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Article

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Academic journal of economic studies

Provided in Cooperation with:
Dimitrie Cantemir Christian University, Bucharest

Reference: Epaphrodite, Befio Paulin (2018). Impact of rational use of forest resources in Central African Republic on its economy. In: Academic journal of economic studies 4 (4), S. 64 - 70.

Academic Journal of Economic Studies
Vol. 4, No. 4, December 2018, pp. 64–70
ISSN 2393-4913, ISSN On-line 2457-5836

Impact of Rational Use of Forest Resources in Central African Republic on Its Economy

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Abstract *Given that the economy of Central African Republic as well as other tropical countries is strongly based on the exploitation of their forests, and also CAR's forests have been exploited since colonial period until now but the economic contributions remain below expectations, in this context this work is looking forwards to analyze what can happen to this economy if some policies towards the rational use of forests could be implemented. This study is the extension of the previous one we did about the importance of wood production in the Central African Republic's economy. In terms of this analysis, first we use multiple-regressions (static model) that help us to get the break point through Chow test and then we use structure change analysis in order to analyze the impact of rational use of forest resources due to changes that happened in the Central African Republic's forest department from 1989 on its economy. The analysis of the rational use of forests through the structural change resulting from the Chow breaking point test shows the existence of break point in the wood production trend. The validity of this test also attests the existence of a structural change in the way forest resources are managed and lead to a change in the effect of wood products on GDP positively and significant.*

Key words Central African Republic, economy, economic resources

JEL Codes: O5, O55

1. Introduction

Protection and rational use of natural resources is becoming increasingly important to cope with the growing demand for wood raw materials, tourism and non-timber forest products (NTFPs). Among natural resources, forests play an important role not only as a source of wood products, but also as a means of protecting the hills, thus regulating the flow of rivers, protecting water and reducing soil erosion, tourism, provision of NTFPs (Mati and Dawaki, 2015). In this term forests are considered as the pillar of the protection of all natural resources as we can see from forests services. In general, natural resources refer to materials and energy in the natural that could be used by humankind in production and in their lives. Bennacer and AIT ATMANE (2016), define natural resources which are also called natural assets as being goods existing in nature, but which are neither produced nor producible by man. These are the factors of production derived from nature, of which the main characteristics are utility and scarcity (Béjaia, n.d.). Forests also play an important role in the regulation and protection of ecosystem and also in production. The forest definition differs from one organism to another and even from one researcher to another. FAO considers the forest (FAO, 2015) as a piece of land of at least 0.5 hectare covered at least 10% by trees whose height at maturity is at least 5 meters (Tchatchou *et al.*, 2015).

The growing recognition of the importance of biodiversity and of forests as the reservoirs of terrestrial biodiversity led to a rapid expansion of protected areas. Moreover, substantial policy efforts was made in order to recognize and create a role for government, forestry companies and populations who live in or near forests in the management of forests and the distribution of benefits from forests. The reason is because forests utilization faces a dilemma. First is to improve management and enhance the public benefits of forests in terms of soil conservation, watershed protection and flood control. But also the substantial pressure to generate revenues and to protect forests for commercial exploitation. As consequence this often can create tensions between government forest agencies and the poor populations that depended on forests for their livelihoods. Therefore some concepts such as social forestry, community forestry, and participatory forestry was introduced in forests management, trying to capture some of the ways people have been involved in forest use and governance to make them more equitable and effective.

In fact, the problems of rational use and the sustainable management of forests were raised after a stream of declarations during different conferences of United Nation. Thereby, the first United Nations Conference devoted to the Environment during what the Club of Rome published its report *Limit of Growth* (Meadows, 1972) drew the attention of the Heads of States and Governments, the international community to the impossibility of further economic growth without taking into account the environmental and social and economic consequences. The International Commission for Environment and Development in the report *Our Common Future* also proposed the concept of sustainable development as a strategic solution to this problem (Brundtland, 1987). It encouraged also the balancing of the natural biosphere benefits and also

social and economic development for human needs without harming the living conditions of future generations. The outcomes of other conferences such as The Second United Nations Conference devoted to the Environment and Development (UNCED, 1992) and the Sustainable Development World Summit (Begossi and De Ávila-Pires, 2005) also enhanced the idea of rational use and sustainable management of forests. Thus, given that the economy of Central African Republic as well as other tropical countries is strongly based on the exploitation of their forests, and also CAR's forests have been exploited since colonial period until now but the economic contributions remain below expectations, in this context this work is looking forwards to analyze what can happen to this economy if some policies towards the rational use of forests could be implemented. This study is the extension of the previous one we did about the importance of wood production in the Central African Republic's economy.

2. Literature review

Forests are considered as economic resources (Zhang and Pearse, 2011), considering the definition of economic resources that are items we can use in producing goods and services that can meet people consuming needs. Indeed, forests can be use combining with some labor and other inputs to produce consumer products such as housing, fuel wood, newspapers, outdoor recreation and other environment services. Forestry sector is defined as all economic activities that mostly depend on the production of goods and services from forests. This would include commercial activities that stand on the production of wood fiber. It would also include activities such as the commercial production and processing of non-timber forest products (NTFPs) and the subsistence use of forest products. Zhang and Pearse (2011) again considered forest product sector as the sector that includes industries that produce these following products: standing timber, logs, and manufactured products such as paper, paperboard, lumber, plywood, oriented strand board, fiber-board and wood furniture. These cited products are exchange on the markets such as stumpage or standing timber market, the log market and the market for manufactured products. In this literature review we are going to emphasize on the importance of forests throughout different kind of forest products and services and also the rationality concept.

2.1. Importance of forest

The objectives, which must provide the means for forest management, have varied widely over the centuries. The forest in the middle Ages had to meet the needs of people who lived in or near: acorns and beechnuts for herds and frequently for men, fruits and game, fuel, especially in the form of coal, as well as service and work woods, recreation (hunting). Economic development, from the sixteenth century roughly, has somehow led to the specialization of forests in favor of quantity production. They were the ones who had to provide the energy and the coppice management made it possible to satisfy this need, with different rotations according to the size of the desired woods. The needs of metallurgy, glassmaking, brick and tile works, ovens, forges and salt works were added to those of men and small traditional craftsmen. The nineteenth century saw the growing importance of large and long logs, which the development of the road network, making the drain possible in great length, has made it possible to recognize the objective of management. Many forests have had to adapt (conversion to high forest). Today, the new objectives assigned to the forest appear multiple and varied.

Common people always consider timber as the only forest product, however, timber resources are no longer considered as the main forest products. Many forest services are now considered such as land for agriculture (normally shifting cultivation), building materials, food and palm wine, medicine, firewood and charcoal, sacred values, bush meat and habitats, shelter and food for many living been including man. Environmental regulation, water production and conservation, erosion control, gathered medicinal plants, indigenous fruits, tourism. Therefore we distinguish two categories of forest products: non-wood forest products and forest wood products (Eastern, Forest, Assessment and Resources, 1996).

Non-wood forest products (NWFPs) are a broad group of products that include all plant and animal resources produced by forests, excluding wood. They can be considered as goods of biological origin other than wood. Most NWFPs are gathered, rather than cultivated, and there is usually limited value addition at the source. Estimates of the extent of people's dependence on NWFPs vary; often extrapolation of local level studies fails to provide a realistic picture of the overall importance of NWFPs in the livelihoods of people at larger scales. Certainly NWFPs are critical to the livelihoods of forest-dependent people, but such dependence declines when agriculture and other activities become major sources of income. It is difficult to get the market value of NWFPs because most NWFPs are consumed as subsistence items or sold primarily in local markets. Wood forest products are considered as all goods derived from the production of wood fiber such as production of industrial round wood, wood fuel and charcoal; sawn wood and wood-based panels; pulp and paper; and wooden furniture. Wood products are the one that have economic value and traded on the international market. That's why in this work we limit ourselves these products as forest products. When we come to forest services, they are several kinds of forest services but in terms of our paper we might keep only three kinds of forest services: productive service, protective service and socio-economic service.

Forests provide productive service because many products are collected from forests, categorizing from wood for timber and woodfuel to food (mushrooms, berries, edible plants, and bush meat), fodder and other NWFPs. Regarding the quantity, wood destined for industrial use is the most important product; among NWFPs, food and fodder are the most significant. According to World Forest Assessment about half the world's forests are reserved for production (as either primary or secondary function) and thus are available to supply wood and non-wood forest products. Society has become increasingly conscious of the ecosystem services (protective services) provided by forests and trees and in some countries such services have become more important than production of wood and non-wood products (FAO, 2015). The setting aside of large tracts of forests as protected areas allied within management objectives including, in some cases, a total ban on logging, reflect the changes in society's priorities. Conservation of biological diversity, maintenance and improvement of watershed values, combating desertification and land degradation, and climate change mitigation and adaptation are a part of key ecosystem services provided by forests. With climate change becoming a key global issue, the role of forests in climate change mitigation and adaptation has become a high profile issue in recent times. Provision of recreational services has also garnered significant attention and in many countries ecotourism, domestic and international, is already an important source of income. Finally, beside productive and protective services, forests provide a wide range of economic and social benefits (socio-economic services) to human being. These include participations to the overall economy such as through employment, processing (transformation) and forest products trade and energy, investments in the forest sector. The social functions of forests can also include the hosting and protection of sites and landscapes of high cultural, spiritual or recreational value. They are often more difficult to measure and can vary considerably from one country to another, in regard to their level of development and traditions.

2.2. Rational use and the institutional framework of forests management in Central African Republic

Rational use concept is derived from rational choice theory which is also known as choice theory or rational action theory. Rational choice theory is a theory for understanding and often modeling social and economic behavior as well as individual behavior (Ogu, 2013) and this is the main paradigm of the current school of thought in microeconomics. It is also at the center of other disciplines such as sociology, philosophy and modern political science. Becker, one of the first to apply rational actor models, more broadly demonstrated that rational choice theory was first popularized by a 1992 Nobel laureate in economics (Becker, 1957). Elster stated the essence of rational choice theory when he said that "in the face of many action plans, people usually do what they believe to be likely to have the best overall outcome" (Elster, 1989). The "rationality" defined by rational choice theory adopts a more specific and narrow definition, which simply means that "an individual acts as a balance between costs and benefits to arrive at an action that maximizes personal benefit" (Friedman, 2009). According to the institutional framework of the forest sector in Central African Republic, the Ministry of Waters, Forests, Hunting, Fisheries and Tourism which is the direct representative of the State, plays a very important role in the management of forest resources. Before 1989, the date marking the adoption of the Declaration of Sectorial Policy and Restructuring of the Ministry of Waters, Forests, Hunting, Fisheries and Tourism, the role of the Ministry was very limited to two domains (flora and fauna) that it had only one Direction (Department). In the field of flora, he was responsible for ensuring reforestation, controlling the exploitation of the forest and repressing forest offenses; while in the wildlife area, he was also responsible for ensuring the protection of wildlife, controlling the exploitation of wildlife and suppressing hunting offenses. We clearly see that in the two areas of the Department's jurisdiction, the predominant aspects were control and repression and do not include management. After this date (1989), the Central African Government had clearly indicated its determination to pursue a coherent policy for the rational management of natural resources. Therefore, without being able to modify fundamentally the former attributions mentioned above, the new organic text of the Department comprising two Departments (Central Services and Regional Services) had favored rather the development aspect by the introduction of agroforestry and by the involvement of rural populations in the various actions that the Ministry intended to conduct on the ground.

After 1989 changes have been made such as: the restructuring of the Ministry with several Departments, seven Regional Departments' Bureau and sixteen Prefectural Inspections' Bureau. The focus was more on Field Services, which are now much more empowered; the adoption of a new Forest Code in which new modifications is made in the allocation of logging permits. We are now talking about an Exploitation and Development Permit (PEA) instead of a Temporary Exploitation Permit (PTE). The forest operator must henceforth be interested in the management aspect and the population must also be involved in the Government's decision-making on the management of natural resources and the establishment of the Forest and Tourism Development Fund (FDFT) on recommendation of the Bretton Woods Institutions, Special Assignment Account "Forestry and Tourism Development" (CAS/DFT). In this way, the State through the Ministry of forests shifted from a law enforcement officer to a development agent. Nowadays, the nomenclature of this Ministry has improved until reaching five Headquarters Department with their representations in all the provinces.

3. Methodology of research

This paper will focus on the forest exploitation in CAR, located mostly in the closed forest of the south-west part of Central African Republic which forms the northern farthest point of the Congo Basin forest (Gindre, 2008). Out of the total surface area of 623,000 km^2 in Central African Republic territory, 283,136 km^2 (45.6%) are forested, with a predominance of the open forest (Gapia and Bele, n.d.). The closed forest covers about 92,500 km^2, or 15% of the national territory. The purpose of this work is to synthesize existing information on the forest exploitation in Central African Republic, based mainly on the bibliographic review. These data are time-series data from in the range of 1970-2015. The use of documents of various kinds such as scientific publications, official documents, newspaper clippings, reports of workshops and scientific meetings will allow for appropriate processing of data and analysis of information collected. Empirically, in terms of our analysis, first we use multiple-regressions (static model) that help us to get the break point through Chow test and then we use structure change analysis in order to analyze the impact of rational use of forest resources due to changes that happened in the Central African Republic's forest department from 1989 on its economy through the model as follow:

$$LGDPMP_t = \beta_0 + \beta_1 LAVA_t + \beta_2 FRGDP_t + \beta_3 MRGDP_t + \beta_4 LRWood_t + \beta_5 LSVlog_t + \beta_6 LWoodF_t + \mu_t \quad (1)$$

Where:

Gross Domestic Product in Market Price (GDPMP) is the real GDP at constant market price of 2010.

Agricultural Value Added (AVA) is the sum of all the values added from different agricultural sector. Forest Rents in percentage of GDP (FRGDP) are by definition round wood harvest times the product of average prices and a region-specific rental rate. This index is calculated for each country according to the method establish by the World Bank in its report named "*The Changing Wealth of Nations: Measuring Sustainable Development in the New Millennium*" (World Bank, 2011). Mineral rents as a percentage of GDP (MRGDP) are also, by definition, the difference between the production value of a mineral stock at world prices and their total production costs. The minerals included in the calculation are tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite and phosphate.

Round wood (RWOOD) is any round wood cut down or otherwise harvested and removed. Sawn and Veneer Logs (SVLOGS) are round wood that will be sawn (or chipped) longitudinally for the manufacture of sawn wood or railway sleepers or used for the production of veneers (mainly by peeling or slicing). Sawn wood (SWOOD), wood that has been produced from domestic and imported round wood, either by lengthwise sawing or by a profile peeling process and which, with some exceptions, exceeds 5 mm in length thickness. And the Wood fuel (WOODF) is a round wood that will be used as fuel for cooking, heating or energy production.

4. Data analysis

Table 1. Stationary test result (ADF)

	Level			First difference		
Variables	ADF C&T	Critical Value (5%)	Result	ADF C&T	Critical Value (5%)	Result
AVA	-1.322698 (0.6110)	-2.928142	I(1)	-5.856996 (0.0000)	-2.929734	I(0)
FRGDP	-1.835624 (0.3590)	-2.928142	I(1)	-8.246402 (0.0000)	-2.929734	I(0)
GDPMP	-2.040810 (0.2690)	-2.928142	I(1)	-6.713742 (0.0000)	-2.929734	I(0)
MRGDP	-2.542479 (0.1127)	-2.928142	I(1)	-6.525347 (0.0000)	-2.929734	I(0)
RWOOD	-1471518 (0.5381)	-2.928142	I(1)	-8.089934 (0.6098)	-2.929734	I(0)
SVLOGS	-1.894588 (0.3319)	-2.928142	I(1)	-7.475021 (0.0000)	-2.929734	I(0)
SWOOD	-2.291226 (0.1791)	-2.928142	I(1)	-6.919294 (0.0000)	-2.929734	I(0)
WOODF	-1.096018 (0.7094)	-2.928142	I(1)	-6150354 (0.0000)	-2.929734	I(0)

Figures in bracket denote MacKinnon (1996) one-sided p-values.

All the variables are stationary at first difference.

Table 2. Multiple-regression result

Dependent variable: LGDPMP

Variables	Coefficients	t-values	Probability
C	23.06373	15.42374	0.0000
LAVA	0.221139	11.39284	0.0000
FRGDP	-0.024055	-5.402595	0.0000
LRWOOD	-1.890208	-3.224809	0.0025
LSVLOGS	0.287054	3.722225	0.0006
LWOODF	1.256457	2.623174	0.0123
R^2= 0.884318 Adj. R^2= 0.869858 F-statistic= 61.15499 p-value= 0.00000			

With LGDPMP the natural logarithm value of the real GDP at constant market price of 2010, LAVA the natural logarithm value of the sum of all the values added from agricultural sector, LFRGDP the natural logarithm value of forest rents in percentage of GDP, LRWOOD, LSVLOGS, LSWOOD are natural logarithm values of RWOOD (round wood), SVLOGS (sawn and veneer logs), SWOOD (sawn wood) and WOODF (wood fuel) respectively.

Table 3. Chow Breakpoint Test: 1989

F-statistic	Probability
7.527611	0.000023
Log likelihood ratio	Probability
44.77182	0.000000

We used the natural logarithm value of sawn and veneer logs as a proxy variable for all wood products to make the analysis of structure change equation and we get the result below.

Table 4. Structure change model result

Dependent variable: LGDPMP

Variables	Coefficients	t-values	Probability
C	23.73893	17.00776	0.0000
LSWOOD	-0.248401	-1.985694	0.0536***
D89	-2.993320	-1.916463	0.0621***
D89*LSWOOD	0.288201	2.055702	0.0461**
R^2= 0.486164 Adj. R^2= 0.449461 F-statistic= 13.24603 p-value= 0.00000			

** Significant at 5% level, *** significant at 10% level.

In order to analyze the effect of the change we introduce two dummy variables: D0 (from 1970 to 1989) and D89 with D89=0 within the period 1970-1989 and D89=1 within 1989-2015.

5. Results

According to our data analysis the result of the unit root test show that all variables were not stationary at level as we can see; the value of ADF test statistics is less than critical value at 5 percent level for all variables. These can also be discern from probability values greater than 0.05, it's mean that we cannot reject null hypothesis of unit root in these variables therefore they have unit-root or they are not stationary and should carry out the test again at first difference. The ADF (table 1) values at first difference are greater than critical value at 5 percent, the probability in parentheses shows values less than 0.05, hence we reject null hypothesis of unit root (no unit root) for all variables at first difference, all other variables are integrated of order one I(1). This allows us to perform our multiple-regression without any risk of spurious model.

The results of the multiple-regression show that, all the parameters of the model are statistically significant at five percent level of significance; with the t-test values respectively 11.39284, -5.402595, -3.224809, 3.722225, and 2.623174 (LAVA, FRGDP, LRWOOD, LSVLOGS and LWOODF) greater than 2. The adj. R^2 0.869 shows 87 percent of variation in dependent variable is explained by independent variables. The joint significant given by F-stat 61.15 p-value (0.00) shows that independent variables are significant determinant of dependent variable.

The Chow test result tells us that the break point occurs at the year 1989 when the Central African Republic's forest department made changes about its structure.

Regarding the structure change analysis, the coefficient of D89 represents the change in the intercept and the coefficient of the interaction between D89 and the dependent variable tells us about the change in slope. From this result we can notice the change in the production due to the structural change using these following equations:

$$\mathrm{LGDPMP} = 23.73 - 0.24 * \mathrm{LSVLOGS} - 3\mathrm{D89} + 0.28\mathrm{D89} * \mathrm{LSVLOGS}$$

First group 1970-1989: $\mathrm{LGDPMP} = 23.73 - 0.24 * \mathrm{LSVLOGS}$

Second group 1989-2015: $\mathrm{LGDPMP} = 20.73 + 0.04 * \mathrm{LSVLOGS}$

The second group model is got by taking the derivative of the first equation with respect to D89 in order to get the effect of structure change in the production of wood products on the economy of CAR. In this equation, the propensity of produce wood products (slope) is positive which mean that with structure change wood products affect the GDP growth positively.

In the first group equation the coefficient of SVLOGS is statistically significant at 5 percent level and has a negative effect on the GDP. This is one percent change in SVLOGS will make the GDP to change by 0.24 percent in the opposite direction. While in the second group equation the one percent change in SVLOGS will lead to 0.04 percent change in GDP but in the same direction (positively). SVLOGS has a statistically significant parameter in the second group equation too. The low positive productivity propensity (0.04 percent) of forest products from 1989 confirms the fact that although the government has made some efforts to change the management system of forest resources, its contributions is still below expectation. These two equations mean that before 1989 the production of timber has a negative effect of the CAR's economy. It was only after this period the country started to gain from the exploitation of its forests. This result is relevant with the reality because the year 1989 was marked by the adoption of the Declaration of Sectorial Policy and Restructuring of the Ministry of Waters, Forests, Hunting, Fisheries and Tourism. This new policy gave the chance to the ministry to become the first manager of the forest resources contrary to the controller and judge role that it was playing since.

6. Conclusions

The analysis of the rational use of forests through the structural change resulting from the Chow breaking point test shows the existence of break point in the wood production trend. The validity of this test also attests the existence of a structural change in the way forest resources are managed and lead to a change in the effect of wood products on GDP positively and significant. The change came from the application of some reforms in the forest department with regards to some policies undertaken by the government of Central African Republic in terms of rational use of forests. We found out also the year 1989 was an important break point in the management of forest in CAR. After this year, the government gave more power to the forest ministry by creating more departments in order to improve its role as actor in the resources management towards a rational use.

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