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Surviving or thriving: Efficiency level of production units and its determinants in Madagascar: A heterogeneous sector

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The main objectives of this study are to analyze the technical efficiency level in these activities and to identify its determinants. The technical efficiency of production units is partly the result of factors related to the economic environment, and partly of specific factors of production units. It has shown that the current efficiency level of informal production units in Madagascar is very low. With the same factors of production they are currently using, they could increase by more than 60% of their production level. On the one hand, too narrow market dominated by low household purchasing power is the main obstacles to the development of these activities. On the other hand, supply constraints such as difficult access to credit and lack of training affect negatively the efficiency level.

Given this significant potential for growth, the informal production units deserve specific development policies to promote their activities and improve employment both in quality and quantity. Efforts should ensure to improve demand conditions in order to increase efficiency and production levels. Encourage the grouping of operators in this sector to expand opportunities by enhancing the image and credibility of their products, increasing their capacity to meet large orders, facilitating the negotiation and integration in formal networks (domestic market and direct export), ensuring good management of competition through the establishment of mutual trust and reduction of transaction costs. Promote income redistribution biased toward the poor (tax policy, social policy, agricultural development policy), principal Informal Sector's product applicants. Target private investment toward specific sectors in order to limit competition between the formal and the informal sector and to make them more complementary. Promote the integration of micro-enterprises in the internal and external value chains by directing investment towards Informal Sector products' applicants channels, developing preferential purchasing and subcontracting and establishing stronger direct links with formal sector and government institutions

Focus on targeted training, appropriate technology and selective granting microcredits programs to improve product quality and promote new products and innovations. They must be based on sectorial analyses of development potential and market saturation levels.

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SURVIVING OR THRIVING:

Efficiency level of production units and its determinants in Madagascar: A heterogeneous sector

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Introduction

After mutual ignorance between informal sector and the state during the 1960s and 1970s, a new approach has emerged since the 1980s. The new vision on this sector is to consider it as an integral part of the national economic system and as an important instrument in the development and the fight against poverty in developing countries without going through the mechanisms of income redistribution. These activities are seen as a means of increasing employment and income for the large majority of households. In Madagascar, the promotion and "formalization" of informal sector activities are a key measure in the National Development Plan (PND).

According to results from employment and Informal Sector Survey in 2012 (ENEMPSI) in Madagascar (Rakotomanana, 2012), the contribution of the informal sector in the economy in terms of wealth and job creation is very important. In 2012, the added value of the informal sector represents 24% of the official total GDP and 36% of non-agricultural market GDP. In the same period, 9 out of 10 jobs are in the informal sector, 75% of which are in informal agricultural enterprises. In Madagascar, 2/3 of households earn all or part of their income from informal sector activities and 80% of total household income is from the agricultural and non-agricultural informal sector. Although the poverty incidence is relatively high especially in households dependent on the informal sector, it is reduced by 15% with the income generated by informal activities. In 2012, without these activities, poverty incidence would have peaked at 86% (instead of 71%) (Rakotomanana, 2012).

The informal businesses are important for vulnerable groups like women and the young population with a low education level. The female labor supply is important in the informal sector outside agriculture: 21% of female employment against 14% of male jobs (Rakotomanana, 2012). Individuals working in informal enterprises are younger (32 years old on average), which on average 10 years younger than the ones in administration (41 years old on average). The average education level is only 5 years for an employee working in non-agricultural informal sector and individuals working in agricultural informal sector did not reach the average primary education (Rakotomanana, 2012).

However, dynamism of these small firms is not immune to the obstacles and productivity and the degree of efficiency in this sector remain relatively low. Constrained both in supply-side (low skills, limited capital and credit access) and in demand-side (tough competition, low purchase power of customers, limited access to formal or public market), the allocation of production factors is not optimal.

Overall, in terms of business income, the heads of Informal Production Unit are far worse off than employees in the formal sector. Indeed, on average, a self-employed person in non-agricultural informal sector earns three times less than a civil servants, and the half of an employee of a formal company. In terms of productivity, the gap is even more important especially when compared to civil servants. Indeed, the self-employed person in the informal sector spends much more effective working hours than their counterparts in the public administration: 40 hours per week for the first whereas it is 36 hours for the latter. Compared to employees in the formal sector, the productivity gap is reduced because the work volume in the formal sector is much more substantial (more than 47 hours per week) (Rakotomanana, 2012).

Therefore, to improve efficiency, it is firstly required to obtain appropriate production techniques and to review the internal organization in the productive process, and to analyze the environment. Empirical studies of firm growth have showed that more than quantity, it is the "quality" and specifically better “allocation” of factors in the use and technical improvements that lead to the production and growth potential border (DIAWLOL, 2005).

On the one hand, an improvement in efficiency can break the vicious circle which links the access to resources with the dynamic of an activity. The inefficiency of a production unit leads to an increase in production costs, reduces profitability and competitiveness, limits the growth of the activities and the profits linked to returns to scale, which reduces the chance of obtaining capital or financing. On the other hand, improving investment needs a context of efficiency of the production system in general and of small production unit in particular. The efficiency limits the waste of productive resources and improves competitiveness.

To implement policies for promoting the informal sector in Madagascar, it is therefore important to respond to the following issue: What are the sources of technical inefficiency of various production units in the informal sector? The main objectives of this study are to analyze the technical efficiency level in these activities and to identify its determinants. The technical efficiency of production units is partly the result of factors related to the economic environment, and partly of specific factors of production units.

Taking account of how important heterogeneity is in the informal sector, this study's originality lies in the way that it focuses on the evaluation of technical efficiency level according not only to the different categories of activity but mostly to the environment and workplace, whether rural or urban. This makes it possible to develop and implement appropriate interventions and specific support policies. Identifying determinants of the technical efficiency allows us to propose the most effective means to reduce poverty via an increase in revenue generated from informal activities.

The study can analyze neither allocative nor collective efficiency, but is limited to the notion of technical efficiency: for any given level of production, it is to use the least quantity of inputs. In other words, it can be defined by saying that it is to achieve the most possible outputs for any given level of factors and inputs. The "technical" qualifier is explained by the fact that no reference to the price of neither inputs nor outputs is made. A production unit is technically efficient (on the production frontier) when, for a given production, and is impossible to produce more with the same volume of inputs. While the company operates under its production frontier, it is technically inefficient. From this viewpoint, the technical inefficiency degree of a production unit is defined by the ratio between the level of production effectively carried out and that which is potentially feasible.

The quantile regression method (Koenker and Basset, 1978) has been retained in order to evaluate the technical capacity of informal production units. This method consists in measuring the inefficiency of a production unit according to the ratio between the observed performances and those estimated for sufficiently high quantiles (higher than 0.8 or 0.9) with identical characteristics which are thus considered as being potentially realizable performances. This method, which is part of the recent progress in techniques for measuring efficiency, attempts to work around the problems which arise when using more habitual methods such as the Stochastic Frontier Analysis (SFA)[1] and the Data Envelopment Analysis (DEA)[2]. Nevertheless, in order to assess accuracy method, given that it is the first study in this domain, the results are compared with those obtained using traditional methods. As far as the identification of determining factors is concerned, the variable indicating the degree of efficiency of each production unit constitutes the variable of interest of the regression models.

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[1] Method initiated by Meusen Broeke (1977), Aigner, Lovel and Schmidt (1977), Battese G, Coelli T. (1988-1992)

[2] Method initiated by Farrell (1957) : see also Charmes, Cooper and Rhodes (1978)

The study has five parts. While the first part gives introduction to the research, the second part is devoted to concepts and methodology. The databases and the variables used will be the subject of the third part. The fourth part will reveal the results of the estimations whereas the last fifth part will deal with the conclusions.

I. Concepts and Methodology

I.1. Concept of production unit efficiency

The notion of efficiency for a production unit seemed subsequent to developing theories about the function of production frontiers. The production frontier is the maximum level of production attainable by a production unit adopting a given production technique and using a given level of inputs. For various reasons, production units are unable to efficiently attain their production frontier.

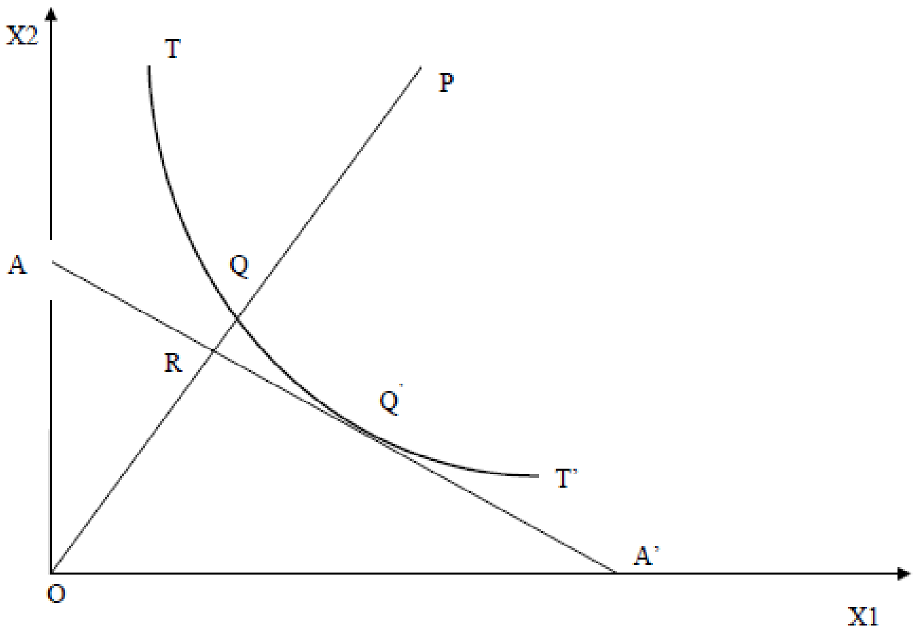
The Economic literature identifies two main forms of efficiency in productive activities: technical or productive efficiency and allocative efficiency.

Technical efficiency: for any given level of production, it is to use the least amount of inputs; equivalently, it can be defined by saying that it is to achieve the most possible outputs for any given level of factors and inputs. There is no reference for price.

Allocative efficiency: it involves the notion of prices of production factors. It refers to the company's ability to choose for a production level of the combination of inputs that minimizes the cost. Allocative inefficiency is due to the use of production factors in the wrong proportions given their price. In this case, the firm overuses or underutilizes factors in relation to another, which makes it more expensive to produce than using the factors in the optimum proportions. A production process is “allocatively” efficient if the marginal rate of substitution between each pair of inputs is equal to the ratio of the corresponding prices.

In order to measure a production unit’s efficiency, the indicators used are functions of the ratio between the level of production actually observed and the maximal level which could have been attained by the same production unit if it had operated with perfect efficiency. The following diagram summarizes the indicators for the measuring a production unit efficiency (Farell, 1957).

Figure 1 : Technical efficiency according to Farell



Source: Farrell, M.J. (1957)

For example, the point P represents the level of production actually attained by the production unit. The curve TT' shows the estimated isoquant curve with a given production technique and inputs (X1, X2). The point Q located on the isoquant curve indicates the efficient production of the unit. At point P technical inefficiency is represented by the segment PQ. It is possible to produce the same output level with a reduction in all inputs in the proportion QP / OP. Thus, Farrell (1957) proposed to measure the degree of technical efficiency by the ratio TE=OQ/OP, which varies between zero and unity (i.e. points P and Q merge).

Although technically efficient, all points on the isoquant are not allocatively efficient. A combination of factors is allocatively efficient if the marginal rate of substitution is the ratio of factor prices. Thus, the point Q' determined by the tangent of the isocost AA' to isoquant TT 'is allocatively efficient. The allocative efficiency of points P or Q is measured by the ratio AE=OR / OQ.

The distance RQ represents the cost reduction if production corresponded to the point Q'. The latter is the efficient allocative point of view, since it is determined by the tangent of the isocost AA' to the isoquant TT'. The product of technical and allocative efficiencies is called total or economic efficiency. Total efficiency is measured by the ratio EE= TE x AE = OR/OP.

For us, efficiency is understood in its technical meaning, which does not refer to prices. This is an appropriate way for the firm to achieve its own objectives. This measure has the advantage of being applicable to all forms of productive organization, such as a private companies or a public service. Allowing to assessing the performance of a production unit and the production boundary analysis provides with interesting elements to better understand the production technology and allows to considering the contribution of different production factors. The production frontier shows maximum outputs for each given level of inputs.

Technical efficiency concepts had their origin predominantly in the work of Koopmans (1951) on the production analysis (Activity Analysis) and were used in an empirical framework for the first time by Farrel (1957). A production process is technically efficient, if and only if increasing the level of a given output or decreasing the level of a given input is possible only by decreasing the level of some outputs or by increasing the levels of some other inputs. Classical economic theory, since Debreu (1951), has formalized Koopmans' concept by referring to Pareto's notion of optimum: a production technique is not at Pareto's optimum if there is still a possibility of increasing the level of outputs and decreasing the level of inputs.

Since then, many empirical studies have emerged and have experienced remarkable growth as evidenced by some publications (Coelli, T.J., Battese G.E., 1996; Lachaud J.P., 2009; Behr A., 2010). Two approaches are used in econometric practice: the parametric approach and the nonparametric approach. The approach is called parametric when a parametric functional form is specified for the production frontier; otherwise, it is called nonparametric. Our work is focused on the nonparametric corpus.

Thus, as the efficiency is calculated by varying the inputs, the outputs or both at the same time; the reference sets are different. The concept of technical efficiency can be defined as follows:

A production unit adopting the production technique (X,Y) ϵ T is efficient if there is no other production technique (X',Y') ϵ T such as (X',Y') ≠ (X,Y) with (X' ≤ X et Y' ≥ Y) where T stands for all possible productions, X for the vector of inputs and Y for the outputs.

I.2. Usual Methods for measuring technical efficiency: advantages and limits

Regarding production frontier analysis, the microeconomic literature distinguishes two main approaches depending on how it is estimated: deterministic boundary approaches and stochastic boundary approaches. The production frontier is called deterministic if any observed gap with the frontier is attributed as being solely due to inefficiency without taking into account errors of measurement and sampling. If, in addition to technical failure, we take into account another random term that encompasses any measurement errors, bad specification of the model, omission of some explanatory variables and events consideration (world prices, input prices, etc ....) that can influence or impact the production, the border becomes stochastic.

Regarding deterministic boundary approaches, there are two main types: parametric and nonparametric. The main difference between parametric approach and nonparametric approach lies in the fact that the first one is based on an explicit statistical model using a functional form (a production or profit function) and a particular probability distribution, which is not the case with non-parametric approach.

In literature, two techniques are the most commonly used to measure production unit efficiency: Statistical Frontier Analysis (SFA) for both stochastic and parametric approaches, and Data Envelopment Analysis (DEA) for non-parametric approaches.

Statistical Frontier Analysis (SFA) is based on the principle that inefficiency as the gap between actual production and the estimated production frontier is part of the residual or noise. In the case of production techniques with one output and multiple inputs, this approach calculates output level by the function:

$y_i = f(x_i,\beta) + \varepsilon_i$ where y_i and x_i respectively designate the output and the vector of inputs of the production unit I, and β being the vector of the estimated parameters.

The term representing the residual ε_i is supposed to be composed of a random error v_i and inefficiency μ_i :

$y_i = f(x_i,\beta) + v_i - \mu_i$ where μ_i is supposed to be non-negative and to obey certain laws of distribution such as half-normal, exponential or gamma laws. The main disadvantages of this method are the bias resulting from the specification errors for the production function, and the high sensitivity of results depending on the distribution law chosen for inefficiency (Behr, 2010).

Data Envelopment Analysis (DEA) introduced by Charmes, Cooper and Rhodes (1978) was notably developed for cases of technical production with multiple outputs and inputs. The DEA method was developed from the work of Farrell (1957), and inspired the "Technical Factor" of Debreu (1951). It determines the efficiency frontier in terms of best practice. It is based on linear programming to identify the empirical production function. This is a method based on the micro-economic theory, which compares similar units taking into account several dimensions (inputs, outputs) simultaneously.

The choice between parametric and non-parametric approaches depends on available information and the objectives of the study. For example, if we are only interested in measuring the efficiency of a sector or firms, the nonparametric approach can be used. On the contrary, if in addition to efficiency, the production technology should be analyzed, it is then advisable to opt for the parametric approach.

In the parametric approach, there is the risk of influencing the result by imposing a functional form that is not the most appropriate. The advantage of the nonparametric approach is that it does not require a specification of the form of production function. However, some criticism was raised against the non-parametric approach. First, the boundary function obtained by nonparametric procedures is deterministic. This means that any gap related to this frontier is attributed to inefficiency: no random variation is possible. Second, the boundary function estimated by such procedures has no statistical property for testing hypotheses. Finally, it is extremely sensitive to extreme values and outliers which serve as a reference for frontier construction.

Another difference between these two approaches is that in the non-parametric approach, information of production units operating in the vicinity of the border is much more important than others in determining the non-parametric boundary. By contrast, in the parametric approach, all observations are relevant in determining the border.

Theoretically, the use of stochastic frontier analysis allows separating the random error term and the technical inefficiency of the production unit and should lead to a more accurate measure of its technical efficiency. Using deterministic methods, which assign as technical inefficiency any gap to the border, would be an over-estimation of technical inefficiency levels.

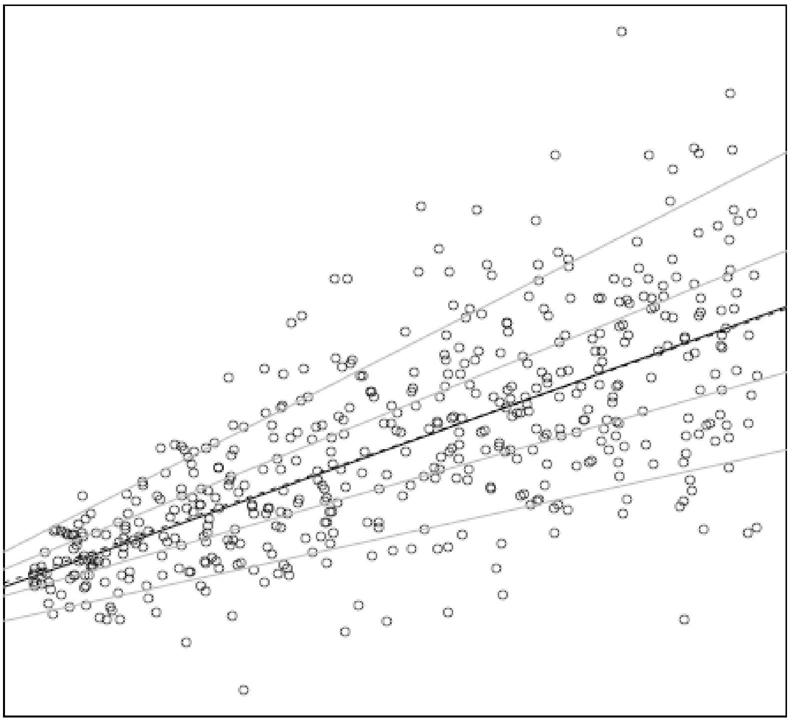
In our study, we will opt for the stochastic and parametric approaches and will use quantile regression technique to measure the technical efficiency.

I.3. Methodology

I.3.1. Quantile regression method

Quantile regression method was introduced by Koenker and Basset (1978). It consists of generalizing modeling technique carried out at the conditional average of dependent variable in order to express conditional distribution quantiles of the dependant variable according to the explanatory variables. In other words, quantile regressions allow determining how the quantiles of the conditional distribution F(Y/X) depend on observable multivariate variables X. So, to avoid unnecessary confusion, It is important to specify that in quantile regression, analyses are based not on simple distribution of the dependent variable F(Y) (specific quantiles of Y), but on conditional distribution F(Y/X) (specific quantiles of Y knowing X).

Figure 2 : Illustration of quantiles regressions for deciles 1,3,7 and 9 (grey curves), median (black curve) and OLS (dotted black curve)



In terms of optimization, as the average and the median are defined as the solutions respectively of the minimization of the sum of squares of residuals and that of the unbalanced sum of the residue absolute values, the quantiles can be defined as the minimization solutions of the sum of the absolute values of residuals, by allocating appropriate weights to the positive and negative values of the residuals. These ideas can thus be formulated:

Simple linear regression consists in finding the solution to the following program:

$$min \sum_{i=1}^{n} (y_i - f(x_i, \beta))^2 \qquad (1)$$

Where *i* is the number of observations, y_i is the value of the dependent variable and x_i is the vector of explanatory values for the individual i and β is the vector of the parameters to be estimated.

For the quantile regression, it is a question of formulating the preceding formula (1) and finding the solution to the program:

$$\min \sum_{i=1}^{n} \rho_q \left(y_i - f(x_i, \beta_q)\right) \quad (2)$$

Where $\rho_{q,}$ the weighting function, corresponds to the quantile q and β_q the vector of the parameters to be estimated which varies according to the considered quantile.

I.3.2. Different analysis stages

The adopted methodology in this research follows the following stages. The first stage consists in evaluating the degree of efficiency by applying the quantile regression method using the following procedure.

Firstly, with the help of the quantile regression method, the production functions are estimated according to the different quantiles of economic performance. Once these estimations have been made, variability is analyzed according to the quantile of the coefficients relative to the different factors of production (mainly capital and labor) indicating their marginal productivity.

Next, in order to build a reference measure of performance for the production frontier (when the production unit is operating with perfect efficiency), performance levels are predicted with the help of the estimated production function for a sufficiently high quantile. Given that the number of observations of our samples is not high enough to obtain reference performance levels, we have chosen the quantile level 0.9 instead of 0.95 which is usually used in studies. As explained in 1.3.1, analyses are based not on production units in quantile level 0.9 of value added or production but on quantile level 0.9 obtained with the conditional distribution of value added or production depending on production factors. Finally, for each production unit, the degree of efficiency is calculated by using the relationship between the performance level actually attained or observed and the predicted reference performance level.

In the second stage, in order to highlight the importance of the contribution made by the quantile regression method in the estimation of the efficiency degree of a production unit, different types of analysis have been carried out. Descriptive analyses are carried out on the previously constructed variable indicating the degree of efficiency in order to verify work hypotheses and isolate a rough draft of discriminating factors. Other analyses, in the form of robustness tests, consist in studying correlations between the obtained variable which indicates the degree of efficiency, and those resulting from the SFA method which are usually used. At this level, two other efficiency degree variables are generated, the one resulting from SFA with the “half-normal” efficiency distribution law and the other resulting from SFA with the “exponential” efficiency distribution law.

The last stage consists in identifying the determinants of efficiency with the help of simple linear regression models. The considered variables are variables which have not yet been introduced into the estimation model of production functions and which are linked to the individual characteristics of the production unit manager, to the economic characteristics of the unit as well as its environment.

I.3.3.Models

The Cobb-Douglas function has been retained for the production functions since it is relatively simple, easy to manipulate and has been unanimously adopted by other authors writing about this subject thus making the comparative analyses of the results easier (Piesse, 2000; Movshuk, 2004; Behr, 2010).In order to simplify the analyses, the production function is a function with only one output and several inputs.

$$y_i = a_o \prod_{j=1}^{k} x_{ji}^{a_j} \quad (3)$$

Where *i* is the number of observed production units and x_{ji} with j=1 to k are the k inputs used for the production of the output $y_{i.}$

In order to identify the determinants of efficiency degree, linear regression have been retained. In order to consider sectoral heterogeneity, three different models are formulated for the ‘industry”, “commerce” and “service” branches.

I.3.4. Advantages of the methodology

There are several advantages in using quantile regression. First of all, the heterogeneity of the informal sector – in which this study is particularly interested – in terms of economic performance (turnover, profit, productivity of factors) is so important that it is not sufficient enough to confine oneself to a single average (provided by a simple OLS) in order to estimate the production function. The error distributions stemming from the estimations can vary according not only to characteristics (explanatory variables), but also according to the economic performances of the production units (dependent variable). By way of an illustration, the dispersion of production level or of added value tends to diminish as the size of production units gets bigger: the coefficient of variation of added value went from 1.8 for one-person units to about 1.0 for units with 3 or more employees.

This method meets the needs of our objective better, which is to propose political economic recommendations and to better targeted actions in favor of the informal sector, particularly of microfinance. Indeed, in reality the productivity of factors of production is not the same, depending on whether an IPU has a relatively small, medium or big scale of activity. The application of quantile regression allows us to provide a more complete analysis by estimating production functions with different coefficients for each production quantile: this allows us to obtain quantified and detailed information about the expected impact of interventions on performance in different segments of the informal sector.

On a technical scale, quantile regression has several advantages: unlike other methods such as the DEA method, it is less sensitive to outliers, it is not reliant on hypotheses about the choice of distribution laws of inefficiency and noise like SFA method (half-normal, or exponential), and it minimizes bias in cases of heteroscedasticity problems. Unlike the SFA method, using quantile regression method allows us to avoid making relatively excessive hypotheses about the independence of inefficiency variables (the second source of errors). This hypothesis is primordial for SFA method and it is only permitted to carry out the procedure in one stage to identify the efficiency determinants. Indeed, determining efficiency factors with another model in the second stage contradicts the hypothesis that the inefficiency variables obtained during the first stage are independent. Furthermore, using a procedure in one stage, the coefficients relative to production factors in the production function may be influenced by the introduction of exogenous variables which are the potential determinants of efficiency. However, due to the fact that the chosen efficiency norms are based on economic performances which were actually achieved by production units, the obtained efficiencies are relative and not absolute, and are sensitive to and dependent on circumstances;

II. Data bases and used variables

II.1. Data bases

The data used in this study results from a series of surveys of the informal sector entitled “1-2 surveys” technically initiated by DIAL/IRD and carried out in Madagascar in 2012 with the UNDP’s financial support. It is a mixed-type study carried out in several phases. The first phase is a survey about employment in 12 000 households. The objectives of this phase were first to understand the activity conditions and how the labor market functions, and then to identify the individuals managing a production unit in the informal sector. The second phase is a survey in 6000 informal production units among those identified in the first phase of the study. This survey comprehensively deals with the characteristics and performances of a production unit, such as its demography, the detailed characteristics of its work force, its production (production branch, raw materials, overheads), its production factors (labor, capital), its investments and financing, its insertion in the economic circuit and its problems and prospects. These data bases allow us to draw up the different accounts of a production unit and to isolate the principal indicators of economic performance such as added value and gross profits. What is more qualitative modules about the economic environment such as support structures to micro-enterprises, micro-finance and its relation with the Government are present in the second phase of the questionnaire.

II.2. Variables

The choice of the dependent variable of the production function focuses on the monthly added value instead of on production or profit.

As for the explanatory variables introduced into the production function, three sorts of inputs are considered: capital, labor and human capital.

- **Capital**: This variable is approximated by the total estimated physical value of the production unit's assets. It is a matter of estimated cost for replacing building, land, machines, cars, and big and small tools.
- **Labor**: This variable includes the total number of hours during which all employees in the production unit work (manager or head of production unit, workforce, family workers, associates, etc.)
- **Human capital**: Several variables have been introduced into the model in order to measure it. The characteristics of the production unit manager are distinguished from those of the dependent workers. The productivity of these two types of work is deemed to be very different, given the large part played by non remunerated work, particularly family help among dependent workers and the high implication of the manager in all tasks throughout the production process.

  - The average number of schooling years of dependent workers: The average is more adapted than the sum of all of the number of schooling years, given that there is no real specialization of tasks within small production units. Every employee often participates in all the tasks and this versatility results in a permanent exchange of experience and know-how between employees[3].
  - The average number of years of experience of dependent workers.
  - The number of years the production unit manager spent at school.
  - The number of years of experience of the manager of the production unit.

It is supposed that all these variables have a positive effect on a production unit level of added value.

Variables indicating different branches of activity (industry, commerce) have been introduced into the model as control variables.

[3] The average rather than the sum of the number of years spent studying is taken into account in certain other studies such as Soderhom and Teal (2003)

Variables of intermediate consumption are excluded from the model as the added value is precisely production minus intermediate consumption and other indirect costs (Söderbom and Teal, 2003).

As for identifying efficiency determinants, the following variables have been retained in the degree of efficiency regression models:

- **Size of production unit**: to capture returns to scale effects on efficiency. Two variables are selected:
  - Total of working hours for manager and employees (in logarithm)
  - Value of physical capital in terms of replacement value (in logarithm)
- **Economic Environment and support structure**:
  - Production cost indicating access to cheap inputs (in logarithm)
  - Access to formal credit (Bank or MFI) (dummy)
  - Membership of Association of producers (dummy)
  - Households as major customers (dummy) indicating demand side constraints
  - Presence of salaries (instead of family workers only) in the production unit (dummy)
  - Registration in the administrative lists (Statistic, tax, …) (dummy)
  - Age of Production unit (years)
- **Characteristics of the production unit manager**:
  - Have followed vocational training for his job (dummy)
  - Male (dummy)
  - Operating in urban area (dummy)
- **Type of activities**:

  Dummy variables indicating different branches of activity (industry, commerce) have been introduced into the model as control variables

III. Estimation of efficiency degree

III.1. Some descriptive statistics

Table 1 shows that production units in informal sector in Madagascar are characterized by low productivity. On average, the apparent labor productivity is estimated around 1000 Ar (≈ USD 0.35) per worked hour. The managers of production units have acquired a relatively long number of years of experience (10 years of professional experience) but only rarely have professional qualifications, dependent workers have attended school for very short periods (less than 2 years), there are very low rates of salaried workers (less than 1% of production units employ salaried workers), and very low rate of credit access for financing capital (scarcely 0.2%).

Detailed analysis highlights that these production units are very heterogeneous. The situations between urban and rural areas are very different: the added value is almost twice as high in urban areas. Amounts of production factors are much higher in rural areas: the amount of capital is twice as high as in rural areas and the number of hours worked is also much higher. In terms of human capital, education level of production unit managers is much higher in urban areas, although they have less experience.

Table 1 clearly shows that the size of production units varies considerably with relatively high standard deviations, both in terms of economic performance levels (outputs) and of levels of factors of production (inputs). Even within the main activity branches (industry, commerce and services), there are still big disparities. Generally, “industry” or “transformation” production units are much less competitive. They create an average added value of about one-half less than the “commerce” and “service” branches. The influence of working hours and the capital stock might play a role in this. Indeed, in the “services” branch, the estimated average level of physical capital is more than the double than that used in the units of the “industry” branch. The average working hours is very low in “industry” (204 hours per month) compared with “service” and “commerce” (244 hours per month). This might be due to demand constraints. Furthermore, production units in the “industry” branch are distinguished by relatively high level of professional experience of their managers: they had more than 11 years of experience compared to only 9 and 7 years respectively in the “services” and “commerce” branches.

Table 1: Descriptive statistics about the characteristics and economic performances of production units in Madagascar in 2012 by Sector, by area

Branch	Variables	average	Standard	dNb. Obs.
Industry	Monthly added value (Ariary)	133	266 268	2 045
	Number of monthly working hours		201	2 045
	Capital (Ariary)	825	3 743 129	2 045
	Average education level of		2.5	2 045
	Average experience of employees		0.7	2 045
	Average education level of Manager		3.5	2 045
	Experience of Manager (years)		11.3	2 045
	Professional training of Manager		0.2	2 045
	Existence of salaried workers		0.3	2 045
	Access to public services (dummy)		0.4	2 045
	Access to capital credits (dummy)		0.4	2 045
Commerc	Monthly added value (Ariary)	291	621 743	2 028
	Number of monthly working hours		186	2 028
	Capital (Ariary)	781	2 943 379	2 028
	Average education level of		3.2	2 028
	Average experience of employees		0.6	2 028
	Average education level of Manager		3.6	2 028
	Experience of Manager (years)		8.1	2 028
	Professional training of Manager		0.1	2 028
	Existence of salaried workers		0.2	2 028
	Access to public services (dummy)		0.4	2 028
	Access to capital credits (dummy)		0.4	2 028
Services	Monthly added value (Ariary)	284	686 452	1 619
	Number of monthly working hours		291	1 619
	Capital (Ariary)	1 959	9 204 062	1 619
	Average education level of		3.1	1 619
	Average experience of employees		0.6	1 619
	Average education level of Manager		4.0	1 619
	Experience of Manager (years)		9.0	1 619
	Professional training of Manager		0.3	1 619
	Existence of salaried workers		0.4	1 619
	Access to public services (dummy)		0.5	1 619
	Access to capital credits (dummy)		0.4	1 619
Total	Monthly added value (Ariary)	232	550 146	5 692
	Number of monthly working hours		226	5 692
	Capital (Ariary)	1 132	5 698 749	5 692
	Average education level of		2.9	5 692
	Average experience of employees		0.6	5 692
	Average education level of Manager		3.8	5 692
	Experience of Manager (years)		9.8	5 692
	Professional training of Manager		0.2	5 692
	Existence of salaried workers		0.3	5 692
	Access to public services (dummy)		0.4	5 692

	Access to capital credits (dummy)	0.4	5 692

Source: INSTAT – DSM/ENEMPSI2012, author's calculations

Branch	Variables	average	Standard deviation	Nb. Obs.
Rural	Monthly added value (Ariary)	154 632	339 727	2 241
	Number of monthly working hours (hours)	196	187	2 241
	Capital (Ariary)	711 913	2 337 690	2 241
	Average education level of employees (years)	1.2	2.5	2 241
	Average experience of employees (years)	0.4	0.7	2 241
	Average education level of Manager (years)	4.1	3.2	2 241
	Experience of Manager (years)	10.3	10.6	2 241
	Professional training of Manager (dummy)	0.0	0.2	2 241
	Existence of salaried workers (dummy)	0.1	0.3	2 241
	Access to public services (dummy)	0.2	0.4	2 241
	Access to capital credits (dummy)	0.2	0.4	2 241
Urban	Monthly added value (Ariary)	283 218	646 383	3 451
	Number of monthly working hours (hours)	254	246	3 451
	Capital (Ariary)	1 405 369	7 059 272	3 451
	Average education level of employees (years)	1.7	3.2	3 451
	Average experience of employees (years)	0.4	0.6	3 451
	Average education level of Manager (years)	6.3	3.9	3 451
	Experience of Manager (years)	8.6	9.2	3 451
	Professional training of Manager (dummy)	0.1	0.2	3 451
	Existence of salaried workers (dummy)	0.1	0.3	3 451
	Access to public services (dummy)	0.3	0.5	3 451
	Access to capital credits (dummy)	0.1	0.3	3 451

Source : INSTAT – DSM/ENEMPSI2012, author's calculations

III.2. Descriptions of the relationships between the production factors and added value.

The figures 1 and 2 describe the relationships between the added value (in logarithm) created by informal production units and the main production factors such as the number of working hours (in logarithm) and the estimated amount of physical capital (in logarithm). The elasticity of the added value is thus analyzed in relation to these factors of production. At this level of analysis, we will especially comment on the level of elasticity as well as the forms of relationship between outputs and inputs. Three large categories of units were considered according to the branch of activities: industry, commerce and services. The figures on the right deal with the relation with capital and those on the left with the relation with working hours.

There are a few important points worth emphasizing. Firstly, the added value rises with the number of working hours and the total amount of physical capital. Secondly, the influence of the labor factor linked to the first variable is, generally, much greater than that of the capital factor linked to the second variable. Thirdly, second order relationships (non linear ones) are relatively weak for added value and the number of working hours. The relationship between the added value and the total amount of physical capital is practically linear. Finally, the relationship between capital and added value are substantially lower in rural areas.

When the relationships are examined on the scale of different branches of activities, a significant difference may be observed, which is the weak elasticity of the added value in relation to the working hours in "commerce" compared with "industry" and "services".

Figure 3 : Relationships between the value of physical capital (log), working hours (log) and added value (log) by Sector

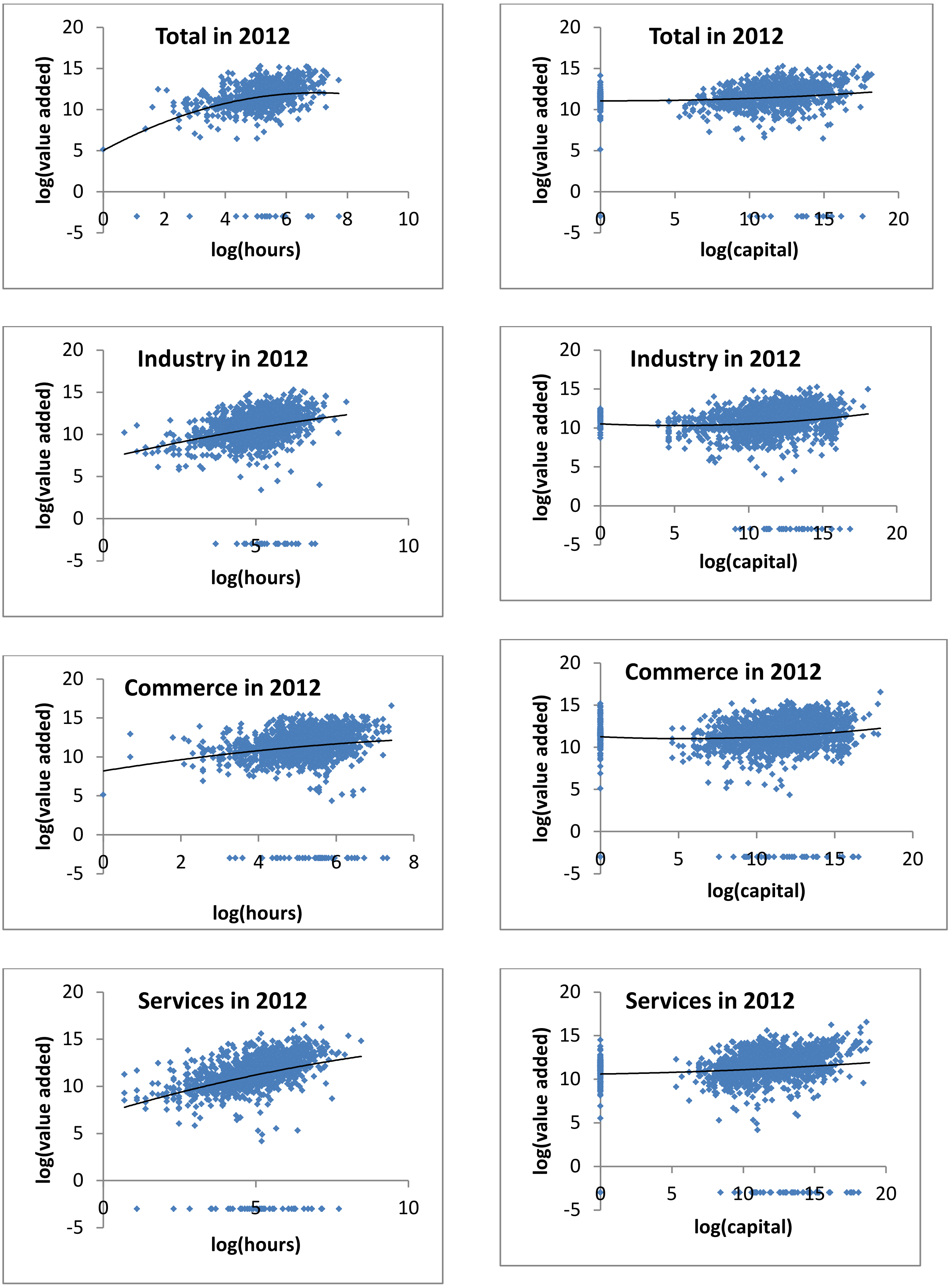
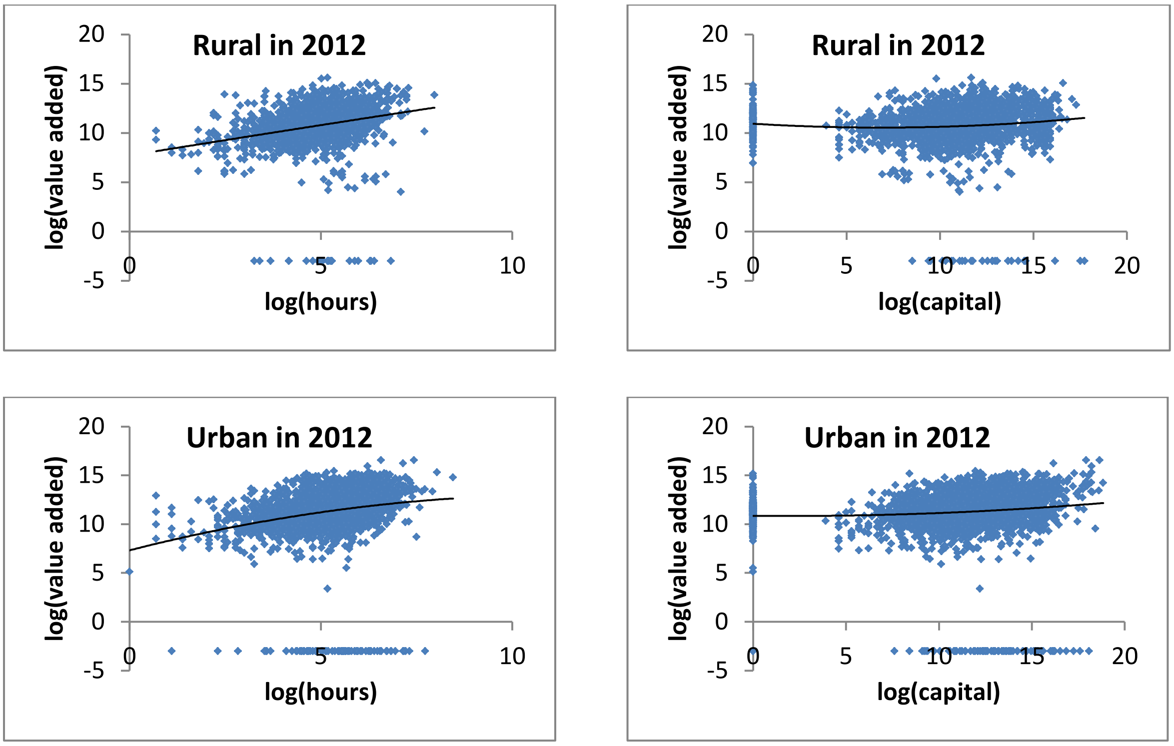


Figure 4 : Relationships between the value of physical capital (log), working hours (log) and added value (log) by Area



Source : INSTAT – DSM/ENEMPSI2012, author's calculations

III.3. Results of estimations of production functions using the quantile regression method

In the first step, simple ordinary linear models (OLS) in Cobb-Douglas form are used to estimate production functions. The results of Breusch-Pagan test show the presence of heteroskedasticity of errors and justify the use of quantile regression.

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of ln_va

         chi2(1)      =    67.02
         Prob > chi2  =   0.0000
```

However, the results of OLS are presented (first columns of tables 2 to 4) with the aim of not only identifying the pertinent variables with the significant help of the parameters, but also and above all, demonstrating the utility of giving the variability of the distribution parameters along the distribution of informal production units when carrying out the quantile regression, which is not possible in a simple linear model.

The estimation of the simple linear model (OLS) justifies the choice of the factors introduced into the production function if the average performance of informal production units is considered. Generally, the coefficients relative to labor, physical capital and human capital are statistically significant with the expected signs, all acting positively on the added value. The variable which indicates the average number of years of experience of dependent workers is the only one which is not significant in the creation of added value. The results confirm the fact previously observed in the descriptive analysis; that is to say, the influence of the labor factor is much greater than that of physical capital: the beta coefficient for capital is 0.16.which is less than the half of those for working hours 0.34. However, the latter's contribution should be neglected. Indeed, the coefficients rise to 0.43 and 0.05 respectively for the "number of working hours" and "total amount of physical capital" variables. As far as physical capital is concerned, three interesting points can be remarked. Firstly, its effects are statistically significant but relatively weak with coefficients of less than 0.07. Secondly, professional experience and practice are more important than academic studies. Finally, the quality of the dependent workers is crucial in relation to that of the production unit manager. These results are valid in both urban and rural areas. However, production units operating in rural areas are characterized by low elasticity of added value with the experiences of the manager and the capital.

Columns 2 to 10 in tables 2 to 4 show the results of the estimations of production functions using the quantile regression method and considering the 10 deciles Q10 to Q90. These results highlight the relatively high variability of the coefficients for the different categories of production unit depending on their level of added value. The parameters are very different among different categories of production units depending on their actual performance level. This proves the handicap of the analysis methods based on models which concentrate only on the average production unit such as the simple linear model or “Stochastic Frontier Analysis”. The changes in value of the parameters per added value decile are recorded in figures 3 to 5. It can be observed that there is a relatively big drop in the elasticity of the number of working hours as the production units in the highest added value deciles are considered. Thus, it ranges from more than 0.6 in the 0.1 decile to less than 0.3 in the 0.9 decile. The coefficient values are even situated outside the confidence range (95%) of the coefficient resulting from the simple linear model for the extreme deciles. Otherwise, for physical capital, except in rural areas, elasticity grows in the upper deciles but the trend is not significant (from 0.04 for the 0.1 decile to 0.6 for the 0.9 decile) and the coefficient values remain within the confidence range resulting from the simple linear model. Especially in urban areas, the other coefficient, which undergoes variations but whose size is relatively low in relation to those relative to labor and physical capital, is the one which is relative to the number of years the production unit manager spent at school. This coefficient follows a downward trend if we go from the lowest to the highest decile. Nevertheless, the estimated values of the parameter are always found within the confidence range of the value obtained by the simple linear model. As far as the other human capital variables are concerned, the coefficients remain practically constant for every decile and remain within the confidence range of the coefficients of the simple linear model.

Table 2: Estimations by quantile regression of the production function in 2012 (Madagascar)

		Decile								
Variables	OLS	Q10	Q20	Q30	Q40	Q50	Q60	Q70	Q80	Q90
Labor										
Working hours (log)	0.429***	0.635***	0.591***	0.593***	0.587***	0.555***	0.518***	0.481***	0.418***	0.337***
Physical capital										
Capital (log)	0.050***	0.046***	0.040***	0.037***	0.041***	0.044***	0.049***	0.055***	0.057***	0.063***
Human capital										
Average education level of employees (log)	0.027***	0.022	0.027**	0.026**	0.023**	0.021**	0.025**	0.029***	0.034***	0.026*
Education level of manager (log)	0.084***	0.086***	0.086***	0.084***	0.080***	0.079***	0.076***	0.077***	0.076***	0.076***
Experience of employees (log)	0.009	-0.019	-0.007	-0.002	0.000	0.013	0.015	0.009	0.015	0.028*
Experience of manager (log)	0.023***	0.042***	0.033***	0.025***	0.022**	0.024***	0.024***	0.020***	0.015	0.016
Branch of activity										
Industry	-0.532***	-0.731***	-0.635***	-0.589***	-0.544***	-0.542***	-0.461***	-0.474***	-0.477***	-0.416***
Commerce	-0.019	-0.409***	-0.253***	-0.186***	-0.070	-0.062	0.042	0.051	0.096	0.230***
Area										
Urban	0.374***	0.336***	0.307***	0.277***	0.267***	0.322***	0.372***	0.370***	0.331***	0.344***
Cons.	8.719***	6.290***	7.151***	7.541***	7.791***	8.201***	8.553***	8.973***	9.726***	10.548***
No. Obs.	5566	5566	5566	5566	5566	5566	5566	5566	5566	5566
R2	0.28	0.17	0.18	0.18	0.18	0.18	0.17	0.17	0.17	0.15

Source: INSTAT – DSM/ENEMPSI2012, author's calculations

Notes: Significance *** at 1%, ** at 5% et * at 10%

Table 3: Estimations by quantile regression of the production function in 2012 (Rural)

					Decile					
Variables	OLS	Q10	Q20	Q30	Q40	Q50	Q60	Q70	Q80	Q90
Labor										
Working hours (log)	0.460***	0.569***	0.601***	0.606***	0.613***	0.600***	0.594***	0.530***	0.482***	0.361***
Physical capital										
Capital (log)	0.031***	0.053***	0.034***	0.033***	0.031***	0.025***	0.028***	0.026**	0.028**	0.020
Human capital										
Average education level of employees (log)	0.036**	0.060**	0.034	0.027	0.030	0.039***	0.049***	0.049***	0.036*	0.020
Education level of manager (log)	0.075***	0.062***	0.068***	0.077***	0.071***	0.072***	0.075***	0.073***	0.077***	0.077***
Experience of employees (log)	-0.002	-0.056*	-0.015	-0.003	0.005	0.000	-0.001	-0.005	0.019	0.041*
Experience (log)	0.011	0.026	-0.004	0.001	0.013	0.019	0.020	0.014	-0.004	-0.022
Branch of activity										
Industry	-0.605***	-0.819***	-0.689***	-0.698***	-0.641***	-0.590***	-0.544***	-0.612***	-0.632***	-0.630***
Commerce	-0.110	-0.538***	-0.328***	-0.260***	-0.133	-0.107	-0.093	-0.091	-0.059	0.071
Cons.	8.841***	6.648***	7.264***	7.606***	7.901***	8.241***	8.540***	9.206***	9.875***	11.134***
No. Obs.	2207	2207	2207	2207	2207	2207	2207	2207	2207	2207
R2	0.24	0.13	0.15	0.16	0.17	0.17	0.17	0.16	0.15	0.15

Source : INSTAT – DSM/ENEMPSI2012, author's calculations

Notes : Significance *** at 1%, ** at 5% et * at 10%

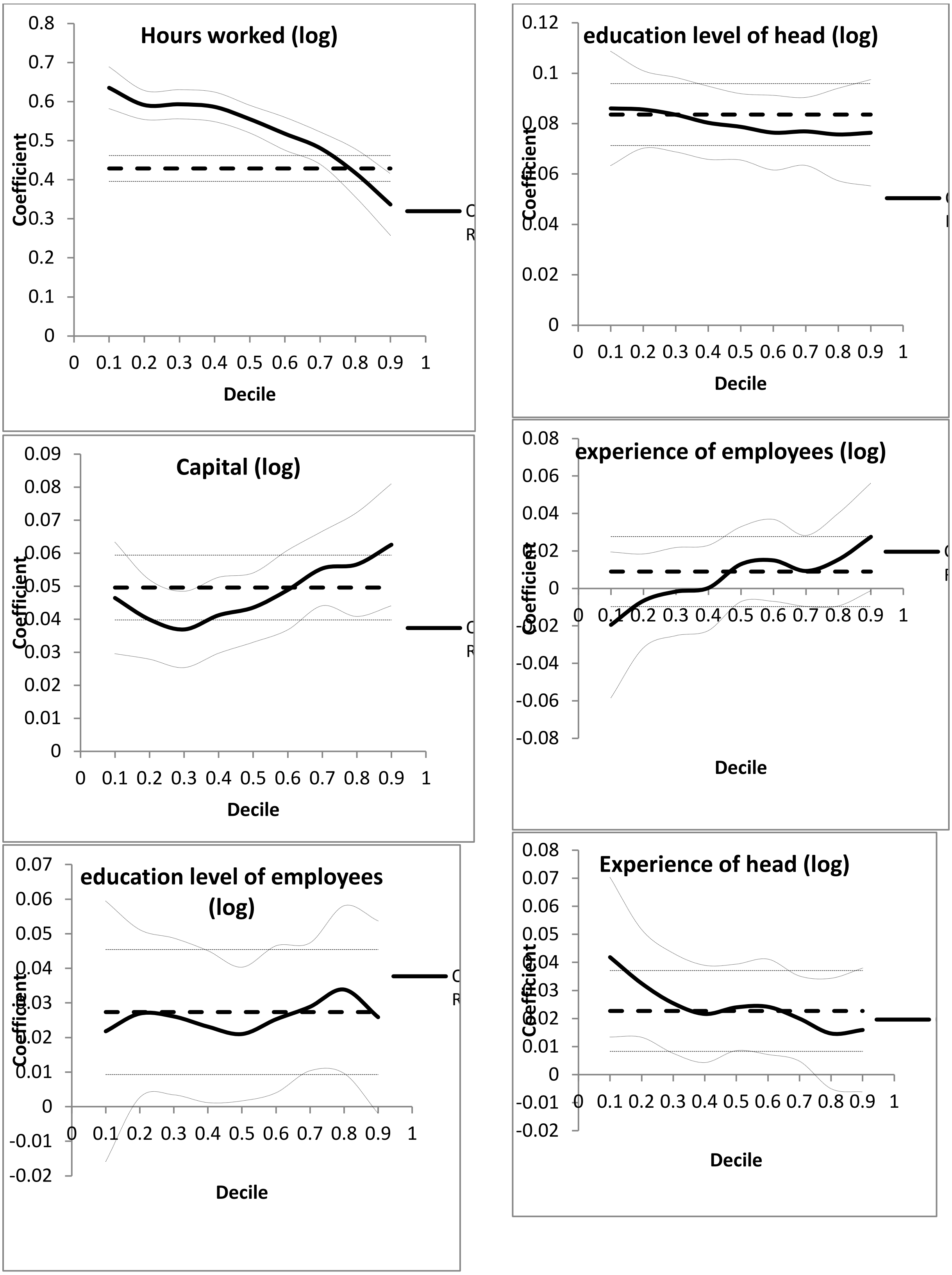
Table 4: Estimations by quantile regression of the production function in 2012 (Urban)

					Decile					
Variables	OLS	Q10	Q20	Q30	Q40	Q50	Q60	Q70	Q80	Q90
Labor										
Working hours (log)	0.405***	0.610***	0.603***	0.584***	0.566***	0.514***	0.481***	0.435***	0.358***	0.299***
Physical capital										
Capital (log)	0.059***	0.043***	0.044***	0.041***	0.052***	0.053***	0.058***	0.064***	0.066***	0.073***
Human capital										
Average education level of employees (log)	0.021*	-0.013	0.026*	0.021	0.021	0.016	0.019	0.024*	0.034**	0.029
Education level of manager (log)	0.091***	0.122***	0.099***	0.090***	0.088***	0.079***	0.071***	0.073***	0.081***	0.076***
Experience of employees (log)	0.018	0.034	-0.011	-0.000	-0.004	0.015	0.016	0.014	0.015	0.027
Experience (log)	0.028***	0.039**	0.049***	0.038***	0.024**	0.025**	0.024**	0.024**	0.021*	0.021
Branch of activity										
Industry	-0.502***	-0.686***	-0.600***	-0.543***	-0.490***	-0.525***	-0.424***	-0.455***	-0.393***	-0.317***
Commerce	0.019	-0.360***	-0.239***	-0.150**	-0.036	-0.013	0.065	0.110*	0.144**	0.268***
Cons.	9.090***	6.830***	7.273***	7.755***	7.982***	8.602***	8.984***	9.473***	10.227***	10.949***
No. Obs.	3359	3359	3359	3359	3359	3359	3359	3359	3359	3359
R2	0.25	0.15	0.16	0.15	0.14	0.14	0.14	0.14	0.14	0.14

Source : INSTAT – DSM/ENEMPSI2012, author's calculations

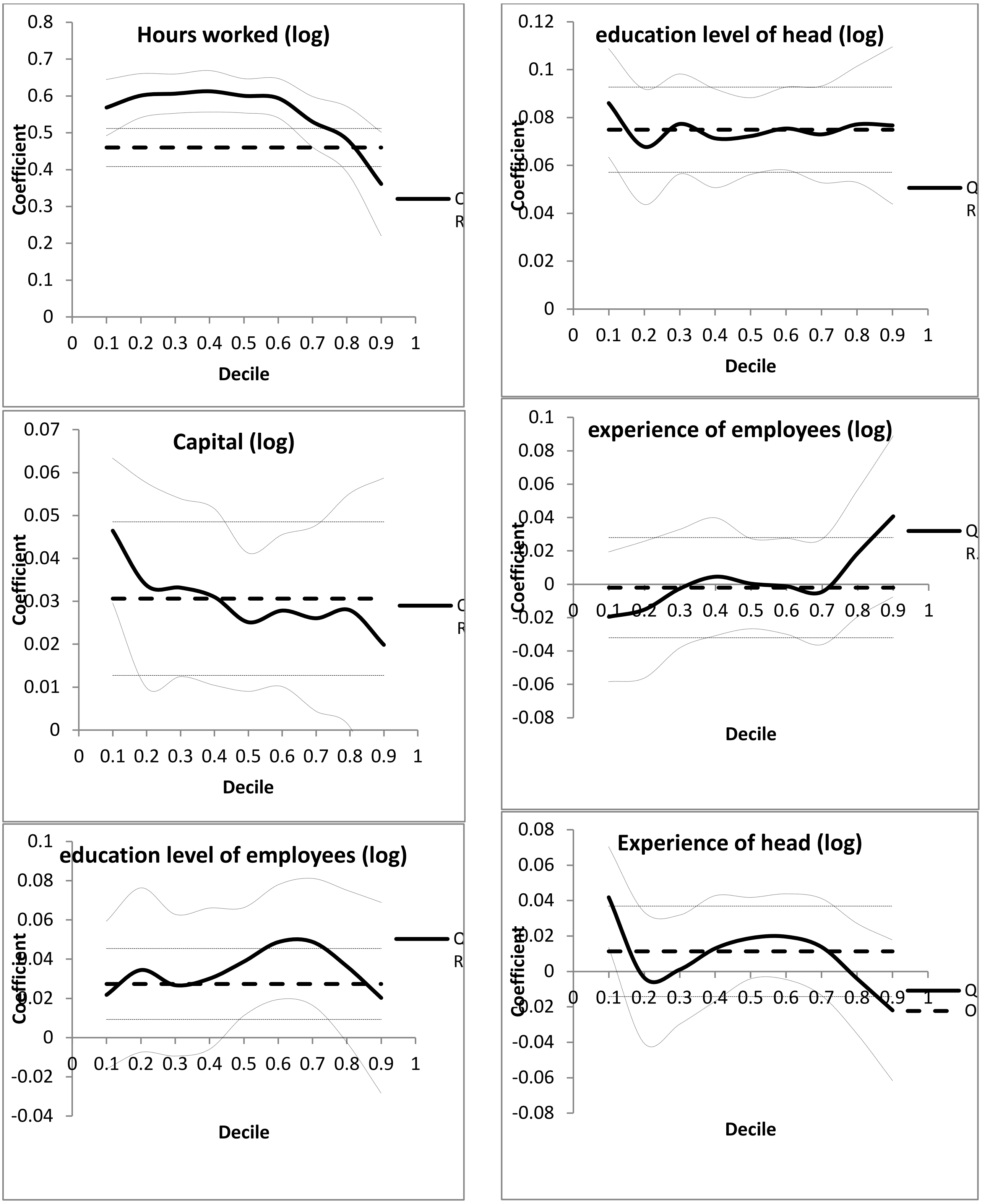
Notes : Significance *** at 1%, ** at 5% et * at 10%

Figure 5 : Variation of coefficients and confidence intervals across decile (Madagascar)



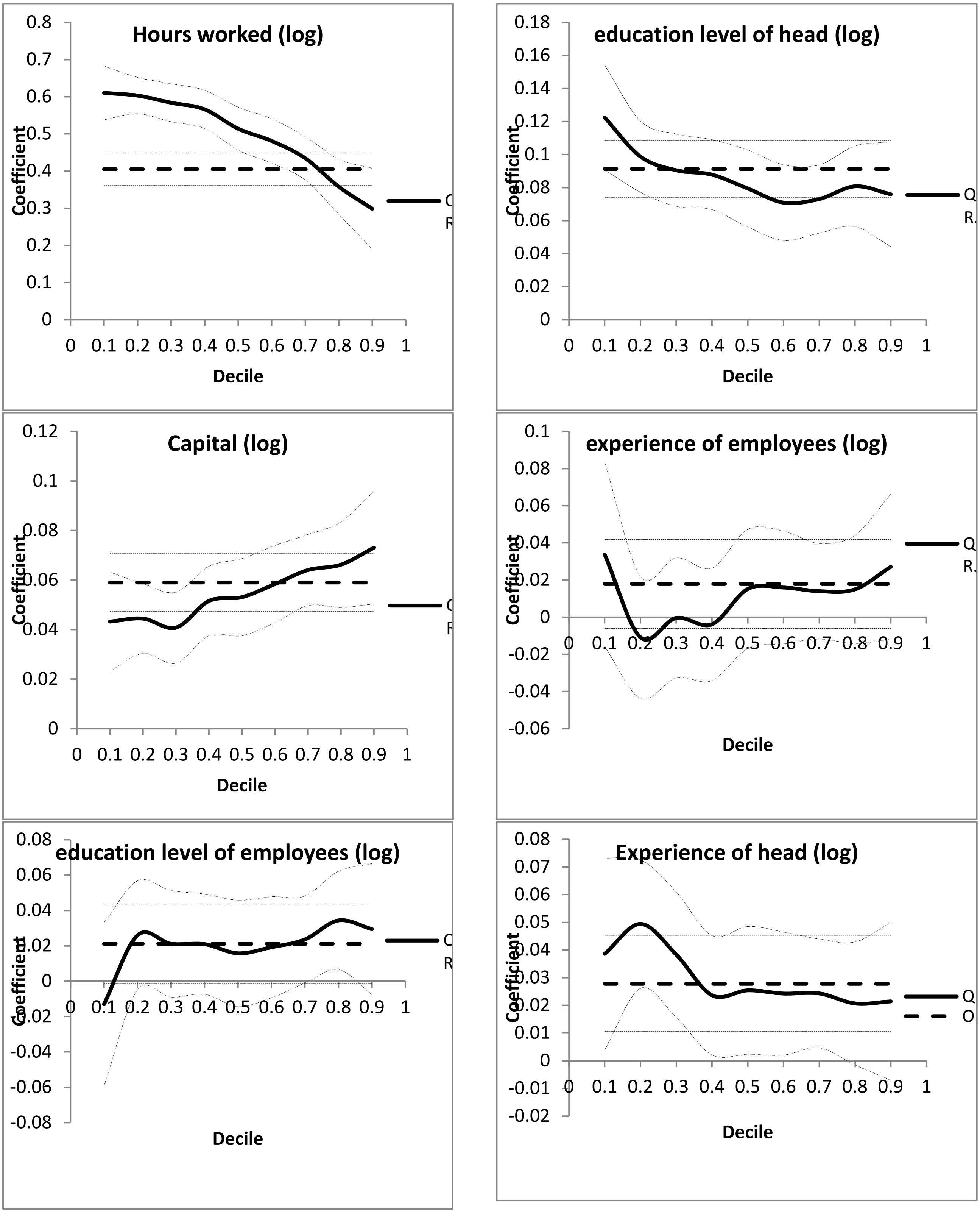
Source : INSTAT – DSM/ENEMPSI2012, author's calculations

Figure 6 : Variation of coefficients and confidence intervals across decile (Rural)



Source : INSTAT – DSM/ENEMPSI2012, author's calculations

Figure 7 : Variation of coefficients and confidence intervals across decile (Urban)



Source : INSTAT – DSM/ENEMPSI2012, author's calculations

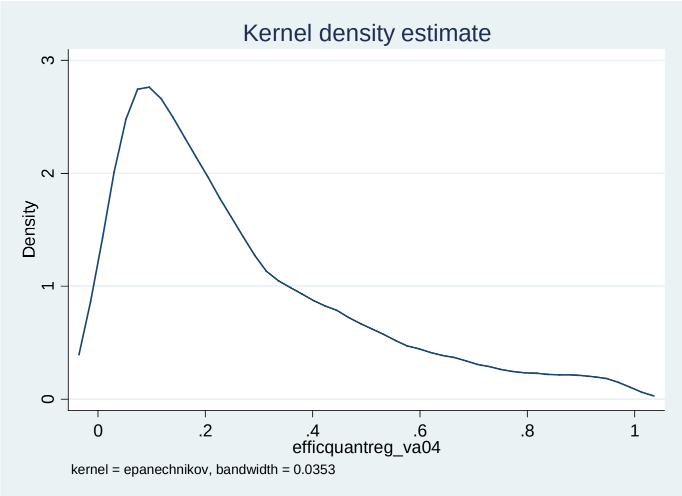
III.4. Description of efficiency degree of production units

The efficiency degree of a production unit is defined as the relationship between the total amount of added value really observed and the predicted amount, using the model obtained for the 0.9 decile which is considered as the reference value at which maximum efficiency is attained for production units sharing the same characteristics.

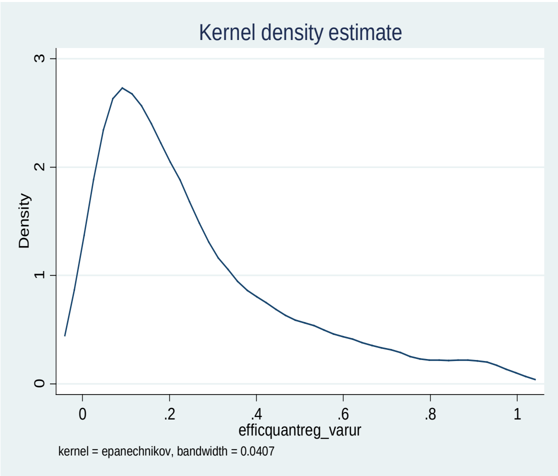
Figure 6 shows the distribution of the efficiency degree of informal production units. This is skewed to the left and resembles the form of the gamma law. The results show that the informal production units are largely quite inefficient. The average efficiency degree is only 33%. This figure means that, on average, informal production units produce only a little more than 33% of their potential production level, given the levels of mobilized production factors. In other words, the current added value could be improved by 66% by adopting more efficient production techniques. Less than one production unit out of four is reaching an efficiency degree over 50%. The majority of informal production units reached less than 22% of their potential production level. The efficiency degree is somewhat higher in urban areas but the difference is only 2 points.

Figure 8 : Distribution of the inefficiency degree of production units in 2012

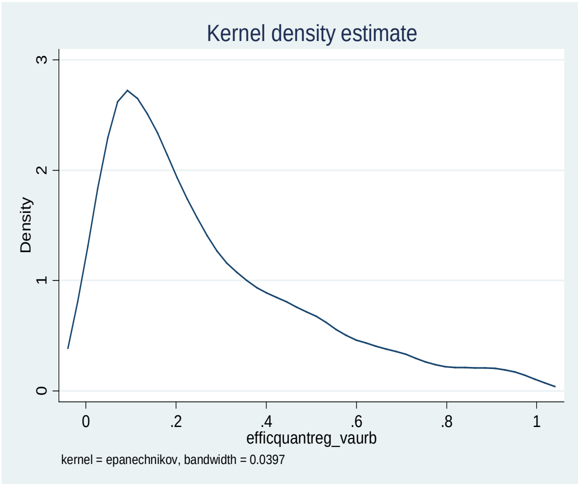
Madagascar



Rural



Urban



Source : INSTAT – DSM/ENEMPSI2012, author's calculations

The descriptive analysis of efficiency degree (table 5) demonstrates a few powerful discriminating factors. Firstly, there is a high correlation between efficiency degree and the real level of a production unit's performance. The more the production unit belongs to the upper fringe, the more efficient it is. The efficiency degree rises from 11% among the units in the first quartile (in added value terms) to 75% among the units of the fourth quartile. Depending on their branch of activity, production units in the "services" branch are, on average, more efficient than those in "industry" or "commerce" branches. Indeed, while the average efficiency degree is less than 32% in the two latter categories, it scarcely reaches 37% for the "services" branch. The existence of a salaried worker within a production unit has a positive effect on its efficiency degree: there is a gap of 16 points between the average efficiency degree of a production unit with salaried workers and one without. The fact that the production unit manager has undergone formal professional training for his job results in a higher efficiency degree: hence the rise of 14% in the average efficiency degree. Appearing on administrative registers is another factor which influences a unit's efficiency degree: 37% for registered units and 29% for those not registered. Having problems of demand (tough competition, low purchasing power) corresponds to a drop in efficiency. Especially in urban areas, units which declare themselves to be victims of this type of problem register an efficiency level 5 points inferior. However, problems linked to supply (obtaining credit or finding premises) do not show up on the technical efficiency degree of the production units. Finally, production units managed by a woman are, on average, much less efficient than those run by a man: 15 points less.

Table 5: Description of the degree of efficiency of informal production units

	Average degree of efficiency (%)		
Area	Madagascar	Rural	Urban
Activity branch			
Sylviculture	42.4	46.4	28.8
Extractive Industry	38.8	41.3	32.2
Alimentation Industry	41.5	42.9	41.1
Garment	23.3	24.2	25.8
Wood	31.6	30.9	44.7
Other industry	41.6	45.0	36.2
Reparation	39.3	40.3	36.5
BTP	43.5	40.0	43.8
Commerce	31.5	30.1	34.2
Transport	47.8	48.8	43.4
Household services	20.2	15.4	22.3
Other services	34.4	28.8	37.0
Activity Sector			
Industry	32.1	33.5	32.6
Commerce	31.5	30.1	34.2
Services	37.1	34.1	37.0
Registering			
No	26.9	25.9	28.7
Yes	36.7	36.5	38.1
Area			
Rural	32.4		
Urban	34.8		
Salaried unit			
No	31.8	31.3	33.4
Yes	47.6	48.0	46.3
Manager having undergone professional training			
No	32.6	32.1	34.3
Yes	46.4	49.5	41.7
Manager's gender			
Female	26.9	25.6	30.6
Male	41.0	41.5	40.0
Declared having experienced demand problems			
No	34.5	33.4	37.8
Yes	32.1	31.8	33.2
Declared having experienced credit problems			
No	33.1	32.5	34.9
Yes	33.1	32.2	34.1
Declared having experienced problems with premises			
No	33.1	32.3	35.4
Yes	32.9	33.7	30.8
Quartile of added value			
Quartile 1	11.5	12.5	8.6
Quartile 2	20.6	22.5	15.1
Quartile 3	38.9	42.6	31.8
Quartile 4	74.9	81.3	66.8
TOTAL	33.1	32.5	34.7

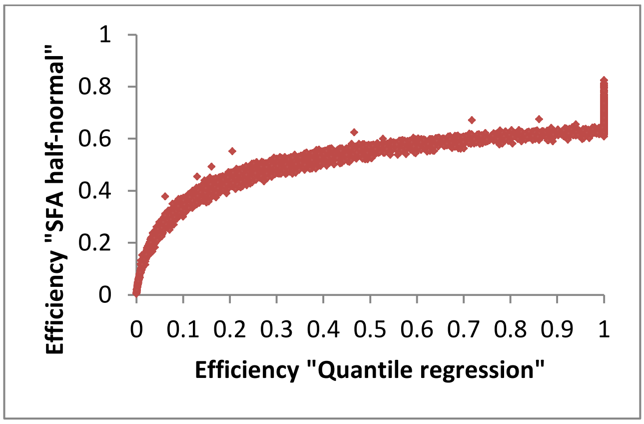
Source : INSTAT – DSM/ENEMPSI2012, author's calculations

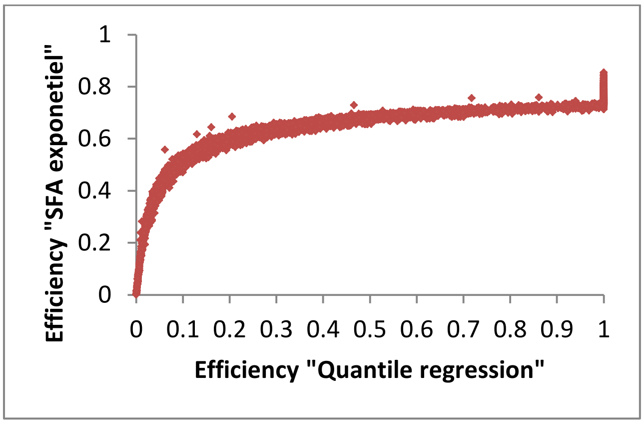
III.5. Comparison with the results from the SFA method

Comparing the results with those obtained using the SFA highlights several phenomena. Firstly, the SFA method tends to overestimate the efficiency degree. Indeed, depending on whether the half-normal or exponential distribution law is retained for inefficiency law, the average degrees of efficiency resulting from the SFA method are respectively 41% and 55%. Furthermore, these figures also show the sensitivity of the SFA results according to the distribution of inefficiency law. Nevertheless, the level of correlation between the inefficiency variable resulting from the quantile regression method and those resulting from the SFA method is relatively high: 0.87 with the SFA-half-normal and 0.77 with the SFA exponential. Figure 7 shows the correlation curves which generally follow logarithmic trends. The degree of inefficiency by quantile regression is considerably inferior to that obtained using the SFA method especially among the least efficient production units.

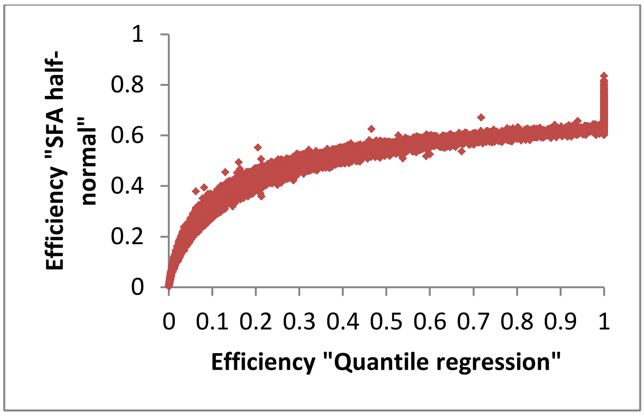
Figure 9 : Correlation curves between the inefficiency variable resulting from the quantile regression method and those resulting from the SFA method

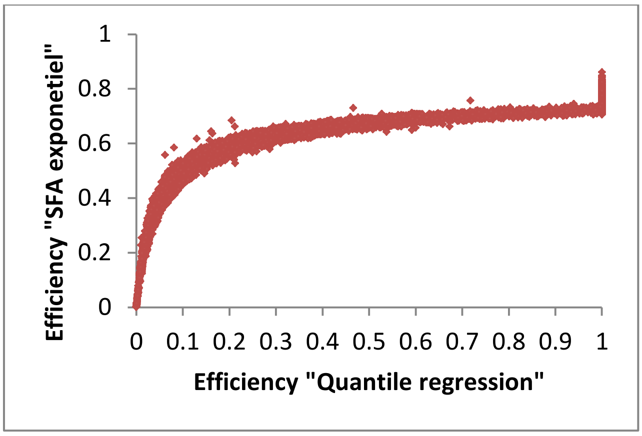
Madagascar



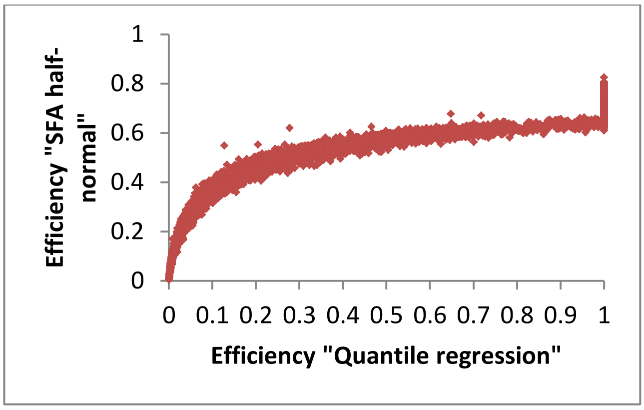


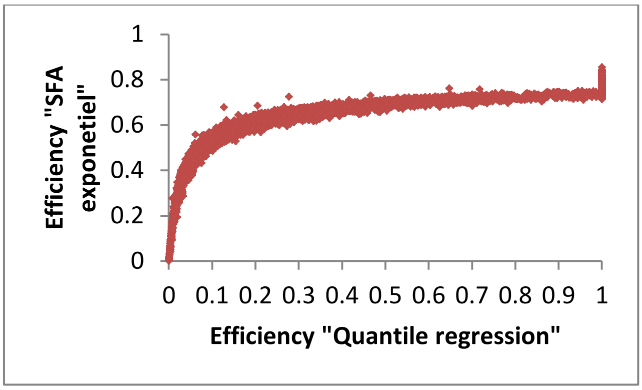
Rural





Urban





Source : INSTAT – DSM/ENEMPSI2012, author's calculations

IV. Informal production unit efficiency determinants

In order to identify factors determining efficiency in informal production units, linear regression models have been estimated. They allow us to easily isolate the relationships with the characteristics of the firms. The model does not claim to identify the direction of the causality which potentially exists between efficiency and certain explanatory variables. Indeed, signing the administrative register or gaining credit access can improve a production unit's efficiency. Inversely, the more efficient a production unit is, the more probable it is that the unit will have access to credit and appear on administrative registers.

The dependent variable is the logarithm of efficiency level in percentage. The explicative variables are already listed in II.2 . Outliers in data (absolute values of studentized residuals rstudent >2), which represent less than 3.5% of observations were excluded for estimations. For the OLS method, test did not detect proble ms of multicollinearity between explicative variables (Variance Inflation factors VIF less than 2.2 and tolerance value more than 0.44), or specification error – omission variables (Test of Ramsey RESET not significative with Prob>F = 0.19). The problem of heteroskedasticity were corrected with the robust option. However, the problem of endogeneity were detected for the "Production cost" variable (Durbin-Hausman test). So, the regression 2SLS with instrumental variable method were applied using rank of production cost as instrument variable.

The results are presented in table 6 to 8 respectively for the whole Madagascar, rural area and urban area. Each table contents four models: the first model includes all observations, while the three other models examine separately the production units belonging to the "industry", "commerce" and "services" branches in order to monitor the inter-sectional differences. The likelihood-ratio test rejects the stability of the coefficients in the separated models. The McFadden R2 level is relatively low which is inherent to the use of cross sectional data.

The coefficients estimated in the efficiency models generally conform to the expected signs and to the results provided by the preceding descriptive analyses. Differences are observed in terms of efficiency levels between the units of production according to the branch of activity. By taking the “service” branch as reference, the coefficient relating to the dummy variables “commerce” is negative and significant at 1% level and non-significant for “industry”. The interpretation of these results is that the “commerce” production units are less efficient than the “service” ones, all other things being equal; hence the predicted results given the descriptive statistics about the average degree of efficiency presented in table 5.

The effects on efficiency of the economic environment and constraints, which the managers of informal production units had experienced, are examined. Constraints linked to demand as well as supply affect the efficiency of activities in the informal sector. Indeed, the coefficient relative to the variables which respectively indicate that households are the major customers of the production unit is negative, especially for “industry” branch. This phenomenon is due to low purchase power of Malagasy households. In other terms, access to other markets such as exportation, formal market (public or private) improve efficiency. This result is reinforced by positive impact on efficiency of association of producers membership because association plays important role in obtaining large orders and direct export. In the supply side, the vocational training undertaken by the head of Informal Production Unit have positive impact on the efficiency, except for “commerce”. The activities in this branch require relatively less technical and technological skills than activities in industry or service sectors. In addition, the estimation results highlight the importance of credit access and on efficiency. But, the coefficient is significant but at only 5%.

The value of capital as well as the number of working hours have significantly negative relationship with efficiency. The more production unit is bigger in terms of capital or labor, the less efficient it is. If this result in the formal sector appears to be the opposite of what intuition tells us, several explanations are possible for the informal sector. This sector tends to be characterized by decreasing returns to scale. Firstly, this result shows the determining role played by the labor factor in the production process in the informal sector. Mostly, hiring additional workers (often family workers) are due to social motivation rather than economic rationality. The job sharing is more important than real job creation induced by increasing production level. Given the small size of the market share because of low purchasing power, of the rarity of big orders or subcontracting, of free entry into a sector and of high competition, some sectors are saturated. In this case, there is a low rate of the use of capital, and the total amount of capital seems overvalued in relation to what is actually used.

The other variables measuring of production units units which have significant relationships with efficiency are “registering” and “the existence of salaried workers” within the production unit. The “registering” coefficient of the production unit is positive and is significant both for the whole model and for “services” also for industry and commerce. Being registered is the sign of a more rigorous management and more developed technologies within the production unit. What is more, the additional costs imposed by administrative control and insertion into the formal circuit incite management to be more efficient with their resources. Likewise, the “existence of salaried workers” variable is associated with positive and significant coefficients for all the models except in the case of “commerce”. The recruitment of salaried workers is the sign of a certain degree of professionalism both on an activity organization level of the production unit and at the level of tasks attributed to each employee. The obligation to produce result principle is probably bigger for a salaried worker than for a family helper or an apprentice. The coefficient linked to the age of the informal production unit is not significant. Thus, experience acquired within the production unit has no significant effect on the production unit’s efficiency.

The demographic characteristics of the production unit manager have a strong influence on efficiency: being managed by a relatively male has a positive effect. The natural qualities of the production unit manager (such as physical strength and maturity) are more important for efficiency than his/her professional qualities. Furthermore, the low efficiency of female-managed units may be due to their very aim in carrying out the activity, which is considered as a simple source of extra household income and is done at the same time as household chores. On the other hand, activities managed by men often constitute the household’s main income, so it requires more profitability and rigor.

Table 6: Linear regression with instrumental variable of the efficiency degree of informal production units (Madagascar)

Variable	Total	Industry	Commerce	Services
Branch of activity				
Industry	0.015			
Commerce	-0.794***			
Size of Production unit				
Production cost (log)	0.302***	0.250***	0.493***	0.194***
Total working Hours (log)	-0.204***	-0.124***	-0.344***	-0.140***
Capital (log)	-0.103***	-0.080***	-0.120***	-0.089***
Economic Environment and support structure				
Tax payment (dummy)	0.084***	0.088*	0.032	0.088
Obtained formal credit (dummy)	0.169**	0.274	0.115	0.167
Member of Association of producers (dummy)	0.199***	0.003	0.114	0.280***
Households as major customers (dummy)	-0.193***	-0.238***	-0.066	-0.090
Existence of salaried workers (dummy)	0.053	0.032	0.058	0.139**
Being registered (dummy)	0.076***	0.139***	0.011	0.043
Age of Production unit (log)	-0.000	-0.003*	0.004*	0.001
Head having undergone training (dummy)	0.253***	0.202**	0.250	0.310***
Characteristics of the head				
Male (dummy)	-0.133***	-0.073*	-0.199***	-0.214***
Urban (dummy)	2.254***	2.160***	-0.004	2.839***
Constant	-0.133***	-0.073*	-0.199***	-0.214***
Pseudo_R2	0.30	0.25	0.45	0.21
N	4573	1669	1770	1134

Source : INSTAT – DSM/ENEMPSI2012, author's calculations

Notes : Significance *** at 1%, ** at 5% et * at 10%

Table 7: Linear regression with instrumental variable of the efficiency degree of informal production units (Rural)

Variable	Total	Industry	Commerce	Services
Branch of activity				
Industry	-0.128**			
Commerce	-0.922***			
Size of Production unit				
Production cost (log)	0.286***	0.221***	0.462***	0.158***
Total working Hours (log)	-0.142***	-0.078**	-0.265***	-0.129*
Capital (log)	-0.113***	-0.112***	-0.108***	-0.092***
Economic Environment and support structure				
Tax payment (dummy)	0.174***	0.172***	0.090	0.281**
Obtained formal credit (dummy)	0.079	-0.874**	0.008	0.523**
Member of Association of producers (dummy)	0.334***	0.193	0.068	0.682***
Households as major customers (dummy)	-0.265***	-0.320***	-0.093	-0.059
Existence of salaried workers (dummy)	0.041	0.231**	-0.035	0.183
Being registered (dummy)	0.090**	0.141**	-0.002	0.100
Age of Production unit (log)	-0.004**	-0.007***	0.002	-0.001
Head having undergone training (dummy)	0.183*	0.180	-0.345	0.371**
Characteristics of the head				
Male (dummy)	0.309***	0.288***	0.240***	0.391***
Constant	2.406***	2.634***	-0.170	3.058***
Pseudo_R2	0.31	0.27	0.45	0.17
N	1776	885	629	262

Source : INSTAT – DSM/ENEMPSI2012, author's calculations

Notes : Significance *** at 1%, ** at 5% et * at 10%

Table 8: Linear regression with instrumental variable of the efficiency degree of informal production units (Urban)

Variable	Total	Industry	Commerce	Services
Branch of activity				
Industry	0.077*			
Commerce	-0.742***			
Production scale				
Production cost (log)	0.311***	0.264***	0.517***	0.206***
Total working Hours (log)	-0.246***	-0.169***	-0.394***	-0.146***
Capital (log)	-0.096***	-0.044***	-0.131***	-0.090***
Economic Environment and support structure				
Tax payment (dummy)	0.032	0.007	0.006	0.042
Obtained formal credit (dummy)	0.186**	0.444**	0.145	0.079
Member of Association of producers (dummy)	0.156**	-0.299	0.109	0.201**
Households as major customers (dummy)	-0.136***	-0.160**	-0.062	-0.088
Existence of salaried workers (dummy)	0.070	-0.102	0.130	0.129*
Being registered (dummy)	0.067*	0.147**	0.018	0.032
Age of Production unit (log)	0.003	0.000	0.005	0.002
Head having undergone training (dummy)	0.260***	0.178	0.534**	0.297***
Characteristics of the head				
Male (dummy)	0.276***	0.206***	0.067	0.395***
Constant	2.074***	1.689***	-0.118	2.548***
Pseudo_R2	0.30	0.26	0.45	0.21
N	2797	784	1141	872

Source : INSTAT – DSM/ENEMPSI2012, author’s calculations

Notes : Significance *** at 1%, ** at 5% et * at 10%

Conclusion

Given the importance of the role played by these income-generating activities in the socio-economic development and in the fight against poverty in Madagascar, improving their efficiency surely constitutes one of the pillars of development policy. The aim of this study is to analyze the technical efficiency degree of informal production units and its determining factors in the case of Madagascar, by using data bases resulting from an informal sector survey in 2012.

The results show that the degree of efficiency of informal production units is very low: the average efficiency was 33% in 2012. This means that by mobilizing the same resources it would be possible to reach a production level three times higher than the efficiency degree currently attained. Less than one out of four production units attains more than half the production level it could achieve, if it was working in perfect efficiency. The situation is different depending on the branch of activity. It is much higher in the “services” branch where the degree of efficiency is more than 37%, compared to less than 32% in the two other branches, “industry” and “commerce”.

Several factors have an influence on a production unit’s efficiency, but these factors differ according to the branch of activity. Demand-side constraints due to low purchasing power of households have a negative effect, particularly in “transformation” activities. To this is added, hiring additional family workers diminishes efficiency because it induces sharing jobs without real creation jobs due to the social motivation instead of economic rationality. However, hiring salaried workers improve efficiency and more efficient production unit employ salaried workers because of their productivity. In the supply side, the impact of the production manager’s professional studies and credit access are only positively significant except in the “commerce” branch. On the other hand, the demographic characteristics of the head of the production unit have the same effect whatever branch of activity is considered. What is more, male-managed units are more efficient than female-managed ones, which might be explained by the fact that the aim of the activity for a woman is to generate extra family income while also doing domestic chores. The more rigorous management of activities and the professionalism generated by the “existence of a salaried worker” and the official “registering” of the production unit also favor efficiency.

Given this significant potential for growth, the informal production units deserve specific development policies to promote their activities and improve employment both in quality and quantity. Efforts should ensure to improve demand conditions especially easier access to the markets in order to increase efficiency and production levels. In light of these analyses, some recommendations are proposed.

- Encourage the grouping of operators in this sector to expand opportunities. Consolidating these production units facilitates the integration of their products in formal networks, for the sake of new clients and market expansion. Indeed, taking the role of guarantor, producer group improves the image and credibility of the products. Reduction in trading costs and risks would encourage large companies to cooperate. Product bundle can meet large orders, outsourcing or subcontracts and even the foreign market (direct export).

Other advantage of creating producers' group in informal sector operators is that it would consolidate the gains of social capital and expand opportunities. Mutual assistance between members improves the work profitability and the economic performance of activities. It also increases the share capital of each operator constituting a damper mechanism of poverty. The "group effect" has had a significant impact by decreasing risk aversion on the behavior of small entrepreneurs. The grouping also promotes cooperative role between the members for proper management of competition. Partnership goes before competition.

Belonging to the same group promotes vertical cooperation between production units while remaining independent from one another with new applications. The group makes more fluid flow of information, creating better knowledge among members, an atmosphere of mutual group, and the conditions necessary for reducing transaction costs.

- Promote income redistribution biased toward the poor (tax policy, social policy, agricultural development policy), principal Informal Sector's product applicants
- Target private investment toward specific sectors in order to limit competition between the formal and the informal sector and to make them more complementary
- Promote the integration of micro-enterprises in the internal and external value chains by directing investment towards Informal Sector products' applicants channels, developing preferential purchasing and subcontracting and establishing stronger direct links with formal sector and government institutions

- Focus on targeted training, appropriate technology and selective granting microcredits programs to improve product quality and promote new products and innovations&. They must be based on sectorial analyses of development potential and market saturation levels.

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