

Economic Analysis of the Investments in Public Infrastructure Impacts on Agricultural Production in Benin

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Abstract

Agricultural activity is to produce food and raw material and then, it plays an important role in economic and social development of the country by contributing in the Gross production growth and by providing employment. In spite of its weight in Benin economy, the sector is characterized by the small level of the exploitation of its numerous potentials of agro ecological areas, the predominance of small exploitation sizes, its vulnerability to climatic hazard, its low productivity, mechanization and intensification levels, ect. This sub exploitation is the results of illiterate of the farmer, the uses of archaic methods and technical production and the shortcomings of direct investments in the sector such as water storage, rural roads, hydro agricultural adjustments, etc. Now, theoretical arguments and historic data reveal a narrow link between the investments in infrastructure and the economic productivity growing, and thus the different components of the economy. This paper examines the links between public infrastructures and the Benin agricultural production according to the renewal interest to improve transport, health and education infrastructures. Using Cobb-Douglas model and Benin data from 1980 to 2009, we show that the investments in infrastructures, mainly in education and transport, constitute a good politics to improve agriculture for a long time.

Keywords: investments, cereal, leguminous plants, transport, health and education infrastructures, agricultural production elasticity

1. Introduction

Benin is a fragment of West Africa, between Nigeria and Togo with numerous agricultural potentialities and various and favorable agro ecological conditions. Like a great Sub-Saharan countries, Benin major population lives in rural area and has its revenue from agriculture. Agriculture occupies 70% of active population, contributes in mean for 39% to GNP during the period of 1990–1999 and insures other than 90% of exportation revenue (MAEP, 2009). Major food crops (maize, cassava, sorghum, yams, peanuts and bean) allow to globally covering food needs but it stays greatly under the potentialities supplied by agro ecological conditions. Cotton, since 1980, constitutes the main exportation crop and the economic growth source because it represents 14% of GNP, 80% of exportation revenues, 45% of fiscal returns and 60% of industrial tissue (Midingoyi, 2008). Motor of Benin economic growth, agricultural sector is characterized by the predominance of small exploitations and its vulnerability to climatic hazards. It is not competitive because of the high input costs, its low levels of mechanization and intensification (fertilizers, pesticides, improved seeds for food crops) and the infrastructure gap.

The country, mainly rural areas, suffers the lack of infrastructures which play a strategic role in development process. According to its stake for the growth, Benin elaborates a strategic axis for infrastructures development in SCRP2 document (Note 1) in 2008. From this date, public infrastructure investments increase year by year. But, very onerous, their realizations are made mainly by borrowing and it becomes necessary to exam their contribution to agricultural sector, support sector of the country development.

Improving agricultural productivity and the necessity of economic growth constitute the great challenge of the millennium for all African countries. Food, energetic and economic crisis are the main symptoms of this imperative. In addition to agricultural practices and techniques gaps with the needs of the growth, agricultural sector suffers direct investment lack (water withholding; hydro-agricultural arrangement, rural roads) to propel its development. Nevertheless, the region, in particular Benin, has numerous agro ecological areas under

exploited for various raisons.

The training effects of public investments on the growth exercise through the supply of intermediate goods and services, the production cost reduction, the productivity factors improving and the increasing of the profit opportunities and the selling of enterprises (Keho, 2004). The public investments expenses are not only the withdrawal, but an effective implement to simulate and sustain the economic activities. In the context, the stake discussion on the role of the public investments, mainly of the infrastructures, in the construction and the economic boost reveals a great importance, as much for economic policy as for economic development. In long term, the economic growth is stimulated by economic policies that encourage the public capital development (Keho, 2004; Gillis et al, 1990). Those analysis on economic growth can and must be done on agricultural sector which constitutes the most important sector in most of African countries in order to exam the influence of public investments on agricultural production growth on one hand and on the economic growth in general on the other.

The economic growth is the sustained increase of the real Gross National Product (GNP) from one year to another. It is a necessary condition for the development. Indeed, the economic growth can't be confused with the development which is interested by the consequences of economic activities on the human life. The growth doesn't necessary imply improving the welfare when development is above all the improvement of the standard living of the nation's or region's population (Biaou, 2006). The growth is thus a tool which can be accompanied by other measures like the training, the mentality change, the shift in production reports, self confidence, human rights respect, security, etc. to achieve development (Biaou G., 2006). The growth can be in short term the product of the population increase and/or the capital, but, in long term, it comes from the productivity increase (Gillis et al, 1990; Biaou G. 2006). This productivity increase results also from the technological progress; that is the appearance of the production means more productive and the discovery of new marketable goods and services. The economic growth, thus is not a single bulkiness produced increase, but also and mainly the innovation effects of the various and sophisticated goods and services effective and adapted to the new needs (CIES, 1973). Theory arguments and history data revealed the existence of a narrow link between the infrastructures investments and the economic productivity, and thus to the all other economic components.

The perception of the public infrastructure role as growth factors has remarkably evolved these late years and s gives renewal interests in the public infrastructures investments effects studies on the economic growth (Aschauer, 1989; Munnell, 1990; Barro et al, 1990; Conrad et Seitz, 1992; Shah, 1992; Lynde et Richmond, 1993; Morrison et Schwartz, 1996 and Khanam, 1999). The infrastructure insufficiency is one of the key obstacles to African development (BAD, 1999; Banque mondiale, 1994; NEPAD, 2001; UN, 2006). For the World Bank (2009), the deplorable infrastructure state in Sub-Saharan African States brakes the economic development of the countries by two points each year and limits the enterprise productivities by 40%. A recent study realized in 24 African countries of which Benin, shows the infrastructure lack in the continent (MIDRAND, 2009) when African pays twice more the basic services than the other zones.

The comparison of the Benin transport infrastructure with the over occidental African countries shows that Benin has the lowest road density (7,0 km to 10000 habitants or 0,05 km per km²); rural roads are damaged, and are insufficient (INSAE/TBS, 2009 et SCRP, 2009). But, through its public investments Programs (PIP), Benin tries to improve its infrastructure level. As a matter of fact, public investment to GIB ratio is 11.5% in 2009. During the period 1980-1989 characterized by crisis, where economy is ruled by the State, the investment shares in the GNB, mainly those of transport, education and Health are respectively 1.30%, 1.32% et 2.86%. Afterwards, during 1990-2005 period, considered as the period of Structural Adjustments Programs (SAP) implementation, economic reforms based on liberalism, and the implementation of the strategy for poverty reduction documents, those ratios became respectively 4.01%, 2.24% and 5.26%. Finally during 2006-2009 period, considered as period of the implementation of the growth strategies for poverty reduction documents, they become respectively 3.37%, 1.74% and 1.87% (MEF, 2010). According to this interest to the public infrastructure importance and the dominant weight of the agriculture in Benin economy, it is important to examine the influence of the public infrastructure incidences on the agricultural production in Benin.

The objective of this paper is to analyze the public infrastructure investments of transport, education and health on the agricultural production generally and the effects of those investments on some mains specific cultures. Then, after the characteristics of the sectors of agriculture, transport, education and health in Benin, the second section reaches the literature revue, the third section discuss the methodological approach and the last section presents the results and discussions.

2. Literature Review

Pioneer in this endogenous growth model domain, Aschauer (1989), using a Cobb-Douglas production function

and USA aggregate chronological data series finds a production elasticity in relation to public capital of 0.39 and those in relation to basic infrastructure (roads, common transport, airports, etc.) about 0.24. Munnell (1990) using the labor productivity as dependent variable confirms Aschauer results that public capital greatly stimulates production. The other studies done by Conrad et Seitz (1992), Shah (1992), Lynde and Richmond (1993), Nadiri and Manueas (1994, 1996), Morrison et Schwartz (1996) and Khanam (1999) who have used a cost function, converge to a great extent to, the same conclusion that the investments in public infrastructures contribute significantly to reduce the production costs of the private sector.

Studying the public education expensive effects on the growth for a great sample of countries, Barro and Sala-i-Martin (1992) found that an increase of 1% in the ratio of public education spending on the GNP during the period of 1965–1985 might increase the average growth ratio by 0.3% per year. In Europe, hospital infrastructures development and the education level have dropped the infant mortality and involving an increase in the population life expectancy (PNUD, 1994). According to Fogel quoted by Schultz (1998), about one third of the productivity gain realized in Western Europe during the late centuries is imputable to the improvement in the health and nutrition. In one study on education, health and poverty reduction spending in Africa, Morrison et al. (2002) show that the state might more invest in the school construction in rural areas in order to allow all to access to education services, than invest in targeted programs more expensive which don't profit to the poor. Fadonougbo and Koba (2008) found that 1% of investments increase in transport in Benin increases the domestic production by 0.33% while 1% increase in health and education respectively induce a domestic production growth of 0.009% and 0.013%. The lack in infrastructure in Africa has direct and indirect repercussions and constitutes a lagging factor for enterprise development. (Kauffmann, 2008). According to Moutoussé (2008), four main factors are endogenous sources of growth: physical capital, technology, human capital and public capital. Romer (1986) (Note 2) points up this importance of knowledge accumulation in the growth process by building a model which relies on externalities phenomena between the firms. He shows that by capital accumulation, each firm gets some knowledge which takes advantage of the other enterprises. He concludes that research development and the growth mutually self-cause. For Robert (1988), we must treat the labor as an amassed human capital like fixed capital. The qualification raising has an external positive effect. By elsewhere, human capital productivity doesn't decrease because individual knowledge level is as efficient as the others level (with whom he communicates) is higher. Individual productivity is function of the efficiency of the team in which he works. Bottone and Sena (2010) point up the labor force characterized by its education, its training and its experiences which is influenced by its institutional environment.

Barro works (1990) permit to demonstrate the public capital importance in the economic growth. They explain the cumulative effects of the infrastructure spending by the fact that they insure the increasing of the growth which induce a raise in public revenue, thus the public expenses, the growth sources. The public infrastructures constitute a growth factor which creates increasing scale yield at long term because of internal economies which they allow for private producers. They explain that capital yields are increasing because the infrastructures first call for equipments and public works politics which, in period of sub production or activity contraction in relation to economy potentiality, are liable to have Keynesian impacts in creating employments and in exercising a positive contra-cyclical effect. They reduce transaction costs and facilitate commercial exchange between interior and exterior borders. They allow economic agents to answer the new demands, in new areas in decreasing the inputs costs, inputs which are necessary to the production of almost all goods and services. They make profitable activities which are not beneficial without them and more profitable those existing. The theorists of endogenous growth recommend to maintain those expenses even in hard conjuncture situation. Some studies show that public investments, especially in rural infrastructures, strongly contribute to the agricultural production growth and to the poverty reduction (MIDRAND, 2009). Those rural infrastructures improve the crop production and selling conditions through the dregs, rural tracks and social infrastructures rehabilitations. The objectives of the investment priority program in infrastructures are not only to reduce the gap between Africa and the developed countries but to make them as economic growth incentives (PNUD, 2009).

3. Methodological Approach

3.1 Agricultural and Public Infrastructures Characteristics in Benin

Activity of food and raw material production, agriculture occupies over than 70% of Benin active population, it contributes to 40% of Gross Domestic Product in 2009 versus an average of 39% during the period of 1990-1999; it insures over than 90% of exports revenue (MAEP, 2009). In spite of the agricultural preponderant weight in the Benin economy, the revenue levels in the sector are the lowest and the sector conceals under exploited potentialities. Hardly 40% of agricultural areas are cultivated and the productivity levels are very low (MAEP, 2009). The analphabetism high level of its personal to adopt modern innovations, archaic production practices

and technical methods, the insufficient investments in direct infrastructures like water withholding; hydro-agricultural arrangement, rural roads explain this potentialities under exploitation. Called economic growth motor, Benin agricultural sector is characterized by a predominance of the small exploitations and its vulnerability to climatic hazards. It is not competitive because of its input high costs, its lower mechanization, its weak intensification level and its lower water control level. The main export crop is the cotton. The food crops (maize, cassava, sorghum /mil, yams, beans and peanuts) allow to globally cover the country food needs; but their productions are largely under the potentialities supplied by ecological conditions. Almost farmers use mining practices which emphasize the natural resources impoverishment (RNIB, 2008). Then, the sector is characterized by the great fluctuations of its rate growth which, during 1980–1989, 1990–2005 and 2006–2009 are respectively 4.58%; 5.10% and 4.3% (MEF, 2010). In the north and center areas, the harness system is being more and more using as production means. The mixed farming system with traditional characteristics limits hazards due to climate changes.

The investments in public infrastructures concern transport, health and education. Transport infrastructures serve to link agents to markets, to reduce the factors costs and to improve economy competitiveness. They have training effects on the other sectors, thus a direct impact on the population standard of living. Investments in roads and transports from the late 70 allowed to construct the transit roads, almost wholly asphalted, which are the two corridors north-south (Cotonou Niger on one hand and Cotonou Burkina on the other hand) and the East-west corridor (Togo-Benin-Nigeria) which play important roles in the regional integration. Despite of this efforts Benin hasn't sufficient roads for the exchange development. To the national network large of 6,076km whose major part is being classified as national roads (MTPT/INSAE/TBS, 2009) add the urban and rural roads which are not well kept and which constitute the main network for agricultural products gathering and evacuation. The network of railways very old and in bad state includes the single voice from Cotonou to Parakou on 438 km. The late globally reform allows to recover one's wind. Benin has one international airport whose road track with 2,400m is not sufficient to easily receive big aircraft. Cotonou portage plays a great role in Benin economy, but its actual capacity is under demand because traffic density is increasing from day to day. Meanwhile, to improve its competitiveness, great reforms are engaged in this sub sector.

In education, Benin country has always reserved a great place to instruction. Hard are Benin villages which haven't primary school. The grammar and secondary schools are met in almost the national area. The north and the south have one public university each one. There exists a great equipment and infrastructure construction program from infant school to the university and the establishment of new university centers. The frame ratios pupil/schoolmaster and student/teacher are respectively 44.9 and 67 in 2009 versus 44,6 and 51 in 2008 (Ministère du plan / TBS, 2009).

As for the health, in 2005, Benin has 425 district health centers, 75 communal health centers, 26 zone functional hospitals, 5 departmental hospital centers 1 national university hospital center, 8 centers of leprosy treatments and 51 centers of tuberculosis treatments. The frequentation ratio of health center services is respectively 45.2% and 46.5% in 2008 and 2009. The ratio of the habitant per doctor is 7979 in 2009, but per district we have one doctor for 10 000 habitants and this ratio is one midwife for 625 habitants.

3.2 Analysis Methods

Causality analysis between public investment and growth recommends the implementation of more rigorous econometrical techniques. Especially, to avoid fallacious valuations, of the causality links in the situation of data non stationary, it is first necessary to appeal to preliminary statistics tests. We used the stationary test of Dicker-Fuller Augmented (ADF) to check unity roots presence before run to Johansen co integration tests. Ramsey missing pertinent variables test, White heteroscedasticity test, Breusch Godfrey autocorrelation test, Fisher global significance test, Cusum and cusum square stability test and Theil prediction test allow to validate the models.

In first time, we aggregate different crop productions by great groups where data are available: cereals (maize, sorghum, rice) tuber and roots (cassava, yams, sweet potatoes, taro), leguminous plants (beans, soja, sezam, gusi, Angolepea), market garden produce (okra, tomato, cabbage, leaves vegetable, onion, etc.) an industrial crops (cotton, pineapple, peanuts, tobacco, oil palm; cashew). Secondly, we use econometric model which, on one hand, focus on the real agricultural gross national production and public investments in transport, health, education infrastructures, private infrastructures and rural active population, and, put relations between those explaining variables and each agricultural production that is, cereals, roots and tubers, the leguminous plants, the market garden produce and industrial crops.

By the literature review light, the economy theory, but also in taking into account information available, model

formulation requires beginning by Cobb-Douglas production function type which expresses the production as function of capital (K) and labor (L). This production function is expressed in the following form:

$$y = f(K, L) \quad (1)$$

The production function booked is Aschauer (1989) ones:

$$Q_t = AK_t^\beta L_t^\lambda P_t^\mu \quad (2)$$

with

$$0 < \beta < 1; 0 < \lambda < 1; 0 < \mu < 1 \text{ et } A > 0$$

Where Q_t the production, K_t the private capital stock, P_t the public capital stock, L_t the employment level. A is a scale parameter. β, λ, μ are the production elasticities in relation to the different production factors.

In this study, the variables used are the real agricultural gross national production in year t ($PIBAR_t$), the rural active population ($PACR_t$), transport infrastructure ($ITRANS_t$), education infrastructure ($IEDU_t$) and health infrastructure ($ISANT_t$). The model equation is:

$$PIBAR_t = A * ITRANS_t^{\alpha_1} * ISANT_t^{\alpha_2} * IEDU_t^{\alpha_3} * INVP_t^{\alpha_4} * PACR_t^{\alpha_5} + \varepsilon_t \quad (3)$$

The logarithmic transformation of this general model becomes:

$$\ln PIBAR_t = A_0 + \alpha_1 \ln ITRANS_t + \alpha_2 \ln ISANT_t + \alpha_3 \ln IEDU_t + \alpha_4 \ln INVP_t + \alpha_5 \ln PACR_t + \varepsilon_t \quad (4)$$

Given that specific agricultural productions have the same explaining variables, their equations are the same, but their coefficients different (table 1).

Table 1. Variable coefficients of the six models

Variables	Constant	Transport	Health	Education	Private Investment	Rural Active Population	Residue
Real agricultural Gross national produce	A_0	α_1	α_2	α_3	α_4	α_5	ε_0
Cereal	A_{01}	α_{11}	α_{21}	α_{31}	α_{41}	α_{51}	ε_1
Roots and tubers	A_{02}	α_{12}	α_{22}	α_{32}	α_{42}	α_{52}	ε_2
Leguminous plants	A_{03}	α_{13}	α_{23}	α_{33}	α_{43}	α_{53}	ε_3
Market garden produce	A_{04}	α_{14}	α_{24}	α_{34}	α_{44}	α_{54}	ε_4
Industrial crop	A_{05}	α_{15}	α_{25}	α_{35}	α_{45}	α_{55}	ε_5

Source: the authors, 2011.

$A_0 = \ln A$ is the constante and $A_{0j} (j=1 \text{ à } 5)$ is the constante for each equation j.

α_i is the agricultural elasticity in relation to explicative variable.

α_{ij} is the agricultural production j elasticity in relation to explicative variables i.

3.3 The Data

Data used are essentially secondary data from 1980 to 2009. Those data are from the following institutions and offices: Institut National de la Statistique et de l'Analyse Economique (INSAE), la Direction Générale des Affaires Economiques (DGAE), le Ministère de l'Agriculture, de l'Élevage et de la Pêche (MAEP), Le Ministère de l'économie et des finances (MEF), la Banque Mondiale (BM), la Bibliothèque du CAPOD et la Bibliothèque du ministère de la santé publique.

4. Results and Discussions

4.1 Explicative Variable Impact on Agricultural Productions at Short-Time

Models at short-term are well specified because the calling force coefficients (residues) are all between -1 and 0 and they are all significant at 5% (table 2). For all those models, the missing variable tests, the normality tests, the autocorrelation tests, the homoscedasticity tests are proper. The cusum and the square cusum test show that residues are steady because their curves are in the corridor.

Table 2. Estimations of the investment in public infrastructure impacts on the agricultural productions at short-time

	Constant	Infrastructures in			Private Investment	Rural active Population	Residues	R ²
		Transport	Health	Education				
Agricultural	0,0104	0,0094	0,0060	0,0517	0,1839**	0,7771**	-0,721***	0,590
GNP	(1,057)	(0,973)	(0,883)	(1,366)	(2,361)	(2,290)	(-3,71)	
Cereals	0,0015	-0,0570**	0,0507**	0,0706	0,3268	1,1875	-0,851***	0,612
	(0,054)	(-2,143)	(2,658)	(1,038)	(1,629)	(1,264)	(-3,94)	
Roots and tubers	0,0116	-0,0396	0,0256	-0,0257	0,2437	1,4491	-0,743***	0,510
	(0,344)	(-1,210)	(1,103)	(-0,310)	(1,006)	(1,294)	(-3,999)	
Leguminous plants	-0,054	0,1415***	0,0215	0,2681***	0,2957	3,097**	-0,117***	0,661
	(-1,37)	(3,58)	(0,739)	(2,818)	(1,010)	(2,353)	(-0,527)	
Market garden produce	-0,006	0,0501	0,0905**	0,0692	-0,2716	3,0687	-0,006***	0,476
	(-0,10)	(0,915)	(2,35)	(0,500)	(-0,65)	(1,599)	(-3,428)	
Industrial crop	-0,084***	0,5619	0,0588	0,4356*	-0,9695	5,2514	-0,516**	0,610
	(-0,86)	(5,06)	(0,855)	(1,857)	(-1,26)	(1,646)	(-2,44)	

Source: Data survey, 2011; *** Significant at 1%; ** Significant at 5%; * Significant at 10%; () t de student.

4.2 Explicative Variable Impacts on Agricultural Productions at Long Time

The Ramsey test shows that there exists a relevant missing variable in roots and tubers, market garden produce and in industrial crop models. But for all the models, the normality test, the auto-correlation test and the homoscedasticity test are all convenable. The cusum and square cusum stability test shows that the residues are stable because their curves are in the corridor. As Theil coefficients near zero, the models can be used for prediction.

Table 3. Estimations of the investment in public infrastructure impacts on the agricultural productions at long Time

	Constante	Infrastructures in			Private investment	Rural active Population	R ²
		Transport	Health	Education			
Agricultural	2.87***	0.0093	-0.0040	+ 0.091**	0.369***	0.7855***	0,992
GNP	(8,86)	(0,6241)	(-0,502)	(2,1252)	(3,3349)	(5,0691)	
Cereals	10,52***	-0,0122	0,0293	0,1939***	0,4413	0,9024**	0.970
	(13,62)	(-0,453)	(1,374)	(2,858)	(1,646)	(2,380)	
Roots and tubers	12,11***	0,0585	0,0093	0,1941*	0,2638	1,4083**	0.961
	(11,23)	(1,5550)	(0,3124)	(2,0514)	(0,7052)	(2,6634)	
Leguminous plants	8,369***	0,0883**	0,0324	0,2937***	0,2807	0,8517	0.946
	(7,418)	(2,2408)	(1,0414)	(2,9651)	(0,7171)	(1,5391)	
Markets garden produce	8,079***	0,1037	0,1003*	0,4027**	0,2900	1,4569	0.931
	(4,3058)	(1,6748)	(2,0531)	(2,2306)	(0,4598)	(1,6064)	
Industrial crops	11,65***	0,7194***	0,1384	0,1314	-1,0754	2,9838*	0.914
	(3,7059)	(6,5448)	(1,5934)	(0,4757)	(-0,9337)	(1,9337)	

Source: Data survey, 2011; *** Significant at 1%; ** Significant at 5%; * Significant at 10%; () t-students; R² Coefficient de détermination).

4.3 Results Analysis and Interpretations

4.3.1 Transport Infrastructures

Investments in transport infrastructures have significant impacts on cereal and leguminous production in short time respectively at 5% and 1% and in long term leguminous and industrial crop productions respectively at 5% and 1%. Then, an increase of 1% in transport investments implies a leguminous production growth of 0.142% and 0.088% respectively at short-time and long time. The negative impact on the cereal production at short-time is essential due to the data. Both crops (cereal and leguminous) are greatly consumed in all Benin regions and so

require transports to insure jobbing between the markets and regions. The industrial crops are generally produced and conveyed to the harbor for exportation. Then the transport roads improvement positively affects and significantly industrial crop production at long time and the cereal and leguminous production at short-time. But, those results are not generalized to all the agricultural products because rural and urban transport investments data are aggregated on one hand and the cereal (maize, sorghum and rice), roots and tubers (cassava, yams, sweet potatoes) aggregate and all crops aggregate in GNP on the other hand. Roads rural investments might have more impacts on each of those crops individually taken, for example, maize or sorghum only. In addition, the market garden produces are perishable and not influenced by transports investments because their production are very limited and they are selling at the farm board, that is in their village or town production.

4.3.2 Health Infrastructures

At short term, health investments affect positively and significantly cereal and market garden produces production at 5%, and at long time, they only affect the market garden produce production at 10%. Then, an increase of 1% in health investment induces a production raise of 0.0567% for cereal and 0.0905% for market garden produces. This result shows a low impact of health investment on agricultural production, perhaps because population frequents feebly health centers or a low population ratio is sick. In addition, data aggregated can explain this low impact because data are not distributed in rural and urban health investments. We can conclude that health investments don't affect directly agricultural production.

4.3.3 Education Infrastructures

Education infrastructures have positive impacts on leguminous and industrial crops production respectively at 5% and 10%. Then, an increase of 1% in education investments induces a leguminous and industrial crop productions raise of 0.268% and 0.436% respectively. In addition, education investments have positive impact on the real agricultural gross national product, cereal, roots and tubers, leguminous and market garden produces productions respectively at 5%, 1%, 10%, 1% and 5% in long time. Education investments are more oriented to rural areas than urban (Ministère du plan, 2007). Those results, higher than those of health investments above all show the effects on long time and confirm the results of Carson (2007). Investments in education have more advantages to the authority and to the whole country. The low impacts are explained by the feeble ratio of schooling on one hand and by the fact that hardly those who are trained in agricultural schools practice agriculture as their activity. Those agricultural trained who might influence villager agricultural practices and increase more agricultural productivities have jobs in administrations. So villagers haven't who to copy to improve their practices and productivities, and agricultural labor productivity is greatly low.

4.3.4 Private Investments

Private investments influence positively and significantly the real agricultural gross national product as well in short-time as in long time. In fact, 1% increase on private investments induces a raise in real agricultural gross national product by 0.184% in short-time and 0.403 in long time. The model results confirm the private sector in economic discussions.

4.3.5 Rural Active Population

Rural active population influences positively and significantly the real agricultural gross national product and the market garden produces at short time. At long time, rural active population influences the real agricultural gross national product, cereal, roots and tubers, and industrial crop productions respectively at 1%, 5%, 5% and 10%. Then, 1% in increase in the rural active population induces a raise of 0.77% of the real agricultural gross national product, of 3.09% the leguminous production (very demanding in manpower for treatment and harvest), of 1.41% of roots and tubers production. The manpower is more requested in agricultural production because the sector is still less mechanized; it is why we have those great correlations. The human capital training will more boost the agricultural productions.

5. Conclusion

This study which main objective is to analyze the public infrastructure impacts on Benin agricultural productions allows to bring out the necessity to improve and to maintain public infrastructures in rural areas. Public infrastructures, above all in transports and in education constitute an efficient political economic tool to sustain agricultural production. Most of those investments in transport, health and education have a positive effect on agricultural production as well in short-time as in long time. But education infrastructure investments have more impacts than others in long time. They improve the standard living and work conditions of rural population who constitutes nowadays the main factor of agricultural growth. This study limits are the lack of the data investments specially at rural level and the absence of qualitative data in the models.

References

- Aschauer, D. A. (1989). Is Public *Expenditure* Productive? *Journal of Monetary Economics*, 25, 177–200. [http://dx.doi.org/10.1016/0304-3932\(89\)90047-0](http://dx.doi.org/10.1016/0304-3932(89)90047-0)
- Banque Africaine De Développement. (1999). Rapport sur le développement en Afrique: Développement des infrastructures en Afrique.
- Banque, M. (1994). *Rapport sur le développement dans le monde 1994: une infrastructure pour le développement* (p. 268). Oxford University Press.
- Banque, M. (2007). Africa Development Indicators.
- Barro, R. (1990). Government Spending in a Simple Model of Endogenous Growth. *Journal of Political Economy*, 98(5), 103–125. <http://dx.doi.org/10.1086/261726>
- Barro, R., & Sala-i-Martin. (1992). Public Finance in models of economic growth. *Review of Economic Studies*, 59, 645–661. <http://dx.doi.org/10.2307/2297991>
- Biaou, G. (2006). *Développement durable: concepts et dimensions*. Edition flamboyant Cotonou, FASEG/UAC.
- Bottone, E. S. (2010). Human Capital Theoretical and Empirical Insights. *The American Journal of Economics and Sociology*, 70(2), 401–423.
- Cies. (1973). Publication du Centre de l'Information Economique et Sociale des Nations Unies, New York.
- Conrad, C., & Seitz, H. (1992). The Public Capital Hypothesis: The Case of Germany. *Recherches Economiques de Louvain*, 58(3–4), 309–327.
- Fadonougbo, E. H., & Richard, K. V. (2008). Infrastructures publiques et croissance économique au Bénin: études empiriques fondées sur les nouveaux modèles de croissance économique; mémoire de maitrise, édition, Nouveaux horizons.
- Gillis, M., & Perkins, H. D., Roemer, M., & Snodgrass, R. D. (1990). *Economie du Développement* 3ème.
- Kauffmann, C. (2009). La participation du secteur privé aux infrastructures en Afrique.
- Keho, Y. (2004). Impact de l'investissement public sur la croissance en Cote d'Ivoire Bulletin de la politique. *Economique et de Développement*, 55, 19.
- MAEP. (2009a). Bénin stimuler l'économie rurale: analyse du climat des investissements pour les entreprises rurales.
- MAEP. (2009b). Contribution du secteur agricole à l'économie nationale.
- Midrand. (2009). Rapport sur les infrastructures de l'Afrique.
- Mindingoyi, G. S. (2008). Analyse des déterminants de l'efficacité de la production cotonnière au Bénin: cas des départements de l'Alibori et de l'Atacora. Mémoire pour l'obtention du master; Gembloux Faculté universitaire des sciences agronomiques.
- Ministere De L'Economie Et Des Finances (MEF). (2003). Statistique des finances publiques: finanstat 2001, 33.
- Ministère De L'Économie Et Des Finances (MEF). (2010). Note d'Orientations Économiques du Budget Général de l'État, gestion 2011.
- Ministère De L'Économie Et Des Finances. (2009). Rapport d'avancement 2008 de la Stratégie de Croissance pour la Réduction de la Pauvreté; Cellule de Suivi des Programmes Économiques et Financiers (MEF/CSPEF).
- Ministère De L'Économie Et Des Finances. (2010). Rapport d'avancement 2009 de la Stratégie de Croissance pour la Réduction de la Pauvreté.
- Montousse, M. (2008). *Théorie Economique* (2nd, ed.). Introduction à l'Economie, 254.
- Morrison, C. J., & Alii, S. (1996). State Infrastructure and Productive Performance. *American Economic Review*, 86(4).
- Munnell, A. H. (1990). Why Has Productivity Growth Declined? Productivity and Public Investment. *New England Economic Review*, 2–22.
- Nations, U. (2009). Rapport sur les pays moins avancés, capacité productive. *Revue Economique*, 49(6), 214.
- OCDE. (2002). Investissements en infrastructure de transport et développement régional.

Tenou, K. (1999). Les déterminants de la croissance à long terme dans les pays de l'UEMOA. Notes d'Information et Statistiques, Etudes et Recherches, No493, BCEAO, Juin.

World Bank. (2006). Africa Database and Africa Development indicators. *CD-ROM*.

Appendix A

Stationary Tests of the Variables

Variables	Level stationnarity		First difference stationnarity	
	ADF test statisitc	Probability	ADF test statisitc	Probability
LNPIBAR	4,544	1,000	-4,095	0,0039
LNIEDU	0,081	0,700	-3,884	0,0004
LnINVP	-2,761	0,222	-4,520	0,0014
LnISANT	0,180	0,731	-6,298	0,0000
LnITRANS	0,330	0,774	-5,545	0,0000
LnPACR	-2,621	0,274	-4,830	0,0007
LnCE	-3,310	0,086	-5,324	0,0002
LnTR	-3,225	0,099	-6,923	0,0000
LnLEG	-2,149	0,228	-5,919	0,0000
LnMA	-2,562	0,299	-8,365	0,0000
LnCI	0,487	0,814	-4,617	0,0000

Source: Data survey, 2010.

Notes

Note 1. Document de stratégies de croissance et de réduction de la pauvreté 2.

Note 2. Quoted by Moutoussè (2008).

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