Middle East and North Africa. On the other hand, human capital has a positive and significant impact on the productivity of MEDA9 countries.

However, studies that have analysed the impact of IDE on total factor productivity multiplied from the 2010s. In this dynamic, Baccouche *et al.*studied the impact of foreign direct investment on the overall productivity of companies in the manufacturing industry over the period 1998-2004. They used the approach proposed by Olley and Pakes (1996). They showed that IDE exerts a positive and significant influence on productivity. On the other hand, the indirect effect of these investments, which is supposed to reflect the intensity of the foreign presence in a given sector, is negative.

Mughal and Vechiu (2015) analysed for the case of developing countries a study on the impact of foreign direct investment on higher education. They used panel data from these countries over the period 1998-2008 and different econometric techniques and specifications to take into account the endogeneity of certain variables. They arrived at the results according to which, in the short term, IDE exerts negative effects on the rate of schooling and productivity.

Goumrhar (2017) studied the impacts of IDE on human capital, technology transmission and productivity gains in 65 developing countries

over the period 1985-2015. He used the method of double least squares (DMC), the GMM method as well as variables such as human capital, trade openness, inflation, financial development and infrastructure. This author observed that human capital is a determining factor in the transmission of technologies and productivity gains by IDE.

Paluku Vagheni (2019) analysed the impact of IDE on total factor productivity in the Democratic Republic of Congo over the period from 1980-2017. Using the ordinary correlation method, this author found that foreign direct investment does not have significant effects on productivity. On the other hand, IDE has a positive and significant impact on the quality of institutions, the macroeconomic environment, the organisation of the market, the development of human capital and the diversification of the economy.

The work of Ouidir and Oukaci (2020) which falls within the framework of this research orientation examined the relationship between foreign direct investment, economic growth and technology transfer in the MENA region over the period from 1970 to 2016. To do this, these authors used the vector error correction model (VECM). They obtained mixed results, namely, in the short term, IDE exerts a negative effect on total factor productivity. On the other hand, in the long term, IDE has a positive impact on total factor productivity.

Lin *et al*., (2020) conducted a study on the effects of IDE on the total factor productivity of the forest industry in China over the period 1999-2007. They used business census data as well as capitals from HMT regions (Hong Kong, Macau, and Taiwan) and capitals from non-HMT regions to conduct their econometric tests. For these authors, the impact of FDI from HMT regions has a positive effect on the productivity of the wood products industry. On the other hand, IDE from non-HMT regions and from HMT regions tend to have the same impact on the productivity of the forest products industry.

For the case of Bangladesh, Rahman and Inaba (2021) conducted a study on the impact of IDE on the PTF by estimating a log-linear Cobb-Douglas production function at the level of Vietnamese firms. They also examined the horizontal and vertical spillover effects of IDE on PTF. They argued that the fallout from IDE on the PTF is undecided. Firms achieved productivity improvement through intra-industry or horizontal linkages. Vietnamese companies win through backward linkages. The increase in foreign presence in the same industry for Bangladesh and in downstream industries for Vietnam is linked to the increase in production of domestic companies.

In developed and less developed countries, very few studies, to our knowledge, seem to have analysed the impact of IDE on PTF. Borensztein *et al*., (1998), using the cross-national regression method on data on IDE flows and PTFs from industrialised countries and 69 developing countries, found that IDEs constitute important vectors of technology transfer which contribute more to economic growth than to domestic investment.

In light of all these considerations, it is interesting to analyse the effects of foreign direct investment on total factor productivity in CEMAC. With this in mind, we present the research methodology used.

3. Research Methodology

3.1. Model specification and study data

From the empirical literature on the impacts of IDE on total factor productivity, several works emerge, in particular, Bouoiyour and Toufik (2009), Bouoiyour, Hanchane and Mouhoud (2009) and Malikane and Chitambara (2017). This work used, among others, the Within estimator methods, the generalised least squares (MCG) and generalised moments (MMG) methods.

In order to achieve the objective pursued in this research, we used an econometric approach based on the empirical work of Malikane and Chitambara (2017) inspired by that of Ashraf and Herzer (2014). They used the generalised method of moments (GMM) in two steps, such as:

$$TPF_{i,t} - TFP_{i,t-1} = (1-\alpha)\, TPF_{i,t-1} + \beta_1\, DTF_{i,t} + \beta_2\, FDI_{i,t} + \beta_3\, DTF_{i,t} * FDI_{i,t} + \beta_4\, x_{i,t} + n_i + \varepsilon_t \quad (1)$$

Or :

$$TPF_{i,t} = (\alpha)\, TPF_{i,t-1} + \beta_1\, DTF_{i,t} + \beta_2\, FDI_{i,t} + \beta_3\, DTF_{i,t} * \mathrm{FDI}_{i,t} + \beta_4\, x_{i,t} + n_i + \varepsilon_t \quad (2)$$

Where i, is the index of the country of origin, t, the time index. The variables α and β represent the parameters to be estimated. DTF_{il} is the distance to the technological frontier representing the technological gap or relative lag in home country i at time t.

X_{il} is a vector made up of other conditional variables that affect productivity. η_{Je} is the unobserved country-specific effect term.

η_{Je} is the usual error term. $IDE_{il} * DTF_{il}$ represents the interaction term to capture the effect of the relative delay.

From these stages, Malikane and Chitambara (2017) retain the following model:

$$TPF_{i,t} - =(\alpha)\ (TPF_{i,t-1} - TPF_{i,t-2} + \beta_1\ (DTF_{i,t} - DTF_{i,t-1}) + \beta_2\ (FDI_{i,t} - FDI_{i,t-1}) + \beta_3\ (DTF_{i,t} * FDI_{i,t} - DTF_{i,t-1} * FDI_{i,t-1}) + \beta_4\ (x_{i,t} - x_{i,t-1}) + (\varepsilon_{it} - \varepsilon_{it-1}))$$

(3)

Where the variables α and β = (1…5); ∂i = (1…4); ε_i and *t* repesent the error term.

Unlike the model of Malikane and Chitambara (2017), we have extended our model by integrating the following control variables: trade openness, human capital, labour force, gross fixed capital formation, political stability and domestic credit provided to private sectors by banks.

These variables were selected because of their theoretical and empirical role on the impact of IDE on PTF. Thus, the dependent variable is total factor production (PTF). This variable constitutes the synthetic parameter of "cost " competitiveness reflecting the efficiency of the implementation of labour and capital. Its analysis is essential to assess the performance of an economy in terms of technology. Thus, in the CEMAC, we retain the following model:

$$PTF_{i,t} = \alpha_0 + \alpha PTF_{i,t-1} + \beta_1\ IDE_{it} + \beta_2\ OUV_{it} + \beta_3\ CAH_{it} + \beta_4\ POA_{it} + \beta_5\ FBCF_{it} + \beta_6\ STAPOL_{it} + \beta_7\ CIFB_{it} + e_{it} \quad (4)$$

Using the system GMM estimator of Blundell and Bond (1998), our model can be rewritten as follows :

$$PTF_{i,t} = \alpha(PTF_{i,t-1} - PTF_{i,t-2}) + \beta_1\ (IDE_{it} - IDE_{it-1}) + \beta_2\ (OUV_{it} - OUV_{it-1})) + \beta_3\ (CAH_{it} - CAH_{it-1})) + \beta_4\ (POA_{it} - POA_{it-1})) + \beta_5 FBCF_{it} - FBCF_{it-1}) + \beta_6\ (STAPOL_{it} - STAPOL_{it-1}) + \beta_7\ (CIFB_{it} - CIFB_{it-1}) + (e_{it} - e_{it-1})$$

(5)

Where *i* is the index of the country of origin. *t*, the time index. The variables α and β constitute the unknown parameters to be estimated. *PTF*, *IDE*, *OUV*, *CAH*, *POA*, *FBCF*, *STAPOL* and *CIFB* data indicate respectively total factor productivity, foreign direct investment, trade openness, human capital, active population, gross fixed capital formation, political stability and domestic credit provided to the private sectors by banks. Thus, the endogenous variable is PTF. It represents the variable to be explained.

The exogenous variables are: foreign direct investments (IDE), which are considered as channels for the transmission of technology and know-how from foreign firms to local companies. IDE can positively influence PTF insofar as the nature and origin of IDE are important determinants of the impact of IDE on the economic growth of host countries. This variable is supposed to have a positive influence on productivity (Bertschek, 1995; Blundell and Bond, 1996; Barrios and Strobl, 2002; Driffield, 2002; Arnold *et*

al., 2011; Alam *et al.,* 2013; Bielschowsky, 1994; Kokko *et al.,* 1996; Aitken and Harrison, 1999; Bouoiyour and Toufik, 2009; Baccouche *et al.,* 2011; Ngongang, 2013; Goumrhar, 2017; Lin *et al.,* 2020).

Trade openness (OUV), based on the assumption that the impact of IDE on growth is linked to the trade policy regime implemented by a given country. Several authors state that total productivity increases when the economy opens up and lets the laws of the market play. This variable measures the importance of trade and trade restrictions. The positive sign between economic openness and total factor productivity is expected (Bouoiyour and Toufik, 2009).

Human capital (CAH), it is measured by the enrollment ratio in secondary education. It is accepted that the higher the level of education, the more growth is positively affected. Thus, technological progress is often linked to education, especially in higher education. Barro (1997) argued that investing in higher and secondary education has a very positive effect on economic growth. Also, the theoretical and empirical literature on this issue shows that the accumulation of the latter is a source of productivity. A positive relationship is predicted between the CAH and the PTF (Hanchane and Mouhoud, 2009; Goumrhar, 2017).

Domestic credits provided to the private sectors by banks (CIFB), they indicate the credits allocated to the different sectors of the economy on a gross basis. This variable is supposed to have a positive influence on productivity.

Active population (POA), this variable constitutes a traditional factor of the growth model. It is present in the work of Kinoshita (2007) and allows demography to be taken into account in the explanation of wealth. The positive sign is expected between the POA and the PTF.

Gross fixed capital formation (FBCF): these are investments made by public authorities in infrastructure such as roads, bridges and other equipment that increase public capital. This variable appears as a source of growth in the studies carried out by authors such as Abiad *et al.,* (2014) and Bom and Lightthart (2014). With reference to these studies, we expect a positive effect of this variable on productivity.

Political stability (STAPOL) is an imperative condition for the development of the country and society. Indeed, political stability improves the business environment conducive to the development of entrepreneurial activity. Thus, political stability is seen as one of the factors that attracts foreign investment to a country. A positive relationship is expected between STAPOL and PTF (Drazen 2000).

3.2. Data

For our empirical analysis, we selected annual data from CEMAC countries. Thus, the data used in this study comes from two (02) sources. Those relating to total factor productivity (PTF), foreign direct investment **(**IDE**),** trade openness (OUV), human capital (CAH), active population (POA), gross fixed capital formation (FBCF) and domestic credit provided to the private sectors by banks (CIFB) are taken from the World Bank database. The variable measuring political stability (STAPOL) comes from the World Governance Indicators database. These data cover the period from 1990 to 2020. The size of our sample is dependent on data availability. Table 1 gives the definition and the different sources of the variables used. Table 2 presents the descriptive statistics of the values used in the model.

Table 1: Definition of variables

Variable	*Définition*	*Sources*	*Expected sign*
PTF	Total factor productivity	WDI	
IDE	Foreign direct investment, net inflows	WDI	+
OUV	Commercial opening	WDI	+
CAH	Human capital	WDI	+
POA	Active population	WDI	+
FBCF	Gross fixed capital formation	WDI	+
STAPOL	Political stability	WGI	+
CIFB	Domestic credit provided to private sectors by banks	WDI	+

Source: Author

Table 2: Results of descriptive statistics

Variables	*Mean*	*Maximum*	*Minimum*	*Std. Dev.*	*Obs*
PTF	24406,55	114765,8	1691,483	24283,51	186
IDE	4,33e+08	4,42e+09	-7,94e+08	7,97e+08	186
OUV	0,0128535	0,0584674	0,001518	0,010649	186
CAH	31,18125	60,058	6,21	16,12715	186
POA	2568966	1,16e+07	137374	2835746	186
FBCF	2 ,70e+09	1,04e+10	7,30ee+07	2,47e+09	186
STAPOL	0,2893598	0,4753152	0,1072911	0,0971524	186
CIFB	8,878541	38,2327	2,01042	5,136408	186

Source: Author

Table 2 shows that the maximum attractiveness value of foreign direct investment flows in CEMAC is 4.42e+09 for a minimum value of -7.94+08. Among all the variables used, labour force and productivity have the highest

average values, while trade openness, political stability and domestic credit provided to the private sectors by banks have the lowest average values.

Regarding the standard deviation (Std. Dev.), the results obtained show that the labour force and the total factor productivity have the highest values and seem to be more volatile compared to the other variables. This result means that the other variables are more closely distributed around their mean. They show less variability with respect to population and total factor productivity. This result indicates that the variables used in this research are more dispersed around their central mean.

4. Estimation, results and interpretation

4.1. Model estimation and results

Any estimate requires the examination of the various econometric tests. Thus, within the framework of this study, we used two types of unit root tests: the stationarity tests of Levin, Lin and Chu (LLC, 2002) and Im, Pesaran and Shin (IPS, 2003) for the CEMAC countries and the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, for CEMAC countries, taken individually. The results of these tests are shown in Tables 3 and 4.

Table 3 shows that at the 5% threshold, some series are not stationary in terms of trend or intercept, while these same series are stationary when the same tests are implemented in first differences. This leads us to conclude that the nine (9) series retained in this study are affected by a unit root and are therefore integrated of the same order.

With regard to the results of the ADF and PP stationarity tests by country, we note that these indicate that all the series used in this model are not stationary in level in so far as the mean, the variance and the covariance are not constant. This result leads us to differentiate the variables in first difference. Thus, after differentiation, at level 1, all the variables have become stationary. In other words, the ADF value is greater than the critical value.

The main results of our research obtained from the GMM model for all CEMAC countries on the effects of IDE on TFP are presented in Table 5.

4.2. Discussion and interpretations of results

From the results of the model, it appears that the total factor productivity lagged by one period exerts a positive and significant impact on the total factor productivity at the 1% threshold in all the equations. This result means that PTF in the CEMAC depends positively on the productivity of the previous period. In other words, this result describes the cumulative dimension of technical progress in this region due to the cumulative

Table 3 : Results of the LLC (2002) and IPS (2003) stationarity tests on CEMAC

Variables		*In level*						*In first difference*					
		IPS	*Prob*	*Décis.*	*LLC*	*Prob*	*Déc.*	*IPS*	*Prob*	*Déc*	*LLC*	*Prob*	*Déc*
PTF	Inter	-0,82	0,97	H_0 Acc.	-2,66	0,68	H_0 Acc.	-4,59	0.00	H_0 Rej	-9,71	0.00	H_0 Rej
	Trend	-1,72	0,25	H_0 Acc.	-5,00	0,03	H_0 Rej.	-4,67	0.00	H_0 Rej	-10,24	0.00	H_0 Rej
IDE	Inter	-2,54	0,00	H_0 Rej.	-2,98	0,33	H_0 Acc.	-8,68	0.00	H_0 Rej	-13,16	0.00	H_0 Rej
	Trend	-4,09	0,00	H_0 Rej	-6,87	0,00	H_0 Rej.	- 8,62	0.00	H_0 Rej	-13,55	0.00	H_0 Rej
OUV	Inter	-2,43	0,03	H_0 Rej	-4,39	0,53	H_0 Acc.	-6,24	0.00	H_0 Rej	-10,99	0.00	H_0 Rej
	Trend	-2,46	0,02	H_0 Rej	-4,58	0,47	H_0 Acc.	-6,31	0.00	H_0 Rej	-11,74	0.00	H_0 Rej
CAH	Inter	-1,45	0,67	H_0 Acc.	-3,70	0,02	H_0 Rej.	-4,73	0.00	H_0 Rej	-8,87	0.00	H_0 Rej
	Trend	-1,99	0,12	H_0 Acc.	-6,84	0,00	H_0 Rej.	-4,84	0.00	H_0 Rej	-9,33	0.00	H_0 Rej
POA	Inter	2,97	1.00	H_0 Acc.	-3,05	0,01	H_0 Rej.	-1,86	0.15	H_0 Acc.	-3,52	0.63	H_0 Acc.
	Trend	-1,72	0,77	H_0 Acc.	-5,57	0,00	H_0 Rej.	-1,28	0.96	H_0 Acc.	-2,88	1.00	H_0 Acc.
FBCF	Inter	-0,93	0,94	H_0 Acc.	-1,92	0,65	H_0 Acc.	-5,47	0.00	H_0 Rej	-9,27	0.00	H_0 Rej
	Trend	-1,78	0,20	H_0 Acc.	-4,80	0,56	H_0 Acc.	-5,50	0.00	H_0 Rej	-9,57	0.00	H_0 Rej
STAPOL	Inter	-0,98	0,92	H_0 Acc	-2,40	0,13	H_0 Acc.	-5,46	0.00	H_0 Rej	-9,48	0.00	H_0 Rej
	Trend	-1,64	0,32	H_0 Acc	-3,74	0,93	H_0 Acc	-5,46	0.00	H_0 Rej	-9,85	0.00	H_0 Rej
CIFB	Inter	-1,64	0,42	H_0 Acc	-6,00	0,00	H_0 Rej	-4,63	0.00	H_0 Rej	-17,67	0.00	H_0 Rej
	Trend	-2,65	0,00	H_0 Rej	-19,33	0,00	H_0 Rej	-5,14	0.00	H_0 Rej	-16,43	0.00	H_0 Rej

Source : Author

Table 4 : Results of the ADF and PP stationarity tests by country

PAYS	*PTF*		*IDE*		*OUV*		*CAH*		*POA*		*FBCF*		*STAPOL*		*CIFB*	
	ADF	*PP*	*ADF*	*PP*	*ADF*	*PP*	*ADF*	*PP*	*ADF*	*PP*	*ADF*	*PP*	*ADF*	*PP*	*ADF*	*PP*
CAM	0,63	0,60	0,92	0,85	0,56	0,61	0,99	0,97	0,99	1.00	0,97	0,99	0,41	0,41	0,05	0,06
	0,00	0,00	0,00	0,00	0,00	0,00	0,05	0,00	0,47	0,61	0,00	0,00	0,00	0,00	0,00	0,00
CGB	0,75	0,79	0,99	0,20	0,76	0,77	0,76	0,78	1.00	1.00	0,33	0,42	0,26	0,24	0,34	0,32
	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,32	0,00	0,00	0,32	0,00	0,00	0,00
GAB	0,72	0,72	0,98	0,56	0,00	0,00	0,70	0,93	0,98	1.00	0,69	0,70	0,06	0,09	0,52	0,57
	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,56	0,00	0,00	0,00	0,00	0,00	0,00
GEQ	0,94	0,93	0,01	0,01	0,88	0,86	0,84	0,82	0,08	1.00	0,33	0,28	0,00	0,00	0,05	0,05
	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,55	0,00	0,00	0,00	0,00	0,00	0,00
RCA	0,51	0,58	0,20	0,05	0,86	0,86	0,88	0,87	0,95	1.00	0,76	0,88	0,01	0,01	0,85	0,81
	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,16	0,37	0,00	0,00	0,00	0,00	0,00	0,00
TCH	0,58	0,58	0,00	0,00	0,40	0,52	0,98	0,97	0,99	1.00	0,66	0,66	0,01	0,02	0,75	0,75
	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,98	0,33	0,00	0,00	0,00	0,00	0,03	0,00

Source : Author

Table 5: Results of the MMG model

Variable	*Equation 1 (PGF)*	*Equation 2 (PGF)*	*Equation 3 (PGF)*	*Equation 4 (PGF)*	*Equation 5 (PGF)*
L.PGF	0,97812***	0,6006104***	1,069125***	1,050235***	2,098592***
	(24,30)	(14,45)	(14,96)	(13,21)	(3,28)
IDE	6,07e-06***	4,61e-06***	0,0000224***	0,0000213***	0,000027***
	(4,42)	(3,18)	(4,43)	(4,33)	(2,91)
OUV	-320420,7**	-179418,4	-1159340***	-1179762***	-1701139***
	(-2,29)	(-1,53)	(-4,66)	(-4,82)	(-5,38)
CAH	333,6487***		225,1032	180,831	1141,493*
	(4,40)		(1,50)	(1,19)	(1,75)
POA	-0,0085034***	-0,0109426***	-0,0064698***	-0,0060909***	0,000297
	(-4,88)	(-6,32)	(-3,01)	(-2,94)	(0,08)
FBCF			-7,05e-06***	-6,77e-06***	--8,70e-06***
			(7,86)	(-8,07)	(-4,67)
STAPOL		-82056,14***			208354,9*
		(-5,79)			(1,94)
CIFB				317,8093	-57,45619
				(1,16)	(-0,12)
Const	6228,84**	52571,71***	25177,05***	23799,33***	-92331,55
	(2,55)	(3,55)	(3,55)	(3,35)	(-1,37)
Observations	155	155	155	155	155
AR(1) p-value	0,046	0,070	0,157	0,196	0,171
AR(2) p-value					
Hansen J-test(p-value)	0,904	0,354	0,450	0,341	0,57
Hansen J-test(p-value)	0,979	0,811	0,17	0,162	0,555

Source: Author

influence of investment in physical capital and past labour on future productivity.

Moreover, these results reveal a noticeably positive and significant effect of IDE on total factor productivity at the 1% threshold in all the equations. This result is consistent with those of authors such as Bertschek *et al.*, (1995) who show that IDE from outside has a positive influence on PTF. This result seems robust insofar as the IDE indicator is significant in the five (5) equations.

In addition, a decrease in trade openness significantly leads to a decrease in PTF at the statistical threshold of 1% in equations (3), (4) and (5). This assumes that in CEMAC, a decline in trade leads to a reduction in PTF,

which in turn causes a reduction in technological know-how in all the countries of the sub-region. Thus, the more a country is open to the world, the more likely it will be to benefit from the externalities, know-how and innovations of other countries. Such an effect is consistent with the predictions of economic theory on the link between trade openness and technical progress (Bouoiyour & Toufik 2009).

Human capital positively and strongly influences total factor productivity at the threshold of 1% and 10% respectively, in equations (1) and (5). As Lucas (1988), Hanchane and Mouhoud (2009) and Goumrhar (2017) suggest, human capital is a measure of the capacity to absorb new technologies that allows countries to increase their productivity. Similarly, economic theory states that technological spillovers have several effects on the technological transfer of a country if the latter develops its absorptive capacity in terms of human capital. In this dynamic, our results confirm the role of well trained human resources in improving productivity and therefore economic growth. One of the fundamental assumptions of the endogenous growth theory seems to be confirmed.

However, the effects of the labour force on total factor productivity are negative and significant at the statistical threshold of 1% in equations (1), (2), (3) and (4). This suggests that a decrease in the labour force leads to a decrease in total factor productivity.

With regard to the « political stability » variable, the econometric results obtained show positive and statistically significant effects on total factor productivity at the 1% threshold. Fragile political stability negatively influences total factor productivity. These results are identical to that of Drazen (2000) who confirms that political instability affects economic performance because it creates uncertainty as to the future return on investment by companies and private agents. This prevents society as a whole from accumulating physical capital.

Conclusion

The objective of this study was to examine the effects of foreign direct investment on total factor productivity in CEMAC using the generalised method of moments (GMM) over the period 1990 - 2020.

The results of the study attest that total factor productivity lagged by one period, foreign direct investment, trade openness, human capital, labor force, gross fixed capital formation and political stability significantly explain the total factor productivity in CEMAC. For this community, the results of the study indicate that the first two variables have a positive impact on PTF at the 1% level. Regarding trade openness, it negatively influences total factor

productivity at the threshold of 1% and 5%, respectively. As for human capital, it exerts a positive influence on PTF at the statistical threshold of 1% and 10%, respectively. The « active population and gross fixed capital formation » variables have a negative impact on PTF at the 1% threshold. On the other hand, political stability influences PTF negatively and positively at the threshold of 1% and 10%, respectively. But, the observation of the results tells us that the gross domestic credits provided to the private sectors by the banks exert insignificant effects on the total productivity of the factors.

From these results, several implications for economic policy emerge.

The first policy implication relates to the positive effects of foreign direct investment on total factor productivity. This result implies that the public authorities of the CEMAC countries must strengthen specific measures in order to attract foreign direct investment in the sectors of activity. They must also improve the business climate so that IDE improves economic growth and total factor productivity.

The second relates to the positive impact of human capital on PTF. We know that strengthening human capital has positive effects on PTF. In the CEMAC framework, it is up to the public authorities to have an adequate level of human capital in all sectors of the economy, as suggested by Moussavou (2021).

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