Public education spending and poverty in Burkina Faso: A Computable General Equilibrium Approach[1]

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Abstract

The paper analyses welfare and poverty implications of different options for creating and using fiscal space for public education expenditures. The analysis uses a multi sectoral computable general equilibrium model calibrated for Burkina Faso. Education is demanded by households as an investment to "transform" unqualified workers into qualified workers. The simulations indicate that a 40% across-the-board increase in public subsidies for primary education, financed by an increase in taxes on household income and sales taxes, not only leads to an increase in welfare but also to a decline in the incidence of poverty for all household types.

Keywords: computable general equilibrium model, public education spending, Burkina Faso

JEL Classification: C6, H5, I2, I3, J2, O5

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1. Introduction

Education is often claimed as a source of human capital accumulation and the engine to spur economic growth in the long term, and undeniably allow poor to escape poverty. It is therefore considered as a central concern for policy makers. Yet, often governments do not have the appropriate tools to enable them to establish priorities between various demands for funding subject to their tight fiscal constraints.

Education is a major concern of the government of Burkina Faso as evidenced by its recent reform aiming to progressively implement compulsory and free education for the 2010-2011 school year. The second reform covers the 2011-2012 to 2014-2015 periods and aims to move towards consolidation of universal primary education. According to the 2010 public expenditure review, total spending allocations to primary education amounted to 15.3% of the public budget in 2008 as opposed to 11.6% for health.

Major reforms are also being carried out to improve the management of public spending in the framework of the Poverty Reduction Strategy Plan (PRSP), through a Public Expenditure Review (PER).[2] Since 2000, the government has taken the initiative to carry out a number of sectoral PERs for health, primary education, infrastructure, rural development, secondary education and justice. Four major challenges are targeted via the PRSP: acceleration of equitable growth, improvement of social services, income creation for the poor and improved governance. In such a context, the government must choose among numerous domestic policy options and state the effects that these choices have on the provision of social services which are essential for the population's welfare.

The main objective of this study is to assess what different options for creating and using fiscal space for public education spending imply for the ultimate objectives of reducing poverty and increasing welfare of the population. To achieve this goal, we use a computable general equilibrium model. The elements of this methodology are presented in section III, where we focus attention on bringing education into the model. In sections IV and V, we paint a picture of the Burkinabé economy with the data used for this study and analyze the distributive effects of a simulated increase in public subsidies for education. To get there, we

[2] A PER responds to the government's expressed need to analyze changes in budget credits and expenditures since 1998 and to account for the results and shortcomings in order to improve links between the budgetary processes and the PRSP. It includes four chapters which address the following questions: (a) study of the allocation of budget credits and budget execution over 1998-2002 and their link with PRSP priorities; (b) institutional examination of program budgets and development of options to better integrate the budget and the budget review process; (c) review of budget execution in the health sector; and (d) review of budget execution in the education sector.

will first have to present in section II, an overview of the theoretical and empirical literature on education, human capital and their effects on welfare.

2. Survey of the Literature

A key study in the analysis of the impact of education on poverty, in a context of computable general equilibrium modeling, is that of Savard and Adjovi (1998). This study introduces externalities to education and health markets without accounting for either the benefits that these services provide to households or their inability to shift demand for these services in response to public policy.

Agénor *et al.* (2002) also tackled this question using a recursive dynamic general equilibrium model to analyze the impact of structural adjustment policy on poverty and income distribution. The labour market is segmented into qualified and unqualified labour, and unqualified workers can become qualified. The decision to acquire the qualification depends on three factors: (i) the expected real wage differential between qualified and unqualified labour markets; (ii) the stock of public capital in education; and (iii) the extent of the credit constraint expressed in terms of the average wealth of an unqualified worker. However, the enormous complexity of this model poses a challenge for advanced understanding of the underlying mechanisms at play.

In another recursive dynamic general equilibrium model, Agénor *et al*. (2005) allow households to transform labour into skilled labour via a qualification production function which is assumed to depend on the total volume of labour and the public stock of capital in the preceding period. However, their model only includes one representative household, which means that changes in the composition of labour in the economy are those of the sole aggregate household.

Jung and Thorbecke (2003) adopt a simpler dynamic model with the goal of analyzing education-growth-poverty linkages in Tanzania and Zambia. They account for three types of workers: uneducated, mid-educated (having completed primary schooling) and highly educated (having completed any level of education beyond primary). They specify a qualification production function as follows:

$$MS_m = AS_m.EG^{\beta m}{}_1.\ (s_l.W_{l0})^{\beta m}{}_2$$

where MS_m is the level *m* of education in a given period (year). AS_m is a scale parameter, EG is public education spending and $s_l W_{l0}$ is the opportunity cost, defined as the household effort supplied (or time invested) s_l in education, multiplied by the wage W_l they will receive if they decide not to pursue an education.

Households choose their level of effort to maximize the value of wealth given current and expected future wages, the interest rate and the unemployment rate. Their model has one important shortcoming though: the constant share of household endowments in unqualified, mid-qualified and qualified workers. In effect, although human capital accumulation in the economy is a function of household choices, the qualification acquisition process in their model does not allow households who wish to change their labour composition to do so. This limits the impact of education on the labour market, and results in an incomplete analysis of its distributive effects.

Bourguignon *et al.* (2006) develop a model to evaluate the MDGs and to estimate the time and expense needed to reach them. They introduce feedback effects into the economy via the labour market. Education is disaggregated by level of education, and student's behaviour during each level is determined by a logistic function linking the performance of the education system to a group of identifiable factors. The labour market is thus affected by the education system because labour evolves as a function of the education system and its performance in each period.

Applications of this approach are provided by Logfren and Diaz-Bonilla (2006) for Ethiopia and by Maisonnave and Decaluwé (2009) for South Africa. However, since the model is used to analyze the feasibility and costs of reaching the MDGs by 2015, it requires accurate historical data. Following a cohort of students requires data for each level of education that the cohort passed through. For example, if the base year is 2000 and completing a given level of education takes 10 years to complete, data is needed for each level of education starting in 1990. Moreover, since the model seeks to capture interactions between public education and health spending, it is difficult to formulate hypotheses or assign elasticity values to the feedback effects.

Dabla-Morris and Matovu (2002) developed a nested dynamic computable general equilibrium model with heterogeneous agents for Ghana. In their model, all households attribute importance to both family consumption and the human capital of their progeny. Parents behave altruistically, and determine the amount of time their children should spend in school using a cost-benefit analysis. Education increases the child's human capital and future wages on the labour market, as well as the parent's utility. However, the fixed cost per level of education means that such expenditures reduce the household's income and consumption.

The benefits of education depend on the qualities and skills of the child, and acquisition of a qualification is endogenized to account for the decision to educate the household in each period. However, their model only has a single representative sector, which varies according to the intensity of each type of labour and the associated wages. This is a

weakness of their model because household income is generally influenced by their factor endowments and sectoral demand for these factors.

Finally, Cloutier *et al.* (2004) constructed a static computable general equilibrium model to study the impacts of public education spending on poverty, welfare and inequality in Vietnam. Their approach is particularly interesting because it introduces a household endowment of qualified and unqualified workers that is flexible for each household category. The households' decision to invest in education results from a trade-off between future benefits (higher income) and the direct and indirect costs of education. The government can thus influence the household decision by reducing the household cost of education, with a resulting increase in education spending.

By devoting more time and effort to education, households can alter the composition of their internal labour force and the associated returns to labour. At the same time, they influence their labour income and thus their total income, permitting an evaluation of the ultimate effects on poverty and welfare. Despite these innovative characteristics, the model is readily subject to critique, given that: (i) it is static and can only partially capture the intrinsically dynamic effects of an education policy and (ii) it is underpinned by the assumption of a representative agent, which limits its significance.

The analytical framework in this study is based on that of Cloutier *et al.*, described above. It is static and is centered on the assumption of a representative agent. However, it is distinguished by a greater level of disaggregation of representative households and differently defined labour market segmentation. In the Burkinabé context, household education decisions regarding education are made on primary education more so than higher education. Our definition of the levels of education or qualification conforms to this specification.

3. Methodology

The methodology is addressed in three steps: the first deals with the CGE model, the second deals with other model parameters and the third analyzes poverty, welfare and the income distribution.

Step 1: The CGE model

The study is based on an archetypal model developed by Decaluwé *et al.*, applicable for a small, open economy with exogenous world prices. The model includes 10 production sectors from the (aggregated) 2004 Social Accounting Matrix (SAM). These sectors[3] include three agricultural sectors, three industrial sectors, three public services sectors and a private

[3] Each sector produces a single good.

service sector. It also includes two categories of labour or education levels: qualified labour and unqualified labour.

The model includes income and expenditures for six representative households from the households survey carried out by the National Institute of Statistics and Demography (NISD) in 2003. Most of the assumptions are those of a standard CGE model. Some important particularities are worth mentioning though. The emphasis is placed on equations which bring human capital and qualifications into the model.

We also assume that household labour endowments are flexible, in the sense that households can modify their own endowments. The household education decision is entirely explained by the investment pattern, modelled as follows: households can alter the share of qualified and unqualified labour via education in order to maximize their income. The choice of this share determines the amount of time allocated to labour and education. This then influences household income, thus affecting consumption and the economy's total production, which is itself a function of human capital.[4] Household demand for education depends on relative wages for qualified and unqualified workers, the opportunity cost of holding qualified work (i.e., that of spending more time in education) as well as the direct cost of education.

Only completion of primary education (or beyond), produced by the "primary education" sector, allows workers to become qualified. We suppose that households must "buy" a given amount of primary education to hold a qualified position. As for the number of units of higher education (secondary, post-secondary or university) "consumed", this is presumed fixed.[5] [6] The cost of producing primary education is paid in part by the government through public education spending and in part by households.

3.1 Households

The behaviour of each household is addressed in two steps: each household *h* obtains utility from consumption of goods and attributes no value to leisure.[7]

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[4] See Cahuc and Michel (1996).

[5] Higher education has a notable influence on wage remuneration (Lachaud, 2003). It is not, however, a priority for household education decisions. The primary participation rate, despite its progress (72% in 2008/2009) with the strong presence of the state and bilateral and multilateral partners, remains a preoccupation in terms of the goal of universal primary education. We can thus consider that it is reasonable to assume that primary education is the ultimate concern of households and the government.

[6] This is a shortcoming of the model because a public policy which allows households to invest in basic education should continue beyond the primary level. In effect we could suppose that among the large number of students who complete primary following the increase in the government subsidy, some continue on to secondary and post-secondary studies. Endogenizing the secondary and post-secondary schooling choices, all the while allowing households to invest in each level of education, would be an important extension.

[7] Incorporating leisure into this model is nevertheless an interesting extension. In effect, if the consumption aspect of education is account for, i.e., if education directly contributes to the household's utility, then education and leisure should become substitutes because households obtain utility from leisure and should be considered jointly. Each household's available time should thus be divided into three parts: leisure time, work time and study time.

$$U_h = U\left(C_1,...,C_i,...,C_n\right) \qquad [1]$$

where U represents a Cobb-Douglas- or Stone-Geary-type utility function maximized by each household in order to determine its consumption C_i, of each good, subject to its budget constraint, yielding a linear demand system.

In the standard model (no education) of Decaluwé, Cockburn and Robichaud, each household possess fixed endowments of qualified and unqualified labour, capital and land. The household thus has no control over its income (or the resulting budget constraint). Its income is comprised of returns to these production factors (labour, capital and land), dividends and transfers (governmental and other). In other words, the household cannot react to a change in returns to these assets. The consumers' choice (satisfying utility maximization) is thus the only decision that is modelled.

Here, the household faces an additional decision because education is also considered. It must choose the share of adult members it wishes to keep in each category of labour (qualified and unqualified).[8] Households can transform unqualified labour into qualified labour by "consuming" a predetermined quantity of units of primary education. Otherwise stated, in the long run, "consuming" enough primary education leads to a larger share of qualified labour in the household. This additional choice allows households to influence their labour income and to determine their investment expenditures in primary education. As in the standard case, however, the household has no impact on other sources of income (factor payments to capital and land, dividends, transfers, etc.).

To start with, since income only depends on endowments of qualified and unqualified labour, and the time (or effort) invested in education, household *h* chooses the share of qualified (δ_h^q) and unqualified (1-δ_h^q) workers to maximize their labour income subject to the constraint of imperfect transformation between qualified and unqualified labour.

In other words, and in conformity with the Cloutier *et al*. (2004) model:

$$\underset{\delta_h^q}{Max}\, YH_h = W_{nq}(1-\delta_h^q)\overline{LS_h} + W_q(1-s)\delta_h^q\overline{LS_h} - s\beta_{h,edb}Pc_{edb}\delta_h^q\overline{LS_h} + non-labor\ income - Pc_{eds}\overline{ED}_{h,eds} \qquad [2]$$

$$s.l.c.\ \overline{LS_h} = B_h^l\left(\beta_h^l[\delta_h^q\overline{LS_h}]^{k^l} + (1-\beta_h^l)[(1-\delta_h^q)\overline{LS_h}]^{k^l}\right)^{\frac{1}{k^l}} \qquad [3]$$

YH_h ≡ Net education spending by household h;

[8] All workers must be either qualified (active or studying) or unqualified.

W_q ≡ Qualified wage;

W_{nq} ≡ Unqualified wage;

Pc_{eds} ≡ Consumer price of a unit of higher education;

Pc_{edb} ≡ Consumer price of a unit of primary education;

$\overline{LS_h}$ ≡ Household *h*'s potential labour, i.e., volume of labour;

δ_h^q ≡ Share of qualified workers in household *h*;

$1-\delta_h^q$ ≡ Share of unqualified workers in household *h;*

$\beta_{h,edb}$ ≡ Share of unit price of education paid by household *h*;

B_h^l ≡ Scale parameter for the constant elasticity of transformation (CET) of labour;

β_h^l ≡ Distributive parameter for the labour CET function;

k^l ≡ Transformation parameter for the labour CET function;

s ≡ Share of active life allocated to primary studies to become qualified;

$\overline{ED_{h,eds}}$ ≡ Volume of higher education demanded by household *h*.

Income from unqualified labour is represented by $W_{nq}.(1-\delta_h^q).\overline{LS_h}$, the product of the unqualified wage and the number of unqualified wage earners in the household. Income from qualified labour, $W_q.(1-s)\delta_h^q.\overline{LS_h}$, for its part, is a function of the qualified wage, the potential number of workers $\delta_h^q.\overline{LS_h}$ and the share s of active life the worker must invest in primary education.

We thus also observe a long-term equilibrium[9] where s % of the household's potential qualified labour is in school in any given year. This allows the household to maintain its desired share δ_h^q of qualified workers. Otherwise stated, in order to increase its qualified labour endowment by $\Delta\delta_h^q$, household *h* must increase the number of units of primary education it "consumes" by $s\Delta\delta_h^q\overline{LS_h}$. The amount of potential working time invested in education increases in the process.

This leads to the first cost of pursuing education (or of having more qualified labour): the opportunity cost $W_q.s\delta_h^q.\overline{LS_h}$. This is a function of the qualified wage because a few additional years of education increases wages but decreases the share of their active life

[9] We analyze the problem from a long term perspective in a static framework within which the volume of students is proportional to the volume of paid qualified labour in each year.

spent on the qualified labour market.[10] At the aggregate level, the quantity of qualified labour is thus lower than its potential level due to the amount of time spent at school. Paid qualified labour is thus $(1-s)\delta_h^q.\overline{LS_h}$ and the number of students is $s\delta_h^q.\overline{LS_h}$. Wages and opportunity costs thus influence the household's choice.

The household is also influenced by the direct cost of education, $s\beta_{h,edb}Pc_{edb}\delta_h^q\overline{LS_h}$. Since primary education is partially subsidized by the government, the household only pays a share $\beta_{h,edb}$ of the total cost of its primary education, which has a unit price of Pc_{edb}. Otherwise said, each unit of primary education provided has a total cost of:

$$\overline{CEDT}_{h,edb} = \beta_{h,edb} + \overline{TED_h} \qquad [4]$$

where

$\overline{CEDT}_{h,edb}$ ≡ Total unit cost of primary education;

$\overline{TED_h}$ ≡ Public unit cost of primary education;

$\beta_{h,edb}$ ≡ Private unit cost of primary education.

This cost is shared (equation 4) between a public cost or subsidy and a private cost which includes school fees paid by households, contributions to parent committees, transportation and housing costs if the student must move or needs tutoring, etc. The total cost and the government subsidy (public cost) are presumed exogenous while the private cost is endogenous. As a result, an increase (decrease) in government subsidies for primary schooling, all else equal, leads to a decrease (increase) in both private costs $\beta_{h,edb}$ and direct costs.

The share of active life spent in studies, the proportion of the unit cost covered by the household and the price of each unit of education thus influence the choice of δ_h^q and 1-δ_h^q via the direct cost of education. The income maximization constraint (equation 3) plays an

[10] In the case of a standard (dynamic) human capital accumulation model (ex: Ben Porath, 1967), the opportunity cost of education is expressed in terms of the wage for unqualified workers. This results from the fact that, in order to increase a household's level of human capital, unqualified workers have to be withdrawn from the unqualified labour market and sent to school. In the case of the present study (comparative static) the opportunity cost takes a somewhat different meaning. The household's trade-off is between a longer period of work (without investing time in education) at a lower wage and a shorter duration of work at a higher (qualified) wage. Since households determine their optimal share of qualified labour, rather than the optimal time to invest in education, we are thus faced with an opportunity cost of having more qualified labour rather than the classic opportunity cost of education. As a result, this cost should express the fact that having more qualified labour implies a smaller share of active qualified workers. In effect, if the wage is higher, having more qualified labour is more beneficial (a higher wage for each year in work) but is also more costly (more years at study, fewer working years working for this higher wage).

important role in modeling the education decision. It represents the limited opportunities to acquire qualifications. Without this constraint, even the slightest change in the benefits or costs of education would encourage the household to allocate all of its labour to one or the other of the types of labour. The ease with which households are in a position to complete this transformation depends on the transformation elasticity[11] associated with the CET function and, as a result, of the value of the transformation parameter k^l.

When choosing δ_h^q and 1- δ_h^q, the household makes a trade-off between the benefits of having more qualified labour in the household and the costs of education (both direct and opportunity costs).

The resulting choice function is:

$$\delta_h^q.\overline{LS_h} = \left(\underbrace{\frac{W_q(1-s)}{W_{nq}}}_{relative\ \ gain} - \underbrace{\frac{s\beta_{h,edb}Pc_{edb}}{W_{nq}}}_{relative\ \ cost} \right)^{\tau^l} \left[\beta_h^l / (1-\beta_h^l) \right]^{\tau^l} (1-\delta_h^q)\overline{LS_h} \qquad [5]$$

$$\frac{\delta_h^q}{1-\delta_h^q} = \left(\overbrace{\underbrace{\frac{W_q}{W_{nq}}}_{skills\ \ premium} - \underbrace{\frac{sW_q}{W_{nq}}}_{opportunity\ \ cost} - \underbrace{\frac{s\beta_{h,edb}Pc_{edb}}{W_{nq}}}_{direct\ \ cost}}^{net\ \ gain} \right)^{\tau^l} \left[\beta_h^l / (1-\beta_h^l) \right]^{\tau^l} \qquad [6]$$

where

τ^l is the constant elasticity of transformation, $\tau^l = 1/(k^l - 1)$.

The benefit of getting educated (accounting for the time invested in education) in this equation is $W_q(1-s)/W_{nq}$ while the cost is $s\beta_{h,edb}Pc_{edb}/W_{nq}$. Thus, if the benefit increases by substantially more than the direct cost, relative to the unqualified wages, all else equal we should expect households to increase their endowment of qualified labour according to the elasticity and their initial labour endowment.

Once δ_h^q and 1- δ_h^q are known, the household supplies a quantity $(1-\delta_h^q)\overline{LS_h}$ of unqualified labour to production activities and a quantity $(1-s)\delta_h^q\overline{LS_h}$ of qualified labour (non-students, i.e., the active share). Remaining potential qualified labour, $s\delta_h^q.\overline{LS_h}$, refers to individuals who are in school and are thus inactive on the labour market.

[11] Cf. step 3 from the methodology section for the choice of this elasticity.

Finally, having defined the budget constraint, the household must then maximize their utility function as usual in order to determine their consumption of various goods and services (other than the two education services, which do not bring any utility to the household).

3.2 Government

The government's income is comprised of taxes collected and transfers from the rest of the world (through bilateral and multilateral cooperation). It allocates between public spending and transfers, and thus determines its deficit or its current surplus. In the case of a surplus, additional funds can then be used to finance investment. Since primary education is partially subsidized by the government, a share of its spending is devoted to this sector. Such spending is endogenous because it depends on households' demand for education.

In effect, the government subsidy for primary education demanded by these households acts as a per-unit subsidy. The volume of government consumption (G_{edb}) of primary education is defined as:

$$G_{edb} = \overline{TED_h} \sum_h s\delta_h^q \overline{LS_h} \qquad [7]$$

Public spending on education does not directly produce human capital. Rather, it reduces the private cost (and thus the direct cost) faced by households, encouraging these households to invest more in primary education. Higher education is also subsidized. However, since household demand for higher education is presumed fixed, the amount of this level of education covered by the government is exogenous, as opposed to the case for the volume of primary education, which is endogenous.

The government budget constraint can be written as:

$$\overline{SG} = YG - Pc_{edb} G_{edb} - Pc_{eds} \overline{G_{eds}} - Pc_{ser} \overline{G_{ser}} - transfers \qquad [8]$$

$\overline{SG}$ ≡ Government savings
$\overline{G_{eds}}$ ≡ Government consumption of higher education
YG ≡ Government income
$\overline{G_{ser}}$ ≡ Government consumption of services other than education

Pc_{ser} ≡ Consumer price of a unit of service.

Government savings ($\overline{SG}$, the current budget surplus), revenues and spending (other than on primary education) are held constant by using sales taxes on consumer products to cover spending. We also compare the results with alternative compensation mechanisms.

3.3 Production factors

Labour, land and capital are the production factors. Land is specific (immobile) and exclusive to the agricultural sector, with returns to land depending on demand from agricultural sectors. Since the economic effects of education, the central concern of this study, are largely felt over the long run, we model capital as mobile between production sectors. This results in a single rate of return to capital across the economy.

Labour is divided into unqualified (not having completed primary school) and qualified (having completed the primary school or beyond) labour. Workers are mobile between sectors, resulting in a single wage for each type of work in each sector. Sector-specific wage variations after the shock are the result of sector-specific labour demand and the relative scarcity of each type of labour. Wage flexibility allows for the labour market clearing.

Algebraically, the equilibrium conditions are:

$$\sum_h LNQ_h = \sum_i LDNQ_i \qquad [9]$$

$$\sum_h LQA_h = \sum_i LDQ_i \qquad [10]$$

where

LNQ_h ≡ Volume of unqualified labour in household *h* and $LNQ_h = (1-\delta_h^q)\overline{LS_h}$; [11]

LQA_h ≡ Volume of qualified labour in household *h* and $LQA_h = (1-s)\delta_h^q\overline{LS_h}$; [12]

$LDNQ_i$ ≡ Demand for unqualified labour by sector *i*;

LDQ_i ≡ Demand for qualified labour by sector *i*.

Given the flexibility of education and the household's labour endowment, the relative scarcity of these two categories is affected by household education decisions. For example, an increase in household education demand, all else equal, would: (i) increase the supply of qualified labour; (ii) decrease the supply of unqualified labour and (iii) decrease the volume of active labour supplied. The expected effects on wages would thus be an increase in wages for unqualified workers relative to qualified workers.

3.4 Production sectors

Each production sector uses a constant returns technology and is perfectly competitive. The output results from the combination of a fixed proportion of value added and intermediate consumption. As for value added, it is represented by a nested constant elasticity of substitution (CES) function of composite labour and capital. Composite labour is itself a

CES function of skilled and unskilled labour. As a result, a change in the composition of household labour supply resulting from a new policy would influence the volume of composite labour and the composite factor as well as that of value added and final output.

3.5 Equilibrium and macroeconomic closure

The macroeconomic closure of the model is as follows:

- Markets for goods and services are perfectly competitive; prices are determined by supply and demand adjustments. Consumption prices, however, are modified by state intervention via fiscal policy.
- We assume full employment[12] for labour, remuneration for which is set by supply and demand adjustments on each market (for qualified and unqualified labour).
- Government savings and the current account balance are held fixed by endogenous adjustment of taxes (on consumption and household income) and the consumer price index.
- Real investment (in volume) is financed by savings of households, the government and the rest of the world.

Step 2: Other model parameters

The model uses parameters from external sources, notably: the income elasticity of demand for products (other than demand for the two types of education); the Frisch parameter; the elasticity of substitution between imported and domestic products; the elasticity of substitution between qualified and unqualified labour; the elasticity of transformation between external sales (exports) and domestic sales; the elasticity of transformation between the two categories of labour, etc. These parameters are either calibrated using the SAM or are borrowed from the literature on CGE models and empirical studies in other developing economies.[13] Specifically, it is assumed that households have a limited ability to "transform" unqualified labour into qualified labour (equation 3). This is reflected by a constant elasticity of transformation function, proposed to be equal to 2.5. Transformation of labour is thus elastic.

Returns to education on the labour market, i.e., the impact of a complete additional year on income, can be estimated using a Mincer equation (Mincer, 1958). In our model, the returns associated with the change from being unqualified (not having completed primary school) to being qualified (having completed primary schooling or more) should lie somewhere between the returns to completion of primary school and the returns to completion of

[12] We could also introduce unemployment. If the unemployment rate for qualified workers is high, we may assume that these workers will not tolerate the additional education effort to acquire a higher skill level.
[13] Details on CGE parameters are addressed by Annabi *et al.* (2006).

secondary school. In the case of Burkina Faso, returns to completion of primary education are assumed to be 9% (World Bank, 2004).

Step 3: Analysis of poverty, welfare and income distribution

The indicators of poverty and the income distribution are constructed using the DAD software package under Stata (Duclos, Araar and Fortin (2009)). The equivalent variation (EV) is used to measure the impact on welfare. The impact of education on welfare is thus measured indirectly via its effects on the net income used to purchase utility-enhancing goods and services. On the one hand, education contributes to the growth in the stock of (better paid) labour. On the other hand, investment spending on education reduces resources available to spend on the goods and services that yield utility or welfare.

We use an absolute poverty line for all household categories in the survey. The consumer price index (CPI) in the simulation varies according to the consumption patterns. These changes in the CPI are then applied to the poverty line, making this threshold endogenous: variations in prices of goods thus alter the poverty line. The FGT indices in the initial situation are first calculated using the total level of real consumption per capita.

After the simulation, each household category's net change in income as generated by the CGE model is then expressed as per capita consumption for each household category in the survey. Moreover, the poverty line is adjusted to account for changes in the CPI resulting from the simulation. The new FGT indices are calculated using this new threshold and new levels of real per capita consumption. Finally, the impact on the FGT indices is evaluated.

4 Basic data and description of the structure of the economy

Calibration of our model is carried out using the 2004 SAM constructed by Nouve and Ouattara (2004) for the World Bank. It contains 119 accounts grouped into six categories: factors, agents, sectors, domestic demand, external demand and accumulation. The SAM includes six household categories with seven sources of income: qualified wages, unqualified wages, gross operating surplus, land rents, transfers from other households, public transfers and transfers from abroad. It also has four types of expenditures: consumption,[14] transfers to other households, taxes and saving.

We specify four levels of education: primary, the first level of secondary, the second level of secondary and post-secondary or university. For the purposes of this study, the first level is the primary education sector, while the three higher levels are aggregated to form the higher education sector. Analysis of labour begins with a much more detailed picture of the

[14] We distinguish education consumption (expenditure) from the other ones which are obtained by maximizing the utility function.

level of household qualifications. We thus specify five levels of qualification: not having completed primary, having completed primary, lower secondary, upper secondary and post-secondary.

In conformity with the objectives of the study, we consider the first level as unqualified labour and aggregate the last four as qualified labour. The poverty analysis is based on data from the Household Living Conditions Survey (HLCS) carried out by the National Institute of Statistics and Demography in 2003. The HLCS includes 8500 households across the 13 regions of the country. It provides information, notably on income, education expenditures and health spending.

The sources of household income by socio-professional category are shown in table 4.1. We find that all household categories earn a large share of their wage income from unqualified labour, with this figuring surpassing 50% of income for private informal wage earners. This explains the poor showing for qualifications in the reference situation.

Returns to capital are the majority (52%-63%) of household income for all household types other than wage-earning ones. All household types receive some income from land, although this share is negligible for public and private formal wage earners (0.4%). The largest share of income for public and private formal employees comes from wages paid to qualified labour (43.2%).

Table 4.1: Household source of income according to socio-professional category (% of net income) [a]

	Public and private formal wage earners	Private informal wage earners	Cotton farmers	Food farmers	Livestock farmers	Independent and inactive	**All households**
Unqualified labour	34.4	59.8	20.6	22	20.7	29.3	**27.1**
Qualified labour	43.2	31.1	0.7	1.3	3	8.1	**11.7**
Capital	20.6	5.3	62.3	59.5	62.9	51.6	**49.4**
Land	1.7	0.4	5.3	5	5.3	4.3	**4.2**
Intra household transfers							
Formal wage-earners – public and private	-	-	1.3	0.9	-	0.4	**0.5**
Informal wage-earners – private	-	-	0.4	0.3	-	0.1	**0.1**
Livestock farmers	-	-	4.6	3.2	-	1.4	**1.7**
Independent and inactive	-	-	1.2	0.8	-	-	**0.4**
Total intra household transfers	-	-	**7.5**	**5.2**	**-**	**1.9**	**2.7**
Public transfers	2.7	1.4	0.3	2.2	2.4	2.7	**2.1**

Transfers with ROW	3.8	3.5	4.1	5.9	6.2	5.1	**5.0**
Gross income	**106.3**	**101.5**	**100.9**	**101.1**	**100.5**	**103.1**	**102.2**

Source: SAM.
[a] ROW stands for rest of world

Public and private employees (whether formal or informal) and livestock farmers do not receive transfers from other households. A share of their income (respectively 0.5%, 0.1% and 1.7%), is thus allocated to transfers to these households without compensation. Government transfers to cotton farmers are marginal, at 0.3% of net household income, and are also quite weak among public and private informal workers. However, among other household categories, they remain fairly evenly distributed and vary between 2.2% and 2.7% of household income. All household groups depend on remittances.

Table 4.2: Household investment in education (% of net income) [a]

	Public and private formal wage earners	Private informal wage earners	Cotton farmers	Food farmers	Livestock farmers	Independent and inactive	**All households**
Primary education spending	2.9	0.6	0.8	1.0	0.4	1.7	**1.3**
Higher education spending	3.4	0.9	0.1	0.1	0.0	1.3	**0.9**
Investment in education	**6.3**	**1.5**	**0.9**	**1.1**	**0.5**	**3.1**	**2.2**
Income net of education spending	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Savings	13.7	14.6	3.4	6.3	18.3	13.9	**11.3**
Direct taxes	5.5	0.2	2.8	0.7	0.7	0.3	**1.8**

Source: SAM.
[a] Net income is calculated after deducting education expenditures.

The share of income allocated to primary education spending among public or private (informal or formal) wage earners is less than spending on higher education due to the substantial presence of the government at the primary and preschool levels[15] (table 4.2). Moreover, we observe that other household types allocate a higher share of their net incomes to primary education than they allocate to higher education. This confirms these households' low share of members in higher education and thus their poor level of qualification in the initial situation.

[15] The government of Burkina Faso attaches a particular interest in the primary education sector, upheld by development partners and actualized by the 10-Year Primary Education Development Plan (PDDEB). This brought the gross school enrolment rate from 44 % in 2000/01 to 74.9 % in 2009/10.

The government draws a major share of its revenues from returns to capital (39.1%) and taxes on products (22.5%) (Table 4.3). Taxes on production and direct taxes are less important sources of revenues, respectively amounting to 5.9% and 6.2% of public revenues.

Table 4.3: Sources of revenue and government budget items

	Value (billions CFA)	Share (%)		Value (billions CFA)	Share (%)
Revenue			**Expenditures**		
Capital	267.8	39.1	Administration	518.6	75.7
Taxes net of subsidies on production	40	5.9	Primary education	50.3	7.3
VAT and other taxes on products	154.5	22.5	Higher education	17.7	2.6
Taxes on imports	79.5	11.6	Household transfers	49.1	7.2
Direct taxes	42.6	6.2	Savings	49.7	7.3
ROW	100.9	14.7			
Total	**685.4**	**100**	**Total**	**685.4**	**100**

Source: SAM.

This income is allocated among current and investment spending (education and other administration), transfers to households and savings (the current budget surplus) respectively accounting for 85.6%, 7.2% and 7.3% of total public expenditures. More specifically, the education expenditures found in the SAM represent 10% of public spending. Well over half, or 73%, of these expenditures are devoted to primary education.

The SAM data show that the total cost of a unit of education differs by household category (table 4.4). We could imagine that a unit of education is more expensive for a rural household because, for example, students must go further to attend classes or pay additional costs for a private tutor. This is also the case for agricultural households living in urban areas on the edge of large cities. This situation would thus definitely affect the simulation results.

Moreover, the share of the cost of education covered by cotton-farming households, food farmers, livestock farmers and the independent or inactive is greater than that paid by the government (see the “private share of unit cost” variable). Wage-earning households, for their part, pay a relatively low share of the unit cost.

Table 4.4: Distribution of education costs [a]

	Private unit cost	Public unit cost	Total unit cost	Private share of unit cost (%)
Public and private formal workers	0.2	0.6	0.9	27.1
Private informal workers	0.1	0.6	0.7	10.1
Cotton farmers	2.0	0.6	2.7	76.7
Food farmers	2.7	0.6	3.3	81.3
Livestock farmers	0.5	0.6	1.1	44.1
Independent and inactive	0.7	0.6	1.3	53.7
All households	**0.4**	**0.6**	**1.0**	**40.0**

Source: SAM, calculated using GAMS.
[a] Cf. equation 4.

Notwithstanding this cost difference between households, it is assumed here that the government subsidy for each unit of education is the same. Since the government subsidy is the same for each unit regardless of its total cost, this has the effect of advantaging some households to the detriment of others.

5. Scenario and simulation results

In order to analyze the impacts of public spending on education in Burkina Faso, we simulate a 40% increase in public primary education subsidies, the same for each socioeconomic household type. When the state wishes to maintain a fixed current balance, an increase in spending requires an increase in taxes to rebalance the budget. This budget-balancing strategy can create distortions and compromise the goal of household poverty reduction.

The impact of the increase in taxes on households would be a function of the nature of this measure. It is recognized that direct taxes or taxes on income and wealth create smaller distortions than indirect taxes. This means that a consumer's level of utility is higher with an

additional direct tax than with an indirect tax, even if the two generate the same levels of tax receipts.

In this study, we adopt two alternative tax mechanisms, summarized in table 5.1, to maintain a constant level of government revenues following its discretionary policy to increase education spending.

In the following sections, the results of the first scenario (SIM1) are first presented in terms of the impacts on education and labour demand, the distribution of household income and consumption prices and welfare, before moving to the results of the alternative scenario (SIM2).

Table 5.1: Scenarios and financing method

Scenario		Financing mechanisms	State budget balance	
			Base	After simulation
SIM1	40% increase in public primary education spending	7.2% income tax increase	49.66	49.66
SIM2	40% increase in public primary education spending	2% sales tax increase	49.66	49.66

First scenario (SIM1)

In this scenario, we assume that the government looks to domestic financing to cover the additional expense[16] through taxes on household income. The overall impact of this policy on poverty and welfare is difficult to predict *a priori*.

a) Education demand and the labour market

We have three mechanisms whereby the public education spending shock is transmitted to households:

The "direct cost" effect: As per equation 4, a 40% increase in the government subsidy ($\overline{TED_h}$) would have the effect of reducing the private unit cost of primary education ($\beta_{h,edb}$) by the same amount for each student. This directly increases the net gain from investment in primary education in equation 6.

The "relative income" effect: Households respond to a decline in the direct cost of education by increasing their investment in primary education which, in turn, increases their supply of qualified labour as well as the time devoted to primary education. Since their overall labour endowment is fixed, this implies that the supply of unqualified labour

[16] The state could adopt a counter-cyclical policy. In this case it could finance the additional spending thanks to the bilateral and multilateral partners' aid to minimize the distortions as much as possible.

must decline. The result is a relative decline in wages for those with qualifications and a decline in the net benefit of primary education.

The "opportunity cost" effect: The decline in relative wages also results in lower opportunity costs. This decline in the opportunity costs is, however, proportionally lower than the decline in relative wages because the share, *s*, of the active life devoted to studies in order to acquire qualifications is less than one. Since the opportunity cost reinforces the "direct cost" effect, the result is an increase in the net gain from primary education.

All else equal, the public subsidy's share of the cost increases from 0.62 to 0.87[17] (table 5.2). Since the total unit cost of education[18] is fixed, this leads to a decline in the private unit cost of education ($\beta_{h,edb}$) from 0.38 to 0.13 for all households together. As a result, the direct cost of education declines, from a share of 0.094 to 0.013. Moreover, the results indicate that the increase in the public subsidy leads to an identical decline in the relative wage and opportunity costs for all households. As we will see later on, this can be explained by the fact that households increase their investments in education, and as a result, their supply of qualified labour. The net effect of these elements is an increase in net gain[19] of 2.78%. The households react by increasing demand for education by 1.2% (variable "Students" in table 5.2).

This increase in the demand for education brings about an identical increase in the volume of labour supplied by households.[20] Since each household's total endowment is fixed, this increase is compensated for by a small decline in the supply of unqualified labour (-0.09%). Although it occupies a greater share of the total amount of labour in the economy, the decline in the supply of unqualified labour did not lead to a decline in the number of active workers in the economy.[21] This figure actually increases by 0.27%.

As table 5.2 shows (cf. the "active labour" variable), 98.34% and 98.55% of cotton- and food-farming households are active in the reference situation. Among these households, the increase in the volume of qualified labour, together with the related decrease in the volume of unqualified labour, leads to an increase in the volume of active labour. However, these results show that an increase in qualified labour and a decrease in unqualified labour following the

[17] We find some deviation relative to the initial goal of 40% because households adjust their behaviour when facing lower costs.
[18] In this part of the study, the word "education" is often used to refer to primary education.
[19] Note that all of these elements are components of the net gain expressed in equation 6.
[20] In fact, the volume of qualified labour, $(1-s)\delta_h^q \overline{LS_h}$ and household investment in education, $s\delta_h^q.\overline{LS_h}$, (the volume of students) are proportional because s (the share of active life) is exogenous (section 4.1).
[21] Note that total active household labour is composed of active qualified labour (26.24%) and unqualified active labour (66.04%).

shock, all else equal, leave the volume of active labour of wage-earning households unchanged. Since agricultural households are a large share of the Burkinabé population (about 80% in 2006 according to the last population census), an increase in the volume of active labour for this group implies the same for the economy as a whole. On factor markets, the increase in the supply of qualified labour and the decrease in that of unqualified labour leads to a decrease in qualified wages (-7.19%) and an increase in the unqualified wage (0.31%), as presented in table 5.3.

The results show that the impact of the public education subsidy on education varies according to the household category and the variation in net gain. All households face the same absolute change in benefits because the public subsidy is uniform. Furthermore, the relative wage and opportunity cost are the same for all households because they observe the same qualified and unqualified wages and also spend the same share of active life in study. Therefore, the change in the net benefits of getting an education is only dictated by that of the direct cost. Given their high initial direct cost and their weak initial net benefits, cotton and food farmers see a larger increase in the net benefit of getting an education after the subsidy shock. However, wage-earnings households with marginal direct costs[22] and thus with the highest net benefit initially see their net benefits decrease after the subsidy shock.

In addition to the benefit shown in table 5.2, the household's education choice also depends on the distributive parameter β_h^l and the transformation elasticity[23] τ^1 (equation 6). The weaker the initial level of the volume of qualified labour, the more the volume of students and qualified workers increases after the shock. Agricultural households have a very low share of qualified household members and thus see a larger increase in the share of qualified members. This contrasts with wage-earning households, who lower their investment in education and thus their supply of qualified labour.

We can conclude that this public primary education subsidy policy improves the benefits of getting an education. This leads to an increase in the supply of qualified labour and, ultimately, to a decline in the supply of unqualified workers in the economy, which brings an increase in unqualified wages.

[22] Note that the small cost for this category of household is more than neutralized by the 40% increase in the public subsidy such that it becomes negative after the shock (cf. bloc simulation: primary education cost, table 5.2). This can be explained by the assumption of fixed unit costs such that 40% of the increase in public spending per unit turns out to be very important for wage earners.
[23] Cf. Section 3 for the elasticity choice.

Table 5.2: Structure and impact on education and labour supply

	Public and private formal workers	Private informal workers	Cotton farmers	Food farmers	Livestock farmers	Independent and inactive	**All households**
Base: cost of primary education							
Private unit cost	0.23	0.07	2.04	2.69	0.50	0.72	**0.38**
Public subsidy	0.62	0.62	0.62	0.62	0.62	0.62	**0.62**
Total unit cost	0.85	0.69	2.66	3.31	1.12	1.34	**1.00**
Share (%) private cost	27.06	10.14	76.69	81.27	44.64	53.73	**38.00**
Simulation: Cost of primary education							
Private unit cost	-0.02	-0.18	1.79	2.45	0.25	0.47	**0.13**
Public subsidy	0.87	0.87	0.87	0.87	0.87	0.87	**0.87**
Total unit cost	0.85	0.69	2.66	3.32	1.12	1.34	**1.00**
Share (%) of private cost	0.00	0.00	67.29	73.80	22.32	35.07	**13.00**
Base: income and education cost							
Relative income	1.09	1.09	1.09	1.09	1.09	1.09	**1.09**
Opportunity cost	0.25	0.25	0.25	0.25	0.25	0.25	**0.25**
Direct cost	0.06	0.02	0.51	0.67	0.12	0.18	**0.094**
Net benefit	0.792	0.832	0.34	0.176	0.726	0.669	**0.756**
Simulation: income and education cost							
Relative income	1.02	1.02	1.02	1.02	1.02	1.02	**1.02**
Opportunity cost	0.23	0.23	0.23	0.23	0.23	0.23	**0.23**
Direct cost	-0.005	-0.043	0.428	0.585	0.059	0.113	**0.013**
Net benefit	0.790	0.829	0.358	0.201	0.727	0.673	**0.777**
Δ % Net benefit	-0.25	-0.36	5.29	14.20	0.14	0.60	**2.78**
Base: Share (%) of total household labour							
Unqualified labour	40.34	62.05	92.68	93.63	85.4	75.34	**66.04**
Qualified labour	46.11	29.33	5.66	4.93	11.28	19.06	**26.24**

Active labour	86.44	91.38	98.34	98.55	96.68	94.4	**92.29**
Students	13.56	8.62	1.66	1.45	3.32	5.6	**7.71**
Result: volume (%)							
Δ Unqualified labour	0.28	0.34	-0.36	-0.49	-0.05	-0.24	**-0.09**
Δ Qualified labour	-0.24	-0.67	13.13	38.11	0.37	1.11	**1.20**
Δ Active labour	0.00	0.02	0.41	1.44	0.00	0.03	**0.27**
Δ Students	-0.24	-0.67	13.13	38.11	0.37	1.11	**1.20**

Source: Authors' calculations.

b) Impacts on household income

In order to evaluate the impact of public primary education subsidies on welfare and poverty, we should start by looking at its effect on the distribution of income and consumer prices. We find five principal transmission channels (Cloutier *et al.* 2008) through which the shock influences household income: the effect on the volume of potential qualified labour, the wage effect, the non-labour income effect, the cost of primary education and the higher education cost effect. Taking the total differential of equation 2, we have:

$$
\begin{aligned}
\Delta YH_h \approx \quad & [W_q(1-s) - W_{nq}]\Delta\delta_h^q \overline{LS_h} \quad \Big\} \text{Volume of labour effect} \\
& + \Delta W_{nq}(1-\delta_h^q)\overline{LS_h} + \Delta W_q(1-s)\delta_h^q \overline{LS_h} \quad \Big\} \text{Wage effect} \\
& + \Delta \text{ non-labour income} \quad \Big\} \text{Non-labour income effect} \\
& \left.\begin{aligned} & -\Delta P c_{edb}\beta_{h,edb} s \delta_h^q \overline{LS}_h \\ & -P c_{edb}\Delta\beta_{h,edb} s \delta_h^q \overline{LS}_h \\ & -P c_{edb}\beta_{h,edb} s \Delta\delta_h^q \overline{LS}_h \end{aligned}\right\} \quad \text{Direct cost effect} \qquad [13] \\
& - \Delta \text{ higher education cost}
\end{aligned}
$$

Since household income mostly comes from payments to production factors, the first three channels perfectly explain the variation in gross household income (after education investment expenditures). The combined effect of these three channels is a 0.61% reduction in gross income for households as a whole (table 5.3).

The "volume of labour" effect, can also be written as $[(w_q - w_{nq})(1-s) - sw_{nq}]\Delta\delta_h^q LS_h$. As highlighted above, an increase in the public primary education subsidy leads to an increase in the net benefit of getting an education, i.e., of investing in primary education. At the new equilibrium, there is an increase in household endowments of qualified labour (i.e., an increase in δ_h^q).

On the one hand, an increase in $\delta_h^q LS_h$, the volume of qualified labour, increases household income by the amount of the qualified-unqualified wage differential $w_q - w_{nq}$ (which we assume is equal to 1-0.91=9%) that workers would have earned during their active working life, $1-s$. On the other hand, household income is reduced by w_{nq} = 91%, where w_{nq} stands for the forgone earning (the opportunity cost of devoting part of the active life in studies). The increase in the opportunity cost $sw_{nq}\Delta\delta_h^q LS_h$ is greater than the increase in active qualified labour, $(w_q - w_{nq})(1-s)\Delta\delta_h^q LS_h$. Therefore, the total net effect is negative.

"Wage" effect: The variation in income as decomposed above also results from the effects on returns to labour. The unqualified wage rate increases by 0.31% while that of qualified labour decreases by 7.19%. Initially, the volume of unqualified labour, $(1-\delta_h^q)LS_h$, is higher than that of active qualified labour, $(1-s)\delta_h^q LS_h$, in the economy. The increase in unqualified wages (0.31%) is fairly low relative to the decline in qualified labour wages (7.19%). Thus, the total effect, $\Delta w_{nq}(1-\delta_h^q)LS_h + \Delta w_q(1-s)\delta_h^q LS_h$, is negative.

"Non-labour income" effect: The impact of the shock on various sectors via wage costs explains the change in returns to other production factors, namely, capital and land. Rather than substituting capital and land for qualified labour becoming cheaper, sectoral demand for these two factors increases. The rates of return to capital and land thus increase in turn (table 5.3).

Finally, the two first effects (labour and wage), and to a lesser extent the third effect, determine the overall impact on gross income. Since these two effects are negative, the total effect on gross income, $[(w_q - w_{nq})(1-s) - sw_{nq}]\Delta\delta_h^q LS_h + \Delta w_{nq}(1-\delta_h^q)LS_h + \Delta w_q(1-s)\delta_h^q LS_h$, is negative. This explains the 0.61% fall in gross income for households as a whole, with variation differing among household categories.

We find a decline in income among formal public and private formal workers as well as among private informal workers. This is because they initially have more qualified labour in the business as usual situation, which sees a decline in wages after the shock (wage effect). Moreover, these household categories do not transform unqualified labour into qualified labour. This has a negative impact on income earned from qualified labour and a positive impact on income earned from unqualified labour for these household categories (volume of labour effects). Since the decline in qualified labour income is larger than the increase in unqualified labour income, and since the change in the other income sources is marginal, their gross income respectively fell by 2.81% and 2.01% (table 5.3).

As for agricultural households (food and cotton farmers), they transform unqualified labour into qualified labour, positively impacting their income from qualified labour. Also, in the reference situation, they have a very high share of volume of unqualified labour, and wages for unqualified labour increase (by 0.31%) following implementation of the new policy. These two effects thus lead to an increase in their gross revenue, respectively by 0.35% and 0.09% for food and cotton farmers.

Livestock farming and independent households also experience a decline in their gross income under the education policy. As is the case for farmers, these households benefit from the positive impact that qualified labour has on their income because they transform unqualified labour into qualified labour through education. Moreover, they are endowed with qualified labour in the reference situation, while wages paid to this production factor fall by 7.19% following the shock. The (negative) income effect thus seems to dominate, leading to a decline in gross income for these household categories.

"Primary education cost" effect: The cost of education is affected in a number of ways. An increase in the public education subsidy leads to a decline in the private unit cost of this type of education. All households benefit from a decline in the unit cost they pay for primary education. Only wage-earner households, who already face a low cost before the shock (table 5.2), benefit from a more than 100% decline in their education expenditures (table 5.3). The result is an increase in net household income. However, increasing investment in primary education (implicitly increasing δ_h^q) directly leads to an increase in the cost covered by households, leading to a decline in net income. Finally, the lower education prices faced by households resulting from the general equilibrium effects of the demand and supply affect their net income.

“Higher education cost” effect: The cost of higher education has no effect on net income because it is presumed exogenous.

The combined impact of all these effects is a 0.53% increase in net income. The agricultural households benefit from a larger increase than other household categories. It was noted above that the consequences of the "volume of labour effect” and “wage effect” was that agricultural households’ gross income increases, while that of other households decreases. Since all households benefit from the lower cost of primary education associated with this policy, it is largely the change in gross income that explains the change in net income. Moreover, the fact that farmers’ gross income increases while other households’ income decreases shows that they benefit more in terms of increased income (table 5.3).

Table 5.3: Structure and impact on household income, by source

	Unqualified labour *h*	Qualified labour *h*	Capital *h*	Land *h*	Other income *h*	**Gross income *h***	Primary ed. spending *h*	Higher ed. spending *h*	**Net income *h***
Base: Share of net income									
Public and private formal wage earners	34.4	43.2	20.6	1.7	0.2	**106.3**	2.9	3.4	**100**
Private informal wage earners	59.8	31.1	5.3	0.4	3.4	**101.6**	0.6	0.9	**100**
Cotton farmers	20.0	1.3	62.3	5.3	11.1	**100.9**	0.8	0.1	**100**
Food agriculture	22.0	1.3	59.5	5.0	12.2	**101.1**	1.0	0.1	**100**
Livestock farmers	20.6	3.0	62.9	5.3	8.1	**100.4**	0.4	0.0	**100**
Independent and inactive	29.3	8.1	51.6	4.3	6.6	**103.0**	1.7	1.3	**100**
All households	**27.0**	**11.8**	**49.4**	**4.2**	**7.7**	**102.2**	**1.3**	**0.9**	**100**
Result: Δ % returns									
	0.31	-7.19	0.10	0.32	-	-	-86.23	0.00	-
Result: Δ %Income									
Formal public and private workers	0.58	-7.41	0.01	0.03	0.00	**-2.81**	-108.1	0.00	0.25
Informal private workers	0.65	-7.81	0.00	0.00	0.00	**-2.01**	-355.3	0.00	0.19
Cotton farmers	-0.06	5.00	0.01	0.08	0.00	**0.09**	-36.4	0.00	0.39
Subsistence agriculture	-0.19	28.19	0.03	0.15	0.00	**0.35**	-98.2	0.00	1.34
Livestock farmers	0.26	-6.85	0.02	0.12	0.00	**-0.08**	-52.2	0.00	0.15
Independents and inactive	0.06	-6.16	0.01	0.09	0.00	**-0.43**	-37.4	0.00	0.24
All households	**0.21**	**-6.08**	**0.02**	**0.11**	**0.00**	**-0.61**	**-86.2**	**0.00**	**0.53**

Source: Authors' calculations.

c) Impact on welfare and poverty

In addition to the income effects explored above, an increase in public education spending affects consumption prices. This price effect of the new policy mostly results from the government's will to maintain a fixed current surplus/deficit (see table 5.1). In this first scenario, the government adjusts its revenue with a tax on household income, which leads to a decline in consumption prices. This, in turn, has a positive impact on welfare and poverty.

Consumption prices vary somewhat between sectors due to general equilibrium effects on production costs and consumer demand: +0.15% (food agriculture), +0.16% (other agriculture), -0.09 % (industry) and -0.33% (other private services).

The final impact on the household consumer price index depends on their consumption profile. Since household consumption is oriented toward industrial products[24] (58.4% of expenditures, as shown in table 5.4) and consumer prices for this type of product decline, the consumer price index necessarily declines for all households (table 5.5). We also find that the decline is greater for wage earners due to the larger share of industrial products and other services in their consumption basket, whose price declined.

Table 5.4: Consumption profiles and impact on consumer prices and the household consumer price index (CPI)

	Food agriculture	Other agriculture	Industry	Other private services	**All**
Base: Share (%) of total consumption					
Public or private formal workers	2.7	12.2	60.8	24.4	**100.0**
Private informal workers	4.3	12.3	63.0	20.5	**100.0**
Cotton farmers	13.9	15.5	57.1	13.5	**100.0**
Food farmers	14.5	20.7	54.3	10.5	**100.0**
Livestock farmers	13.0	13.3	62.2	11.5	**100.0**
Independent or inactive	5.8	15.5	59.0	19.7	**100.0**
All households	**10.2**	**16.0**	**58.4**	**15.5**	100.0
Results: Prix					
Δ Sales tax *i*	0.00	0.00	0.00	0.00	**0.00**
Δ Domestic sales price *i*	0.15	0.16	-0.14	-0.34	**-0.44**
Δ Consumption price *i*	0.15	0.16	-0.09	-0.33	**-0.37**

Source: Author's calculations

Returning to our initial goal of investigating the effect of an increase in public education spending on poverty and welfare in Burkina Faso, we find that the joint effects on income and prices determine the final effects on poverty and household welfare. Table 5.5 shows that welfare improves for all household categories due to the positive effects of lower consumption prices and higher nominal income. We find that the increase in welfare is greater among agricultural households than others and that it is more related to income increase.

Table 5.5: Impact on welfare and poverty

	Δ % Net income ***h***	Δ% CPI ***h***	Δ %Welfare (EV/Net income) ***h***	Poverty line (in CFA)	Poverty rate (P0 in %) ***h***	Δ% Poverty rate (P0) ***h***	Δ % Poverty gap(P1) ***h***	Δ % poverty Severity (P2) ***h***

[24] We consider industrial products in a fairly broad manner. These are essentially transformed agricultural products, food commodities, etc.

Public and private formal workers	0.25	-0.11	0.23	82672	4.72	-0.57	-0.02	-0.01
Private informal workers	0.19	-0.10	0.18	82672	6.53	-0.00	-0.03	-0.02
Cotton farmers	0.39	-0.06	0.39	82672	18.25	-0.00	-0.08	-0.03
Food farmers	1.34	-0.04	1.24	82672	57.49	-0.33	-0.22	-0.13
Livestock farmers	0.15	-0.06	0.11	82672	52.28	-0.48	-0.21	-0.11
Independent and inactive	0.24	-0.09	0.22	82672	18.73	-0.47	-0.08	-0.03
All	**0.53**	**-0.07**	**0.49**	**82672**	**46.39**	**-0.42**	**-0.18**	**-0.10**

Source: Authors' calculations

Considering the poverty, we see that the average income increases and the average cost of households' consumption baskets declines. The resultant of this effect is higher real income at the national level and a 0.42% reduction in the number of poor in the country.

Looking at socio-professional categories, we see that the three (FGT) poverty indices decline across all household types. More specifically, farmers register a lesser decline in the average cost of products due to the increase in the price of agricultural products (which they consume more of), though this is somewhat offset by a greater increase in nominal income relative to other household categories. Thus, the decline in the incidence of poverty among these households is comparatively low. It is clear that the price drop for industrial products and other services (table 5.4) is more beneficial for wage-earning households than for other households. This explains the substantial decline in poverty among public and private formal workers.

Second scenario (SIM2)

Much like the first simulation, there is an increase in public spending on primary education, but here the additional expenditures are covered by a compensatory tax levied on consumer products (an indirect tax). In order to ensure the robustness of our results, we thus compare the effects of this new form of financing the government spending to the previous results. Our discussion will be limited to the major changes observed in the results.

The effective indirect tax rate is endogenously determined at 2% and leads to an increase in indirect tax revenues. Nominal income remains unchanged across the board. Consumption prices are a weighted average of the price of imports and that of domestically produced sales, plus indirect taxes. This "average" price is determined using the share of imports and domestic consumption for each product.

The introduction of an additional tax increases consumption prices of products, especially for products which are initially highly taxed and which constitute a large share of households' consumption baskets: industrial products (+0.05%), agricultural food products (+0.11%), and other agricultural products (+0.12%). As for the product from the other private services, they record a decline in consumption prices (-0.32%).

Finally, the consumer price index increases for all households, but wage-earning and independent households perform the best in this regard because they consume more products from other private services (table 5.4), which decline in price. Since the increase in nominal income (0.47%) is greater than that of the CPI (0.03%), however, the poverty indices decline at the national level, by -0.33% for the incidence of poverty, -0.13% for the poverty gap and by -0.07% for poverty severity. The analysis by socio-economic group shows that poverty is unchanged among wage-earning households, while it decreases among other household categories: food farmers (-0.33%), livestock farmers (-0.40%) and independent and inactive workers (-0.07%).

As should be expected, the decrease in the number of poor in such a scenario is smaller than in the previous scenario. In fact, for the same level of nominal income, the increase in consumer prices resulting from the tax on consumer products also reduces real household income. However, all households benefit in terms of improved welfare. For the reasons described above, the 0.40% improvement in measures of welfare in this scenario is somewhat countered by the increase in consumption prices.

6. Conclusion

Like many other countries, Burkina Faso has made education a major focus of its development strategy. This option is all the more important because it occurs in a context where more than two-fifths of the population remain under the poverty line. By incorporating the acquisition of qualifications into a static CGE model, while allowing households to alter their demand for education and their labour endowment, this study was able to analyze the impact that an increase in public primary education spending has on welfare and poverty.

The effect of increased public primary education spending on households can thus largely be explained in terms of its impacts on income (gross and net) and its impacts on consumption prices: lower consumption prices and higher nominal income for household improve their welfare.

On the one hand, the increase in education subsidies leads to an increase in demand for education among households involved in farming, livestock, or who are independent or inactive. There is also an increase in the volume of qualified labour and a decline in the volume of unqualified labour supplied on factor markets. Since production sectors respond by adjusting demand for these two production factors, the result is a decrease in qualified wages and an increase in wages for unqualified workers. The combination of the decline in qualified wages and the change in labour endowments benefits households' gross income except among wage-earning households. As for income net of education expenditures, all households benefit from an increase.

On the other hand, the increase in demand for primary education together with the supply from the education sector leads to a higher quantity of primary education "traded" in the economy. The government covers a portion of the unit cost of primary education – a share that is the same for each household category – and a large number of units of education. The government balances its budget by increasing sales taxes, leading to an increase in consumption prices. This price change leads to an increase in the consumer price index for all households, with the size of the increase depending on their consumption basket. However, if the government opts to adjust by taxing household income, the average cost of households' consumption baskets declines and this leads to a greater benefit in terms of welfare. Finally, it is the combination of price and income effects which determine the impact of the shock on welfare and poverty. All household types benefit from an increase in welfare and a decrease in poverty. This is also true for the economy as a whole.

These results are interesting because they show us that, given the current situation of the Burkinabè economy, a 40% increase in government spending on education in Burkina Faso would have substantial and differentiated impacts which benefit the poor and non-poor alike. It also highlights that the method of financing an additional spending policy in the education sector conditions the impact of the policy.

According to the simulation results, financing the policy through a tax on household incomes would have greater redistributive effects – a greater decrease in the number of poor households – than if it is financed by a sale tax. This finding shows that the government must choose wisely when considering policies to domestically finance education policy. Clearly, this is an encouraging result with respect to the poverty reduction strategy.

For future research, it would be interesting to endogenize the level of secondary and post-secondary education in a dynamic model by dividing the labour market into four: unqualified labour, primary qualified, secondary qualified and post-secondary qualified. We could then allow households to make more complex decisions by allowing them to select the level of education they wish to attain through investments in education.

References

[1] Agenor, P.R, Izquierdo, A. and Fofack. H. 2002 IMMPA: "A quantitative macroeconomic framework for the analysis of poverty reduction". World Bank Policy Research Working Paper 3092.

[2] Agénor, P.-R., Bayraktar, N. and Aynaoui. K. E. 2005. Roads Out of Poverty? Assessing the Links between Aid, Public Investment, Growth, and Poverty Reduction. World Bank Policy Research Working Paper 3490. World Bank.

[3] Annabi, N., Cockburn, J. and Decaluwe, B. 2006. “Functional Forms and Parameterization of CGE Models,” Poverty and Economic Policy Network Working Paper 2006-04.
[4] Ben Porath, Y. 1967. “The Product of Human Capital and Life Cycle Earnings”, Journal of Political Economy, 75:352-365.
[5] Bourguignon, F, Bussolo, F., Pereira da Silva, A., Timmer, H. and D. Van der Mensbrugge.2006. MAMS-Maquette for MDG Simulations: a simple Macro-Micro Linkage Model for Country-specific Modeling of the Millennium Development Goals or MDGs. World Bank Mimeo; 2004.
[6] Cahuc, P. and Michel. P. 1996. “Minimum wage, unemployment and growth”, European Economic Review, 40:1463-1482.
[7] Cloutier, M. H., Cockburn, J. and Decaluwe, B. 2004. "Éducation et pauvreté au Vietnam. Une analyse en équilibre général calculable". Draft working paper, PEP.
[8] Cloutier, M. H., Cockburn, J. and Decaluwe, B. 2008. “Education and Poverty in Vietnam: a Computable General Equilibrium Analysis” PEP Working paper 08-04.
[9] Dabla-Norris, E. and Matovu. J.M. 2002. “Composition of Government Expenditures and Demand for Education in Developing Countries”. IMF Working Paper 78.
[10] Duclos, J-Y., Araar, A. and Fortran, C. 2009. DAD 2.1 “A software for Distributive Analysis”, Page web: http//www.mimap.ecn.ulaval.ca.
[11] Jung, H.S. and Thorbecke, E. 2003. “The impact of public education expenditure on human capital, growth and poverty in Tanzania and Zambia: A general equilibrium approach”, Journal of Policy Modeling, Elsevier, Vol. 25:8:701-725.
[12] Logfren, H. and Diaz-Bonilla, C. 2006. “An Economywide Model for Analysis of MDG Country Strategies.” Techincal Documentation, World Bank Mimeo.
[13] Maisonnave, H. and Decaluwe, B. 2009. "Politique éducative et marché du travail en Afrique du Sud. Une analyse en équilibre général calculable dynamique". CIRPEE Working Paper.
[14] Nouve, K. and Ouattara, A. 2004. "Une matrice de Comptabilité Sociale pour le Burkina Faso pour l’année 2004". World Bank.