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Full length Research

Agricultural Response to Investments and Credits in Benin. What Conclusions for the Cotton Sector

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This study critically evaluates the agricultural response to investment and credit in Benin. In this article we develop an autoregressive vectors model to estimate the short-term public investments and Agricultural Credit dynamics on the cotton production. Results show that investment and agricultural Credit policies do not induce positive reactions of cotton supplies. In addition, the response time of the Beninese cotton producers to financial incentives is quite long and they are little sensitive to the new agricultural cotton policy.

***Keywords*:** vector autoregressive model –investments- Agricultural Credit - cotton
JEL Classification: G13, L11, O24, O33

INTRODUCTION

The financing of the agriculture always appeared at the right place among the strategies of implementation of the developing countries'agricultural policy. In Benin, the government has implemented credit and financing incentive programs aiming to stimulate the agricultural production, to assure the food safety, to develop the expanding sectors and to improve the living conditions in rural areas. The participation of banks on the credits and the financing of the farming sector are still low in relation with the nature of the national banking scale. The contribution of the banking sector to the agriculture finance is diffuse. The fund set up by commercial banks are more intended for the sector's backing activities: shelling, import and distribution of inputs and in a limited way organized by firm modern poultries. So the classic banks are directly involved in the cotton sector, offering credit lines to the cotton's shelling companies in order to market the seed cotton; they also grant credit lines to imports and inputs distribution companies of cotton. On other hand, the direct participation of classic banks in the financing of the family agriculture which represents almost all of the agricultural production is insignificant even almost null. Agricultural credit and microfinance institutions try to mitigate this insufficiency through the credits granted to them by classic banks which are neither adapted nor equipped to manage high risks and high costs portfoliosuch as credits granted to the family exploitations.

However, results of financial support were generally below expectations. We note, indeed, a low exploitation of the potential of production, maintaining peasant's production systems at a traditional level, which resulted in the stagnation of the main export crops production, low exploitation of the agricultural potential and the excessive weakening of the food security in front of various food crises. The probable causes stigmatize, on one hand, the lack of positive reaction of the farmers in economic incentives and, on the other hand, the inadequacy of the financial institutions on the peasant conditions in a little favorable global economic environment. Indeed, whereas the peasant put forward their social needs in the choices of financing, we have as spicy that the organized financial structures had little served their initial clientele. For instance, the disappearance of the "Banque Béninoise de Development and the Caisse Nationale de credit Agricole", which are due to the mismanagement, the embezzlement and to the limited capacity of its financing. Needs in financing for the farming sector at long-term are still high. The elasticity of the agricultural growth compared with the agricultural expenses is rather weak in Benin compared with the African average. The

agricultural expenses are 7, 9 or 6, 1 % a year, according to the level of elasticity of the agricultural growth compared with the agricultural expenses. These rates are much higher than the current trend of growth between 2000 and 2006, which are situated in 4, 6 % on average. To reach the OMD1 in 2015 the required expenses growth rates are still higher - 22, 8 % for the weak elasticity and 17, 6 % for the high elasticity. To reach the OMD1 in 2020 the required expenses growth rates are a little more low, 13, 9 and 10, 7 % according to, respectively, the scenarios weak elasticity and high elasticity. The realization of the objective of the Strategic Plan for boosting Farming sector (Plan Stratégique de Relance du Secteur Agricole (PSRSA)) will require the annual agricultural expenses growth rates of 25, 5 % for the weak elasticity and 19,7 % for the high elasticity. However, the financing of the PSRSA, to reach the goal of reduction of the poverty, will require an increase of the part of the agricultural expenses in the total public expenses withanaverage rate of 8, 6 to 29,2 % for the weak elasticity or 21,1 % for the high elasticity. Other factors limit the development of the farming sector concern essentially the existence of an inconsistent agricultural policy and a bad strategic choice; the non-controlof the technical routes; the bad cultural practices; the impoverishment of grounds, especially those of the fitted out slums. Besides, the enclosing of the production zones, the impracticability of a large number of runways, especially during the rainy season, the absence of adequate stores of storage, fitted out markets, the non-existence of a policy and measuresof standardization and certification are so many handicaps for the access of farm produces to the various national and international markets. The current laws in the country do not facilitate the access to the financing to the economic operators, so much to the multipliers and distributors of seeds so that they can assure the availability to producers so that they can get the improved seeds. The consequences of the weakening of the productive investment in agriculture on the agricultural sectors in Benin are well known: decrease of the production; of the productivity; agricultural income; the rural migration towards Nigeria and other bordering countries; decrease of the sales in real terms, losses of competitiveness and greater outside dependence. In a perspectiveof sustainable andfavorable cotton sector for the producers' well-being in Benin, it urge that the public and private investments are realalong periods of agricultural campaigns. The investment is not any more today than a simple renewal than the excessive extension of the operating life of the existing equipment is generative of high maintenance costs and losses of productivity. It is thus completely hoped that this article can contribute to the financing of the agriculture in the optics of the increase of the productivity and the improvement of the cotton producers' well-being.

After the literature review in the second section, the third section exposes first of all the model and the econometric options. It describes then data and specifies variables. The fourth section presents the results and the discussions and the fifth proposes the conclusion.

LITERATURE REVIEW

The literature review is centered on the investments impacts on the agricultural production. It highlights the complementarity between public and private capital as well as the simultaneous necessity of various types of public capital. The public investment can indeed take various forms: the agricultural research and vulgarization services, the irrigation, the rural runways, the electrification and the rural education. For example the development of new varieties by the national research is useless if the innovation is not relieved by the services of vulgarization. Several reasons explain the decline of this highlighting. Results generally are often mediocre at the level of certain agricultural project types. The complexity and the loans costs in the agriculture are very unfavorable and influence the pressure groups in favor of the agriculture and the environment in developing countries. All the mediocre results concern the absence of integrated rural planning and especially the lack of cash and inputs credits to the small producers who remain the most numerous. The access to credits and to the unproductive investments slows down the growth and the agricultural productivity of developing countries. This major handicap does not allow to widen the possibility for a sustainable agricultural diversification. The non-control of the water is also a factorwhich does not favor the global efficiency of investments. It is probably in the field of the financing of the irrigation that the reduction of the outside help had the most fatal consequences for the agricultural production. Ellsasser (1993) shows how the access to appropriate financing allows farmers to secure and to develop their economic activities. Indeed, for Nowak (1993), credit policies must not be negatively considered, as being "failures", engulfingenormous money as an instrument of development. According to him, there was an error on the instructions for use in Africa where the financial systems were too fast transplanted, centralized and badly managed. Quality indications can be deducted from evaluations of the yields on previous public investments. They show yieldssuperior to the average in the agricultural research, what would indicate an underinvestment. According to the Department of the evaluation of the retrospective operations of the World Bank (Evenson, 1994; Umali, 1992) shows that the investments in the field of the vulgarization seem so generally profitable. The projects of irrigation and rural infrastructure have, generally speaking acceptable yields, while in the domains of the breeding, the Agricultural Credit and the integrated rural planning, the results were often bad. You should not inevitably conclude that there are no possibilities of investment in an activity or a given sub-sector. The bad conception of a project can often contribute to mediocre results. For

example, the mere results recorded by the rural integrated planning projects in the 70s and 80 were mainly owed to their operational complexity and to the top-down approach adopted then for their planning. With the decentralization of the financing and a wider participation of the interested in the planning and in the realization, the results should be better in the future.

The weakness of the investment is the key variable and the investment in rural area is indicated as essential element in the struggle against poverty and food insecurity (World Bank, 2008; Barrett and al. 2010; DeJanvry, 2010; DeJanvry and Sadoulet, 2010). The households are trapped by poverty being then in a vicious circle and it is necessary to find levers capable to break these chains (Poulton and al., 2006). We expect from the investments growth positive impacts on the food security not only in rural area but also in urban area, for the price drop consecutive to the production growth allowing to satisfy at the same time the peasant and the urban (FAO, 2012). To generate this investments growth, numerous authors advance the necessity of public, essential goods to create a more favorable environment (Barro and Sala-I-Martin, 1995; Aghion and Howitt, 1998). Indeed, in the absence of public investments in rural area (or still of their weak efficiency, even their misappropriation), the supplies of public goods (roads, warehouses of storage, irrigation, electricity, access to the health and to the education) are inadequate, enhancing considerably cost dropping then economic profitability.The weakness of the population density inducing high cost of infrastructures building explains partially this situation in numerous countries of Sub-Saharan Africa (Fafchamps and al., 2005). Several studies show similar results (sGarcia, 1975; Texeira, 1976; Graber, 1976; Drummond, 1972; Taylor and al, 1986). Especially, Steitieh(1971) shows that the increase of the investments in the factors of production such as the mechanization and the fertilizers' equipmentis not enough to increase the production. It is necessary to set up a system of management and effective information for the operations. In other words, the farmers having access to the credit can buy modern factors of production but it does not still guarantee the good use of these factors. Kouakou (2001) shows in Côte d'Ivoire, concerning the necessity of creating an agricultural bank. The rice paddy's producer having access to the credit and those having no access to the credit have not a same economic efficiency. This difference of economic efficiency is due to a difference of technical efficiency, all the farmers having the same efficiency of resources allowance. As a consequence, the study reveals that the credit is an important stimulant contributing to the development of the farming sector. Having traced the history financial institutions and having presented those who exist at present, the change of approach in the management of these structures and the creation of a new agricultural bank is recommended .Cherbbi (2005) shows that the investments in the farming sector are dedicated to the big hydraulics and to the irrigation, while the small farmers do not arrange a capacity of investment and while the agricultural bank credits are little developed. He demonstrates with a VAR model where the farmers have enough appropriate resources to finance inputs and where the AgriculturalCredit is essential. Besides, if the short-term interest rates are lowered, the investment is favored and the capital accumulation is improved. These results obtained in the whole of the farming sector are transposable in the irrigated sector. Altogether, investment and credit policies induce reactions on the agricultural production more important than on the demand. Furthermore, the response time of the Tunisian farmers in financial incentives (in the investment or in the credit) is rather long and they are very sensitive to the uncertainties of the policy. In developing countries the national investors are more numerous than the foreign investors. Media and observers are focused on the foreign investors due to the fact that they are really the buyers of big surfaces. But if the national investors, through purchases or emphyteutic leases, work generally on more reduced surfaces, the importance of the number of their acquisitions made by the national investment a factormore significant than the foreign direct investment, has the local scale (Taylor and Bending, 2009), (Cotula and al. 2009). And in certain cases, the national investors possess or desire comparable surfaces has those of the foreign investors (Huicoma company with 100 000 hectares, Yatassaye with 20 000 hectares in Mali, Gold Star Farms Ltd with 10 000 hectares in Ghana). Generally, the interest of the national investors' concerns to the unorganized rural lands, in particular in suburban zone, fertile farmlands or lands with tourist vocation. A study carried out recently in some countries of western Africa (Hilhorst, Nelen and Traoré , 2011) reveals that more than 95 % of investors is intern 15, that 45 % live in provinces or the investments are realized and 37 % in capitals. In the zones which made the object of survey for this study, the acquired maximum surface is 504 hectares in Benin, 300 hectares in Burkina Faso and 632 hectares in Niger. The land investments are the opportunityto increase the investments in the agricultureand to develop the farming sector and the rural areas (Braun and al., 2009). The foreign Investments in particular allow the influx of new technologies and capital. If the State for its part reinvests receipts generated by the investment in land and agricultural projects, it participates then itself in the increase of the production and the income, and in the improvement of the rural population's living conditions. When harmonize private investments and appropriate form of contractual agriculture, the small partner farmers can have an access guaranteed in work, coherent prices for their products and thus satisfactory income. Some of these positive impacts are already locatable in operations in progress, while in other cases they are still only simple potentialities. So that the return on

investment is maximized, it is necessary that the part of the added value serving to pay the capital or the highest possible. The remuneration for the work, the cost of the access to the ground and the various taxes must be then reduced at least (Cockerel and al ., 2011). It is these conditions which the International Financial Institutions intend to impose since the Consensus of Washington by liberalizing markets like crazy, and by decreasing the role of States. Besides, the investment can require resources superior to receipts pulled by the current production and dependent on expected receipts in the future and the liquid assets. Finally, it was often underlined by the experts (Dixit and Pindyck, 1994) that the decisions of investment can be irreversible, at least to a certain extent. Considering this irreversibility, any information coming to justify the choice to wait for other more precise information before making a decision of investment acquires an additional value. The investment is defined as running costs concerning machines and buildingsused for the production. This document uses the same data as the study of the OECD (2002) dedicated to the effects related to the risks, and proceeds to estimations and to comparable simulations. Conrad and al (1992) show that in Germany, the impact of the public capital is higher in the industry and the agriculture than in the services. This result was confirmed by Munnell (1993) for the United States. On the other hand, in seven countries Latin American of the study of Rioja (2004), three sectors (agriculture, industry, and service) benefited from the increase of the public investments during 1990s, but it is the service sector which the most benefited from the development of infrastructures. Teruel and al (2005) concluded that by reducing the production costs, the public infrastructure allowed to improve the productivity in the agricultural sector in the Philippines.

Numerous works dealt with the importance of the joint liability in the efficiency of this plan of credit. The objective is to conceive better this plan to spread the access to the credit in the family agriculture of PMA increasingthe potentials of agricultural development of these countries. This mechanism of joint and several guarantees was developed in the analysis of cooperative credit banks. These organizations reduce the problems of information thanks to better guarantees of refund and to mechanisms of credible penalties for the failing members. Ghatak and al (1999) showed that a cooperative credit bank formed freely for the loan of group revealed a positive matching between the levels of risk of every member. The most reliable individuals in the refund join between them within the same group. A good structuring of the producers groupings would allow, in term of repayment, better performances than the other types of existing contracts (arrangements storekeeper /farmers or agricultural contracts). However, this mode of organization is not still very effective nor very wide-spread. In many countries of sub-Saharan Africa, the credit is still managed by rustic non-specialized associations as the former GV. The emergence of structures specialized, professionalized as the GPC is an interesting way to be developed in Burkina Faso and to be set up in other countries as in Mali for example. The works of Armendariz de Aghion (1999) highlight the advantages of the mechanism of the joint liability in groups of credit. A lender in monopoly position can release more private profits with this mechanism than with a classic individual credit, if and only if, the costs of mutual supervision are little raised within the group and if the social penalties with the failing are credible enough. The risks of production being correlated between the producers of the same group of credit, these incite them to improve the mutual supervision and to allow an expected release of pensions more important for the body of loan. However, the producers cannot share the risk as previously, and the members who have the biggest aversion at the risk will not want to participate any more in the group credit. The size of the group makes change the strategic behavior and the level of supervision between the members of the group. A bigger group can improve the level of supervision; but there are, also, pernicious effects, giving more scale to the opportunist behavior. A group of an intermediate size is thus desirable. Besley and al (1995) developed a model of gamestheory applied to the group credit repayment with joint liability. These show that there are two types of opposite repayment incentives and that the negative incentivecan be reduced with the use of internal social penalties to the grouping, where from their role of social guarantee. These theoretical models show clearly how the joint liability can return a group of effective credit in its repayments, returning the attractive plan.

METHODOLOGY

Data, models and econometric options

This sub-section is centred on the source of the data, the modelling and the econometric options.

Data

The data used in this article come from two sources (primary and secondary). The primary data are obtained by survey based on the Accelerated Method by Participative Research. This method used to generate soon information which are analyzed with the cooperation of the cotton producers (Ghirotti, 1994; Nianogo, 1994). Although its application requires a high quality community and sensibility (Water - Bayer et Bayer, 1995). The obtained results supply a big understanding of the financing constraints of the agriculture, the cash and inputs credits access and the investments in the cotton production. The method also allowed to identify the age brackets of the cotton producers having access to the credits, in which period

cash credits are available, the various rates and the term of repayment of credits. The various methods of inputs credits repayments are revealed and especially the selling of these inputs. All in all, 1 000 cotton producers were concerned in two passages counterparts hanging the harvest and the post-harvestsperiod between October, 2010 and September, 2012. The information processing with the software Excel 2010, confirms that 750 questionnaires supplied with reliable information that is a 75 % rate. As regards the secondary data, they come essentially from statistics of the Ministry of Finance. These statistics concern the various budgets assigned to the agriculture from 1995 till 2013.

Model Specification

Notation
E denote the expected value
Pthe vector of the investments;
X is the vector access to credits (hectare);
Ψ is the vector of the yields (Ton / hectare);
W is the vector of the costs related to the credits access;
J is the cotton activities index for example, j =1…J;
The sign ~ denotes a random variable;
The signs ˇ and ◦ upon or under another symbol denote a simulation by computer of a randomvariable.

Vectors P and Ψ Are obviously random, we shall thus write P ~ andΨ ~ afterward. The vector X is the set of surface allocations; it represents the exploitation's decision variables and is not thus random. Let us assume for the moment that a hectare of a certain culture needed determined quantities of inputs variable (fertilizers, treatments), seeds, and services). The vector W represents then the cost of these inputs that is the variable cost. The variable cost in the hectare is different according to the activities because inputs are not the same and is known of the developer as it makes its decisions of sowing (Certain decisions relative to inputs can be made after the decision of sowing, in function for example of the climatic progress of the current year. In case, *w* should be seen as a random vector. As far as the largest part of the decisions of inputs is taken before the sowing, we consider that the random part of W is unimportant). Thus W is a vector predetermined in the decisions of sowing surface that is not randomas regards the modelling. With this notation, we can write the problem of maximization of the farmer's expected utility in the following way:

$$\max_X E\left[\frac{(\tilde{P}'\tilde{\Psi}*X-W'X)^{1-\rho}}{1-\rho}\right] \quad \ldots\ldots(1)$$

where the sign ' indicates the transposition of vector and the sign * indicate the matrix product element by element. Thus$\tilde{\Psi}*X$ represent the random vector of productions $\tilde{\Psi}_j X_j$. A major problem of the agricultural modelling in the investments (see for example Moschini, 2001) comes because of the presence of two correlated randomvectors: the investments and the credits access, $\tilde{P}$et $\tilde{\Psi}$. This problem can be solved by joining these two vectors in the only one

$$\tilde{\theta} = \tilde{P}' * \tilde{\Psi}.$$

The vector $\tilde{\theta}$ can be interpreted as a vector of yields in value to the credits access. Since the annual realizations of $\tilde{P}$ and of $\tilde{\Psi}$ are observed in the MAEP, it is possible to calculate the annual realizations of$\tilde{P}$ and of $\tilde{\Psi}$ thus to consider directly the parametric's distribution who best approximatethe observed distribution$\tilde{\theta}$.
Formally, in the problem (1), we can then interpret the allocations X as productions. The advantage of this interpretation is that itmoves the whole random aspect of the problem on $\tilde{\theta}$of X.
If we suppose a homothetictechnology the vector W can be then interpreted as a function of unit cost. Nevertheless, there are strong assumptions that the agricultural production is not homothetic. We should thus replace the term W'X in (1) by a function of cost C (X). Below, we discuss certain properties as this cost function should possess.

Functional form of cost function

In order to allowto surface allocationsX to preserve their interpretation of output, it is necessary to think in term of the production expected by the surface: we can always dedicate many of ha to a certain culture without the cost in the hectare increases. Thus, the interpretation of X is of a hectare producing of the quantity expected by the culture in question.
The variable, allocable inputs and giving rise to an explicit expense in the MAEP are among five for the cultures: fertilizers (chemical, biological and organic, without distinction until 2012), pesticides (treatments) services, seeds and other non-specified loads. These inputs are rather complementary between them: for example without seed, the output is null independently of the other inputs. If this complementarity is strict enough, the proportions of inputs are fixed. Between cultures, these inputs are specific to every culture: fertilizers for cereal are not those of cotton.
There is thus no reason so that they have the same price and the second-class crossed coefficients of the cost functionrelative to it are all useless. In terms of modelling, it implies that only the surface matters as variable input because, by culture, all other inputs are function of the surface and between cultures, there is no relation. In the model (1), the surface allocations X are thus sufficient to capture the expenses associated with the variable inputs.
The non-allocable inputs (that is the allocation of which by culture is not given for the MAEP and our inquiries) are mainly fixed factors: the work, the capital, and the machines. There is also a consumption of hydrocarbons, but it is an unimportant expense with regard tothe group. These fixed factors have this unusual feature that every culture is going to require their services at some point in

the year. Thus, the farmer is going to choose his cultures in particular on base of the moment when they are going to occupy fixed factors. It is a very important element of diversification. The quotas and the constraints of rotation play a similar role. Being given these characteristics, the economic problem of the farmers, of least in the short term, is partially a problem of allocation.

Consequently, most of the present cultures on a farm at some point should not compete as regards their needs in services of fixed factors because they use them at the different moments in time. Thus in the function of cost, the crossed coefficients of second degree relative to the outputs should be null: an increase of a certain culture production has no impact on the marginal cost of the other cultures otherwise than by the fact that the total surface of the exploitationhas to remain the same.

Following Howitt (1995), it is reasonable to consider that on an exploitation given at some point (that is in the short term), increase the production of a certain culture be expensive more and more. The main argument of Howitt is the heterogeneousness of the factorland but also extends in the fixed factors and in the variable inputs: as the farmer dedicates a bigger and bigger part of his exploitation to a certain culture, the lands which he assigns to this culture are less and less suited, it is forced to use variable inputs more and more extensively and fixed factors in less and less optimal periods. Thus every unit of output is expensive more and more.

Consequently, in terms of modelling, we can represent the effect of the fixed factors and the variable inputs in a function of cost simply through the output. It is a way simple to model technical relations on which there are no data in the MAEP and in our inquiries, because the use of the fixed factors during one year is unknown.

In the short term, to summarize, by hectare the proportions of variable inputs are imposed and the allocations of fixed inputs service are represented by the produced quantities. There are thus only the outputs in the cost function and the crossed coefficients of second degree are null. Consequently, the variable cost function that is in the short term defined on surfaces can be written as:

$$C(X) = \alpha' X + \frac{1}{2} X' \beta X$$

Where the vector (Jx1) α and the matrix (JxJ) $\beta$are unknown of the investigator, with the exception of the terms outside the diagonal of ß, which are hopeless null. The absence of crossed terms implies that the function of cost multi-output C X) is reduced to the sum of J functions of cost in an output $\alpha_j X_j + \frac{1}{2}\beta_j X_j^2$, and we can thus speak about an average cost variable:

$$\bar{C}_j(X_j) = \alpha_j + \frac{1}{2}\beta_j X_j.$$

The marginal cost is:

$$C'_j(X_j) = \alpha_j + \beta_j X_j,$$

Where the notationC'_jindicates the first derivate of the cost function compared with X_j. To simplify, we shall write afterward $\bar{C}_j$ and C'_j. The average variable cost is observed in the data of the MAEP and our inquiries but not the marginal cost, we canwrite$C'_j = \bar{C}_j + \frac{1}{2}\beta_j X_j$,. The problem of optimization (1) can now be written as:

$$\max_X E\left[\frac{(\tilde{\theta}' X - C(X))^{1-\rho}}{1-\rho}\right] \quad \text{.....(2)}$$

The sum of the assigned investments has to be inferior or equal to the total agricultural surface of the exploitation at the time of the decision of access to the credits. The equality is imposed supposing that it is always optimal for the farmer to use all the available surface. The termω is the multiplier of Lagrange associated with the constraint of surface that is the opportunity cost of the surface. J+1 first- conditions of the problem (2) are:

$$\left[(\tilde{\theta}_j - C'_j)(\tilde{\theta}' X - C(X))^{-\rho}\right] = \omega \quad \text{j = 1...J .....(3)}$$

$$\sum_j X_j = \bar{X} .$$

From the point of view of the farmer, it is thus about a system of J+1 non-linear equation in unknown J+1: X_j – The decisions of cultivation andω - the opportunity cost of Investments. The cost function of C X) and the investments ρ Are known while the access to the cash credits $\tilde{\theta}$ are random but with known probability distributions.

Estimations

From the point of view of the investigator, we observe decisions of sowing - that we suppose optimal - and afterward realizations of the yields in values which allow to estimate the probability of distribution of these yields. The aversion at the riskρAnd the opportunity cost of the surfaceω Are unknown (for the investigator). The average costs variable $\bar{C}_j$ are known by the data of the MAEP and our inquiries, but not the marginal costs$\bar{C}_j$. It is thus a question for the investigator of estimating their value on basis of the system (3) of J+1 equations, that is J marginal costs plus, ω, plus ρ. Generally, there is thus infinity of solutions. We are going to impose a value of the coefficient$\rho$of aversion at the risk on basis of the literature to solve the system for the other unknowns. According to the table 1 above if ρ Varies between 0 and 0.2, we can impose the median value (one) in the system (3). Afterward, asensibility analysis will allow to measure the impact of the choice of a value forρ.

To make operational the system (3), it is necessary to determine the expectancy. This is generally impossible in a analytical way - except in certain particular cases - but possible in a numeric way. Knowing that price giving

is independent between them, as well as the distributions of yields, it results that every $\tilde{\theta}_j$ is independent from other elements of the vector $\tilde{\theta}$. The numeric resolution of the system (3) implies only thus to generate J series of simulationof multidimensional vector that should be the case if components of vector $\tilde{\theta}$ are not independant between them.. By writing:

$$\Omega_j = \frac{1}{s}\sum_s\left[\breve{\theta}_{js}(\breve{\theta}_s' X - C(X))^{-\rho}\right]$$
s = 1,…..,S et
$$\Omega = \frac{1}{s}\sum_s\left[(\breve{\theta}_s' X - C(X))^{-\rho}\right]$$
s = 1,…,…………………………………3,

We can rewrite the system (3) in the solving shape β_{jj} et ω :

$$\Omega_j - \left(\bar{C}_j + \frac{1}{2}\beta_{jj}X_j\right)\Omega = \omega$$
j = 1…J
$$2\sum_j \frac{\Omega_j - \omega - \bar{C}_j\Omega}{\Omega\beta_{jj}} = \bar{X}$$
……………………………………………………..…4

In the data, the constraint of total investment is always respected by definition, the last equation of the system (4) runs this information to estimate the value of ω. The system (4) thus has J+1 equations and unknown J+1: J coefficients β_{jj} and the cost of opportunity of investment ω.

$$\beta_{jj} = 2\left(\frac{\Omega_j - \omega - \bar{C}_j\Omega}{X_j\Omega}\right) \qquad j = 1,\dots,J$$
$$\omega = \frac{\sum_j \frac{\Omega_j - \bar{C}_j\Omega}{\beta_{jj}} - \frac{\Omega\bar{X}}{2}}{\sum_j (^1/_{\beta_{jj}})} \dots\dots(5)$$

The system (4) can be solved exploitation by exploitation for every year when data are available. The obtained values will be every time different. To face this diversity, several solutions are possible. Weatherwe use only the last year on the basis it is the year when the technical progress is the most advanced and when it is thus about the most useful information for purposes of simulation orwe can release hypotheses of the cost function, what implies to estimate additional coefficients.

CONCLUSION

To summarize, the individual data of credits access and investments present in the MAEP and survey allow to estimate the distribution of the investments in values. From these distributions, we were able to solve in a numeric way the system (4) to calculate J marginal costs C_j' and the opportunity cost of the surface ω. The simulation aimed to estimate the modifications of credits access when certain exogenous variables change. It will result from these modifications the expected produced quantities. Afterward we saw some examples, but generally in a simulation, the system (4) is modified - for example in the distribution of the yields in values $\tilde{\theta}_j$– and we solve it for exploitation X while J marginal costs C_j' and the opportunity cost of investment ω are known at the moment.

Our study shows the present exploitation of the important rigidity of its cultural plan and is relatively well protected from the investments due to its cultural choices. Consequently it is little interested in the insurance yield or by the futures market. For that, this analysis is congruent: in Banikoara zone, the variability to the credits accessis too low so that the insurance is attractive. Also, the futures market is not interesting for a regulated production as the cotton as far as the variability of the credits access does not change in the future

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