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Matching the Education System to the Needs of the Economy : Evidence from Burkina Faso

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Abstract

In spite of recent advances, in terms of access to, and quality of, education recorded in Burkina Faso, data show a mismatch between the provisions of the education system and the needs of the economic sectors, in terms of skilled labor. In this paper, we investigate how to match the supply of skilled labor provided by the education system to the needs of the economic activities. We identify the branches of economic activity for which an increase in the quantity and/or in the quality of relevant labor supply could lead to productivity gains. We apply a non-parametric technique (α –returns to scale) in order to measure the returns to scale associated with labor in the economic sectors. We also estimate a multinomial logistic model in order to investigate the determinants of these returns to scale. Overall, results show that productivity gains are feasible in the majority of economic sectors. More specifically, improving the education level of farmers and artisans is particularly important for productivity gains. We also find that the education system must focus on ongoing training programs, especially in the area of agriculture and crafts.

Keywords: Education, Labor market, Productivity

JEL Codes: I25, J24, O55

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1. Introduction

Skilled labor may be considered an important input for economic development (Schultz, 1961; Becker, 1964). Enhancing the labor force's ability is particularly important in developing countries where human capital level is generally low. In the last two decades, with the support of international development partners, many developing countries have taken action targeting the education sector, in order to increase the qualified labor pool in the economy. Like almost all developing countries, Burkina Faso has launched several projects aiming to improve the human capital level of its population. While many projects focus on primary education, important efforts have also been undertaken to develop secondary and tertiary education. Much progress has been made with these efforts.

For example, according to INSD data (*Institut National de la Statistique et de la Démographie*), the gross primary school enrollment rose from 44.7%, in 2000, to 74.8%, in 2012, while the gross secondary school enrolment increased from 9.72%, in 2000, to 24.68%, in 2010. The number of secondary and tertiary classrooms also grew by more than 100% but the share of secondary vocational schools decreased from 11.18% in 2000 to 10.39% in 2009. Similarly, the share of secondary students enrolled in vocational programs was 8.01% in 2000 and decreased to 5.53% in 2009. In addition, Moumoula and Bakyono-Nabalou (2005) find that in 2004, only 1.25% of secondary education graduates had studied in vocational programs. Most of Burkina Faso secondary students are enrolled in general education programs (mathematics, literature, history, etc.). Furthermore, gross enrollment in tertiary school increased from 0.99% to 3.9%, between 2000 and 2011. Bakyono-Nabalou (2001) shows that in 2001 the University of Ouagadougou (the main university in Burkina Faso) had seven departments—more than 70% of graduates were trained in literature and administration, 20% in medical and natural sciences, and less than 9% in mathematics, physics, and chemistry. Ouedraogo-Rouamba (2010) points out that the University of Ouagadougou was created during the 1960s with an agreement with France to model the training system after the French system. According to Zida (2006), despite reforms in 1985, 1991, and 2000, the structure of the training programs has not significantly changed since the university's creation and special focus is still given to language and literature programs. Considering that the needs of the economic sectors in terms of skilled labor have changed since the 1960s, the structure of the programs may be inadequate.

When comparing the specialties of recent graduates to what the economy could need, one could indeed question the adequacy of the education. Let us take, for example, the agricultural sector. Figures 1 and 2 show that, in 2011, the agricultural sector represented about 32% of the whole economy, while only 1%

of university graduates had studied agriculture.[2] The majority of graduates specialized in social sciences, business, and law. Meanwhile, vocational education is very limited, with INSD data showing only about 5% of secondary education students enrolled in vocational programs during the academic year 2008-2009. Moreover, Figure 3 shows that more than 80% of the labor force is involved in agriculture while this sector contributes to less than 40% to the GDP. Considering that more than 80% of the total labor force is involved in less than 40% of the total production of the economy, one can question the productivity of the labor involved in agriculture. Similar remarks could be made regarding the industry and services sectors. Thus, there seems to be a disjunction between the products of the education system and the needs of the economy.

Given the findings above, we will explore how to adjust the education system's priorities to produce a skilled labor force better matched to the needs of the branches of economic activity. In other words, we will identify economic sectors in which productivity gains can be achieved by adjusting the quantity and quality of the labor force. We will focus on cases in which it is necessary to increase the supply of skilled labor in some specific fields.[3] We aim to identify skilled-labor specializations that are more relevant for achieving productivity gains. Thus, we will measure returns to scale associated with labor involved in 17 branches of economic activity in the 13 regions of Burkina Faso. We will consider seven professional categories of labor involved in the 17 branches. Our attempt is to identify occupations for which an increase of the labor force could lead to productivity gains. First, we will present a brief review of literature on the issues of education and labor market adequacy. Second, we will discuss the methodology applied to evaluate returns to scale, as well as the data used to compute them. Finally, we will present our results of the study, followed by a conclusion.

2. Education adequacy: A literature review

According to Dumartin (1997), until 1970, economists were convinced that macroeconomic predictions would help anticipate the future needs of the economy in terms of labor. However, Ahmad and Blaud (1973) show that predictions failed to perfectly anticipate the future needs of the economy. In addition, problems related to transitions from school to the labor market have raised interest in the study of education adequacy. Psacharopoulos (1986) is one of the first authors to formally study the issue of

[2] We are not suggesting that farmers have to hold university degrees, but we are illustrating the lack of interest for the fields of studies that appear to be connected with the most popular occupations of the population in Burkina Faso.

[3] This is more extensively discussed in the section 3.

education adequacy, suggesting a model for measuring the cost of misallocation through the education levels. Since Psacharopoulos (1986), numerous approaches have been applied to the study of education adequacy.

According to Vincens (2005), qualitative adequacy has to be distinguished from quantitative adequacy. In Vincens' terms, qualitative adequacy is the capacity of a skilled worker to properly accomplish tasks related to his assigned position. In other words, abilities that workers acquire through the education system should match the demand for specific skills in the labor market. Quantitative adequacy means the education system has to provide the labor market with the necessary volume of properly skilled labor, according to the needs of the various sectors of the economy.

Using data from both graduations and employment, Dumartin (1997) calculated a Gini index for the education adequacy. According to this author, education-employment adequacy occurs when the proportion of graduates in each level of study is equivalent to the employment rate with the same level of study.

Topel (1997) notices that for the education system to properly meet the needs of the labor market, adequacy has to be not only static, but also dynamic. Dynamic adequacy is especially important in the context of technological change. Berman, Bound, and Griliches (1994) find that technological changes can affect the labor demand structure. Johnson (1997) also shows that wage inequalities remain until the education system reacts to the technological changes. According to Smith (2001), changes in relative wage and sector-specific employment dynamics can help verify whether education adapts to technological evolution.

In order to achieve static and dynamic adequacy, education systems must respond to the labor market incentives. Education adequacy could thus be related to the capacity of the education system to respond to the labor market signals. Freeman (1986) and Boudarbat (2008) show that students' career choices are sensitive to the expected wage in the labor market. For instance, high wages could be a signal that there is a lack of skilled labor in a specific field, and educational training programs have to respond to the signal. Inadequacy would then persist until the education system responds to the labor market signals. Ryoo and Rosen (2004) find that the American engineering education system responds strongly to economic signals such as wages and research and development expenses. However, Bardhan, Hicks, and Jaffee (2013) find that education is more sensitive to long-term signals compared to the labor market's short-term signals.

Furthermore, the cost of education could be a constraint to education adequacy. Indeed, Montmarquette, Cannings, and Mahseredjian (2002) and Boudarbat (2008) find that education expense is an important determinant of students' career choices. According to Boudarbat (2008), factors related to financial aid programs affect students' career choices. Montmarquette *et al*. (2002) specify that the sensitivity of career choices also depends on socio-demographic factors, such as gender and age.

There are several attempts in the literature to address the problem of education adequacy. In many developed countries, policies to improve education adequacy concentrate on the development of vocational education (Weisberg, 1983; Grubb, 1985) or the implementation of laws regarding post-secondary education (Neave, 1985). Psacharopoulos (1986) finds that these policies failed to ensure a perfect transition from school to labor market. In addition, these laws have not succeeded in changing students' choices in terms of career. In many developing countries, governments intervene directly, using policy to encourage enrollment in specific fields at universities. However, Chapman and Windham (1985) show that these policies also failed to ensure education adequacy for the labor market. Nowadays, policies concentrate on coordinated actions both in the labor market and in the education sector. Nowadays, governments from all around the world, at different extents, attempt to tackle the issue of the education adequacy by implementing coordinated and comprehensive interventions targeting both the education sector and the labor market (World Economic Forum, 2013; 2014). For instance, some countries put in place some public-private partnerships in defining new programs of studies that are oriented toward the needs of the private employers.

The mismatch between the education system and the needs of the economy, in terms of skilled labor can be interpreted as misallocation of resources in the economy. Perfect allocation of resources in the economy is found to be important for economic productivity and growth (Restuccia and Rogerson, 2008; Hsieh and Klenow, 2009; Jones, 2011). According to Romer (1990), perfect allocation of resources is about the use of the optimal quantity and quality of capital in the economy. However, Melitz (2003) finds that resource misallocation occurs when the marginal productivity of the production factors is different in the sectors of the economy. In this situation, reallocating production factors through economic sectors could improve the productivity of the economy. Resource misallocation is then associated with lost productivity. In addition, other studies investigate over-education as one of the determinants of education inadequacy (Berg, 1970; Plassard and Tran, 2009). ILO (2014) links skills mismatch in the labor market to over-education or under-education. According to Sala (2011), skills mismatch in the labor market refers to the fact that individuals' levels or types of skills are inadequate in view of particular job requirements. However, this author points out that no accepted, unified theory of skills mismatch exists.

We can now define education adequacy as a process aiming to provide the economy with the optimal quantity of qualified labor. This adequacy must be not only static but also dynamic, in the sense that it is important to properly anticipate the future needs of the economy in order to better guide education policies. In this paper, we explore how productivity gains can be achieved by adjusting both the quantity and the quality of the labor involved in the branches of the economic activity in Burkina Faso. This information can help identify the needs of economic sectors in terms of skilled labor, in order to increase their productivity. In other words, we attempt to determine the type of labor the economic sectors need in order to improve their productivity levels. In the following section, we will describe the methodology used.

3. Methodology and Data

In order to determine whether the quantity and quality of the seven categories of labor involved in the different economic sectors are optimal, we must measure the returns to scale associated with labor in the 17 economic sectors we have identified. Increasing returns to scale indicate that the labor used is not optimal, and an increase in the labor quantity and quality could lead to a more than proportional increase in the output for that branch of economic activity. Similarly, decreasing returns to scale indicate that the labor used is not optimal and a decrease in the labor quantity and quality could improve the productivity of the considered economic branch. Given that each one of the studied economic branches uses different quantities and qualities of the labor specialties, it could be possible to identify the more relevant categories of labor for which an increase could be associated with greater productivity gains.

Regions in Burkina Faso have varying characteristics. The needs of a particular economic branch may differ from one region to another. For this reason, we will consider each branch of the economic activity in each of the 13 regions as a separate observation, which we will call a Decision Making Unit (DMU). A DMU is then an economic branch in a given region. In order to measure returns to scale in these DMUs, we need to apply an appropriate quantitative method to data from Burkina Faso.

There are two main approaches for measuring returns to scale in the literature on efficiency and productivity analysis: parametric, and non-parametric approaches. These methods are based on the estimation of a production or a cost frontier, and the measurement of the returns to scale using this estimated frontier. The major drawback for parametric approaches is that they generally require assumptions about the functional form of the frontier and the distribution of the error terms. As an alternative to parametric approaches, Data Envelopment Analysis (DEA) is a non-parametric technique that is widely used to calculate returns to scale. However, Boussemart *et al* (2009) point out that DEA doesn't properly capture increasing returns to scale, given the convexity assumption regarding the production set. Leleu, Moises and Valdmanis (2012) also discuss this issue and we base the following discussion about returns to scale on these authors.

DEA is not appropriate for the measurement of returns to scale for two reasons. First, according to Lau (1979), returns to scale must be directly connected to a homogeneous technology. Consequently, the analysis of returns to scale has to be linked to the homogeneity assumption. A complete characterization of homogeneous technology is given by Färe and Mitchell (1993)[4]. Given this characterization, homogeneous technology cannot be assumed in the DEA framework. Second, Leleu, Moises and Valdmanis (2012) show that DEA is appropriate for efficiency measurement, but fails to capture increasing returns to scale, essentially due to the convexity assumption. In fact, Laurens, Kuosmanen and Post (2000) show that the convexity assumption constraints the frontier to exhibit decreasing marginal rates of substitution between inputs and outputs. For this reason, increasing returns to scale are not well captured when the production set is assumed to be convex. In addition, this requires inputs and outputs to have strictly positive values.

$\alpha -$returns to scale methodology introduced by Boussemart *et al*. (2009) addresses the issue of convexity. By relaxing the convexity assumption and including the origin to the feasible production plans, $\alpha -$returns to scale method allows a proper estimation of increasing, decreasing, and constant returns to scale. We will then use $\alpha -$returns to scale methodology in order to compute returns to scale associated with the labor using data from Burkina Faso.[5] This semi-parametric method is based on an

[4] Consider an input *x* used to produce an output u. The production technology is considered homogeneous of degree α if one of the following conditions are met: (i) $L(\theta u) = \theta^{1/\alpha} L(u)$; (ii) $C(\theta u, p) = \theta^{1/\alpha} C(u, p)$; (iii) $D_i(\theta u, x) = \theta^{-1/\alpha} D_i(u, x)$; (iv) $P(\theta x) = \theta^{\alpha} P(x)$; with $\theta > 0$, $L(u) = x$, $P(x) = u$, $D_i(u, x)$ an input distance function, $C(u, p)$ a cost function that depends on the price *p*,

[5] Although $\alpha -$ returns to scale methodology allows the convexity assumption to be relaxed, this method still has some limitations. The main drawback regarding non-parametric methods in general is linked to the fact that these are deterministic methods and there is a bias associated with the efficiency measurement using non-parametric methods. Simar and Wilson (1998) suggest a bootstrap procedure allowing this bias to be estimated especially in the case of DEA but, to the best of our knowledge, there is no method allowing an estimation of the bias associated with $\alpha -$ returns to scale.

application of the notions of strictly increasing, and strictly decreasing, returns to scale on homogeneous multiple-outputs technologies.[6]

Following Boussemart *et al*. (2009), as well as Leleu *et al*. (2012), let us consider a production technology *T* that transforms inputs $x=(x_1,x_2...x_n)\in R_+^n$ into outputs $y=(y_1,y_2...y_p)\in R_+^p$. The technology *T* can be defined as:

$$T=\{(x,y)\in R_+^{n+p}:\ x \text{ can produce } y\} \quad (1)$$

According to Leleu *et al*. (2012), the defined production technology is said to be homogeneous of degree α if for all $\beta>0$

$$(x,y)\in T\Rightarrow(\beta x,\beta^{\alpha}y)\in T \quad (2)$$

Constant returns to scale correspond to $\alpha=1$, while strictly decreasing and increasing returns to scale are respectively given by $\alpha<1$ and $\alpha>1$. Boussemart *et al*. (2009) call this property, $\alpha-$ *returns to scale*.

Leleu *et al*. (2012) suggest an empirical strategy, allowing the computation of $\alpha-$ returns to scale. Let us consider a set of *J* observations $A=\{(x_1,y_1),...,(x_J,y_J)\in R_+^{n+p}\}$, with (*j=1...J*) and λ a set of parameters. The corresponding production technology can be estimated by enveloping the observations. Assuming the convexity of the production set, DEA method could be used in order to estimate a production frontier enveloping these observations:

$$T_{CRS}=\{(x,y)\in R_+^{n+p}: x\geq\sum_{j\in J}\lambda_j x_j, y\leq\sum_{j\in J}\lambda_j y_j, \lambda_j\geq 0\} \quad (3)$$

This technology corresponds to the traditional DEA Constant Returns to Scale (CRS) method treated by Charnes, Cooper, and Rhodes (1978) and can be extended to a more general class of homogeneous technologies introduced by Färe and Mitchell (1993) and adapted by Boussemart *et al*. (2009). This extension is based on an application of a CES (Constant Elasticity of Substitution) function to the input side and a CET (Constant Elasticity of Transformation) function to the output side of the equation (3). This yields the equation (4):

[6] See Boussemart *et al*. (2009) for more details about strictly increasing and strictly decreasing returns to scale.

$$T_{\gamma,\delta} = \{(x,y) \in R_+^{n+p} : x \geq (\sum_{j \in J} \lambda_j x_j^{\gamma})^{1/\gamma}, y \leq (\sum_{j \in J} \lambda_j y_j^{\delta})^{1/\delta}, \lambda_j \geq 0\} \qquad (4)$$

It can be noticed that $T_{1,1} = T_{CRS}$. In other words, the DEA-CRS model can be considered a special case of the model presented in equation (4), when $\lambda = \delta = 1$.

Following Boussemart *et al*. (2009), from the technology defined in equation (4), an input distance function can be derived for each DMU *k*:

$$E(x_k, y_k) = \min_{(\theta,\lambda \geq 0)} \{\theta : \theta x_k \geq (\sum_{j \in J} \lambda_j x_j^{\gamma})^{1/\gamma}, y \leq (\sum_{j \in J} \lambda_j y_j^{\delta})^{1/\delta}\} \qquad (5)$$

$E(x_k, y_k)$ gives the Farrell (1957) input technical efficiency measure. Farrell output measure, as well as hyperbolic measures, can be directly derived from this input distance function using linear programming. The value of the returns to scale parameter α is given by:

$$\alpha = \frac{\gamma}{\delta} \qquad (6)$$

γ greater than δ means that, for the DMU *k*, outputs increase faster than inputs (and returns to scale are increasing), and γ smaller than δ means that outputs increase slower than inputs (and returns to scale are decreasing). The ratio of γ and δ shows the relative increase of outputs, with respect to the inputs.

In equation (5), γ and δ are *a priori* parameters, but their optimal values can be found by applying a goodness-of-fit method. We consider a range of 1600 feasible values of α (from 0.1 to 3) for each DMU.[7] To do so, we let γ and δ vary from 0.2 to 0.6 at intervals of 0.01, and we compute 1600 different values for the input distance function. Following Leleu *et al*. (2012), we select the best technology as the one associated with the maximum value of the input distance function. In other words, the optimal value of α for each DMU is the one associated with the maximum efficiency measure.[8] In order to compute $\alpha-$returns to scale, we need to define the variables we expect to use.

[7] In Leleu *et al*. (2012), the values of γ and δ vary between 0.05 and 4 at intervals of 0.05 and the feasible values of α lie between 0.01 and 80. In this study, we consider a smaller interval in order to increase the precision in the search of the optimal values of these parameters.

[8] Given the inputs and the outputs used, as well as the set of feasible values for the efficiency level, it is assumed that DMUs apply the most efficient technology in order to achieve the maximum productivity level that is feasible.

As mentioned above, the purpose of the current paper is to compute $\alpha-$returns to scale associated with the labor involved in 17 branches of the economic activity in Burkina Faso. These 17 branches have been identified in the 2003 survey on households' living conditions in Burkina Faso.[9] This survey has also collected information about wages, the main occupations of respondents, as well as other economic and demographic information and covers all the 13 regions of Burkina Faso.[10] The data we use allow us to identify the occupation of each worker, the region of residence, as well as the sector in which each worker is employed. In order to compute $\alpha-$returns to scale, we need to define inputs and outputs for each DMU.[11]

For the inputs, we would like to have proxies for the quantity, and the quality, of the seven categories of labor considered. We thus use the number of workers from each of the seven occupations involved in each DMU as proxies for the labor quantity. We also consider the mean years of schooling of all the workers employed by each DMU as a proxy for the labor quality.[12] The output is the value added, generated by the labor in each of the 17 economic branches. A proxy for the labor value added is given by the sum of the annual wage earned by the workers involved in each DMU.[13] We thus have a total of eight inputs and one output.

Table 1 presents descriptive statistics of inputs and outputs used. We can notice from this table that occupations related to the primary sector seem to be the most popular in Burkina Faso. We have a total

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This is the "benefit of the doubt" or "put DMUs in their best light" principle that governs most of the non-parametric efficiency measurement methods including the DEA approach. In the DEA case, the input and output weights that are chosen are the ones that are the most favorable to the DMUs.

[9] Cf. Figure 4 for a description of the 17 economic branches. The regions of Burkina Faso are: *Boucle du Mouhoun, Cascades, Centre, Centre-Est, Centre-Nord, Centre-Ouest, Centre-Sud, Est, Hauts-Bassins, Nord, Plateau-Central, Sahel, Sud-Ouest.*

[10] The most recent survey on households' living conditions has been conducted in Burkina Faso in 2009. We have access to this dataset but, due the lack of information about some key variables, the 2009 data are unusable for the current study.

[11] Recall that each DMU corresponds to an economic activity in one of the 13 regions of Burkina Faso.

[12] Recall that we don't have information about whether the studies achieved are related or not to the occupations. For this reason, considering the education level by occupation is somehow not relevant. In addition, because of the limited number of observations and the constraint on the number of variables, it seems appropriate to keep the average years of schooling as one variable instead of considering its breakdown by occupation as 7 different input variables. Furthermore, some sectors of activities are missing for some provinces and having many variables will incorporate several 0 values in the model. This can artificially decrease the variance between the DMUs and undermine the accuracy of the results.

[13] We consider the natural logarithm of the sum of the annual wage to account for inequalities in earnings. In addition, given the fact that the inputs are exclusively related to the labor and since we would like to focus on what the labor produces, we only consider a proxy for the value added generated by the labor force. In fact, the assumption is that workers are paid according to their marginal productivity and the wages only reflect the product of the labor.

of 126 DMUs due to lack of data.[14] Input and output variables have been calculated using data on about 23,000 individuals from the 2003 survey on households' living conditions in Burkina Faso.[15] The following section presents and analyzes the results.

4. Returns to scale in the economic sectors

The purpose of this study is to determine how to adjust the supply of skilled labor in order to reduce education inadequacy, thus enhancing the productivity of the economic sectors in Burkina Faso. To do this, $\alpha -$returns to scale have been calculated for each DMU. Recall that the value of α is supposed to lie between 0.1 and 3. Returns to scale are decreasing, constant, or increasing, respectively, for α smaller than, equal to, or greater than 1. Results in Table 2 show that 68% of the DMUs register increasing returns to scale, while 20% and 12% register constant and decreasing returns to scale, respectively. It can be stated that only 20% of the economic branches in the regions of Burkina Faso use optimal quantity and quality of labor. The average value of α is 1.9, showing that returns to scale are overall increasing. This result indicates that a 1% increase in the number of all categories of workers, as well as in their average education level in all sectors, could be associated with an increase of about 1.9% in the labor income. However, Table 2 shows that the average value of α for the DMUs with increasing returns to scale is about 2.4, suggesting an increase of 2.4 % of the output generated by the labor, given an increase of 1% of the labor quantity and quality only in these DMUs.

A detailed analysis shows that the highest average value of α is recorded in the *Region du Centre*. This implies that returns to scale associated with the labor are more increasing in the *Region du Centre,* compared to the other regions of Burkina Faso. The *Region du Centre* contains the city Ouagadougou, which is the capital of Burkina Faso, and the largest city in the country. According to UERD (2002) and Ouattara and Somé (2006), the *Region du Centre* is the most attractive region for internal labor migration in Burkina Faso. Ouattara and Somé (2006) find that about 26% of all internal migrants choose the *Region du Centre* as their destination, with the majority of migrants coming from rural areas. The attractiveness of the *Region du Centre* could be linked to the increasing returns to scale, with respect to labor that the economic sectors in this region experience.

[14] We have 17 branches and 13 regions; the total number of DMUs should be 221.

[15] These individuals are on average 32 years old and about 49% of them are male. The survey data have been aggregated to have data at the level of economic sectors for each region.

Figure 4 shows the average value of α by branch of economic activity. The analysis of returns to scale by economic activity shows that, on average, all the studied economic branches experience increasing returns to scale, except two economic branches: fish farming and extraterritorial organizations[16] activities. This result indicates that, overall, the level of quantity and quality of labor used by the economic branches is smaller than the optimal level. This could also indicate that the education system does not necessarily provide the required quantity and quality of labor. In addition, there is room for improving the productivity of the economic sectors. In other words, increasing the supply of qualified labor specializing in the most relevant fields for some of the economic activities, could lead to productivity gains.

It should be noted that the branch of agriculture, hunting, and forestry has the highest intensity of increasing returns to scale. This branch mainly includes agriculture and livestock. Our results suggest that an increase in the quality and the quantity of the labor involved in this economic branch could lead to important productivity gains.[17]

Although the branch of agriculture, hunting, and forestry registers the highest increasing returns to scale, this economic branch appears to be the least efficient branch, on average, while the branch of hotels and restaurants register the highest average efficiency score (Figure 5).[18] The average efficiency for the whole sample is about 55%, suggesting that there is an inefficiency issue in the use of labor by the economic branches. A rank correlation test, between $\alpha -$ returns to scale and the efficiency scores, shows that these two variables are negatively correlated for the whole sample, at 5% significance level. This indicates that the DMUs that experience higher increasing returns to scale could achieve relatively higher productivity gains, not only by making a better use of the labor force (technical efficiency) they are already employing, but also by increasing their size (increasing returns to scale).

5. What matters for productivity gains: Increasing labor quantity or quality?

We now question which is more significant for productivity gains: increase the quality of workers, or increasing the quantity of workers? In order to give a proper response to this question, we perform a multinomial logistic regression. We investigate the relationship between labor quantity or quality, on one

[16] This branch includes the activity of international or regional organizations such as the United Nations or the ECOWAS (Economic Community of West African States).
[17] Results suggest that a 1% increase in the labor quantity and quality in the branch of agriculture, hunting, and forestry could lead to an average increase of about 2.7 % in the labor output of this economic branch.
[18] Recall that we are performing a relative measure of efficiency and returns to scale. A change in the sample could lead to other results.

hand, and the possibility of achieving productivity gains, on the other hand. Let *D* be the dependent latent variable with the following characteristics: *D*=1 if $\alpha < 1 \Rightarrow$ possible to improve the productivity level by decreasing the inputs of the DMU (decreasing returns to scales); *D*=2 if $\alpha = 1 \Rightarrow$ not possible to improve the productivity level by adjusting the size of the DMU (constant returns to scales); *D*=3 if $\alpha > 1 \Rightarrow$ possible to improve the productivity level by increasing the inputs of the DMU (increasing returns to scale). The regression model can be defined as:

$$P_r(D) = f(Z, \eta, \omega) \qquad (7)$$

where $P_r(D)$ is the probability for a given DMU to be in one of the three alternatives (*D=1, 2, 3*), *Z* a matrix of explanatory variables, η a set of parameters to be estimated and ω an error terms[19].

Multinomial logistic regression will allow estimation of the marginal effects associated with each regressor on the probability that a DMU be in one of three alternatives. However, we will focus on how productivity gains could be achieved by increasing the education level of workers, or by increasing the number of workers (the alternative with *D*=3). In fact, the idea underlying this analysis is to predict the potential for DMUs to achieve productivity gains, given the education level of workers involved in these DMUs, and the number of workers used, all things being equal.[20]

Model 1 in Table 3 shows marginal effects associated with the probability of having increasing returns to scale. This result suggests that the quantity and the quality of labor are both positively related to the potential for DMUs to achieve productivity gains. However, the effect of labor quality is slightly higher than the effect of labor quantity. This may indicate that productivity gains are more likely to take place given an increase in the education level of workers rather than an increase in the number of workers.[21] This result could vary when considering the different categories of occupations.

Models 2 and 3 in Table 3 show marginal effects associated with the workers quality (mean years of education for each occupation category) and marginal effects associated with the labor quantity (number of workers for each occupation category) for each one of the seven occupations considered. For each

[19] See Greene (2011) for details about multinomial logistic models. Table 3 shows the explanatory variables used.
[20] We assume here that returns to scale are invariant with respect to changes in the value of only one input. We also assume that, even though increasing returns to scale suggest an increase in the productivity level given an increase in all inputs, the contribution of each input to the possibility of achieving these productivity gains could be different.
[21] Recall that a change in size of the DMUs (a simultaneous change in all inputs and outputs) may induce different results regarding returns to scale and achievable productivity gains.

occupation, we can compare the effect of increasing the education level with increasing the quantity of labor, on the probability of being able to achieve productivity gains. Both the education level and the number of workers, or artisans, are positively linked with the potential for DMUs to achieve productivity gains.[22] However, the education level of artisans seems to have a stronger relationship with productivity gains, compared to the number of workers involved in these two categories of occupation. In addition, increasing the number of farmers seems to not have any effect on productivity gains, while an increase in the level of education of farmers appears to be associated with higher potential for achieving productivity gains.[23]

That said, the literature shows mixed results about the effect of education on agriculture in Africa, but most of studies seem to reveal that education has a positive effect on agricultural productivity. A literature review conducted by Ogundari (2014) shows that 41% of the papers examined find education as a major driver of the productivity in the African agriculture over the years, followed by years of farming experience (27%), and age of farmers (22%). Ogundari (2014) also shows that, among studies that find significant effect of education on African agricultural productivity, about 73% find a positive effect while 27% find a negative effect. Vandenbosch (2006) suggests that strengthening post-primary agricultural training could be a way for improving agricultural productivity in Africa. In addition, Spielman, Ekboir, Davis, and Ochieng (2008) show that post-secondary agricultural education and training can contribute to agricultural development by strengthening innovative capacity. Davis *et al*. (2012) also find that a farmer field school project introduced in East Africa had a positive impact on farmers' productivity, and increased farmers income by about 61%. Formal agricultural education and training could therefore play a role in improving the productivity in Burkina Faso economy as well.

The education level of the security workers is also associated with a higher potential for productivity gains. However, less than 1 % of the total labor force is involved in this activity. Productivity gains also seem to be associated with the number of domestic and administrative workers, but the education level of these categories of labor force does not have any influence on the probability of having increasing returns to scale.

[22] The coefficient associated to the quality of the security workers is also significant. However, very few individuals are involved as security workers in our data (less than 1% of all workers compared to 80% for farmers and about 3% for artisans).

[23] This could be a contrast with the result found above that suggested an increase in the quality and the quantity of farmers could be associated with productivity gains. However, the analysis here is about the effects of an increase only in the labor quality or only in the labor quantity on the probability of having increasing returns to scale.

6. Discussion and conclusion

The current paper is an attempt to study the issue of the mismatch between the education system and the needs of the economy, in terms of skilled labor in Burkina Faso. To do this, we evaluated the returns to scale associated with the labor involved in 17 branches of economic activity in Burkina Faso. In order to properly capture increasing returns to scale, we applied $\alpha-$returns to scale methodology proposed by Boussemart *et al*. (2009). On average, almost all of the economic branches register increasing returns to scale. The intensity of these increasing returns to scale appears to be higher for the branch of agriculture, hunting, and forestry, and lower for the branch of transport and communication. Overall, results show that productivity gains could be achieved by proportionally increasing the quantity, and the quality, of the labor involved in all the studied economic branches, though higher productivity gains could be achieved in the branch of agricultural activities.

Productivity gains seem to be driven by the quality of the labor, rather than the quantity of the labor. In other words, an increase in the level of education of workers already involved in the labor market seems to be associated with higher productivity gains, compared to an increase in the number of workers, without any change in their education level. Overall, an increase in the education level of farmers and artisans is associated with strong productivity gains. One policy implication that could emerge from these findings is that the education system must focus more resources on ongoing training programs, especially in the areas of agriculture and crafts, in order to better match the labor force to the needs of the economic branches, and thus increase the overall productivity of the economy. We have mentioned that vocational secondary programs are limited in Burkina Faso. Providing vocational education programs, especially in the areas of agriculture and crafts, would make graduates of those programs more successful in their fields, thus increasing economic productivity. We also think that providing special training programs for already active farmers and artisans (perhaps in their mother tongues) would be another way to improve economic productivity.

Although the current paper fosters a better understanding of how to match the education system to the needs of the economy, some limitations should be highlighted, in particular the fact that the analyzed data set is not current. Though this may seem important, we are convinced that the structure of the economy of Burkina Faso has not changed significantly enough in ten years to invalidate our results. With the availability of a more recent data set, this study could be reproduced, and the results compared with the findings herein.

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Annex

Table 1 Descriptive statistics

	Mean	Std. Dev.	Min	Max
Inputs				
Farmers, stockbreeders,fishermen, hunters	141.746	457.435	0	2796
Administration workers, liberal professions	6.143	15.164	0	116
Traders	14.960	73.391	0	758
Artisans	4.952	19.617	0	186
Domestic workers and diverse services	3.841	9.844	0	76
Security workers	0.651	4.196	0	46
Other jobs and professions	3.810	8.409	0	48
Years of schooling	5.580	4.045	0	14
Output				
Labor value added (in millions of CFA)	672030	1992461	153.43	12800000
Other variables				
Average age of workers	33.161	3.758	20.800	42
Proportion of males	0.649	0.244	0	1
Mean hours of weekly work	33.603	3.856	19.643	36.923
Proportion of urban population	0.621	0.359	0	1
More than one year experience in the current occupation	0.908	0.116	0.4	1

Table 2 $\alpha -$ returns to scale descriptive statistics

	Obs	Mean	Std. Dev.	Min	Max
Decreasing returns to scale	15	0.686	0.263	0.371	0.999
Constant returns to scale	25	1	0	1	1
Increasing returns to scale	86	2.407	0.492	1.007	2.696

Table 3 Multinomial logit results[24]

	Model 1	Model 2 Labor quantity	Model 3 Labor quality
	Marg. effects on the probability of having increasing returns to scale	Marg. effects on the probability of having increasing returns to scale	Marg. effects on the probability of having increasing returns to scale
Total number of workers	0.0179*** (0.0061)		
Mean years of education	0.0185* (0.0102)		
Average age of workers	-0.0059 (00076)	-0.0039 (0.0069)	-0.0025 (0.0127)
Proportion of males	-0.0381 (0.1304)	-0.1823** (0.0906)	-0.2592 (0.1907)
Mean hours of weekly work	-0.0026 (0.0152)	0.0030 (0.0132)	-0.0146 (0.0110)
Proportion of urban population	0.1486 (0.1151)	-0.0168 (0.0842)	0.0810 (0.1530)
More than one year experience in the current occupation	0.1522 (0.2876)	0.2192 (0.1914)	0.5192 (0.4266)
Farmers, stockbreeders, fishermen, hunters		0.0305 (0.0208)	0.0243* (0.0131)
Administration workers, liberal professions		0.0569*** (0.0089)	-0.0025 (0.0079)
Traders		0.0012*** (0.0020)	0.0098 (0.0177)
Artisans		0.0342*** (0.0106)	0.0748*** (0.0267)
Domestic workers and diverse services		0.0741*** (0.0191)	-0.0056 (0.0146)
Security workers		0.2008*** (0.0725)	0.2971*** (0.0608)
Other jobs and professions		0.0758*** (0.0124)	0.0126 (0.0113)

*significant at 10%; ** significant at 5%; *** significant at 1 %

[24] Model 1 aggregates the labor quantity and quality into two different variables that are considered as regressors. Model 2 includes the number of workers from each of the 7 occupations as explanatory variables, while Model 2 considers the education level of the 7 categories of occupations as regressors.

Figure 1 Value added by sector[25]

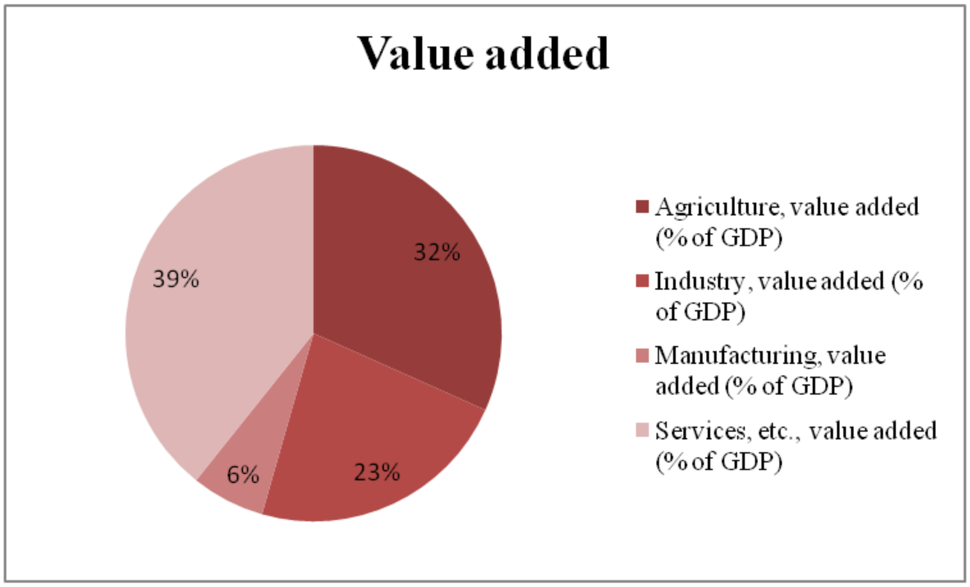
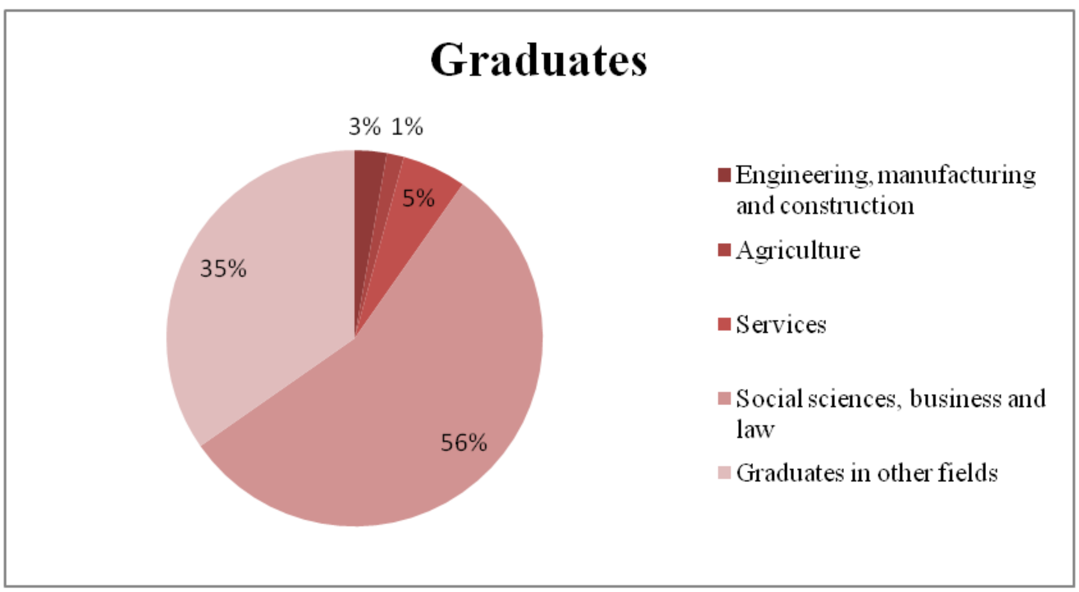


Figure 2 University graduates by sector[26]



[25] Source : WDI
[26] World Bank Education Statistics (EDSTAT)

Figure 3 Employment VS production[27]

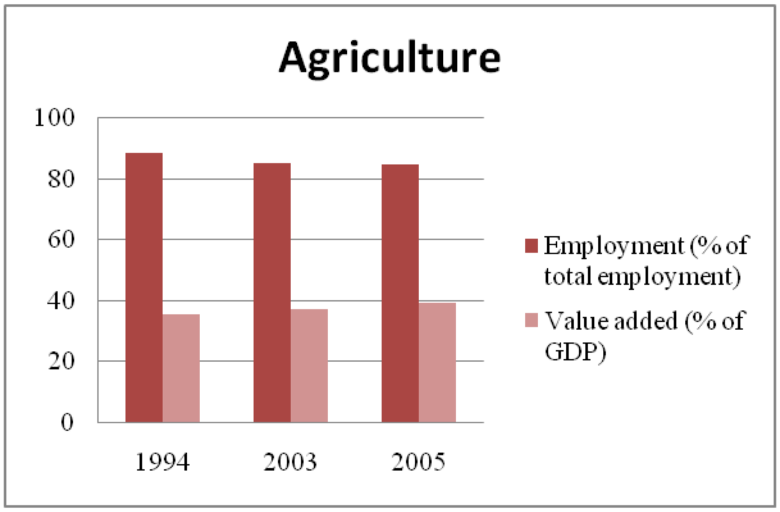
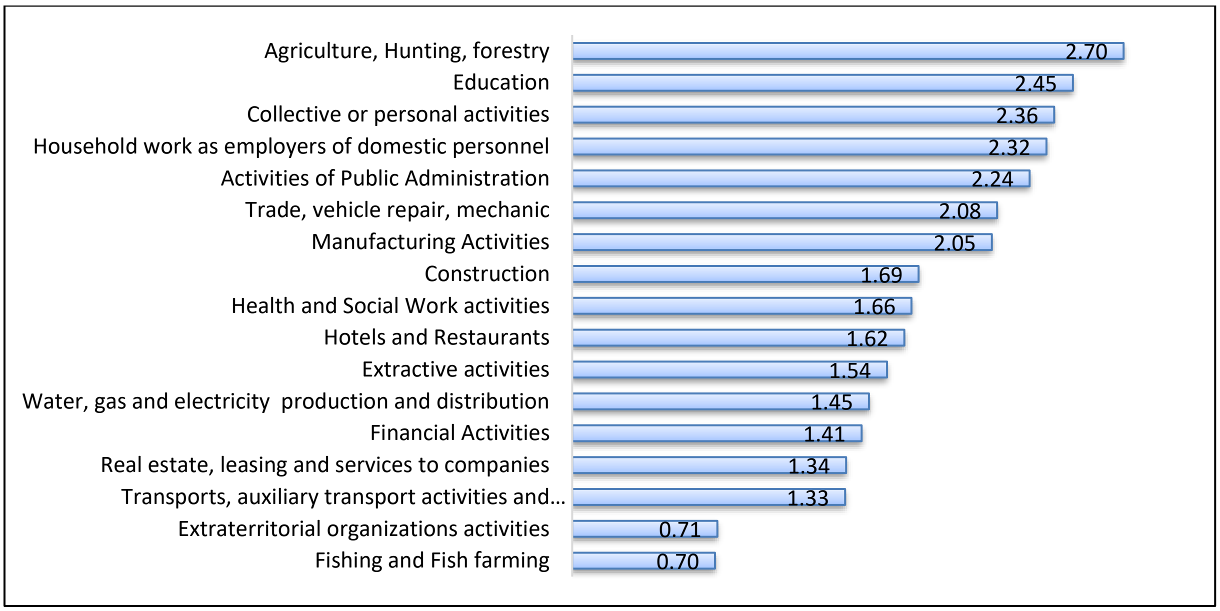


Figure 4 Average α – returns to scale by economic branch[28]



[27] Source: WDI (World Development Indicators).

[28] The majority of the DMUs belongs to the agricultural sector. As already mentioned, about 80 % of the population is involved in agriculture.

Figure 5 Average efficiency by economic branch