Overemployment, Underemployment and the opportunity cost of time

Building policy agendas for developing economies

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Abstract: Focusing on individual labor market positions, this article proposes a new approach to elicit and measure constraints faced by rural households. Under market imperfections, individuals fail to equalize their hourly income to their shadow wage and become over- or underemployed. We estimate and explain this gap in a stochastic frontier framework for rural Vietnam. Both employees and farmers are found to fail in equalizing their hourly income to their shadow wage. Constraints faced by farmers are found to be stronger than that of employees: farmers' marginal revenue of labor is 3 times higher than their shadow wage while market wages earned by employees are 1.5 times higher than their shadow wages. Price risk is found to be the most important constraint faced by Vietnamese rural farmers while employees would benefit from the development of the road network.

Keywords : Market imperfections, Shadow wages, Allocative efficiency, Vietnam.

JEL classification: D1 ; J2 ; O12 ; Q12

Introduction

Even in the most advanced economies, people face market imperfections that constraint their behavior and reduce economic efficiency. In developing economies, where these failures are the most important, they can even prevent people from escaping out of poverty by limiting the range of opportunities they can grab. From an economic policy point of view, De Janvry, Fafchamps and Sadoulet (1991) showed that market imperfections can make peasants irresponsive to price incentives, limiting the impact of standard development tools. Hence, a central question for economic development is to elicit the market failures that households face and to solve them. Empirical literature has extensively shown that rural households are very likely to be constrained and theoretical literature provides many possible sources for market imperfections, but which are the most relevant remains unanswered. The objective of this article is to find which are the most important in order to propose an agenda for economic policy based on microeconomic empirical evidence of the constraints faced by rural households in Vietnam.

As noted by Barrett, Sherlund and Adesina (2008) "the principal asset of the poor is their labor". And it is also a very flexible input for agricultural production. So, the main hypothesis in this article is that if a household is constrained by some market failure, this latter can be recovered when studying household members' labor market position. This idea was initiated by Skoufias (1994) who argued that differences between market wage and marginal revenue of labor indicate a labor market constraint. Recently, Barrett, Sherlund and Adesina (2008) mitigated this result[1] by demonstrating that price uncertainty can also explain the gap between market wage and marginal revenue of labor, so that the same stylized fact (the inequality between market wage and marginal revenue of labor) can be explained by two phenomenons. The cause of this puzzling result lies in assumptions made for the identification of individual cost of time (also called opportunity cost of time, implicit wage or shadow wage): While Skoufias (1994) assumes that farmers can equalize their marginal revenue of labor to their shadow wage and that they are labor market constrained, Barrett, Sherlund and Adesina (2008) consider that output price uncertainty prevents farmers from adjusting their marginal revenue of labor to their shadow wage but put the labor market constraint aside, so that employees can equalize market wage and shadow wage. Both market failures highlighted by the authors surely exist and this article introduces an econometric method for retrieving shadow wages in a framework where both constraints bind.

Assuming that other market failures could cause this gap, this article will test for many possible sources of inefficiency in a "horse race" approach. The argument is that interpretations of

[1] Their approach is based on Barrett (1996) so that the two articles will be cited indifferently

econometric results are often limited by mathematical formalization of the theoretical framework. In this case, the methodology should be reversed: econometric results should draw the way we are building theoretical models. A general econometric framework is proposed in which both farmers and employees can be constrained and in which we can test for possible sources of market failures including, among others, labor market constraint and price uncertainty.

The approach consists in measuring individual shadow wages given that market imperfections prevent households from equalizing it to market wage and marginal revenue of labor. Basic microeconomic theory emphasizes that the shadow wage is the marginal rate of substitution from consumption to leisure valuated at the market price of consumption. So, the objective is to measure and explain the gap between this marginal rate of substitution and observed prices of labor (market wage or marginal revenue of labor) by some variables representing possible market failures proposed by the economic literature presented in the following section. The main difficulty is that the marginal rate of substitution is not observed. Section 3 will demonstrate that the problem can be handled by the estimation of a mixture of stochastic frontier models when we assume Cobb-Douglas utility functions. The method is very instructive as it allows us to determine whether people are constrained or not, who is constrained, why and how much, answering the four basic questions that must be asked when studying market imperfections.

Econometric application to Vietnamese data for 2004, presented in section 4, shows that most of Vietnamese rural workers are under-employed (96% of the sample): their shadow wages are 2.5 times lower than observed labor prices (market wage or marginal revenue of labor). Hence, reducing market imperfections could generate large efficiency gains and may be welfare improving. Econometric results demonstrate that the development of roads for employees and price stabilization policies toward peasants are very promising ways to increase economic efficiency in Vietnam. Finally, constraints faced by farmers are found to be stronger than that of employees, confirming the intuition developed by Barrett (1996).

Literature Review

The approach developed in this article is essentially based on two related literatures: the analysis of household's constraints and the measurement of shadow wages. We present them in two distinct sub-sections despite the fact that some references belong to the two literatures in order to highlight the advances proposed in this paper.

2.1 Household constraints

The problematic of the literature about households' market imperfections has slightly changed in the recent years: While first approaches mainly questioned the presence of a constraint within the population, following articles clarified the problem, focusing on three main topics: Who is constrained? How much are they constrained? Why are they constrained?

2.1.1 First approaches: Is there a constraint?

Many studies have analyzed the existence of market failures by testing the separation hypothesis: if a constraint binds, then consumption and production decisions are taken simultaneously (they are not separable) so that household characteristics (number of children, age of household head, educational level, etc.) affect production decisions such as market participation, input choices, level of production, etc. Econometric tests have provided contrasting results: While Lopez (1984) and Grimard (2000) reject the separation hypothesis for Canada and Côte d'Ivoire, Benjamin (1992) cannot reject the hypothesis that household structure does not affect labor allocation decisions in rural Java. Bowlus and Sicular (2003) do not reject separability only for localities benefiting from sufficiently developed movements of resources, but separability is rejected overall in their sample, indicating that "factor markets remain underdeveloped" in China.

2.1.2 Who is constrained?

As noted by Carter and Yao (2002), "Global tests for separability […] are theoretically inappropriate when the market failures […] differentially constrain some, but not all households". Hence, the central question is not whether a constraint binds or not but whose constraint binds? Two main advances have been made in this sense by Lambert and Magnac (1998) and Vakis, Sadoulet, De Janvry and Cafiero (2004). Lambert and Magnac (1998) extend Skoufias (1994)'s method demonstrating theoretically that "a necessary and sufficient condition for recursivity to hold is that implicit prices […] are equal to market prices". Computing standard errors for implicit prices, they can test individually the equality between shadow wage[2] and market wage for each household and show that "non recursivity is a common case in their sample" of households in Côte d'Ivoire.

Considering that this test is too sensitive to the specification and the estimation of a production function for agriculture, Vakis, Sadoulet, De Janvry and Cafiero (2004) propose another approach based on mixture models: Given that household characteristics affect production decisions only for constrained households, they prefer to measure the probability that a household is constrained (household characteristics affect production decisions) or not. Their study focuses on on-

[2] Note that the shadow wage is supposed to equal the marginal revenue of labor as in Skoufias (1994)

farm labor supply and estimates the probability that a household is constrained (household characteristics affect on-farm labor supply). They find that, on average, a household has a probability of 0.51 of being constrained in rural Peru, confirming that market failures affect a large part of the population in rural areas.

2.1.3 Why are they constrained?

Many possible constraints have been proposed in the literature (see for example: Sadoulet, De Janvry and Benjamin (1998) for price bands, Barrett (1996) for price uncertainty, Carter and Yao (2002) for land transfer rights, De Janvry, Sadoulet, Fafchamps and Raki (1992) for credit constraint). Most of the time, a theoretical model is introduced in order to focus on the constraint analyzed and interpretations of econometric results are driven by the hypothesis made when building the theoretical model. Because different models can explain the same phenomenon (see the introduction), policy implications can become confused: Why should we believe one interpretation more than others? Is the constraint under scrutiny the most important? Vakis, Sadoulet, De Janvry and Cafiero (2004) try to answer this question by putting some explanatory variables in the switcher equation of their mixture model so that they can test for some possible origins of non-separability and find that both demand (education, ethnicity, etc) and supply (availability of job opportunities) variables affect the probability of being constrained. This is a clear value added as compared to standard approach: while sources of non-separability are usually proposed by theory, Vakis, Sadoulet, De Janvry and Cafiero (2004) propose an econometric approach which could help identifying the most important failures faced by rural households and build more relevant theoretical models.

2.1.4 How much are they constrained?

Once one knows that households are constrained and why, a question remains: how much are they constrained? How much do they behave differently as compared to unconstrained ones? This is a central question because if constrained household do not really differ from unconstrained ones, then, there is no reason for a specific development policy toward them and standard policy tools should apply. This problem was questioned by De Janvry, Fafchamps and Sadoulet (1991) who showed that market failures reduce the price elasticity of cash crop supply from 0.99 with no market failure to 0.18 when labor and food markets fail. It means that if a government wants to increase cash crop supply, it will have to increase the price of cash crops 5.5 times more if households are constrained than if they are not in order to obtain the same result. So the same economic policy would cost 5.5 more if households are constrained. This is a good argument for making government more sensitive to the problem of market failures.

Other studies focused on the output gap generated by market failures as a measure of the importance of inefficiencies: Estimating a "generalized indirect production function" in which a parametric function of other prices, cost and quasi-fixed inputs is substituted for shadow prices, Bhattacharyya and Kumbhakar (1997) show that market imperfections induce an output loss of almost 12% for rice growers in West Bengal, India. Using an ex ante classification between credit constrained and unconstrained households, Boucher and Guirkinger (2008) estimate that "agricultural production could increase by 26% in Piura, Peru, if all credit constraints were eliminated".

The method proposed by Vakis, Sadoulet, De Janvry and Cafiero (2004) could easily be used to measure the "labor gap" generated by market imperfections. Hence, the method could answer the four basic question mentioned before (Is there a constraint? Who is constrained? Why? How much?) in a unified framework. However, in this framework, market failure variables influence the probability of being constrained but this gives no information about the inefficiency cost of each constraint.

An alternative approach based on factor price equalization as in Skoufias (1994) or Lambert and Magnac (1998) is preferred here. However, while Lambert and Magnac (1998) argue that non rejection of factor price equalization on one market does not imply that recursivity holds because non-recursivity could arise because of another good, we argue that if a household is constrained, this constraint will always prevent him from reaching his optimal level of utility, so that the shadow price of labor will differ from observed labor prices whatever the source of inefficiency.

The strategy relies on the idea that the gap between the shadow wage and observed labor prices (market wage or marginal revenue of labor) can be explained by market imperfections. A central issue is thus the measurement of individual shadow wage.

2.2 How does the literature (mis)measure the opportunity cost of time?

The opportunity cost of time is the price that one wants to be paid in order to work one more hour. As everybody has his own unobserved preferences over leisure and consumption, it is difficult to measure this opportunity cost directly. So, the economic literature uses to derive this shadow wage by assuming that it equals some other observed or easy-to-compute value. Here, I will distinguish between works devoted to the analysis of employed and self-employed people.

2.2.1 Employees

As long as one considers that people do not face labor constraints, she can observe individual shadow wages simply by retrieving individual hourly wages of employees[3]. This assumption has been recently criticized by Feather and Shaw (1999) who consider that employees can be over-employed or under-employed because they are not free to choose their working time. In their framework, an individual is considered as under-employed (over-employed) if she would prefer to work more (less) for the same hourly wage. Using specific questions allowing them to distinguish ex-ante who is over or underemployed, they show that over-employed (under-employed) earn an hourly wage significantly lower (higher) than their shadow wage. So, observed market wages are not good measures of the shadow wage. The main drawback of this approach is that we need to know if people are over or under-employed ex-ante and this information is rarely available. The method needs to be extended to the case of unknown sample separation in order to be widely used.

2.2.2 Self-Employed

Market wages have been the only measure of the shadow wage for a long period of time during which self-employed people were considered as simple selection problem just like unemployed people. Thus, when Heckman (1974) developed his technique which allows recovering shadow wages for unemployed people, the method was also applied to self-employed. In 1993, Jacoby showed that we have much more information about self-employed than about unemployed: in his framework, the marginal revenue of labor equals the shadow wage. Thus, one can retrieve self-employed shadow wages by simply estimating a production function. Skoufias (1994) used this result and tested the equality between market wage and marginal revenue of labor (considered as equating the shadow wage) and concluded that agricultural households are constrained on the labor market. Recently, Barrett, Sherlund and Adesina (2008) mitigated this result: They assumed no labor market imperfection but introduced allocative inefficiency due to uncertainty on output price for agricultural households and found the inequality between market wages and marginal revenue of labor. Hence, the same result (the inequality between market wage and marginal revenue of labor) can be explained by two possible imperfections: labor market imperfections and price uncertainty. Policy implications become confused.

As noted earlier, the source of the problem lies in the identification of the true shadow wage: if it differs from both market wage and marginal revenue of labor, how can we measure the opportunity cost of time?

[3] The problem of unemployed people is usually handled by Heckman's selection technique.

What really is the "shadow wage"? Turning back to basic microeconomic theory

3.1 Standard neoclassical framework

Consider an individual with utility $U = U(X, l; z)$ where "X" is the level of consumption, "l" the number of hours spent for leisure activities and "z" some individual characteristics determining preferences over consumption and leisure. Each individual wants to maximize utility with respect to a budget constraint:

$$p_X X = y_0 + wL + p_Q Q - p_I I$$

Where "$p_Q Q = p_Q Q(h, I)$" is the value of household production, "h" is on farm working time, "I" is a vector of inputs (with a price vector "p_I") used in the production process, "y_0" is non labor income, "L" is off-farm working time and "w" is hourly wage paid on the labor market.

If no other constraint binds, we obtain the standard result that the marginal rate of substitution from consumption to leisure equals the price ratios:

$$\frac{U_X}{U_l} = \frac{w_m}{p_X} = \frac{p_Q}{p_X}\frac{\partial Q}{\partial h}$$

In this setting, the "shadow wage" is simply the marginal rate of substitution from consumption to leisure (U_X/U_l) valued at the market price of the consumption good (p_X) which equals the market wage and the marginal revenue of labor at equilibrium.

$$w^* = p_X \frac{U_X}{U_l} = w = p_Q \frac{\partial Q}{\partial h}$$

Assuming that the shadow wage w^* equals the market wage w or the marginal revenue of labor $p_Q \partial Q/\partial h$ simplifies the analysis because we don't need to account for unobserved preferences. However, if some constraint binds (labor market constraint, price uncertainty, etc.) then the shadow wage doesn't equal any observed value anymore and we have to focus on the problem of individual preferences over consumption and leisure.

3.2 Deviations from the neoclassical equilibrium

Assuming a Cobb-Douglas utility function $U = X^\alpha l^\beta$, we know that

$$w^* = \frac{\beta}{\alpha}\frac{p_X X}{l}$$

Our problem is that we do not observe individual relative preference for leisure (β/α) and we only know that $p_Q.(\partial Q/\partial h) \neq w^* \neq w$ is likely to occur. However, this issue can be overcome by posing $k_Q.p_Q.(\partial Q/\partial h) = w^* = k_M.w$ (where $k_Q > 0$ and $k_M > 0$) . To make things clearer, consider the case of employees.

3.2.1 The case of employed people

Assume that $w^* = k.w$ where $k = 1$ if our individual is not labor constrained. Following the terminology of Feather and Shaw (1999), if $k \geq 1$ $(0 < k \leq 1)$, then our worker is overemployed (underemployed): he would prefer to work less (more) for the same hourly wage.

Substituting w^* by its expression, we obtain the following relation:

$$\frac{p_X X}{wl} = \frac{\alpha}{\beta} k$$

Our problem is to distinguish between preferences heterogeneity α/β and individual labor market constraint k. Note that k bears two informations: it tells us whether people are constrained or not (if $k \neq 1$ or not) and how much they are constrained (how far is k from 1). It already answers two of the questions highlighted earlier: who is constrained and how much?

The identification strategy relies upon Feather and Shaw (1999)'s classification which allows splitting employees into two groups: overemployed and underemployed. Considering underemployed workers, we know that $k \leq 1$. Assume that the heterogeneity of preferences can be modeled as: $\alpha/\beta = f(z).\varepsilon$ where ε is unobserved heterogeneity.

We obtain:$(p_X X)/(wl) = f(z).\varepsilon.k$

Taking logs, we obtain a stochastic "production" frontier model (see Aigner, Lovell and Schmidt (1977) and Meeusen and Van den Broeck (1977)) so that ε and k can be separated by maximum likelihood estimation:

$$\ln\left(\frac{p_X X}{wl}\right) = \ln f(z) + v - u$$

Where $v = \ln \varepsilon$, is random and $u = \ln(k) \geq 0$.

The same result applies to overemployed people with a small (but important) difference, so that we obtain a stochastic "cost" frontier model:

$$\ln\left(\frac{p_X X}{wl}\right) = \ln f(z) + v + u$$

Our problem now reduces to the estimation of a mixture of two stochastic frontier models: one for underemployed people (the "production" model) and one for overemployed people (the "cost" model).

3.2.2 The case of self-employed

If one wants to adopt this approach for self-employed people, she needs to measure the marginal revenue of labor that should replace the market wage "w" in our equation. The standard approach (Skoufias (1994), Lambert and Magnac (1998) or Barrett, Sherlund and Adesina (2008)) relies on the estimation of a production function that is often subject to critics (dealing with zeros in input quantities, missing variables, reduction of a long decision process to a simple equation, etc.). In order to avoid estimating such function, we follow Le (2009) and assume that $Q = Q(h, I) = q(I).h^{\gamma}$, so that the marginal revenue of labor is $MRL = p_Q.\gamma.(Q/h)$.

We obtain:

$$\ln\left(\frac{p_X X}{l}\frac{h}{p_Q Q}\right) = \ln f(z) + \ln\gamma + v \pm u$$

where γ is labor elasticity of output.

Hence, the final econometric specification is:

$$lhs = X\beta + S\delta + v - su$$

Where

$lhs = \ln(p_X X) - \ln(wl)$ if our individual is an employee,

$lhs = [\ln(p_X X) - \ln(l)] + \left[\ln(h) - \ln\left(p_Q Q\right)\right]$ if our individual is self-employed,

$X\beta = \ln f(z)$ represents observed preferences heterogeneity,

S=1 if the individual is a farmer and S=0 otherwise,

$\delta = \ln\gamma$ is the production function parameter which helps identifying the marginal revenue of labor without estimating a production function,

$v = \ln\varepsilon$ is random and represents unobserved preferences heterogeneity,

$u = \ln(k) \geq 0$ is our "inefficiency parameter" and $s = -1$ if overemployed, and $s = 1$ if underemployed.

3.2.3 Incorporating explanatory variables for inefficiency scores

In Barrett (1996)'s framework, farmers' labor position is determined by household net food buyer or net seller status which is related to land endowment: If the household owns a big cropping land, he is a net seller of the production good and labor is underemployed. However, if land is scarce for the household, he is a net buyer and labor is overemployed. It is thus necessary to include household land endowment as an explanatory variable of inefficiency scores of farmers in the model. Furthermore, the objective of this article is to provide a framework allowing us to design a policy agenda for rural households. Other explanatory variables that could influence "k", the inefficiency score will be introduced in order to perform a Horse Race for market imperfections. To do so, we adopt the stochastic frontier formulation proposed by Huang and Liu (1994) and Battese and Coelli (1995) which assumes that $u = \ln(k) = Z\lambda + w$ where $w \geq -Z\lambda$.

The final specification is:

$$lhs = X\beta + S\delta + v - s[Z\lambda + w]$$

Where $w \geq -Z\lambda$, $s = -1$ if overemployed, and $s = 1$ if underemployed.

Method, data and estimation results

4.1 Estimation method

The identification strategy relies on the estimation of a mixture of two stochastic (truncated normal) frontier models (a "production" and a "cost" frontier) that share the same frontier. Following Huang and Liu (1994), we assume $v \sim \mathcal{N}(0; \sigma_v)$ and $w \sim \mathcal{N}(0; \sigma_w)$ truncated below at $-Z\lambda$. Battese and Coelli (1995) note that this specification is consistent with that of Kumbhakar, Ghosh and McGuckin (1991) which simply states that $u \sim \mathcal{N}_+(Z\lambda; \sigma_u)$. The corresponding likelihood is:

$$L = \prod \{p_o l_o + (1 - p_o) l_u\}$$

$$l_u = \frac{1}{\sigma_S} . \phi\left(\frac{\xi + Z\lambda}{\sigma_S}\right) . \boldsymbol{\Phi}\left(\frac{Z\lambda}{\sigma_S \tau} - \frac{\xi\tau}{\sigma_S}\right) . \left[\boldsymbol{\Phi}\left(\frac{Z\lambda}{\sigma_u}\right)\right]^{-1}$$

$$l_o = \frac{1}{\sigma_S} . \phi\left(\frac{\xi - Z\lambda}{\sigma_S}\right) . \boldsymbol{\Phi}\left(\frac{Z\lambda}{\sigma_S \tau} + \frac{\xi\tau}{\sigma_S}\right) . \left[\boldsymbol{\Phi}\left(\frac{Z\lambda}{\sigma_u}\right)\right]^{-1}$$

Where $\sigma_S = \sqrt{\sigma_v^2 + \sigma_u^2}$, $\xi = y - X\beta - S\delta$, $\tau = \sigma_u/\sigma_v$, p_o is the share of the population overemployed and l_u (l_o) is the likelihood associated to under(over)employed workers.

Estimation is performed via an Expectation – Maximization (E-M) algorithm (Dempster, Laird and Rubin (1977)) in order to deal with mixture. One of the main problems with this algorithm lies in the choice of initial values that must be good enough to catch the global maximum. Our strategy is to get a random value for p_o, then get initial values for the other parameters given this probability and switch to the EM algorithm and run 10 iterations[4]. Then, get another p_o and maximize again, and so on. The operation is repeated 30 times and we finally got the best parameters obtained (those that maximize the log-likelihood) and used it as initial values for a "long run" E-M algorithm[5]. This last run of the EM algorithm comprises a maximum 500 iterations[6], followed by a final maximization of the incomplete log-likelihood.

4.2 Estimation sample and Data

The method is tested on Vietnamese Household Living Standard Survey (VHLSS) data for the year 2004. Even if the approach should be applicable to an industrialized country (Feather and Shaw (1999) show that the employees in the United States suffer from over and underemployment), a developing country is supposed to be a best framework because constraints should be more likely to occur. Furthermore, as long as the objective of the article is to propose policy tools against poverty, a developing economy is more appropriated.

4.2.1 Individual data

VHLSS 2004 collects data from 46,000 households and include detailed questions about household members (age, sex, education, health, etc.), employment, agriculture, aquaculture, forestry, non-farm activities and household expenditures. In order to narrow the sample under scrutiny and to remain in the scope of the literature about market imperfections, we only keep employed workers and farmer in rural areas and drop information about urban areas, aquaculture, forestry and non-farm business. We only keep information about the main job (multiple job holding is widespread in Vietnam). The final sample contains 14 316 individuals. For each observation, information about age, sex, education and household size is collected and will be used as control variables for preferences heterogeneity. Mean expenditure in the household, leisure time, on-farm

[4] Each maximization step comprises a maximum of 20 iterations and likelihood tolerance is fixed at 0.01.
[5] Likelihood tolerance for maximization steps of the long run algorithm is fixed at 0.001 and the maximum number of steps is 25.
[6] Convergence of the long run EM algorithm is declared if the improvement of the incomplete log-likelihood is less than 1.0E-06

working time, hourly wage if employed and agricultural production value were used when computing the left hand side variable. Finally, following Barrett (1996)'s argumentation, land per head endowment in the household is collected as a determinant of farmers inefficiency scores.

4.2.2 Finding constraints in the data

The objective of the article is to elicit binding constraints of households in rural Vietnam. So we have to include variables representing possible constraints in the model. VHLSS data propose three sources for such variables: household questions about the constraints faced during production activities, community level questions about the most important constraints faced by farmers, and questions about "infrastructures" in the commune.

4.2.2.1 Household level questions

Household level questions should be preferred as they better capture individual situations. However, the questionnaire only proposes few possible constraints (access to capital, lack of knowledge about new technologies, disasters, prices variations or demand/supply balance) limiting the scope of the study (see table 1). Furthermore, only 42% of interviewed farmers declare themselves as constrained in their production activities and this tends to show that individuals are not aware of the constraints they face[7].

4.2.2.2 Community level questions

The commune questionnaire contains information about « the main difficulties faced by commune's farmers in agricultural production ». Constraints highlighted concern access to capital, lack of new varieties, lack of technical knowledge, prices or demand/supply impact, market access, irrigation network, disasters, pest disease, access to agricultural services and inappropriate agricultural policy. As in the case of household questionnaire, the main constraint cited by community leaders is access to capital (see table 2). This is not surprising as long as if farmers are declared capital constrained, the leader can expect to obtain public subsidies from the Central Government. Above all, this kind of information is not very useful for economic policy: For example, if commune leaders point out that "lack of knowledge" is a great constraint for farmers, what should be done? Does the development of information centers could solve the problem? Do farmers really apply advices given by staff members? Building a good policy for reducing households' constraints requires an ex-ante evaluation of the impact of policy tools.

[7] This problem could be referred to a « nay-saying ». See Couch and Keniston (1960).

4.2.2.3 Infrastructure variables

The main critics against information given by the household and the commune leader are subjectivity and the impossibility of ex ante evaluation of development policies. Infrastructure data correspond much better to our objectives. The choice of relevant infrastructure data follows household and commune questionnaires: we focus on output and input market access, credit constraint, meteorological and epidemic disasters, access to information and new technologies and quality of infrastructures such as irrigation and electricity networks.

Market access is represented by the distance from the hamlet to the nearest market and we distinguish between input and output markets. Credit constraint is approximated by the distance to the nearest institutional lender (State Bank, Private Bank or Credit Organization).

Irrigational network is measured by the share of irrigated land in the commune and access to electricity is a dummy variable equal to one if the commune is connected to the national electricity network and zero otherwise.

Vietnam has a tropical monsoon climate and experiences frequent weather-related natural disasters. Uncertainty generated by meteorological events can prevent farmers from predicting their marginal revenue of labor, so that they fail in equalizing it to their shadow wage. Recent disasters are included in the regression in order to measure this phenomenon.

Access to information is proxied by the distance to the nearest extension center and household level dummies recording meetings with extension center staff members. As noted by Munshi (2008), technological knowledge is an important issue in rural areas and numerous studies focus on social networks in order to understand technology diffusion across groups. Here, we try to determine the way political leaders should intervene to increase the rate and the speed of technological adoption. This issue is summed up into three variables: distance to the nearest extension center, having visited an information center, or having been visited by a promotion agent. The best form of promotion of new technologies with farmers should be revealed.

Land market may severely constrain farm households. Considering that productivity of land is limited, the absence of a land market can make farmers underemployed. According to Barrett (1996), peasants are risk averse and their labor position (over or underemloyed) is determined by their land endowment: Net sellers (abundant land) are underemployed, while net buyers (scarce land) are overemployed. Fortunately, these two effects act with different signs: while price uncertainty makes farmer with a small land endowment overemployed, land market constraint makes them underemployed.

In the case of employees, we are interested in finding what could reduce job scarcity in rural areas. Indeed, employees are supposed to find a better match between shadow and market wages if many job offers are available. Distance from the hamlet to the nearest road accessible by car is found to be potential instrument for economic policy toward employees.

4.3 Building variables representing possible constraints

If no constraint binds, then households are supposed to succeed in equalizing labor prices and the inefficiency score k equals one. Hence each "constraint variable" included in the model must be built so that it equals 0 if the constraint does not bind and a positive value otherwise. The construction of distance variables (to financial organizations, markets or information center) is thus natural: log transformations of recorded distances are used and distances inferior to 1km are recoded as 1. Natural disasters are also easily coded as 1 if a catastrophe occurred in the last year and zero otherwise. Finally, the percentage of non-irrigated land in the commune is used to control for the irrigational network.

Other variables must be constructed in a less natural way: Having visited or having been visited by agricultural promotion services must be coded so that farmers who didn't access to information are coded as one and others have zero. The same applies to the access to the national power grid.

Last but not least is the problem of land. In Barrett (1996)'s framework, there exists a land per head ratio for which farmers are self-sufficient (neither net sellers nor net buyers). Hence, low land per head endowments are related to overemployment and high land per head endowments are associated to underemployment. The expected relationship is thus:

$$k_{farmer} = \alpha_0 + \alpha_1 \ln (landperhead)$$

If $\alpha_1 < 0$, then the price risk effect proposed by Barrett (1996) dominates. Farmers are price risk averse and price stabilization policies should be implemented. If $\alpha_1 > 0$, peasants are constrained by their land endowments. Development projects should focus on improving land productivity or the extension of cropping area.

4.4 Constraints on coefficients

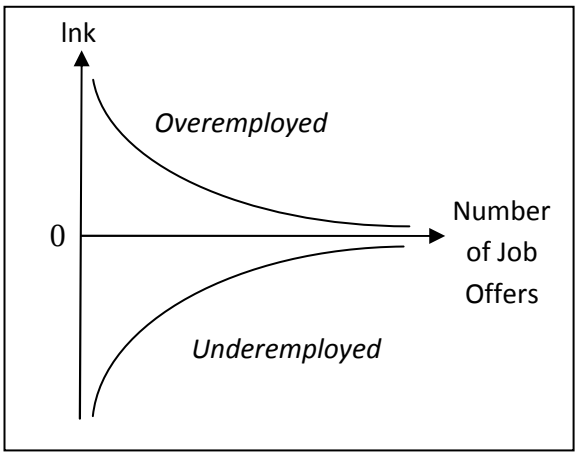
As explained above, we estimate a mixture of two models sharing the same stochastic frontier. This raises the question of the parameter estimated in the two groups (over or underemployed). Should they be different, equal or opposite? The answer depends on the activity considered: Employees only suffer from job scarcity which can make them both over and underemployed, while

farmers may face many constraints at the same time and each of them will tend to make her over or underemployed.

4.4.1 Employees

Consider first the case of an employee: if a worker can choose between a large numbers of jobs, she can surely find a position where her wage equals her opportunity cost of time ($k = 1$). However, if job offers are scarce, she may be overemployed ($k \to +\infty$) or underemployed ($k \to 0$). Job scarcity will always move the worker away from the equilibrium as presented in figure 1: the expected relationship between job scarcity and our inefficiency variable "k" is decreasing if our worker is overemployed and increasing if she is underemployed. Variables affecting access to employment have opposite effects on "k" for overemployed and underemployed. Parameters of employees' determinants of inefficiency will be constrained to be symmetric in the two groups ($\lambda_o = -\lambda_u$ for employees).

Figure 1 – Expected relationship between job scarcity inefficiency variable "k"



4.4.2 Self-Employed

In the case of self-employed workers, this symmetry disappears. In fact, whatever the position of the farmer with respect to his shadow wage (over or underemployed), a quantity constraint on an input which is complementary with household labor will induce underutilization of both the input and labor so that the worker will be underemployed. To make things clearer, consider a peasant A who is underemployed and a farmer B who is overemployed. If a new constraint on an input appears, then farmer A will become "more" underemployed, while farmer B will be "less" overemployed and may become underemployed too. There is no reason why over- or underemployed farmers would suffer differently from the same constraint. So we will constrain parameters of self-employed workers to be the same in the two groups ($\lambda_o = \lambda_u$ for self-employed).

4.5 Empirical tests

Econometric application is performed in two steps: First, a test between Lambert and Magnac (1998) and Adesina, Barret and Sherlund (2008) is proposed and demonstrates that both farmers and employees fail in equalizing labor prices. However, it seems that constraints faced by farmers are stronger than that of employees. Then, a Horse race including other relevant variables representing possible constraints is performed and confirms the importance of income uncertainty as a major constraint to peasants' behaviors while employees would benefit from improved road networks..

4.5.1 First test: Barrett (1996) versus Lambert and Magnac (1998)

Table 6 presents estimation results for a test based on Lambert and Magnac (1998) and Barrett (1996). First, a comparison of the labor elasticity of the Cobb-Douglas production function with those found in the literature tends to support the approach proposed here: Estimated elasticities found in the literature are very heterogeneous: While Strauss (1986) finds an elasticity of 0.6 for rural Sierra Leone, Deolalikar (1988) estimates it at 0.35 for rural South India, Jacoby (1993) obtains 0.10 for Peruvian Sierra and Skoufias (1994) finds 0.13 for rural India. Finally, Le (2009) estimates this elasticity for Vietnam and finds 0.0472 for males and 0.0782 for females. These last results seem to be very low as compared to other studies. Our method gives results closer to that found in the literature: estimated labor elasticity of production is 0.37, close to Deolalikar (1988) and comprised between 0.05 and 0.6 confirming its consistence.

Also, determinants of preferences present consistent results: preference for consumption increases with age; women have relatively lower shadow wages than men. More educated workers expect higher wages. Finally, household size decreases the preference for consumption, as in a model in which people enjoy spending time with relatives[8].

Econometric results confirm the intuition that individuals fail in equalizing shadow wages and hourly income. Furthermore, we find a large proportion of underemployment in the population: shadow wages are lower than their observed hourly income. This result implies that an increase in labor demand could be absorbed by the labor force without strong pressures on wages. It confirms the consensus which usually considers that Vietnamese work few hours and that labor demand could increase without inflation.

[8] U-shape tests (Lind and Mehlum, 2007) reject turning points for all variables.

Table 6: Barrett (1996) versus Lambert and Magnac (1998)

Dependent variable: lhs		Coefficient		Standard errors
Preferences over consumption and leisure (Log of α/β)	Age	0,045	***	(0,003)
	Age^2	- 0,000	***	(0,000)
	Female	0,164	***	(0,015)
	hhold size	- 0,242	***	(0,016)
	hhold size ^{2}	0,012	***	(0,001)
	nb of children	- 0,144	***	(0,014)
	nb of children ^{2}	0,006	**	(0,003)
	nb of members aged 65+	0,035		(0,037)
	nb of members age 65+ ^{2}	- 0,019		(0,020)
	Attained Primary School	- 0,076	**	(0,032)
	Attained Lower Secondary School	- 0,022		(0,023)
	Attained Higher Secondary School	- 0,072	***	(0,021)
	Attained Post Secondary Education	- 0,076		(0,048)
	Vocational Training	0,022		(0,027)
	Constant	- 1,279	***	(0,074)
	Log of σ_v^2	- 1,452	***	(0,076)
Production Function Parameter	Log of γ	- 0,988	***	(0,039)
	Labor Elasticity of Output "γ"	*0.37*		
Employees' Inefficiency	Log of Distance to the nearest Road	0,255	***	(0,037)
	Log of σ_u^2	- 0,947	***	(0,087)
	Inverse logit transformation of p_o	- 2,228	***	(0,121)
	Proportion of overemployed workers	*9,7%*		
Farmers' Inefficiency	Log of Land per hand	- 0,666	***	(0,030)
	Constant	4,938	***	(0,321)
	Log of σ_u^2	0,204	***	(0,053)
	Inverse logit transformation of p_o	- 3,970	***	(0,177)
	Proportion of overemployed farmers	*1,9%*		
	Number of observations	14 316		

*** p<0.01, ** p<0.05, * p<0.1

Interpreting inefficiency parameters

Empirical results support our intuitions regarding the determinants of allocative inefficiency: increasing farm size tends to decrease inefficiency scores of farmers and makes them underemployed as predicted by the model of Barrett (1996) where farmers are price risk averse. Proximity of roads is found to have a significant impact on allocative efficiency of employees: reducing the distance to the nearest road makes employees' inefficiency scores to tend towards zero (perfect allocative efficiency), while increasing this distance can make workers either overemployed or underemployed.

Table 6 shows that allocative inefficiency is present in our data and it proposes sources for such inefficiencies. However, it does not tell us how strong is the allocative gap generated by these failures. Answering this question needs some additional steps: first, individuals must be classified as over- or underemployed. Then, a prediction of individual inefficiency scores must be performed.

Classification is based on the following formulae:

$$d_{oi} = 1 \text{ if } p_o l_o / \{p_o l_{oi} + (1 - p_o) l_{ui}\} > 0.5 \text{ and zero otherwise}$$

$$d_{ui} = 1 \text{ if } p_o l_{oi} / \{p_o l_{oi} + (1 - p_o) l_{ui}\} < 0.5 \text{ and zero otherwise}$$

Where $d_{oi} = 1$ ($d_{ui} = 1$) for individuals classified as overemployed (underemployed).

Then, inefficiency scores are predicted given our classification. Battese and Coelli (1988)'s formula for inefficiency scores is used to predict individual differences between shadow wage and market wage or marginal revenue of labor:

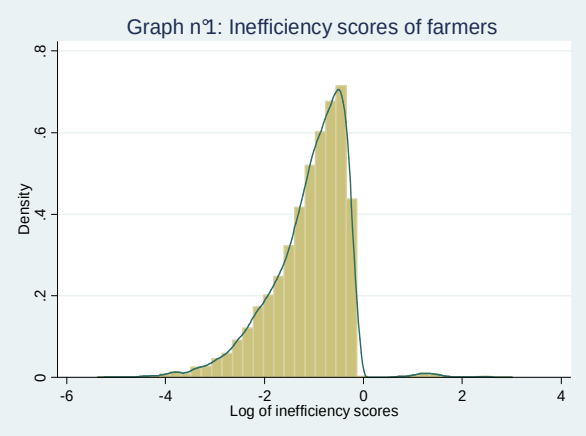
$$k_i = E\{\exp(-s u_i) \,|\xi_i\}$$

$$k_i = \frac{1 - \boldsymbol{\Phi}\left(\frac{\sigma^* - \mu_i^*}{\sigma^*}\right)}{1 - \boldsymbol{\Phi}\left(\frac{-\mu_i^*}{\sigma^*}\right)} . \exp\left(-\mu_i^* + \frac{1}{2}\sigma^{*2}\right)$$

Where $\mu_i^* = (-s\xi_i . \sigma_u^2 + Z\lambda . \sigma_v^2) / \sigma_S^2$, $\sigma^* = \sigma_u . \sigma_v / \sigma_S$, $s = -1$ if overemployed, and $s = 1$ if underemployed

Distinguishing between farmers and employees, we obtain the distributions for inefficiency scores presented in graphs 1 and 2.

Both farmers and employees appear as strongly underemployed even if farmers are more constrained than employees (table 7).Farmers' shadow wages appear as being 3 times lower than their marginal revenue of labor, while market wages are 1.5 times higher than employees shadow wages. Given their hourly income, most of the Vietnamese workers in our sample would prefer to work more. Policy implications for employees are straightforward: job opportunities should be made more accessible, and developing road access is a promising tool. Concerning peasants, the link with farm size emphasized by Barrett seems to prove correct: increasing farm size tends to make peasants underemployed. Following Barrett's framework, this result highlights the importance of policies aiming at stabilizing producer prices in Vietnam: In fact, underemployed farmers in Barrett's model are net sellers and income risk averse: price uncertainty leads them to underemploy inputs and reduces output.



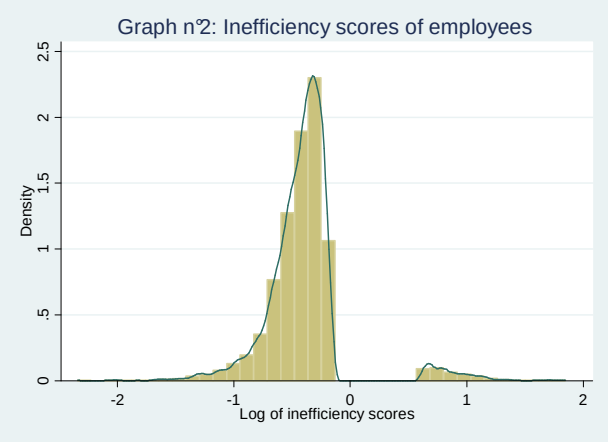


Table 7 – Mean comparison test for inefficiency scores

	Underemployed			Overemployed		
	Observations	Mean inefficiency score	Standard Error	Observations	Mean inefficiency score	Standard Error
Employees	3883	-0,458	0,004	183	0,873	0,172
Farmers	10164	-1,121	0,007	86	1,415	0,052
Difference		0,663			-0,542	
H_1: diff<0 (Pvalue)		1,0000			0,0000	
H_0: diff=0 H_1: diff≠0 (Pvalue)		0,0000			0,0000	
H_1: diff>0 (Pvalue)		0,0000			1,0000	

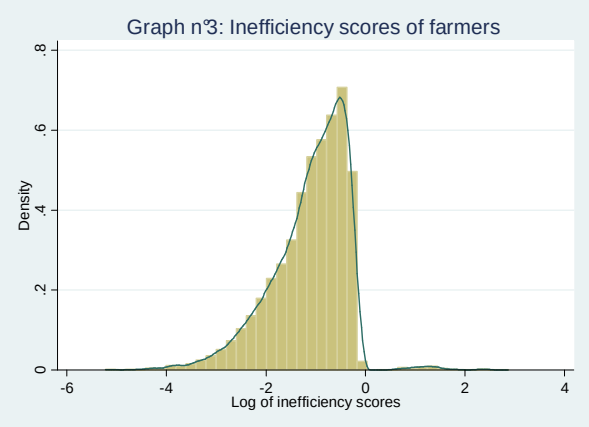
4.5.2 Robustness test: Include other possible constraints

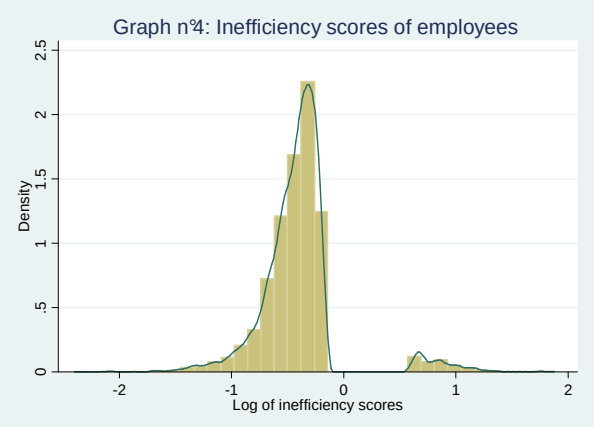
The objective of the paper is to propose and agenda of economic policies that could improve economic efficiency for rural areas in Vietnam. Other possible constraints are thus introduced. We follow the household and commune questionnaires and include output and input market access variables, credit constraint, meteorological and epidemic disasters, access to information and new technologies and quality of infrastructures such as irrigation and electricity networks.

Results presented in table 8 are consistent with those found in the previous section: the determinants of individual preferences still present the same coefficients, and estimated labor elasticity of production remains around 0.35. Inefficiency scores presented in graphs 3 and 4 remain similar to the previous estimations, and the weight attributed to price risk (land per head in our estimations) remains the same. Furthermore, it remains the main contributor to underemployment of farmers. Other factors generating underemployment are credit constraint and meteorological or epidemic disasters (Vietnam hardly suffered from the avian flu in early twenties, and the first cases

were discovered in December 2003). Factors generating overemployment are the absence of national electricity network and low level of irrigation.

Our results highlight factors participating to the stabilization of peasants' incomes. Indeed, irrigational networks facilitate farmers' job and make output more predictable. Credit access allows investments in new technologies which often increase the stability of agricultural output. Farmers far from their output market lose market power and can hardly find buyers for their production so that selling prices are unpredictable. Finally, as noticed earlier, the sensibility of farmer to their land endowment reveals their price risk aversion.





Price uncertainty is still the main difficulty faced by peasants in rural Vietnam even after controlling for other possible constraints. Allocative inefficiencies generated by price uncertainty significantly reduce the amount of opportunities peasants can grab. In a sense, price uncertainty prevents Vietnamese farmers to escape out of poverty. This result should bring policy leaders and economists to pay attention to price and income stabilization policies. Recently, Ghosh and Whalley (2004) demonstrated that price stabilization policies may be welfare improving for Vietnam. Other policy options such as the implementation of futures markets should be analyzed in order to propose the best policy mix for Vietnam. These questions are of particular importance in light of recent evolutions of agricultural prices on world markets.

Conclusions and policy implications

The implementation of development policies requires important adaptations to the specificities of the country under scrutiny. The aim of this paper is precisely to recover what are the main constraints faced by workers living in rural areas in Vietnam in order to propose a policy agenda focusing on these failures. Our point of view is that difficulties faced by workers will always influence their labor market equilibrium so that one can retrieve these market imperfections when analyzing

individual labor market positions. Precisely, workers can be under or overemployed: they would like to work more or less respectively given their hourly income (market wage for employees and marginal revenue of labor for farmers). This article proposes to measure the gap between hourly income and individual shadow wages (also called opportunity cost of time or implicit wage) and explain it by variables representing possible difficulties that workers could face. The main difficulty of the approach is to obtain a measure of shadow wages against which we can compare observed hourly incomes (market wages or marginal revenue of labor). Assuming Cobb-Douglas preferences over consumption and leisure, we show that individual opportunity costs of time can be though as a stochastic frontier around which observed hourly incomes are distributed. Overemployed workers are located over the frontier while underemployed people stay below the frontier.

Estimation on a sample of 14,000 individuals in rural Vietnam shows that employees could benefit from the development of road network that help them to catch better job opportunities while farmers primarily suffer from price uncertainty. Risk averse farmers underemploy labor as demonstrated by Barrett (1996). Priority should thus be given to policies aiming at reducing income volatility in the agricultural sector. Different policy options must be considered. Ghosh and Whalley (2004) emphasize the welfare gains that could be obtained from a price stabilization policy. Other instruments such as the implementation of agricultural futures markets (or the use of existing markets as proposed by Morgan and Vaillant (1999))) should be analyzed. Finally, the large share of underemployment found in our sample (96%) confirms the idea that labor demand could increase in Vietnam without strong pressures on wages, so that inflation could be limited. Also, given that most of Vietnamese workers are underemployed, the reduction of failures should increase the activity rate and be a source of growth.

Table 8: Introducing determinants of allocative inefficiency

Dependent variable: lhs		Coefficient		Standard Errors
Preferences over consumption and leisure (Log of α/β)	Age	0,050	***	(0,0030)
	Age²	- 0,001	***	(0,0000)
	Female	0,165	***	(0,0144)
	hhold size	- 0,244	***	(0,0158)
	hhold size ²	0,012	***	(0,0013)
	nb of children	- 0,148	***	(0,0139)
	nb of children ²	0,004		(0,0031)
	nb of members aged 65+	0,050		(0,0362)
	nb of members age 65+ ²	- 0,020		(0,0199)
	Attained Primary School	- 0,009		(0,0303)
	Attained Lower Secondary School	- 0,018		(0,0231)
	Attained Higher Secondary School	- 0,079	***	(0,0213)
	Attained Post Secondary Education	- 0,098	**	(0,0482)
	Vocational Training	0,037		(0,0267)
	Constant	- 1,423	***	(0,0738)
	Log of σ_v^2	- 1,472	***	(0,0775)
Production Function Parameter	Log of γ	- 0,963	***	(0,0435)
	Labor Elasticity of Output "γ"	*0,38*		
Employees' Inefficiency	Log of Distance to the nearest Road	0,243	***	(0,0379)
	Log of σ_u^2	- 0,908	***	(0,0825)
	Inverse logit transformation of p_o	- 2,159	***	(0,1210)
	Proportion of overemployed workers	*10,35%*		
Farmers' Inefficiency	Log of Land per hand	- 0,616	***	(0,0260)
	Constant	4,086	***	(0,2820)
	Log of Distance to the nearest output market	0,096	***	(0,0201)
	Log of Distance to the nearest Input Market	0,011		(0,0174)
	Log of Distance to the nearest Bank	- 0,046	***	(0,0139)
	Log of Distance to the nearest Extension Center	- 0,007		(0,0162)
	Has been visited by an agronomist	- 0,073		(0,0533)
	Has visited an agronomist	0,115	***	(0,0336)
	% of non irrigated land in the commune	0,717	***	(0,0615)
	Not connected to the national power grid	0,400	***	(0,0829)
	Meteorological disaster	- 0,074	**	(0,0352)
	Epidemy	- 0,153	***	(0,0349)
	Log of σ_u^2	0,042		(0,0541)
	Inverse logit transformation of p_o	- 3,949	***	(0,1780)
	Proportion of overemployed farmers	*1,89%*		
	Observations	14 316		

*** p<0.01, ** p<0.05, * p<0.1

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Appendix: Tables and Graphs

Table 1: Individual and household characteristics for employees

Variable	Mean	Standard deviation	Min	Max
Dependent variable (lhs)	-1.86	0.68	-5.28	1.79
Age	32.03	11.65	8	87
Female	0.36	0.48	0	1
Number of children in the hhold	1.21	1.10	0	5
Nb of people aged of 65+ in the hhold	0.22	0.51	0	3
household size	4.95	1.78	1	14
Primary school	0.94	0.23	0	1
Low secondary school	0.72	0.45	0	1
High secondary school	0.30	0.46	0	1
Post secondray studies	0.07	0.25	0	1
Vocational training	0.81	0.40	0	1
Consumption per head	4103.36	2383.30	782.31	35856.9
Hours of work per year	1694.76	725.52	36	5400
Hourly wage	4.12	3.47	0.06	70.31

Table 2: Individual and household characteristics for peasants

Variable	Mean	Standard deviation	Min	Max
Dependent variable	-3.62	1.14	-9.81	0.75
Age	36.62	16.35	6	98
Female	0.54	0.50	0	1
Number of children in the hhold	1.48	1.34	0	10
Nb of people aged of 65+ in the hhold	0.28	0.57	0	3
household size	5.16	2.03	1	20
Primary school	0.91	0.29	0	1
Low secondary school	0.59	0.49	0	1
High secondary school	0.13	0.34	0	1
Post secondray studies	0.00	0.06	0	1
Vocational training	0.70	0.46	0	1
Consumption per head	3262.05	1764.51	654.96	32421.6
Hours of work per year	1161.63	687.25	4	3744
Value of Agricultural production (thousand VND)	19034.79	20633.12	68	422492

Table 3: Households self-declared constraints

Farmers self-declared constraints (number of positive/negative responses)		
	Yes	**No**
Has your household faced any difficulties in production during the last 12 months?	3149	5123
Most frequent difficulties faced in production during the last 12 months		
Lack of capital/Difficult access to sources of capital	2136	1013
Lack of knowledge on new technologies and techniques	1226	1923
Natural disasters/droughts/ floods/failures in doing business	1197	1952
Affected by prices/Demand-Supply balance	1527	1622

Table 4: Difficulties faced by farmers as declared by commune leaders

Main difficulties faced by commune farmers in agricultural production (number of positive/negative responses)		
	Yes	**No**
Lack of capital/Difficult access to sources of capital	827	1317
Lack of new varieties / varieties suitable for local conditions	453	1691
Lack of technical and new technology knowledge	586	1558
Prices / Demand and Supply impact / Unstable consumption market / difficult access	893	1251
poor irrgational network	323	1821
Calamities / droughts / floods	512	1632
Difficult access to agricultural services	47	2097
Inapropriate agricultural policy	167	1977

Table 5: Determinants of labor allocative inefficiency

Variable	Mean	Standard deviation	Min	Max
Constraints faced by employees				
Log of distance to the nearest road	0.12	0.46	0	4.09
Constraints faced by farmers				
Log of land per capita	8.39	0.90	0.15	12.01
Log of distance to the nearest Extension Center	2.11	0.99	0	5.30
Have been visited by an information Center staff member	0.11	0.31	0	1
Have visited an information Center	0.46	0.50	0	1
Have access to national electricity network	0.93	0.26	0	1
Percentage of irrigated land in the commune	0.60	0.35	0	1
Suffered from meteorological disaster in the last year	0.36	0.48	0	1
Suffered from epidemic disaster in the last year	0.34	0.47	0	1
Log of distance to the nearest Credit Institution	0.02	0.22	0	4.60
Log of distance to the nearest output market	1.08	1.37	0	4.60
Log of Distance to the nearest input market	1.36	1.57	0	4.60