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Abstract

Understanding how much human capital accumulation and human capital variables contribute to explaining income growth in Burkina Faso is the main objective of this paper. The paper contributes to the literature on link between human capital development and prosperity of occupied people, by applying a new perspective based on the use of the Oaxaca–Blinder variance decomposition procedure. This methodology makes it possible to quantify the relative contribution of each explanatory factor to income growth, and also allows distinguishing both factors endowment effect and returns to endowment effect. The analysis is applied to data of household Living Standards Measurement Surveys conducted in 2009, 2014 and 2018. We found that the endowment in human capital, health, nutrition, education, and productive employment, has a positive and significant influence on income of occupied people. In addition, the decomposition method revealed that the impact of human capital factors on income growth is all the greater when the contributions of the endowment effect and the return effect are both positive and high.

Keywords: *Human capital; Oaxaca–Blinder; Decomposition Methods; Income growth; Prosperity.*

1. Introduction

The level and distribution of human capital endowments (general education, technical skills, health, and nutrition) are among the main determinants of income inequality and poverty (Mincer, 1958). According to Sen (1997) and Bebbington (1999), people who are endowed with human capital are not only better qualified, more productive and more efficient than those who are not, but they are also better able to transform their potential into reality.

From a long-term economic perspective, the proponents of endogenous growth consider that human capabilities, that is education, technical skills, nutrition, and health, which are nothing other than the essential dimensions of human capital development, are the real driving forces behind economic growth and increased prosperity (Lucas, 1988; Romer, 1990; Hanushek, 2013).

Further, the literature on equity and equality of opportunities suggests that human capital plays a key role in improving the prosperity of households and individuals, and that human capital accumulation is one of the main levers for equalising economic opportunities among social groups and between genders, particularly in vulnerable communities (Moser, 1998; 2006; Roemer, 2002; Lefranc et al., 2008; Baye and Epo, 2015). Therefore, according to these authors, the accumulation of human capital influences economic growth and household and individual prosperity, and helps to reduce income inequality.

Since the mid-1980s, investment in human capital has been an important aspect of public policy in Burkina Faso. Whether it was in the 1984-1985 People's Development Programme (*Programme Populaire de Développement*) or its successor, namely the 1986-1990 Five-Year People's Development Plan (*Plan Quinquennal de Développement populaire*), the development of education and health across the country's counties and provinces was one of the main dimensions of these two public policy frameworks (Ministry of the Economy and Finance, 2001). During the 1991-2000 decade, even with the implementation of four structural adjustment programmes, the main aim of which was to improve the country's public finance situation, the goals (expressed in the two policy documents) of expanding public provision of education and health, were maintained to continue guiding public development action in Burkina Faso.

During the two-decade period from 2001 to 2020, which saw the establishment of the Strategic Framework for Poverty Reduction (*Cadre Stratégique de Lutte contre la Pauvreté, CSLP*), the two phases of which were implemented from 2001 to 2010,

followed by the Strategy for Accelerated Growth and Sustainable Development (*Stratégie de Croissance Accélérée et de Développement Durable, SCADD*) for 2011-2015, and the National Economic and Social Development Plan (*Plan National de Développement Économique et Social, PNDES*) for 2016-2020, as the country's development frameworks, the development of human capital remained one of the pillars of each of these frameworks (Burkina Faso, 2000, 2004 and 2011, Burkina Faso, 2016).

Given the importance attached to human capital in Burkina Faso's government policy over the past thirty-five years, performance indicators in health and education have gradually improved significantly. The gross secondary school enrolment rate, which was only 6.9% in 1990, rose to 21.9% in 2010 and reached 40.7% in 2020. The gross enrolment rate at tertiary level rose from 0.75% in 1990 to 1.0% in 2000, before rising to 3.6% in 2010 and 7.6% in 2020. In terms of health performance indicators, life expectancy at birth rose from 49.4 years in 1990 to 57.1 years in 2010, before rising to 61.2 years in 2019. Over almost the same period, household prosperity in Burkina Faso, as measured by the incidence of poverty, initially rose slightly between 1994 and 2009, from 44.5% to 46.7%, before drastically falling to 40.1% in 2014 and to 36.2% in 2018.

A brief review of the co-variation of the indicators of the accumulation of health and education endowments with the incidence of monetary poverty among Burkina Faso's households reveals an acceleration in the accumulation of education endowments over the decade 2010-2020 and, at the same time, a deceleration in the accumulation of health endowments. As a result, the incidence of poverty, after rising slightly between 1994 and 2009, fell sharply during the decade.

Given the heterogeneities mentioned above, which over time affected the relationship between human capital accumulation variables (endowments) and the incidence of poverty, the following question arises: What is the contribution of each of these variables to improving household and individual prosperity? And since the impact of human capital endowments on household prosperity varies over time, the second question to be answered is: What are the factors underlying the variability in the extent of the relationship between human capital and prosperity? In other words, have the returns from human capital endowments in terms of their contribution to prosperity changed over time?

Based on this questioning, the overall aim of this research is to determine the factors behind the increase in prosperity among the employed in Burkina Faso, particularly between 2009 and 2018.

Specifically, the first step was to identify the determinants of working people's incomes between 2009 and 2018. Secondly, among the determinants, we assessed the impact of human capital variables on the improvement in working people's incomes. Thirdly and finally, the research set out to assess the variation over time in the returns to human capital variables in terms of improving the prosperity of working people.

The remainder of this research report summarises the results of country case studies that have shed light on those questions. It is structured as follows: Section 2 presents the study's theoretical framework and reviews the relevant literature on the subject; Section 3 describes the methodology; Section 4 presents and discusses the results, while Section 5 is the conclusion.

2. Theoretical framework and review of the empirical literature

Review of the theoretical literature

The relationship between the development of human capital and increased prosperity for individuals and even for entire nations dates from Schultz's (1961) seminal article on investment in human capital, which encompasses education, skills, health, and nutrition. In his article, Schultz (1961) defends the idea that investment in the accumulation of these human capital endowments expands opportunities for labour market participation and household prosperity, which translates into income gains.

Besides the positive impact of the above-mentioned dimensions of human capital on labour market participation and household income growth to the benefits of capital accumulation, many authors have added the fact that capital accumulation also contributes to increasing household prosperity and well-being and to reducing inequality and poverty (Becker, 1975; Schultz, 1993; Roemer, 1998; World Bank, 2005; Santos, 2009; Teixeira, 2014; Becker, 1995).

According to authors such as Punam (2014), Cumming et al. (2019), and the Commission on Growth and Development (2010), enhancing people's human capital endowments enables them to contribute to growth and benefit more from it.

In addition, the Commission on Growth and Development (2010) recognises that investment in human capital, particularly in education and health, promotes equality of opportunity and access to paid employment. Similarly, Mincer (1991), Ridell (2011), Larionova and Varlamova (2015), by adding nutrition to the education and health components of human capital, have highlighted its positive contribution to generating equal opportunities for all citizens.

Becker (1995) used literature review to analyse the role of human capital in reducing poverty. In the theory of human capital put forward by authors such as Becker (1964), Grossman (1972), Becker and Tomes (1976), education and health are identified as the main determinants of current and future well-being. The two factors increase employment and employability prospects (Yuko et al., 2006). Recent advances in the formalisation of human capital theory by Cunha et al. (2006), Cunha and Heckman (2008) and Heckman (2007) have further confirmed the role of human capital accumulation in household prosperity.

The theoretical literature on the relationship between human capital development and increase in household income or well-being has established the direction of the prevailing relationship between human capital endowments and the variables that relate to income and well-being. It has also identified the channels through which

human capital variables lead to an increase in income and well-being. However, it has not established a hierarchy relating to the extent of the contribution of each of the dimensions of human capital to income and well-being variables. Similarly, it has not predicted whether the influence of the accumulation of human capital endowments on household prosperity and well-being is likely to change over time. There is thus a need to review the empirical literature on the relationship between human capital accumulation and household prosperity and well-being.

Review of the empirical literature

There is an extensive empirical literature on the relationship between human capital accumulation and increase in household and individual prosperity. It can be subdivided into two categories: literature on the relationship between human capital accumulation and individual productivity, and literature on the relationship between human capital, well-being, and income inequality.

Human capital and individual productivity

This line of research on the positive impact of human capital on individual productivity has particularly focused on the influence of education on farmers' productivity. In this regard, Kafando et al. (2022) have grouped together the empirical work carried out according to the channels through which the accumulation of human capital leads to enhanced productivity. The first channel through which education contributes to enhancing farmers' productivity concerns improving their managerial skills. This managerial-quality channel, which enhances farmers' productivity, has been identified notably by Asadullah and Rahman (2009) and by Reimers and Klasen (2013). Enhancing farmers' managerial skills has enabled them to optimise their use of fertilizers and pesticides.

The second channel through which farmer education leads to enhanced productivity has to do with farmers' better management of asymmetric information on input markets. According to some studies, educating farmers helps them to acquire inputs at affordable prices and to sell their produce at better prices, which results in better profits and higher incomes. This channel has been identified by authors such as Nelson and Phelps (1966); Welch (1970), Lockheed et al (1979), Schultz (1975), Schultz and Schultz (1982), Asfaw and Admassie (2004), and Salahuddin et al. (2020).

The third channel is related to the easy adoption of technologies induced by the status of being educated. According to this channel, educated farmers adopt new agricultural techniques more quickly than uneducated ones, and thus increase their income more quickly (Nelson and Phelps, 1966; Feder et al.,1985; Lin, 1991; Foster and Rosenzweig, 1995; Weir and Knight, 2004; Myeni et al., 2019).

Finally, the fourth channel has to do with the fact that education has the effect of reducing risk aversion. In turn, reduced risk aversion encourages farmers to adopt new technologies, which are generally more productive and profitable (Asadullah and Rahman, 2009).

Human capital, poverty, and income inequality

Because education provides individuals with skills and abilities that enable them to find better-paid employment, it has the knock-on effect of improving their incomes and therefore of reducing their poverty. Numerous case studies exist, which formally establish the positive impact of capital accumulation and education on the reduction of poverty and/or income inequality.

In relation to the positive influence of education on poverty reduction, Appleton (2001) highlighted the fact that during the 1990s, improvement in living conditions and reduction in monetary poverty were more rapid among educated people than uneducated ones.

For example, Aref (2011) found that education had a positive and significant impact on reducing poverty in the rural areas of Iran. Chaudhry and Rahman (2009) found the same result based on data from rural Pakistan. Aloysius' (2010) study of Cameroon used logistic regression to highlight the fact that as the employed population attained higher levels of education and greater professional experience, the probability of them being poor reduced. The case study by Ahmad et al. (2005) on unequal access to secondary education in rural Bangladesh led the authors to identify education as an important determinant of poverty reduction. Moyo et al. (2022) obtained virtually the same result, based on data from Western Cape Province in South Africa, namely that improving the level of education led to a reduction in poverty in the province in the long-term.

In addition to education and skills, health and nutrition have been identified in numerous empirical studies as determinants of poverty reduction. For example, in the case of health, Yingya Yang et al. (2022), using quantile regression on data from rural China, found that access to public health services was essentially for the accumulation of the health capital. Improving the health status of individuals increases their individual capabilities, which in turn are required to reduce the relative poverty of rural households.

The above review of empirical literature stresses the importance of human capital as a determinant of household prosperity and/or improved well-being. Above all, it reveals the overall impact of specific dimensions of human capital development on household well-being or income, but without generally identifying which of the human capital dimensions had the greatest impact on either income or well-being as variables. Given that the strength of the relationship between human capital endowments and the well-being indicator was found to vary over time, this study adopted an analytical perspective that identified the factors underlying that variation in the influence of human capital on well-being. In addition, the approach used in the study enables several dimensions of human capital to be taken into account at the same time.

3. Methodology and research data

Methodology and research data

The Blinder-Oaxaca decomposition method was used to assess the contribution of the various dimensions of human capital to the increase in prosperity observed in Burkina Faso between 2009 and 2018, and to identify the factors underlying the variation in the extent of their influence on prosperity trends.

The method is based on the estimation of a model of the determinants of the prosperity variable. Thus, following Epo et al. (2021), by designating *Y* as the function of the generation of a person's income, a function whose arguments are made up of the vectors of exogenous and endogenous variables, the income generating mechanism of this function is specified as indicated in Equation 1:

$$\boldsymbol{LnY = a_0 + \sum_{k=1}^{K} a_1 Z_k + \eta_1 E_1 + \sum_{j=2}^{j} \eta_j E_j + \epsilon_1} \quad (1)$$

The term *LnY* represents household income taken as a logarithm. E_1 is an indicator of the labour market participation, and *E* represents human capital endowment, which encompasses level of education and training (or qualifications), quality of nutrition, health capital, etc. The vector *Z* contains *K* exogenous variables as determinants of household income level. The coefficient *a* is a *K* vector of the parameters of exogenous explanatory variables. As for the vector η, it contains the coefficients of potential endogenous explanatory variables. Finally, ϵ_1 is the vector containing both the random error terms and the variables that are unobservable but are correlated with the endogenous determinants of income.

Estimating the parameters contained in the vector η will provide the effects of a household's human capital endowment on its standard of living; that is, its level of income. However, given that both household income and human capital endowment are jointly determined in the same equation, the error term ε_1 in Equation 1 is likely to be correlated with the variables characterising human capital endowment.

Once Equation 1 had been properly estimated, the Blinder-Oaxaca decomposition method was used to assess the contribution of each of the income explanatory variables to changes in income, while quantifying the factors underlying each contribution. All that was done using the following formula:

$$\underbrace{\underbrace{Ln\bar{Y}_{t+n} - Ln\bar{Y}_t}_{\text{Endowment effect}} = \{E(X_{t+n}) - E(X_t)\}'\beta_{t+n}}_{\textbf{Observed component}}$$

$$\underbrace{\underbrace{+E(X_{t+n})'(\beta_{t+n} - \beta_t)}_{\text{Coefficient effect}} + \underbrace{\{E(X_{t+n}) - E(X_t)\}'(\beta_{t+n} - \beta_t)}_{\text{Interaction effect}}}_{\textbf{Unobserved component}} \quad (2)$$

X is the vector of explanatory variables (exogenous and endogenous) in Equation 1. The term to the left of the equal sign measures an individual's income growth, while the terms to the right of it measure the share of income growth attributable to the endowments in the different characteristics of the vector *X*. The second term to the right-hand side of the equal sign measures the share of income growth arising from an increase in returns from the different characteristics in the generation of income. Finally, the third term on the right-hand side component of Equation 2 expresses the interaction between the endowment effect and the coefficient effect.

The data

The data used in this study were taken from the multi-sector surveys conducted in 2009, 2014 and 2018. They were collected using the World Bank's Living Standards Measurement Survey (LSMS) format. The data from each of the three surveys are nationally representative. Given the focus of this study, which is an analysis of the effects of human capital dimensions on the increase in individual incomes, it narrowed down the LSMS databases to those concerning the employed population; that is, basically those aged between 18 and 60.

The variables used were constructed as follows: The variable representing a person's prosperity was the person's household expenditure per capita. The human capital dimensions were constructed as follows: Education was represented by the average number of years spent studying; health capital was represented by the dichotomous variable of whether or not a person frequented a modern health centre (state-run or private health clinic) for medical care; employment was identified by the person's status, whether or not he/she was underemployed and, alternatively,

by the dichotomous variable of whether or not he/she was employed in the formal sector; Finally, the dietary diversity score was used to identify the quality of a person's nutrition. This is a score on an index ranging from 1 to 12 of the Household Food Diversity Score (HFDS) proposed by FAO. This index measures 12 groups of food products, ranging from cereals to roots and tubers, to meat, to fish and seafood, to dairy products, etc, to sugars and "other products". An HFDS equal to 12 means perfect diversity in a person's diet.

In addition to the human capital variables, age, gender, area of residence, and marital status were also included as determinants of income.

To estimate each of the equations to determine the change in income from one year to the next, the databases for the years in question were pooled.

The average values for the different variables are given in Table 3 below.

Table 3: Average values of the different variables

Variables		2009	2014	2018
dtet	Per capita expenditure	155,585.9	219,447.3	282,418.2
Dtetd	Expenditure per capita adjusted for fluctuations in the price of the basket of goods	155,585.9	186,922.7	223,786.2
YEDUC	Number of years of education	1.45	1.74	2.46
age	Age	34.87	34.10	34.39
HFDS	Food Diversity Score	7.68	8.21	9.60
Female (%)	(=1 if female)	54.39	53.71	52.70
Urban (%)	(=1 if urban area)	27.79	34.72	39.19
Married (%)	(=1 if married)	92.18	77.22	76.57
Under-employment (%)	(=1 if underemployed)	69.40	78.77	78.22
Health_Centre (%)	(=1 if a person frequents a modern health centre)	8.54	9.76	13.76
alpha_pere (%)	(=1 if father is literate)	10.96	11.15	12.95
alpha_mere (%)	(=1 if mother is literate)	5.30	5.83	6.02
access_health (%)	(=1 if a person has access to health centre)	71.33	74.52	92.23
access_education (%)	(=1 if a person has access to a formal-education centre)	45.37	53.72	62.81
Sector (%)	(=1 if in formal employment)	2.56	4.09	4.34

4. Results

Results of the estimations of the determinants of the employed population's prosperity

The equations used to identify the determinants of the employed population's income growth between 2014 and 2018 and between 2009 and 2018, were estimated alternately using the Ordinary Least Squares estimators, the Instrumental Variables Estimator (IV), and the Control Function method.

The results of the estimation of the determinants of income growth between 2014 and 2018 are reported in Table 4, while those of the determinants of the changes in income between 2009 and 2018 are reported in Table 5.

The results reported in columns 2 and 4 of Table 4 are qualitatively comparable. The same is true of the results contained in columns 2 and 4 of Table 5. For the sake of conciseness, only the results in column 4 of the two tables are commented upon below. The coefficients contained in those columns were estimated using the Control Function approach, which considered the endogeneity of education, dietary diversity, and frequenting a modern health centre as variables; The approach also considered the unobservable heterogeneity of some of the income determinants.

Regarding the endogeneity of the three human capital accumulation variables mentioned above, the null hypothesis of no endogeneity was tested against the alternative hypothesis in the two estimations of the determinants of income growth. The chi-square statistics with three degrees of freedom associated with each of the tests and the associated p-values are presented in Appendices 1 and 2. The probabilities associated with the chi-squared statistics for the two tests were zero each time; Therefore, the null hypothesis of no endogeneity bias was also rejected each time.

It transpires from column 4 of Table 4, which shows the estimations of the effects of the various determinants on income growth between 2014 and 2018, that education had a positive and significant impact on the well-being of Burkina Faso households. A one-year increase in the number of years of schooling produced an increase of 0.022 log points (2.2%) in the employed population's income.

The effect of dietary diversity on the employed population's income was also positive and significant. An increase of one unit in the household dietary diversity

index led to an increase in income of 0.103 log points, or 10.3%. The fact that an employed person was underemployed resulted in a shortfall in income of around 15%, compared to a person who was not underemployed.

In relation to households' socio-demographic and geographical characteristics, being married was positively correlated with income growth. In fact, the transition from being unmarried to being married led to an average increase in income of 0.015 log points. As for area of residence, living in an urban area also led to a significant and positive increase in income. The increase in income induced by migration from rural to urban areas was 0.146 log points (14.6%).

The age of the employed worker did not have a significant direct effect on the average income of the members of his or her household. Being a female had a weak negative effect, but not a significant one, on the growth in the per capita income of the members of her household, which is an indication of the weakness of the gender discrimination phenomenon in the remuneration of paid employees.

Different regions of Burkina Faso differ in terms of the specificities of their factor endowments and the economic opportunities they offer. Therefore, for the purposes of this study, we subdivided the country into 5 economic regions: Ouagadougou (the capital city), the Grand Centre (Greater Centre) region, the Grand Est (Greater Eastern) region, the Grand Sahel (Greater Sahel) region, and the Grand Ouest (Greater Western) region, with the last one being used as the reference region since it was the most agricultural zone in the country. Because of the agricultural orientation of this region, the growth between 2014 and 2018 in per capita household income was the lowest there, while it increased in the other regions. For example, compared with this reference region, the variation in per capita income was 39.1% higher in Ouagadougou and 7.8% higher in the Grand-Est region.

Finally, over time, the real per capita income grew by around 0.027 log points (2.7%).

Table 4: Results of the estimation of the determinants of the change in income between 2014 and 2018

	(MCO)	(IV)	(Control function method)
	(1)	(2)	(3)
YEDUC	0.022***	0.035**	0.022***
	(28.23)	(2.80)	(24.00)
Health_Centre	0.139***	3.045***	
	(18.21)	(3.74)	
SDAM	0.103***	0.381***	0.103***
	(60.93)	(3.64)	(50.80)
Years2018	0.027***	-0.484***	0.027**
	(3.98)	(-3.91)	(3.19)

continued next page

Table 4 Continued

	(MCO)	(IV)	(Control function method)
	(1)	(2)	(3)
Female	-0.008	-0.108***	-0.006
	(-1.66)	(-3.96)	(-0.58)
Urban	0.146***	0.062**	0.146***
	(27.06)	(3.14)	(26.29)
Married	0.016*	-0.042	0.015*
	(2.49)	(-1.21)	(2.29)
Age	-0.000		0.001
	(-0.16)		(1.63)
Age^2	0.000		
	(0.51)		
Underemployment	-0.152***	-0.042	-0.151***
	(-24.22)	(-1.27)	(-22.69)
Grand_Est	0.078***	0.195***	0.078***
	(12.29)	(5.07)	(12.54)
Grand_Centre	0.070***	0.294***	0.070***
	(10.11)	(3.72)	(10.02)
Grand_Sahel	0.049***	0.262***	0.049***
	(7.84)	(5.12)	(7.75)
Ouaga	0.391***	0.529***	0.391***
	(27.23)	(5.99)	(23.07)
_cons	10.963***	8.311***	10.956***
	(388.01)	(9.64)	(402.19)
N	25 527	25 520	25 527
R^2	0.32		

z statistics in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001

In Table 5, the various direct effects on the employed population's increase in income were estimated over a wider time span, using the combined databases of the successive multisectoral surveys conducted between 2009 and 2018.

The signs of the coefficients of the human capital variables in column 4 of Table 5 are identical to those of the corresponding coefficients in column 4 of Table 4. The differences between them lie only in the magnitude of the coefficients. Each coefficient in Table 5 is significantly higher than the corresponding coefficient in Table 4. Consider just the following two examples: One, the direct contribution of education to the change in income, which was only 0.022 log points over the period between 2014 and 2018, became 0.048 log points when the time span for the change in income ran from 2009 to 2018; two, in the case of a person's under-employment

status, the direct contribution was -0.151 log points over the 2014-2018 period and -0.224 log points for the 2009-2018 period. These results show that it takes time for human capital variables to have a full impact on income.

The analysis of the determinants shows that human capital accumulation, encompassing education, health, being in full employment (as opposed to being under-employed), and dietary diversity, had a direct and significant effect on the employed population's prosperity. In addition to the human capital variable, context variables such as area of residence (urban or rural), region of the country, and which period was covered by the survey, also had direct and significant effects on the increase in employed people's income. Among the socio-demographic variables, only marital status, but not age or gender, had a significant direct effect on the change in income.

Table 5: Results of the estimation of the determinants of the change in income between 2009 and 2018

	(MCO)	(IV)	(Control function method)
	(1)	(2)	(3)
YEDUC	0.048***	0.059***	0.048***
	(36.73)	(5.86)	(32.02)
Health_Centre	0.154***	3.305***	
	(11.59)	(5.33)	
SDAM	0.077***	0.309***	0.077***
	(34.56)	(3.48)	(29.47)
Years2018	0.451***	-0.155	0.451***
	(39.67)	(-0.91)	(45.98)
Female	-0.034***	-0.118***	-0.034***
	(-4.35)	(-3.93)	(-4.35)
Urban	0.266***	0.002	0.229***
	(25.93)	(0.02)	(18.90)
Married	-0.023	-0.069	-0.022
	(-1.79)	(-1.92)	(-1.70)
Age	0.002		-0.000
	(1.12)		(-0.03)
Age^2	-0.000		
	(-0.84)		
Underemployment	-0.224***	-0.102**	-0.224***
	(-24.15)	(-3.01)	(-23.73)
Grand_Est	0.073***	0.063*	0.073***
	(6.93)	(2.02)	(7.33)
Grand_Centre	0.106***	0.102*	0.107***
	(8.96)	(2.15)	(9.65)

continued next page

Table 5 Continued

	(MCO)	(IV)	(Control function method)
	(1)	(2)	(3)
Grand_Sahel	0.104***	0.299***	0.104***
	(9.39)	(4.27)	(8.91)
Ouaga	0.360***	0.291***	0.360***
	(19.93)	(5.97)	(17.68)
_cons	10.953***	8.977***	10.882***
	(245.79)	(13.08)	(354.17)
N	23 949	23 949	23 949
R^2	0.38		

z statistics in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001

Results of the estimation of the sources of the employed population's income growth using the Blinder-Oaxaca decomposition method

To assess the contribution of each of the factors underlying the direct contribution of the determinants of income to its growth, the income function was subjected to the Blinder-Oaxaca decomposition method. As in the analysis of the direct effects of the determinants on the change in income, the two time periods (2014-2018 and 2009-2018) formed the basis of the analysis.

Thus, by breaking down the contribution of the determinants of the change in income into the endowment effect, the factor return effect, and the effect of the interaction between the other two effects, Table 6 shows that between 2014 and 2018, Burkina Faso recorded a 0.229 logarithm-point increase in the employed population's income. This income differential was by far more attributable to the effect of the increase in factors (0.274 log points) than to the effect of the return on factors (0.06 log points). Finally, and still overall, the effect of a value of 0.105 log points of the interaction between the other two effects had a negative impact on the change in income.

The contribution to the sources of income growth between 2014 and 2018 of the significant predictors of income identified through the econometric regressions summarised in Table 4 is also provided by the Blinder-Oaxaca decomposition. These detailed results are also shown in Table 6. Firstly, they highlight the important role played by human capital (health, education, not being under-employed, and quality of nutrition) in improving household well-being.

The score for the increase in endowments (endowment effect) in education was 0.04 log points; it was 0.009 log points for health, 0.174 log points for dietary diversity, and 0.01 log points for under-employment.

The effect of the returns from the use of factors was estimated at 0.047 log points for education, 0.011 points for health, and -0.141 points for under-employment. The positive sign for the return effect for education, health, and dietary diversity means a strengthening of the efficacy or productivity of these factors over time. As for the interaction terms between factor return effects and endowment effects, they were all found to be negative.

In relation to the variables, the 0.018 log-point increase in the rate of urbanisation (endowment effect) was lower than the return effect (0.043 points) of living in an urban area, which was found to be positive, unlike the interaction effect (-0.008 log points). This finding is logical, since living in an urban area increases an employed person's income, and the socio-economic integration of people who migrated from rural to urban areas improves over time, providing them with higher incomes.

The contribution of the determinants of the change in income was also broken down between the endowment effect, the factor return effect, and the interaction effect on the data relating to the change in income between 2009 and 2018. The results are shown in Table 7. Apart from the level of the coefficients, these results are similar (within two coefficients) to those in Table 6. Indeed, the -0.043 log-point effect of the returns from education was negative, signifying a drop in the contribution of an additional year to an increase in the employed population's income.

Similarly, over this comparison period, the return effect of living in an urban area became negative, even though it was not significant (-0.012 log points). Finally, the endowment effects (of -0.026 log points) and the return effects (of -0.067 log points) of underemployment were found to be significantly negative. These last two parameters show that an increase in the proportion of underemployed workers and the duration of underemployment had a negative effect on their income growth.

Table 6: Results of the Blinder-Oaxaca decomposition of the factors in the change in income between 2014 and 2018

	Differential	Endowments	Coefficients	Interaction
	(1)	(2)	(3)	(4)
Prediction_1 (Years=2018)	12.068***			
	(1193.43)			
Prediction_2 (Years=2014)	11.839***			
	(4548.95)			
Difference	0.229***			
	(21.92)			
YEDUC		0.041***	0.047***	-0.022***
		(12.26)	(8.70)	(-7.92)

continued next page

Table 6 Continued

	Differential	Endowments	Coefficients	Interaction
	(1)	(2)	(3)	(4)
Health_Centre		0.009***	0.011***	-0.004**
		(6.05)	(3.52)	(-3.23)
SDAM		0.174***	0.344***	-0.050***
		(22.41)	(6.65)	(-6.60)
Years2009		0.000	0.000	0.000
		(.)	(.)	(.)
Female		0.000	-0.000	-0.000
		(0.63)	(-0.00)	(-0.00)
Urban		0.018***	0.043***	-0.008***
		(7.54)	(5.95)	(-5.00)
Married		0.000	-0.028	-0.001
		(1.04)	(-1.74)	(-1.47)
Age		0.001	0.539***	-0.001
		(0.46)	(3.43)	(-0.47)
Age^2		-0.001	-0.244**	0.001
		(-0.27)	(-3.10)	(0.27)
Underemployment		0.010***	-0.141***	-0.006***
		(4.65)	(-8.70)	(-4.26)
Grand_Est		0.005***	0.024***	-0.003**
		(3.76)	(4.74)	(-3.19)
Grand_Centre		-0.004**	0.025***	0.003**
		(-2.91)	(6.46)	(2.80)
Grand_Sahel		0.003	-0.015***	-0.007***
		(1.57)	(-3.75)	(-3.61)
Ouaga		0.017***	0.012***	-0.007***
		(7.76)	(5.04)	(-4.58)
_cons			-0.555***	
			(-5.88)	
Total		0.274***	0.060***	-0.105***
		(27.08)	(7.01)	(-13.07)
N		25 527	25 527	25 527

z statistics in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001

Table 7: Results of the Blinder-Oaxaca decomposition of the factors in the change of income between 2009 and 2018

	Differential	Endowments	Coefficients	Interaction
	(1)	(2)	(3)	(4)
Prediction_1 (Years=2018)	12.068***			
	(1193.43)			
Prediction_2 (Years=2009)	11.637***			
	(2264.21)			
Difference	0.431***			
	(38.01)			
YEDUC		0.035***	-0.043***	0.018***
		(11.15)	(-6.88)	(6.29)
Health_Centre		0.010***	0.009*	-0.003*
		(6.56)	(2.38)	(-2.32)
SDAM		0.241***	0.545***	-0.109***
		(23.23)	(10.02)	(-9.92)
Years2009		0.000	0.000	0.000
		(.)	(.)	(.)
Female		0.000	0.016	0.001
		(0.63)	(1.79)	(1.32)
Urban		0.027***	-0.012	0.004
		(9.71)	(-1.50)	(1.50)
Married		0.003	0.029	0.006
		(1.12)	(1.45)	(1.44)
Age		-0.006	0.436*	0.006
		(-1.82)	(2.53)	(1.73)
Age^2		0.005	-0.193*	-0.005
		(1.72)	(-2.23)	(-1.63)
Underemployment		-0.026***	-0.067***	0.007***
		(-9.45)	(-3.81)	(3.64)
Grand_Est		0.001	0.024***	-0.001
		(1.09)	(4.16)	(-1.06)
Grand_Centre		-0.001	0.017***	0.000
		(-0.71)	(4.00)	(0.70)
Grand_Sahel		0.001	-0.030***	-0.005***
		(1.50)	(-6.42)	(-3.83)

continued next page

Table 7 Continued

	Differential	Endowments	Coefficients	Interaction
	(1)	(2)	(3)	(4)
Ouaga		-0.002	0.010***	0.001
		(-1.19)	(4.18)	(1.15)
_cons			-0.517***	
			(-4.97)	
Total		0.289***	0.223***	-0.081***
		0.035***	(21.48)	(-6.61)
N		23 949	23 949	23 949

z statistics in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001

5. Conclusion

The results of this study's various estimations show that the accumulation of human capital (health, nutrition, education, and quality employment) has a positive and significant influence on the Burkinabe households' well-being. They show that health and nutrition were essential in explaining the increase in income of the employed population. Education was also found to have a net positive effect on their income growth. However, underemployment on the part of the head of household was found to be a factor that significantly reduced household income.

The decomposition carried out of the sources of the recorded increase in household income between 2014 and 2018, in essence revealed that this increase was more related to the endowments themselves than to an increase in the returns from the same endowments. But when the timeframe for analysis was extended to cover the years from 2009 to 2018, it turned out that, overall, the contribution of the endowment effect and that of the return to endowment effect were both significant.

Given that in the equation decomposing the factors of the change in income between 2009 and 2018, the return effect was found to be significantly negative and that the coefficient of its direct effect on income was relatively low, the study recommends that reforms should be introduced that are aimed at improving the external efficiency of education in Burkina Faso. In addition, since the endowment effect was found to be significantly positive, it follows logically that any policy to expand the provision of education would lead to an increase in the working population's income.

Since the health endowment effects and their effects of the returns from them were positive and significant, but limited, expanding the provision of modern health services and enhancing their performance are among the measures that should be undertaken. Finally, combating underemployment among the working population and enhancing urbanisation are also pro-prosperity policies to be developed for the benefit of the working population.

Notes

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References

Ahmad, A., Hossain, M., & Bose, M. L., & al. 2005. Inequality in the access to secondary education and rural poverty in Bangladesh: An analysis of household and school level data. In Workshop on Equity and Development in South Asia, India, volume 2005.

Aloysius Mom Njong. 2010. The effects of educational attainment on poverty reduction in Cameroon". *Journal of Education Administration and Policy Studies*, Vol.2 (1): 001–008.

Appleton, S. 2001. *Education, incomes and poverty in Uganda in the 1990s*. Technical Report, CREDIT Research Paper.

Asadullah, M. N., & Rahman, S. (2009). Farm productivity and efficiency in rural bangladesh: the role of education revisited. *Applied Economics*, 41(1), 17-33. https://doi.org/10.1080/00036840601019125.

Aref, A. 2011. Perceived impact of education on poverty reduction in rural areas of Iran. *Life Science Journal*, 8(2), 498–501.

Asfaw, A., & Admassie, A. 2004. The role of education on the adoption of chemical fertilizer under different socioeconomic environments in Ethiopia. *Agricultural Economics*, 30(3), 215-228. https://doi.org/10.1111/j.1574-0862.2004.tb00190.x.

Baye, M.F. 2006a. "Growth, redistribution and poverty changes in Cameroon: A shapley value decomposition analysis". *Journal of African Economies,* Vol. 15, No.4: 543–570.

Baye, M.F. 2006b. "Structure of sectoral decomposition of aggregate poverty changes in Cameroon". *African Development Review*, 18(3): 309–29.

Baye, M.F. and Epo, B.N. 2015. "Impact of human capital endowments on inequality of outcomes in Cameroon". *Review of Income and Wealth*, 61(1): 93–118.

Bebbington, A. 1999. "Capitals and Capabilities: A Framework for Analyzing Peasant Viability, Rural livelihoods and Poverty". *World Development* 27: 2021–2044.

Becker, G.S. 1964. *Human capital.* Columbia University Press (2nd ed. in 1975).

Becker, G.S. 1975. "Human capital: A theoretical and empirical Analysis, with Special Reference to Education". NBER, pp. 13–44. http://www.nber.org/books/beck75-1.

Becker, G.S and N., Tomes. 1976. "Child endowments and the quantity and quality of children". *Journal of Political Economy*, 84: S143–S162.

Becker, G. 1995. Human capital and poverty reduction. *Human Resource Development and Operations* Working Paper No. HRO 52. Washington DC: World Bank.

Blinder, A.S. 1973. "Wage discrimination: Reduced form and structural estimates". *Journal of Human Resources*, 8: 436–55.

Burkina Faso. 2000. *Cadre stratégique de lutte contre la pauvreté (CSLP)*, Ouagadougou, Burkina Faso.

Burkina Faso. 2004. *Cadre stratégique de lutte contre la pauvreté (CSLP)*, Ouagadougou, Burkina Faso.

Burkina Faso. 2011. *Stratégie de croissance accélérée et de développement durable (SCADD)*, Ouagadougou, Burkina Faso.

Burkina Faso. 2016. *Plan de développement économique et social (PNDES)*, Ouagadougou, Burkina Faso.

Commission on Growth and Development. 2010. *Equity and Growth in a Globalising World,* World Bank, 2010. Edited by Kanbur, Ravi; Spence, Michael. ISBN: 978-0-8213-8180-9, eISBN: 978-0-8213-8181-6, DOI: 10.1596/978-0-8213-8180-9.

Cumming, D.J., Johan, S., Uzuegbunam, I.S. 2019. An Anatomy of Entrepreneurial Pursuits in relation to Poverty. *Entrepreneurship and Regional Development.*

Cunha, F. and J., Heckman. 2008. "Formulating, identifying and estimating the technology of cognitive and noncognitive skill formation". *Journal of Human Resources*, 43: 738–782.

Cunha, F., J. Heckman, L. Lochner and D., Masterov. 2006. "Interpreting the evidence on life cycle skill formation". *Handbook of the Economics of Education,* Volume 1. Edited by Eric A. Hanushek and Finis Welch. © 2006 Elsevier B.V. DOI: 10.1016/S1574-0692(06)01012-9.

Datt, G. and Ravallion, M. 1992. "Growth and redistribution components of changes in poverty measures: A decomposition with application to Brazil and India in the 1980s". *Journal of Development Economics*, Vol. 38: 275–295.

Epo, B.N. and F.M. Baye. 2016. "Effects of reducing inequality in household education, health and access to credit on pro-poor growth: Evidence from Cameroon". In *Inequality after the 20th century: Papers from the sixth ECINEQ Meeting*, pp. 59–82.

Epo, B.N and F.M. Baye. 2012. "Patterns of absolute and relative pro-poor growth in Cameroon". *African Journal of Economic Policy,* Vol., 19, No. 2.

Epo, B.N. and F.M. Baye. 2013. "Determinants of inequality in Cameroon: A regression-based decomposition analysis". *Botswana Journal of Economics*, Vol. 11, No. 15: 2–20.

Epo B. N., F. M. Baye, G. Mwabub, D. K. Mandab, O. Ajakaiyec, S. Kiprutod, M. K. Muriithib, P. K. Samoeid, R. G. Mutegi, M. Olecheb, T. W. Mwangid and A. Wambugub. 2021. Human Capital, Household Prosperity and Social Inequalities in Sub Saharan Africa. Framework paper of African Economic Research Consortium's project on Human Capital Development in Africa. Nairobi, Kenya, August 2021.

Fisher, A.G.B. 1946. *Education and economic change*. South Australia: W.E.A. Press.

Foster, J., J. Greer and E. Thorbecke. 1984. "A class of decomposable poverty measures". *Econometrica*, 52(3): 761–776.

Foster, J.E. and A.F. Shorrocks. 1991. "Subgroup consistent poverty indices". *Econometrica*, 59: 687–709.

Grossman, M. 1972. "On the concept of health capital and the demand for health". *Journal of Political Economy,* 80: 223–255.

Hanushek, E. 2013. "Economic Growth in Developing Countries: The Role of Human Capital". *Journal of Economic Growth*, 17(4).

Heckman, J., J. 2007. "The Economics, Technology, and Neuroscience of Human Capability Formation." *Proceedings of the National Academy of Sciences*, 104, 13250–13255.

Kafando B., N. Thiombiano, E. Pelenguei and P. Bazié. 2022. "Analysis of human capital effects:

A systematic review of the literature". *International Journal of Human Resource Studies*, Vol. 12, No. 4.

Kakwani, N. 2000. "On measuring growth and inequality components of poverty with application to Thailand". *Journal of Quantitative Economics,* 16: 67–80.

Larionova, N.I. and Varlamova, J.A. 2015. "Analysis of human capital level and inequality interaction". *Mediterranean Journal of Social Sciences*, 6 (1): S3.

Lefranc, A., N. Pistolesi and A. Trannoy. 2008. "Inequality of opportunities vs inequality of outcomes: Are western societies all alike?". *Review of Income and Wealth*, 54: 513–546.

Lockheed, M. E., Jamison, D. T., & Lau, L. J. 1979. Farmer education and farm efficiency: A survey. ETS *Research Report Series*, 1979(2). https://doi.org/10.1002/j.2333-8504.1979.tb01182.

Lucas, R.1988. "On the Mechanics of Economic Development". *Journal of Monetary Economics,* 22(1).

Mincer, J. 1962. "On-the-Job training: Costs, returns, and some implications". *Journal of Political Economy,* 70(5), Part 2.

Mincer J. 1958. "Investment in human capital and personal income distribution". *The Journal of Political Economy*, Vol. LXV1, No. 4.

Mincer, J. 1991. *Education and unemployment*. National Bureau of Economic Research. NBER Working Paper No. 3838.

Ministry of the Economy and Finance, (2001), Retrospective macroeconomic study of Burkina Faso. Ministry of Economy and Finance. December 2001. Burkina Faso.

Moser, C.O.N. 2006. Asset-based approaches to poverty reduction in a globalized context: An introduction to asset accumulation policy and summary of workshop findings. Working Paper 01. Washington, DC: Brookings Institution.

Moyo, C., Mishi, S., & Ncwadi, R. 2022. Human capital development, poverty and income inequality in the Eastern Cape Province. *Development Studies Research*. 9(1), 36-47. https://doi.org/10.1080/21665095.2022.2032236.

Mwabu, G. 2009. "The production of child health in Kenya: A structural model of birth Weight". *Journal of African Economies*, 18: 212–260.

Nelson, R. R., & Phelps, E. S. 1966. Investment in humans, technological diffusion, and economic growth. *The American Economic Review*, 56(1/2), 69–75.

Neuman, S. and R. Oaxaca. 2004. "Wage decompositions with selectivity-corrected wage equations: A methodological note". *The Journal of Economic Inequality,* 2(1): 3–10.

Oaxaca, L.R. 1973. "Male-female wage differentials in urban labour markets". *International Economic Review,* 14(3): 693–709.

Punam, P. 2014. *Africa New Economic Landscape*. Brown J. World Aff. xxi (1).

Ravallion, M. and M. Huppi. 1991. "Measuring changes in poverty: A methodological case study of Indonesia during an adjustment period". *World Bank Economic Review*, 5: 57–82.

Reimers, M., & Klasen, S. 2013. Revisiting the role of education for agricultural productivity. *American Journal of Agricultural Economics*, 95(1), 131–152. https://doi.org/10.1093/ajae/aas118.

Ridell, S. 2011. "The impact of education on employment incidence and re-employment success: Evidence from the US labour markets". *Economic Working Paper.*

Roemer, J.E. 1998. *Equality of opportunity*. Cambridge, MA: Harvard University Press.

Roemer, J.E. 2002. "Equality of opportunity: A progress report". *Social Choice and Welfare,* 19: 455-471.

Romer, P.M. 1990. "Endogenous technological change". *Journal of Political Economy,* 98(5).

Salahuddin, M., Gow, J., & Vink, N. 2020. Effects of environmental quality on agricultural productivity in Sub–Saharan African countries: A second generation panel based empirical assessment. *Science of the Total Environment*, 741, 140520.

Santos, M.E. 2009. "Human Capital and the Quality of Education in a Poverty Trap Model". Oxford Poverty & Human Development Initiative (OPHI). Oxford Department of International Development.

Schultz, T.P (Ed.) 1993). *Investments in women's human capital*, Chicago, IL: University of Chicago Press.

Schultz, T.W. 1961. "Investment in human capital". *American Economic Review*, 51(1): 1–17.

Schultz, T.W. 1962. "Investment in human beings". *Journal of Political Economy,* Supplement. Chicago: University of Chicago Press.

Schultz, T.W. 1975. "The value of the ability to deal with disequilibria". *Journal of Economic Literature,* Vol. 13, No. 35: 827–846.

Schultz, T. W., & Schultz, T. W. 1982. Investing in people: The economics of population quality. Univ of California Press. https://doi.org/10.1525/9780520318540.

Sen, A. 1976. "Poverty: An ordinal approach to measurement". *Econometrica*, 44: 219–231.

Sen, A. 1997. *On economic inequality*. Oxford: Oxford University Press.

Sen, A. 1998. "Mortality as an indicator of economic success and failure". *The Economic Journal*, 108: 1–25.

Shorrocks, A.F. 1999. Decomposition procedures for distributional analysis: A unified framework based on Shapley Value. Mimeo. Department of Economics, University of Essex, Essex.

Teixeira, P.N. 2014. "Gary Becker's early Work on Human Capital: Collaborations and Distinctiveness". *IZA Journal of Labour Economics*. ISSN: 2193-8997 3, 1–20. Springer, Heidelberg.

Welch, F. 1970. Education in production. *Journal of Political Economy*, 78(1), 35–59. https://doi.org/10.1086/259599.

Wooldridge, J.M. 2015. "Control function methods in applied econometrics". *Journal of Human Resources*, 50(2): 420–445.

World Bank. 2005. Introduction to poverty analysis. World Bank Institute. http://siteres ources.worldbank.org/PGLP/Resources/PovertyManual.pdf.

World Bank. 2013. Shifting gears to accelerate shared prosperity in Latin America and the Caribbean. Document of World Bank No. 78507. Washington DC: World Bank.

World Bank. 2015a. Poverty forecasts, monitoring global development prospects. Demographic Trends and Economic Development, Washington, DC.

World Bank. 2015b. A measured approach to ending poverty and boosting shared prosperity: Concepts, data, and the twin goals. Policy Research Report. Washington, DC: World Bank.

Yang, Y., L., Zhou, Ch. Zhang, X., Luo, Y., Luo and W. Wang. 2022. "Public health services, health human capital, and relative poverty of rural families". *International Journal of Environmental Research and Public Health*, 11089. https://doi.org/10.3390/ijerph191711089.

Yuko, A., J.M. Kim. and A., Kimhi. 2006. "Determinants of Income Inequality among Korean Farm Households". Economic Research Centre, *Discussion paper*, No. 161, School of Economics, Nagoya University.

Appendix

Appendix 1: Tests of the endogeneity of variables and instrument validity tests for the regression of the change in income between 2014 and 2018

Underidentification test (Kleibergen-Paap rk LM statistic): 17.938
Weak identification test (Kleibergen-Paap rk Wald F statistic): 4.491
Stock-Yogo weak ID test critical values: <not available>

Hansen J statistic (overidentification test of all instruments): 0.265
Chi-sq(1) P-val = 0.6069
-endog- option:
Endogeneity test of endogenous regressors: 456.321
Chi-sq(3) P-val = 0.0000
Regressors tested: YEDUC Health_Centre SDAM

Instrumented: YEDUC Health_Centre SDAM
Included instruments: Years 2018 Female Urban Married Underemployment Grand_est Grand_centre Grand_sahel Ouaga
Excluded instruments: age age2 alpha_pere access_education
Chi-sq(2) P-val = 0.0001

---

1. Endogeneity test for education level and health status

H_0: There is no endogeneity problem; that is, the OLS and Instrumental Variable models are equivalent.

H_1: There is an endogeneity problem; that is, the estimated coefficients of OLS and IV models are significantly different. The OLS model is inconsistent (i.e. not convergent). We should therefore prefer the IV model, which is unbiased.

Under the null hypothesis, the statistical test has a chi-square distribution with the number of degrees of freedom equal to the number of the instrumented variables. The *p*-value associated with the endogeneity test statistic is zero. We therefore reject the null hypothesis of no endogeneity bias. **The number of years of education, the dietary diversity score, and the use of a modern health centre are endogenous variables.**

2. Over-identification test or instrument exogeneity test

The Sargan, or Sargan-Hansen test, also known as the Hansen or J test, is used to test a hypothesis of over-identification in a statistical model. It is used to test the validity of an instrument and to verify its exogeneity. It is based on the hypothesis that the error term should not be correlated with all the exogenous variables if the instruments are valid. If the estimator of the error term is not explained by the instruments, then the instruments are exogenous, and therefore valid.

H_0: All the instruments are valid; that is, they are not correlated with the error term.
H_1: At least one of the instruments is not valid.

If the p-value is >0.05, then the model is correct. If the *p*-value < 0.05, then at least one of the instruments is not valid.

The *p*-value associated with the over-identification test statistic is 0.6069. Therefore, we cannot reject the null hypothesis that the instruments are valid. All four instruments (age, age^2, alpha_pere, access_education) are valid.

3. Test for under-identification or weak identification

The null hypothesis of the Kleibergen-Paap rk LM statistic is that the equation is under-identified; that is, the relevant instruments are correlated with the variables suspected of being endogenous. The p-value associated with the test statistic is zero. We therefore reject the null hypothesis of under-identification. The four instruments are relevant; that is, they are correlated with the number of years of education, the dietary diversity score, and frequenting a modern health centre for medical care.

Appendix 2: Tests of the endogeneity of variables and instrument validity tests for the regression of the change in income between 2009 and 2018

Under-identification test (Kleibergen-Paap rk LM statistic): 38.329
Chi-sq(2) P-val = 0.0000

Weak identification test (Kleibergen-Paap rk Wald F statistic): 9.617
Stock-Yogo weak ID test critical values: <not available>

Hansen J statistic (overidentification test of all instruments): 1.535
Chi-sq(1) P-val = 0.2153
-endog- option:
Endogeneity test of endogenous regressors: 349.901
Chi-sq(3) P-val = 0.0000
Regressors tested: YEDUC Health_Centre SDAM

Instrumented: YEDUC Health_Centre SDAM
Included instruments: Years2018 Female Urban Married Underemployment Grand_est Grand_centre Grand_sahel Ouaga
Excluded instruments: age age2 alpha_pere access_education

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