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Original Research Article

Effect of mobile telephony adoption on small informal firm productivity in Burkina Faso

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The adoption of information and the communication technologies [ICT] has many productive externalities on firm productivity. In this paper, we study the relation between the mobile phone adoption and the technical effectiveness of the informal production units of the urban district of Ouagadougou. The results of the stochastic frontier show that the adoption of mobile telephony affects positively the productivity of the small informal units of production in Ouagadougou city.

Key words: Informal production units, technical effectiveness, technology acceptance, Burkina Faso

INTRODUCTION

Economic activity in Burkina Faso is in large part carried out by small informal production units. The economic performance of this country, is influenced mainly by rural activities (agriculture) which contributed to 35.0% of the Gross domestic product (GDP) in 2008 (Ministère de l'agriculture et de l'hydraulique [MAH], 2008) and by informal activities in the urban areas whose contribution to the GDP is still poorly understood. The informal sector is particularly important for a country needing to absorb a growing urban population due to rural migration. The informal sector employed 285,900 active people in 2001 and 47.0% of employment in this sector is occupied by the women. Data also showed that in the urban district of Ouagadougou, six households out of ten drew their income from an informal production unit (Institut national de la statistique et de la démographie [INSD], 2001).

The informal sector however has many problems. Producers are often badly organized and work with poor equipment. Their management methods are often inadequate and their adoption of new technologies is weak. In 2002, 21.4% of the informal firms of Ouagadougou recognized that the fact to do not hold accountancy and their bad organization is a source of vulnerability (INSD, 2002). At this period, 42.0% of the informal industrial production units also estimated that a big part of their vulnerability comes from their under equipped. It is difficult to delimit all the contour of the informal sector. But, in Burkina Faso, the definition of the informal sector is made comparatively to the size of the unit as recommended by Barthélémy (1998). Indeed, any production company whose annual sales turnover is lower than Franc de la communauté financière africaine [FCFA][1] 15 million and 30 million for those exerting in the general trade is considered as informal. The government of Burkina Faso adopted that to integrate the informal sector in the formal circuit in order to reduce the costs of transactions for the access to the credit and the public programs of promotion but also to lead them to contribute to the tax effort of the nation. That permits to 24.0% of the informal units of production of Ouagadougou to pay taxes since 2002; however, we can retain like principal characteristic of the Burkina Faso informal sector, the fact that the operators are under qualified, and their activities are also very badly organize (complete absence of accountancy and legal personality). Their ignorance of modern modes of organization affects their productivity particularly and this increases their vulnerability. The capital of the production unit is confused with the capital of the owners, which does not allow them to control well the lifespan as well as the productivity of this capital in the economic activity. It implies that, when the capital is depreciated in its social use, it is the result of the economic activity which must make it possible to replace the capital. In these conditions, the speed of depreciation of the capital can be higher than its contribution to the production of the informal unit of production. For example, when the promoter buys a motor

[1] local currency

bike thanks to the receipts of his production unit in the objective to use it to facilitate his production activities, i.e. Displacement for seeking inputs, or seeking contracts ; the same motor bike is used intensively in the social activities which are out of the field of the company. This double use shortened the lifespan of the motor bike and its depreciation in the activities out of the production unit represents a cost for the company.

Developing countries are increasingly affected by climate change and are also subject to sociopolitical instability. In the particular case of Burkina Faso, the floods of the first September 2009 involved considerable damage to property. For the informal sector alone the floods caused a loss of a value of more than CFA, 3.385 billion which is approximately 65.0% of the losses undergone by the industrial and commercial sector (Post Disaster Needs Assessement, Ministère de l'Economie et des Finances [MEF], 2009). These losses included a 4,261 million loss of capital. In the case of the floods which can involve the displacement of the production unit, no adoption of information and the communication technologies (ICT) can involve losses of customers. Thus, in 2003 when the large market of the town of Ouagadougou experienced a damaging fire the traders were obliged to change market to continue their activity. Many lost their customers since they had never left their telephone coordinates to their customers.

The adoption of ICT has many productive externalities. These modern technologies are seldom adopted by the informal production units of the least developing countries (LDCs). The concern of this paper is to analyze the influence of the information and the communication technologies (ICT) adoption on the productivity of the informal firms of the urban district of Ouagadougou. The paper is particularly concerned to answer the following questions (i) what are the determinants of the adoption of mobile telephony (MT) by the informal units of production in the district of Ouagadougou and (ii) which is the effect of this adoption on the technical effectiveness of the informal production units of the urban district of Ouagadougou?

The paper is organized as follows: section 2 presents the model of mobile telephony adoption and the model of the adoption impact on the technical effectiveness of the informal production units. Section 3 presents data, some descriptive statistics before the discussion of the econometrics models results. Section 4 summarizes the important results.

Models of analysis

The adoption of new technologies has been examined from several theoretical and empirical perspectives. In a general way, researchers have tried to determine the factors which influence the decisions of adoption. Jamison and Lau (1982) show that the reasons of the low levels of adoption of new technologies are to be sought under several angles. The authors count factors of social order, economic, technical, and environmental. Feder Juste and Zilberman (1985) point out that the decisions of adoption of technologies strongly depend on the differences in information circulation. Dadi, Burton, and Ozanne (2004) introduce the economic incentives like the prices of the factors of production and the outputs as determining factors of the adoption of technologies. Eisemon, and Nyamete (1988) think that the determinants of the adoption must be required by regarding the adopting potentials as moving in a socio-economic environment with strong intra and inter influence. In addition to these factors we can add other factors that are not less important. It is the example of the quality of communication infrastructures, the environmental and commercial risks, social and demographic gravities. The theory of the diffusion of the innovation suggested by Rogers (1995) identifies also five other factors determining in the adoption or the diffusion of a new technology. It is the relative advantage, the complexity, the compatibility, the testability and the observation. Tornatzky and Klein (1982) note that compatibility, the relative advantages and the complexity of technology influence more the adoption of the news technologies and their thesis is empirically supported by the results of Davis, Bagozzi, and Warshaw (1989). Through a model of acceptance of technology, these authors discover two factors of a psychological nature which would determine the adoption of a technology. It is the perception of the utility and the perception of the facility using of this technology. If the perception of the utility and the perception of the facility of the use influence the general attitude of the user of the technology, the facility of use more significantly influences the adoption of a technology through the car effectiveness and the instrumentality. Bandura (1982) and Lepper (1985) agree on the fact that the effectiveness is one of the principal factors which underlies the intrinsic motivation of an individual, and it is what explains the direct link between the perception of the facility of use and the attitude. Davis Bagozzi and Warshaw (1989) show that the intentions to use a system and the perception of the utility have a bond stronger than that relation which exists between the intention and the perception of the utility of use. So the perception of the utility is the element which influences more the decision of use of a technology. The theory of the reasoned action stipulates that the attitude of the individual in front of one technology is determined by its beliefs on the consequences of this technique multiplied by its evaluation of these consequences. In addition, the intention to adopt a technique is determined by the subjective standards, which are (the later) determined by the normative beliefs of the individual. The theory of the reasoned action postulates moreover that all the other factors which influence the individual make it in an indirect way, which has an impact on the attitude or the subjective standards.

Taking into consideration these various theoretical

predictions, the adoption of mobile telephony must be analysis with many precautions. Initially, mobile telephony is a technology of network and the relevance of its adoption for a given informal unit of production depends on dismantles adoption of its suppliers and its customers. Of this made, when in a given locality, the rate of adoption is very weak, that can slow down the decision of adoption of the Mobile telephony [MT] by the small firm contractors. Concerning the adoption of mobile telephony, the International telecommunication Union (ITU) shows that it is the technology whose adoption knew a sustained rhythm through the world. The penetration rate of mobile telephony in the developing countries is estimated at 2.3 whereas this rate is of 9.4 in the developed countries for the year 2008 (Zahonogo, 2011). The speed of adoption of this technology in Africa is low compared to the other continents. In 2007, there were twenty one mobiles telephony (MT) for hundred people (21 MT/100) in Africa (ITU, 2007). For the ITU (2009), this report is justified by the fact that the cost of the communication through mobile telephony is very high and accounts for approximately 41.0% of the African monthly average income. Inside Africa, there exists much divergence in the adoption of MT. Burkina Faso has a density of 7.46% of MT what is weak compared to the density of MT in some countries like Senegal, Nigeria, and Ghana which is estimate at 20% (ITU, 2007). Thus, in spite of the capacity of MT to affect the economic growth and poverty, Bagchi and Udo (2007) think that the weakness of its rate of adoption could prevent it to accelerate the economic growth in West Africa. When a country has a big rate of adoption of MT it is very beneficial for it economic growth and Roller and Warverman (2001) estimate that the adoption of the fixed telephone for example explains approximately a third of the growth of the GDP of the Organisation for Economic Co-operation and development [OECD] countries between 1970 and 1990. For Waverman, Meschi, and Fuss (2005) mobile telephony can also play the same part in the LDCs. On a sample of 99 countries observed between 1988 and 2003, these authors find that MT affects twice more the productivity in the LDCs than in the developed countries. The way by which the MT can affect the productivity goes first of all by the development of loyalty of its customers. Thanks to the MT, the promoter can modify the appointments with his customers; join them in the event of modification of the structure of the market or any other modification. In addition, the adoption of the MT enables him to contact its suppliers in any time and any place under the assumption that the communication is fluid.

For Taylor (1994), the analysis of the adoption of MT has however a little different from the demand for the other goods and services. This difference comes owing to the fact that the services of MT are not consumed in a way individual and egoistic, but in network. The consumption of MT has externalities of network thus, and consequently it is the existence of the network which makes useful the adoption of MT. Thus, the adoption of MT by a producer (have and use) would influence his production only if its customers and supplier also use MT. That means that the probability of adoption of MT is influenced by the externalities of network and many other factors. For Bagchi and Udo (2007) the factors which can specifically influence the adoption of MT in Africa are: economic environment, the level of education of the producer, the quality of the infrastructures of communication, culture as well as the extent of network (N) i-e. the number of individuals with whom he can connected.

Let start with the following relation:

$$MT = \begin{cases} 1 \quad with \quad a \quad probability \quad p \\ 0 \quad with \quad a \quad probability \quad 1-p \end{cases} \quad (\mathbf{1})$$

Where it is supposed that when $MT = 1$, the producer has and uses a cell phone. We then seek to explain the probability p, because once we know why p takes such values, then the reasons who push to the adoption or not of MT are known.

For each producer, we try to determine the factors which explain its probability of adoption. As the dependant variable is a probability, it should be made sure that the relation who exists between the explanatory variables and the endogenous variable will always lead to an estimated value of the dependant variable ranging between 0 and 1. So we can pose that:

$$P_i \equiv prob\left[MT_i = 1 \middle| q \right] = F(q_i'\theta) \quad (\mathbf{2}),$$

where q is the vector of the explanatory variables, θ the parameters associated and $F(\cdot)$ the density cumulative function of the distribution which ensures that $0 \le p_i \le 1$. Within the framework of this work, we choose to work with the Probit model so that $F(\cdot) = \Phi(\cdot)$ (**3**), i-e. cumulative density of the normal distribution. The reasons which can justify this choice are multiple. First of all, the Probit and Logit models lead to the same values estimated except for the extreme cases where the Logit model is more powerful than the Probit model. The other model which could be used is the linear model of probability which has as an only defect not to ensure that the values of the estimated endogenous variables are so that: $0 \le \hat{p}_i \le 1$. But, it is shown that when the marginal effects are evaluated at the average of the sample, the linear model of probability has same qualities as the two other models (Cameron and Trivedi, 2005). But the last one is also heteroscedastic.

For a given producer i, let $L(\cdot)$ be the likelihood function of probability, we can write that:

$$L(\theta_{probit}) = \sum_i^N \left\{ MT_i \ln F(q_i'\theta) + (1 - MT_i) \ln(1 - F(q_i'\theta)) \right\} \quad (\mathbf{4}).$$

The solution of (4) is obtained through the first order conditions, so that the optimal values of the parameters are those which resolve the following equation:

$\sum_{i+1}^{N} w_i(y_i - \Phi(q_i'\theta))q_i = 0$ (**5**), with

$w_i = \phi(q_i'\theta)/\left[\Phi(q_i'\theta)(1-\Phi(q_i'\theta)\right]$ (**6**), which varies between the individuals.

Likewise, with the relation (5) we can determine the value $\hat{\theta}$ i-e. the optimal value of θ. Thus, it remains to estimate the effect of the adoption on the productivity of the producers. For a given producer i producing a good y with inputs X .We suppose that it social and demographic characteristics (Z) and the adoption of MT also affect its efficiency. If MT represents the binary variable indicating when it takes value 1 that the producer adopted the MT and $f(X;Z,MT\cdot N)$ the production function of the receipts of the producer, we can write that[2] $f(X;Z,MT\cdot N) = P_y \cdot y$ (**7**) if we agree that in Burkina Faso the idea of undertakes overrides the idea of to show a profit. To determine the optimal demand of the factors and consequently his optimal production, it is supposed that the producer maximizes receipts derived from the use of $X, Z, MT\cdot N$ under his budget constraint.

$Max\ \ f(X,Z,MT\cdot N)$ (**8**)

S/C $C(X, appl(N)) = R$, where R is its available income affected to its production activity and $appl(N)$ represents the number of emitted call which is function of the number of customers and suppliers that he calls. Explicitly, we can write this budgetary constraint as follows:

$C(X, appl(N)) = R = \xi = P\cdot X + \left[\upsilon + \nu appel(N)\right]MT$ (**9**).

Where $R = \xi$, υ is the fixed cost of obtaining the mobile phone, ν the costs associated to the use of the telephone (cost of access to the network plus the cost of the call). We can use the function $appl(N)$ like an identity function so that: for $MT = 1$ then $MT\cdot N = N$ and $appl(N) = N$. The Lagrange function associate to this problem of the producer is the following:

$L(X,N,\lambda) = f(X,Z,N) + \lambda(\xi - \upsilon - P_X \cdot X - \nu N)$ (**10**), by supposing that $MT = 1$.

The first order conditions give:

$f_X - \lambda P_X = 0$ (i)

$f_N - \lambda P_N = 0$ (ii)

$\xi - \upsilon - P_X \cdot X - \nu N = 0$ (iii)

Taylor (1994) recommends observing that the budgetary constraint changed owing to the fact that it becomes:

$\xi - \upsilon = P_X \cdot X - \nu N$ (**11**) instead of (**9**). Then, after arrangements of the relations (i) (ii) and (iii) we lead to the functions of factors demand in the following form:

$appl(N) = appl(\nu, P_X, \xi - \upsilon, N)$ (12)

$X = X(\nu, P_X, \xi - \upsilon, N)$ (13)

All these demand functions differ from the ordinary functions of demand by the fact that they depend on the effect of network. By assumption, these demands are positively related to the externality of network. Thus, which is essential in these functions is the fact that they are positively related to the externality of network. Otherwise, through the scale effect of production, the adoption of MT affects the productivity i.e. the efficiency of the producer.

This last information shows that the demand for MT is theoretically endogenous. But, if the empirical obviousness then shows that the demand for MT is made in the form of demand of consumption and not for the production targets, the demand for MT is not endogenous in the system of production of the informal production unit. As the answer to this question is purely empirical, we cannot naively reject the assumption of endogeneity of the MT variable in the function of production. It is consequently to find a suitable method to test that. If the problem arose in the opposite direction, we can use the method of Rivers and Vuong (1988). But in our case, this method is not usable. The alternative method which could be used is that of Heckman (1978, 1979), but in our case, we are not interest by the sample partition. This way, another option at our disposal is to use the order treatreg to estimate the system of the equations of the dummy endogenous variable and the production function. It is possible to make thus by using the method of the MLE to estimate this system. But under these conditions, it is impossible to evaluate the inefficiency so that we could estimate only the parameters of the production function. The objective of this study is not however to estimate the parameters of the production function, but a stochastic frontier of production. Fortunately, Kutlu (2010) showed how to estimate a frontier of production in the presence of explanatory endogenous variables. We will adopt the method suggested within the framework of this study by Kutlu with an important nuance. In the proposal of Kutlu, the explanatory endogenous variables are continuous variables, however in our case the endogenous explanatory variable is a dummy variable. We then combine the ideas of Heckman and Kutlu to correct the endogeneity in our model.

As the objective function of the producer is given by: $f(X,Z,MT(N)) = P_y \cdot y(\cdot)$, it is noticed easily that this function reached its optimum when we replace the arguments by their optimal values [in equation (12) and (13)] so that:

$f^* = f(X^*, Z, ICT\cdot N^*) = f(\nu, P_X, \xi - \upsilon; Z, N) = f\left[(x;z)\theta\right]$

, or $y\left[(x;z)\theta\right]$ (**14**).

[2] We suppose here that the producer is a price taker on the market

Where $x' \equiv (regrssor)'$ and θ can be write as $\theta \equiv (\beta \quad \delta)'$.

We can then try to measure the contribution of each factors to the realization of the maximum production, i-e. the reduction of the inefficiency.

Thus, if we suppose that the production is carried out with a given inefficiency, we can specify the function of production to be able to collect the effect of the adoption of the MT on the inefficiency. To be done, in present work, we adopt to specify the function through the method suggested by Myers and Liu (2009).

To estimate the effect of the adoption of MT on the performances of the producer, we need a very adequate model because the effects of the characteristics of the producer on the technical inefficiency are very sensitive to the specification of the model. The choice of the suitable model is related to ambiguous procedures. Myers and Liu (2009) used the method of Bootstrapping to evaluate the performance of the alternative models suggested in the modeling of the stochastic frontier of production. They thus identified that the suitable model is the model KGCHLBC[3] which makes it possible to prevent the assumption that all the producers use the same technology.

That is for N firms $(i = 1,2,...,N)$ producing each a certain quantity of output y_i (expressed in logarithm) starting from a vector of input x_i' and the vector of the exogenous variables z_i' exerting an influence on the inefficiency of the firm. Let us suppose that the unobserved border y^* is give by the relation: $y^* = x_i'.\beta + v_i$ **(15)** with $v_i \sim N(0, {\sigma_{v_i}}^2)$ and independent of x_i, z_i and β is the vector of the unknown parameters to estimate. The effective output of each firm is equal to the potential output with an error (u_i) whose distribution depends on z_i. That makes it possible to write that: $y_i = x_i'.\beta + v_i - \tilde{u}(z_i, \delta)$ where $\tilde{u}_i(z_i, \delta) \geq 0$ **(16)**, i.e. that the effective production is at most equal to the potential production. But in our case of figure, $\tilde{u}_i$ and v_i are not independent since there exist explanatory endogenous variable in the function of inefficiency. To control the endogeneity of the dummy variable MT in the relation (16), we will derive Mills reverse ratios ($\tilde{\lambda}$) in the equation of the adoption of mobile telephony and integrate them in the relation (16). This way, we obtain the relation (16'): $y_i = x_i'.\beta + v_i - u(z_i, \tilde{\lambda}_{1i}, \tilde{\lambda}_{2i}; \delta)$ where u_i and v_i are independent. In the relation (16') δ is the vector of parameters of the function of the inefficiency. Conditioning by z_i and $\tilde{\lambda}$ we also supposes that u_i is independent of x_i. Then we pose thereafter that $u_i \sim N^+\left[\mu \exp(\not{z}_i'\delta), {\gamma_{u_i}}^2\right]$, with $\not{z} \equiv \left[z \vdots \tilde{\lambda}\right]$. By taking the natural logarithm we obtains: $\ln u_i = \ln \mu + z_i'\delta$. If we integrate this expression in the equation (16') we obtain the equation of the stochastic Frontier of production which will be estimated:

$y_i = x_i'.\beta + v_i - (\ln \mu + \not{z}_i'\delta)$ **(17).**[4]

At finish, the relations who will be estimated are the relation (2) for the adoption of MT and the relation (17) for the determination of the influence of this adoption on the productivity of the producer. But before having the results of the estimates, some descriptive results are showed in the following section.

Data, descriptive statistics and results of the estimates

Data

To answer these questions the study will be based on data collected within the framework of the studies of education production in the informal area realize by Western and center African Network for Research in Education[5] and covered four branches of industry of the urban district of Ouagadougou. The activities of the informal sector which is concerned in this investigation is the actors of the informal sector working in the hairstyle, motor bike mechanics, the seam and joinery on wood. The choice was related to these activities by the fact that the actors of these various activities use capital and labor to deliver a service whose quality influences the demand. The productivity in these activities depends then on the capacity of the contractor to better combine the factors of production to satisfy the customers. The difference in the level of equipment between these activities is also not too important so that a big part of the performance comes from the innovations resulting from the adoption of the ICT, and the organization and competences of the labor. The investigation was carried out in 2010 and related to three hundred small units of production of the urban district of Ouagadougou. In the objective to prevent that the production units are to count in the same area, sixty informal production units were retained in each of the five districts that account the town of Ouagadougou. While referring to the data of the first phase of investigation 1,2,3 of the INSD (2001), the number of informal unit of production by under category of activity was retained according to the representativeness of each under category of activity on the 179 581 units counting in 2001 by the INSD on all the extent of the town of Ouagadougou. From this information, to arrive to a self

[3] It is a model introduce by Kumbhakar Ghosh et McGukin (1991) improve by Huang et Lee (1992) and after by Battese et Coelli (1993).

[4] In these conditions, ICT is integrated in Z

[5] www.rocare.org

weighted sample, 25.2% of the three hundred production units were listed in the activities of hairstyle (male and female), 24.3% in the seam, 28.2% in the activities of motor bike mechanics and 22.3% in joinery on wood. Collected information related to number of the employees and their socio demographic characteristics (age, the level of education, the characteristics of the attended elementary school, the type of contract establishes with the owner, the number of workday lost by the members of the unit due to a disease). At the level of the production unit, the collected data related to the duration of day's work, the level of investment of the unit, the type of room which shelters the production unit, the availability of a phone number for the unit, the risks related to the production and the problems that the operators meet with the agents of the central and decentralized administration. Information on the type of customers (parents, unknown, State, ONG, etc.), the time that the head of the production unit passed in his workshop and the amount of transfer he receives from his parents and relatives are also available in the database.

Descriptive statistics

These statistics show that the adoption of new technologies by the small production units of Ouagadougou is very weak. Only 0.3% uses a computer within their workshop and 9.3% installed a fixed phone. The weak adoption of the fixed telephone can be explained by the importance of the costs of installation, so that if the chief of these informal units feel the need for the use of the phone, the adoption of mobile telephony is to be very high. The data show that 95% of the chiefs of these informal units have and use the services of the mobile phone. The difficulty is to know if this telephone is used for the needs for the activity or if a big part of the factors which explain its detention is due to other external causes of the activity? In this paper, we suppose that the cell phone is used in the facilitation of the economic activities and made it enough to be seen like an adoption of MT for the needs for production. Other statistics on the variables use in the models are show in Table 1.The variables retained within the framework of this research to explain the adoption of the MT are the number of unknown customers who addressed a demand to the firm (un_cus), a dummy variable indicating by 1 that the head of the production unit is a man (sex), dummies representing the branches of activity ($mecha, seam and hairs$) and the time that the head of the production unit passes within his company. This variable is measure by a dummy ($head\_ab$) which marks that the owner is generally in his unit when it takes value 1. Another dummy variable d_trans shows for his values 1 that the head of the production unit receives much transfer from his parents. The $hous\_inc$ variable gives the share of the income of the production unit coming from the demand of the family members or knowledge of the head of the production unit.

The dependant variable on the model of the stochastic frontier is the monthly total income generated by each firm (Rev_tot). The explanatory variables in the production function are the labor collected through the number of workers per firm (L). The capital of the firm (K) is collected through the value of the room in which the activity of the firm is carried out. The number of hours during which the firm works per day ($Hour\_w$).

The influenced judicious variables in the inefficiency function are: the number of effective year pass at school by the head of each firm. This variable is representing by two dummies. The dummy d_P indicates that the head has a primary school level and d_s indicate that the head of the informal firm has a secondary school level. $Score\_rav$ represents the score of the Raven test obtained by the head. The experience ($Exper$) collected by the number of working years of the head. The Ill_nes variable represents the number of days of unavailability of the members of the firm due to a disease by month. MT is the dummy variable indicating the presence of the cell phone in the firm. P_gov is a dummy which indicates if the head already had problems with the local government in the performance of his activities. The dummy $Risk$ indicates if the head thinks that its activity is risky.

Results of the estimations

This section discusses and presents the results of the regression of the adoption of MT and the effects of this adoption on efficiency of the producers. The estimates of the stochastic frontier are carried out on Frontier 4.1. The results of the adoption are initially discussed before interpreting those of efficiency.

Results of the adoption models

The model of adoption is estimated by using the method of Jackknife to correct the standard errors of the estimated coefficients. The results of the regression are consigned in Table 2. The statistic of Fisher testing the overall significant activity of the coefficients of the model shows that at the threshold of 5% at least one of the coefficients is significant. The results make it possible to say that the probability of adoption of mobile telephony is higher among women compared to the men head of a small informal unit of production. The most skilful owners of production unit are those who have a higher probability of adoption. That can be explained by the fact why these contractors are most technically, they have many customers and adopt mobile telephony to communicate with their customers. Also, the heads of a production unit who are generally absent in their workshop are those which adopt more mobile telephony.

Table 1. Variables of the Models

Variables	Obs	Mean	Std. Dev	Min	Max
Adoption Model					
TM	301	.94	-	0	1
Sex	301	.81	-	0	1
Scor_hab	301	4.66	2.25	0	10
un_cust	301	64.58	27.4	0	100
Mecha	301	.28	-	0	1
Seam	301	.24	-	0	1
hairs	301	.25	-	1	1
Head_ab	301	.6	-	0	1
D_trans	301	.03	24.8	0	1
Hous_inc	301	32.1	24.8	0	100
Production Function Variables					
Rev_tot	301	94498.3	70466.2	4000	500000
L	301	3.67	1.5	1	8
K	301	310760.8	354689.9	5000	2500000
Hour_w	301	10.9	2.3	-	17
Efficiency Function Variables					
d_p	301	.39	-	0	1
d_s	301	.39	-	0	1
Scor_rav	301	1.7	1.	0	4
Exper	301	11.4	6.6	0	35
Illnes	301	24.2	19.3	0	100
P_gov	301	.1		0	1
Risk	301	.9		0	1

Legend: $Score\_hab$ = the score of ability test obtained by the head, un_cus = umber of unknown customers, $mecha$ = motor bike mechanics, $seam$ =seam and joinery on wood, $hairs$ = hairstyle, $head\_ab$ = 1[the contractor is generally in his unit], d_trans = 1[the contractor receives much transfer from his parents], $hous\_inc$ =enterprise's income coming from parent or relatives demand, Rev_tot = Total income of the enterprise, L =Labor, K =Capital, $Hour\_w$ = number of works' hours, d_P=1[the head of the enterprise has a primary school level], d_s=1[the head of the informal firm has a secondary school level], $Score\_rav$ = the score of the Raven test obtained by the head, $Exper$ = experience of the head of the enterprise, P_gov =1(the head already had problems with the local government], Ill_nes = number of days of unavailability of the members of the firm due to a disease, $Risk$ =1[the head thinks that its activity is risky]

The estimate of this model then made it possible to derive the inverse ratio of Mills which will be integrated in the model of the stochastic Frontier of production.

Results of the stochastic production function

Before interpreting the result of the regression, it is useful to test the validity of the functional form. Table 3 shows the results of the tests which were carried out. The first test consist to test that all the coefficients of the model are null. The results of the test show that at threshold of 5%, we can reject this hypothesis. We then tested (2 in Table 3) the existence of technical efficiency in the model. The results also show that the functional form integrating the effect of technical efficiency is supported by the data. We are now interested to be ensuring that technical efficiency varies with the variables introduced into the model of efficiency. This hypothesis is also confirmed with statistics of chi-square with thirteen degrees of freedom of 46.53. These three test show that we can thus interpret the results of the estimate which are robust with respect to the problems tested. The results of the regression show that the variance

Table 2. The Probit regression results

Probit regression	Number of obs	=284
	Replications	=283
	F(9, 282)	=3.50
	Prob > F	=0.0004
Log likelihood = -45.538979	Pseudo R2	=0.2603
tm	Jackknife	

Variables	**Coef.**	**Std. Err.**	**z**
sex	-.97**	.39	-2.44
Mecha	-.09	.67	-0.14
scor_hab	.15**	.08	1.98
un_cus	.02	.06	0.33
seam	-.51	.65	-0.78
hairs	-.9	.71	-1.39
Head_ab	-.01**	.005	-2.97
d_trans	-1.02	.84	-1.21
Hous_inc	.01	.07	0.23
_cons	.51	6.9	0.07

Significant at 1%:***; significant at 5%: **

Legend : $mecha$ = motor bike mechanics, $Score\_hab$ = the score of ability test obtained by the head, un_cus = umber of unknown customers, $seam$ =seam, $hairs$ = hairstyle, $head\_ab$ = 1[the contractor is generally in his unit], d_trans = 1[the contractor receives much transfer from his parents], $hous\_inc$ =enterprise's income coming from parent or relatives demand.

Table 3. Test on the validity of the functional form of the model

N test	Null Hypothesis (Ho)	LR	chi-square	Decision
1	Any coefficient is significant	32.0	25.0	No Ho at 5 %
2	No technical efficiency effect (TE)	41.97	3.84	No Ho at 5%
3	Technical efficiency effect but coefficients null	46.53	22.36	No Ho at 5%

Source: Results of the tests

of technical efficiency is positive and accounts for 43.3% of the total variability of the dependant variable. In Table 4 we present the results of the simultaneous estimate of the production function and the function of the technical efficiency. The significant parameters are those followed by star(s).

The results of the model of the stochastic production function are overall interpretable. The economic inputs influence together the productivity of the informal firm of Ouagadougou. But, labor is more productive than the physical capital. An increase of 1% of the level of the labor (l[6]) respectively of the physical capital (lK) involves an increase of .46% respectively .16% of the production ($lrev\_tot$)[7] of the firms in the sample. This result can be explained by the fact that in these spheres of activities, a firm can exert with very little capital. The essence of the difference between the firms comes from the capacity to use labor to deliver a well service. But in the sample more, the firm work during long hours during the day more its productivity drops. That shows that the firms which are less productive cannot reduce the difference between them and very productive firms by increasing their number of work hours by day. The variables which represent the characteristics of the promoter do not influence the efficiency of the firm. The fact that the promoter is educated (i.e. has a primary level of education [d_p] or secondary [d_s]) does not improved the efficiency of his firm. The

[6] l is the logarithm of L and lK is the logarithm of K.

[7] Where rev_tot is the total income.

Table 4. The stochastic production function results

Variables	Coeff	Std. Er	T-ratio
	9.78 ***	.34	28.24
l	.45 ***	.08	5.9
lk	.16 ***	.03	5.74
hour_w	-.17**	.07	-2.23
Model of inefficience			
	.14	.74	.19
d_p	.54	.37	1.43
d_s	.25	.34	.74
Scor_rav	-.06	.12	-.5
Exper	-.07	.06	1.19
Exper2	.002	.002	.84
MT	.02 **	.009	2.12
Inv1	-4.31***	1.62	2.66
Inv2	.05	.14	.38
risq	1.52***	.46	3.27
P_Gov	. 35	.29	1.2
Ilnes	-.04**	.018	-2.47
credit	.10*	.07	1.49
Parameter of the variances			
σ^2	1.15 ***		3.46
γ^2	.88 ***		21.08
Log likelihood	-270.4		

Average technical efficiency: **0,604**

Legend: L =Labor, K =Capital, $Hour\_w$ = number of works' hours, , d_P=1[the head of the enterprise has a primary school level], d_s=1[the head of the informal firm has a secondary school level], $Score\_rav$ = the score of the Raven test obtained by the head, $Exper$ = experience of the head of the enterprise, Exper2=experience square, MT= Mobile telephony, P_gov =1(the head already had problems with the local government], Ill_nes = number of days of unavailability of the members of the firm due to a disease.

variable $Score\_rav$ is a variable which makes it possible to control the endogeneity of the education variable. This variable is a proxy of the cognitive capacities of the individual. The experience ($Exper$) of the head of the firm does not influence the efficiency of the small firm in the sample.

The most interesting result comes from the variable of interest. The coefficient associate with the MT variable appeared with a positive sign showing that the adoption of the MT affects the productivity of the producer positively. The empirical obviousness shows that the difference in productivity between a promoter who adopted the MT and who did not adopt it is approximately .02%. Other interesting results are those related to the risks variable. The data show that the promoters of informal firm who think that their activity is risky are also the most productive promoters. The empirical obviousness also shows that on average, the promoters of the informal firm are efficient at 60.4%. The efficiency of the production units whose members contracted diseases is also affected negatively. When a member of a production unit in the sample falls ill, this drop productivy of this unit of .04%.

Conclusion

The objective of this paper was to show that the informal firms of the urban district of Ouagadougou have a low level of adoption of the mobile telephone. But, the descriptive statistics show that a high proportion of the promoters of the informal firms of this city adopted the mobile telephone (MT). Nevertheless, it is necessary to keep in mind that we could not make the share of the things between the share of the motivation of the adoption which comes from the spirit of a MT like work tools and like a final consumption. The results of the model of adoption show that the adoption of the MT is influenced by the intrinsic capacities of individual i-e. its capacities to collect customers. Consequently, we can say that on the one hand it is the preoccupation of the development of customer loyalty which pushes to the adoption of the MT. The adoption of MT adoption is

influenced positively by the gender and the results show that women head of small informal production unit adopt more telephony mobile than men. The contractors who are sometime out of their workshop are also those who more adopt telephony mobile in the sample. The efficiency function results show that the adoption of mobile telephony has a positive effect on the productivity of the small informal firm in the sample.

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REFERENCES

Bagchi K, Udo G (2007). "Empirically testing factors that drive ICT adoption in Afica an OECD set of nation, " Issues in Inf. Syst. 8(2): 45-52.

Bandura A (1982) "Self-efficacy mechanism in human agency? " Am. Psychol. 37(2).

Barthélémy P (1998). "Le secteur urbain informel dans les pays en developpement : une revue de littérature, " Rév. Rég. et Dev. 7.

Cameron AC and Trivedi PK (2005). Microeconometrics : Methodes and Application. Cambridge University press (Chapter 14).

Dadi L, Burton M, Ozanne A (2004). "Duration analysis of technological adoption in Ethiopian agriculture". J. of Agric. Econ. 5(3).

Davis I, Bagozzi R, Warshaw R (1989). "User acceptance of computer technology: a comparison of two theoretical models", Manag. Sci. 35(8): 982-1003.

Eisemon TO, Nyamete A (1988) "Schooling and Agricultural Productivity in Western Kenya," J. East Afr. Res. and Dev. 18: 44-66.

Feder G, Just R, Zilberman D (1985). "Adoption of agricultural innovations in developing countries A survey",Econ. Dev. and Cult. Chang., 33(2):255-298.

INSD (2003) . Le secteur informel dans l'agglomération de Ouagadougou : Performances, insertions, Perspectives. Enquêtes 1-2-3. Premiers résultats de la phase 2. Décembre 2000- Novembre 2001.

ITU (2009). The world in 2009: ICTF acts and Figures: world telecommunication/ICT indicators databse.

ITU (2007). Telecommunication ICT markets and Trends in Africa, ITU, Geneva.

Jamison DT , Lau LJ (1982). Farmer Education and Farm Efficiency. Baltimore, Johns Hopkins University Press.

Kutlu L (2010). "Battese-coelli estimator with endogenous regressors? " Econ. Lett. 109(2): 79-81

Lepper MR (1985). "Microcomputers in education: Motivational and social issues? " Am. Psychol. 40(l): 1-18.

Myers R, Liu Y (2009). "Model selection in stochastic frontier analysis with an application to maize production in Kenya? " J. of Product. Anal. 31(1):33–46.

PDNA_Burkina: Rapport de l'évaluation des impacts, des pertes et des besoins en reconstruction suite aux inondations du 1er Septembre 2009 au Burkina Faso

Rivers D, Vuong QH (1988)."Limited information estimators and exogeneity tests for simultaneous probit models," J. of Econom. 39(2):347–66.

Roeller LH, Waverman L (2001). "Telecommunications Infrastructure and Economic Development: A Simultaneous Approach," Am. Econ. Rev. 91(4):909-23.

Rogers EM (1995). Diffusion of innovation. Free Press New-York, 4th Edition.

Taylor LD (1994) . Telecommunication demand in theory and practice. Dordrecht; Kluwer Academic press.

Tornatzky LG, Klein KJ (1982). Innovation characteristic and adoption implementation: a meta-analysis of findings. IEEE transactions on engineering management.

Waverman L, Meschi M, Fuss M (2005) The Impact of Telecoms on Economic Growth in Developing Countries.

Zahonogo P (2011). "Les déterminants de l'adoption de la téléphonie mobile au Burkina Faso," Cairn.info.