Journal of Economics and Public Finance
ISSN 2377-1038 (Print) ISSN 2377-1046 (Online)
Vol. 6, No. 1, 2020
www.scholink.org/ojs/index.php/jepf

Original Paper

Education and Poverty in Morocco: A Computable General Equilibrium Micro-simulation Analysis

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Received: January 1, 2020 Accepted: January 12, 2020 Online Published: February 25, 2020

doi:10.22158/jepf.v6n1p116 URL: http://dx.doi.org/10.22158/jepf.v6n1p116

Abstract

The paper uses a micro-simulation computable general equilibrium model (CGE) to analyze the impact on poverty of public spending in higher education in Morocco. The model incorporates 7062 households derived from the 2007 National Survey on Household Living Standards (ENNVM). Two scenarios are simulated: a 100% reduction in the unit cost of higher education supported by households and a 50% reduction in public spending on higher education. In this study, it is assumed that the investment behavior of households is linked to the share of the unit cost financed by the government in higher education. The results show that the policy of exempting households from bearing any unit cost of higher education encourages them to invest massively in education, which leads to increasing their income and consequently improving welfare and reducing poverty and inequalities. On the other hand, the reduction in public investment in higher education affects negatively the behavior of households to invest in education which leads to a decrease in welfare, an increase in poverty and a rise of inequalities.

Keywords

CGE model, Education, Microsimulation, Poverty

1. Introduction

Morocco has made considerable progress in several areas in recent years. At the economic level, ambitious sectoral policies have been implemented with the main objective of building a competitive, prosperous and inclusive economy. These policies relate more specifically to tax reform, the signing of several free trade agreements, the improvement of the business climate to enhance the attractiveness of the country to foreign investments, the acceleration of the structural transformation of the agricultural and industrial sectors. In social matters, the efforts made have certainly contributed to improving the

living conditions of the population, and this by significant enlargement in access to basic social services (drinking water, electricity, roads, education and health in particular in rural areas), increasing life expectancy and alleviating poverty and vulnerability.

Despite these advances, Morocco is today called upon to overcome new challenges and respond to complex requirements linked mainly to rapid and structural changes in the international and national environment. These changes concern several dimensions, namely the emergence of the digital economy, the evolution of digitalization, the growth of inequalities and climate change. In this context, improving the quality of the workforce is considered one of the prerequisites for overcoming these challenges and successfully making any transition to a higher level of development (Note 1). Therefore, the Moroccan public authorities continue to devote colossal budgets to the education and training sector in order to finance school support programs, particularly in disadvantaged urban areas and in rural areas.

In this context, this study aims to quantify and analyze the impacts of level of investment of households in higher education on poverty and income distribution. It is assumed that the investment behavior of households is linked to the share of the unit cost financed by the government in higher education. The simulation of the direct and indirect impacts of shocks on poverty is carried out thanks to a quantitative analysis framework based on the results of a micro-simulated general equilibrium model (CGEM). The data from the National Survey on Household Living Standards (ENNVM) carried out by HCP in 2007 are fully retained. These data concern 7062 households. Likewise, the model is calibrated based on data from the 2015 Social Accounting Matrix (SAM) published by HCP.

The economic structure and education system in Morocco are presented in section 2. The evolution of poverty indicators and public policies to fight poverty and inequalities are discussed in section 3. Section 4 presents a brief review of the literature on education and the human factor in economic thought and the modeling of poverty and education in computable general equilibrium. The fifth is reserved for the global description of the model. In the sixth section, the results obtained from the two simulations carried out are analyzed, specifying their impact on household welfare, poverty and income distribution. The seventh section is devoted to conclude.

2. Morocco's Economic Structure and Public Policies to Fight Poverty

2.1 The Economic Structure of Morocco

Over the past 15 years, Morocco has recorded positive GDP growth rates that have fluctuated between 2% and 6.3%, against rates that did not exceed 2.5% on average in the 1980s and 1.6% in the 1990s. This growth is mainly driven by domestic demand and in particular by household consumption expenditure as well as by the voluntarist investment effort undertaken by the public authorities. In fact, the public investment rate went from 22.3% in 2001 to 14.7% in 2007 and to 17.61% in 2018. On the other hand, the contribution of net foreign trade to growth remained negative. This is generally due to the fact that the value of imports tripled from 2000 to 2015 despite the sustained increase in exports. Morocco's trade deficit reached 18.6% of GDP in 2018.

In addition, the production structure is dominated by the tertiary sector with a share of 56.7% in 2018. For secondary activities, the processing industry is the main driver of Moroccan industry with a share of 16.14% of GDP. Agriculture remains very dependent on climatic conditions and rainfall, which makes its share in production fluctuating and variable from one year to the next. In terms of employment, it is notable that the growth of national economic activity did not allow to generate enough jobs, especially for young graduates and in the urban environment. Thus, the participation rate continues to drop, from 51.3% in 2001 to 46.2% in 2018 and the unemployment rate reached 9.8% in 2018 against 8.9% in 2011 considered the lowest historical level.

Table 1. The Economic Structure of Morocco

	2001	2007	2018
GDP growth	6.3	2.7	3
Activity rate	51.3	51	46.2
Unemployment	12.5	9.8	9.8
Public investment (in% of GDP)	22.28	14.7	17.7
Production structure	100	100	100
Agriculture	15.57	13.73	13.92
Industry	30.96	27.31	29.38
Services	53.47	58.96	56.70
Fiscal deficit (in% of GDP)	-2.62	0.16	-3.7
Trade deficit (% of GDP)	-3.53	-22.03	-18.6

Source: Bank Al-Maghreb (Annual reports from 2001 to 2018).

2.2 The Education System in Morocco

The Moroccan education system includes five levels: preschool (2 years), primary (6 years), college secondary (3 years), qualifying secondary (3 years) and university (3 years of study to obtain a license plus 2 years to get a master). Schooling is compulsory for all children between the ages of 6 and 15. Compulsory education, also known as “basic education”, includes primary education and college secondary education.

The education system in Morocco is funded by four main actors: the state, local authorities, households and external partners including NGOs. Although the Education and Training Charter provided for the need to diversify sources of funding, the state still remains the main provider of education funds. Its share amounted to almost 98.01% in 2003-2004. The participation of communities, according to data from the National Education Account of 2004, was around 121.7 million dirhams, which represents only 0.49% and that of households amounted to 0.46%. The funding contribution from other external partners represented only 0.37% of all contributions (Note 2).

This important investment in the education sector has made significant progress. In fact, the enrollment rate of children aged 6 to 11 increased from 84.6% in 2000/2001 to 99.8% in 2018/2019, approaching the generalization of full primary education. Similarly, gender disparities and the gaps between rural and urban areas decreased significantly between 2000/2001 and 2018/2019. Regarding college secondary school enrollment, the generalization objective is only partially achieved. In 2018/2019, 91.8% of 12-14-year-olds were in school compared to 60.3% in 2000/2001. For the qualifying cycle, the enrollment rate reached 66.9% in 2018/2019 compared to 37.2% in 2000/2001 (Note 3).

However, despite quantitative progress, the Moroccan education system continues to lag considerably behind in terms of performance. One of the most revealing indicators of the quality of education is the results obtained by Morocco in the international TIMSS and PIRLS tests. The last PIRLS test carried out in 2016 shows that Moroccan students are very weak in reading. Out of a total of 50 participating countries, Moroccan schoolchildren obtained a score of 358 points, which is far below the international average set at 500 points. This survey ranks Morocco in 47th place. In the TIMSS 2015 study, Moroccan students achieved a score of 377 in mathematics and a score of 352 in science, results well below the international average (Note 4).

3. The Reality of Poverty in Morocco

3.1 The Evolution of Poverty Indicators in Morocco

3.1.1 Monetary Poverty

Between 2001 and 2014, Morocco made significant gains in the fight against poverty, such as the size of the poor population decreased from 4,461,000 in 2001 to 1,605,000 in 2014. Indeed, the poverty rate fell from 15.3% in 2001 to 4.8% in 2014, registering an average annual decrease of 8.5%. During this period, poverty was quickly resolved in the two areas of residence. The poverty rate fell from 7.6% to 1.6% in urban areas and from 25.1% to 9.5% in rural areas, respectively, which corresponds to an average annual poverty reduction rate of 11.3% in the cities against 7.2% in the rural. These developments show that the urban environment has benefited better from the improvements made in terms of poverty reduction (Note 5).

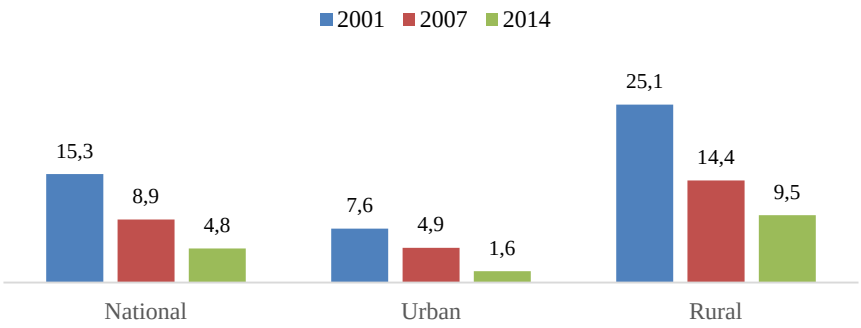

Figure 1. Evolution of Poverty Rate by Area of Residence (in%)

By using the other poverty indices that are part of the FGT family of indices, we can see that poverty in Morocco is a phenomenon deeply rooted in rural areas. In 2014, the poverty gap index was 0.94% at the national level, i.e., the amount of money necessary to transfer to the poor in order to lift them out of poverty represents 0.94% of the poverty line. In rural areas, this index reached 1.86% compared to 0.32% in urban areas. Between 2001 and 2014, the poverty gap fell significantly from 3.5% to 0.94%, indicating an average annual decrease in the cost of poverty eradication of 9.6%. Regarding the poverty severity, the evolution of this index shows the improvement in the degree of inequality among the poor themselves; and this by reducing the gap between the consumption expenditure of the poor and the poverty line. Between 2001 and 2014, this index decreased from 1.2% to 0.3% at the national level, from 0.5% to 0.1% in urban areas and from 2.2% to 1.6% in rural areas. However, despite the significant decrease recorded between 2001 and 2014, the poverty severity also remains a rural reality.

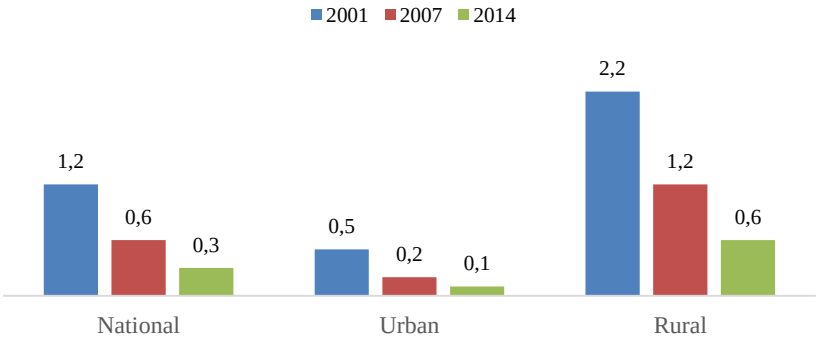

Figure 2. Evolution of the Poverty Severity Index (in%)

3.1.2 Multidimensional Poverty

The Multidimensional Poverty Index (IMP), used for the first time in the 2010 UNDP Human Development Report and developed by the Oxford Poverty and Human Development Initiative (IOPH), is based on an approach centered on capabilities. This index has just complemented the monetary poverty measures thanks to a more general approach. It has three dimensions, like the HDI: health, education and standard of living, which are expressed by 10 indicators, all having the same weighting in their dimension. A household is considered to have multidimensional poverty when it suffers from deprivation in 33% of weighed indicators.

In Morocco, the number of people living in multidimensional poverty fell from 7.5 million in 2004 to 2.8 million poor in 2014. The incidence of multidimensional poverty thus dropped from 25% to 8.2% between the two periods at the national level, from 9.1% to 2.0% in urban areas, and from 44.6% to 17.7% in rural areas. It is remarkable that multidimensional poverty also remains a rural phenomenon: out of 2.8 million poor people according to the multidimensional approach, 2.4 million are rural; which means that almost 85.4% of the population living in multidimensional poverty lives in rural areas (Note 6).

The decomposition of multidimensional poverty according to the source of deprivation shows that in

2014, the share of deficiencies in terms of adult education amounted to 34% and that of the non-education of children was 21.3%. Deprivation in terms of health and housing conditions achieved 10.9% and 14.1% respectively. Deprivation in terms of access to basic social infrastructure explains 19.7% of multidimensional poverty.

3.1.3 Subjective Poverty

Since 2007, the measurement of perceived or so-called subjective poverty has been based, according to the HCP, on a welfare scale classifying households according to their own subjective perception (Note 7). In this context, despite the improvements recorded on the poverty reduction front, Morocco remains confronted with a high level of subjective poverty, especially in rural areas. Thus, 42.3% of Moroccans consider themselves to be in a situation of subjective poverty in 2014, i.e., 37.9% in the urban environment and 49% in the rural environment. On the other hand, this rate was 39.4% at the national level in 2007, 37.4% in the urban environment and 42.0% in the rural environment.

In 2014, subjective poverty was 55.3% among women and 57.6% among young people under 25 years of age. Similarly, the rate of this poverty was 61.7% among the lower classes, 37.7% among the middle classes and 9.4% among the wealthy classes. Therefore, it should be noted that the observed difference between the rate of subjective poverty and monetary poverty is a frequent phenomenon in developing countries (Note 8).

3.1.4 Human Development Index (HDI)

In terms of the Human Development Index (HDI), Morocco has made significant progress in recent years, even if there is significant room for improvement. Between 1980 and 2017, the HDI value of Morocco increased from 0.4 to 0.667, an increase of about 67% and an average annual increase of about 1.4%. Life expectancy at birth has increased by 18.5 years, the mean years of schooling has reached 4.3 years and gross national income per capita has in turn increased by around 110% (Note 9).

Table 2. Evolution of the HDI of Morocco for the Period 1980-2017

	Life expectancy at birth	Expected years of schooling	Mean years of schooling	GNI per capita (PPP $)	HDI value
1980	57.6	5.9	1.2	3 490	0.399
1990	64.7	6.5	2.2	3 800	0.458
2000	68.7	8.5	3.4	4 394	0.530
2010	74	11.1	4.2	6 353	0.616
2017	76.1	12.4	5.5	7349	0.667

Source: human development reports published by UNDP.

3.1.5 Inequalities

To measure the level of income distribution inequality in a country, the Gini coefficient or index is

frequently used. In Morocco, income inequality dropped significantly between 2007 and 2014 from 40.7% to 39.5%. This decreasing concerned both areas of residence: the Gini coefficient went from 41.1% to 38.8% in urban areas, and from 33.1% to 31.7% in rural areas.

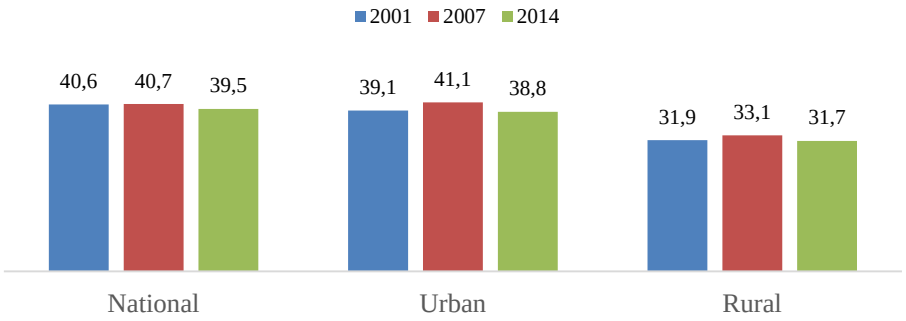

Figure 3. Evolution of the Gini Coefficient between 2001 and 2014

3.2 Public Policies for Poverty Alleviation

Since the early 2000s, Morocco has implemented several sectoral strategies and policies aimed at reducing poverty and inequality. These programs concerned, among others:

- Reinforcement of social support programs for students: This mainly involves the establishment of a "TAYSSIR" program which aims to combat school dropout among students from disadvantaged areas by conditional cash transfers to parents of these students. In addition, the launch of the Royal Initiative "a million schoolbags" has allow to reduce the costs linked to schooling by distributing school supplies and textbooks for the benefit of pupils in public education. Other social support programs have been reinforced, namely school transport, improved catering in school canteens and the extension of boarding schools and "DAR ATTALIBA".

- Improvement of the sanitary conditions of the population: Several actions have been undertaken in order to address the deficiencies in the supply of health care. In 2012, the Moroccan public authorities generalized the Medical Assistance Plan (RAMED) to the poor and vulnerable populations in order to be totally exempt from hospital costs. In addition, the government has continued its policy of reducing the price of medicines, expanding the supply of mobile care in rural areas and expanding basic medical coverage.

- Reducing social and territorial disparities in rural areas: Morocco has placed the development of the rural world and mountainous areas at the heart of these concerns. Consequently, a colossal budget of 50 billion dirhams has been set aside for several programs aimed at reducing the shortcomings suffered by the inhabitants of these areas. These include the following programs: the global rural electrification program (PERG), which made it possible to go from a rural electrification rate of 18% in 1996, the year of its launch, to 99.43% at the end of 2016. The Grouped Supply Program for Rural People's Drinking Water (PAGER) which contributed to achieving a rate of access to drinking water in rural areas of 96% at

the end of 2016 against 26% at the end of 1997. The National Program of Rural Roads (PNRR) which made it possible to reach an accessibility rate of rural populations to roads of 79.3% in 2016, especially in the most disadvantaged provinces.

- Fight against unsanitary housing: Aware of the precarious living conditions in the slums and the dangers run by the households living in the constructions threatening ruin, the Moroccan public authorities launched several programs to facilitate the access of the vulnerable households to housing decent. Over the past 20 years, the housing sector has seen significant achievements, which has allowed to greatly reduce the housing deficit by almost 67% and to significantly reduce the problem of unsanitary housing.
- Promotion of employment: To fight unemployment and encourage self-employment and entrepreneurship, the government has implemented a variety of public support programs for youth employment. These include, the "IDMAJ" program, the "TAHFIZ" program, the "TAEHIL" program and the "Self-Employment" program.
- Implementation of the National Initiative for Human Development (INDH): The launch of this Initiative was announced by His Majesty the King in his Speech to the Nation on May 18, 2005. The first phase of this initiative (2006 -2010) was aimed at reducing poverty, precariousness and social exclusion. A second phase of the INDH was launched in 2010 for the period 2011-2015, with particular attention given to actions that create wealth and employment, accelerating the development of mountainous areas and widening the participation of women, young people and people with special needs. In order to consolidate the achievements of the first and the second phases of the INDH and give it a new impetus, a third phase was launched in September 2018 covering the period 2019-2023. The programs of this last phase focus in particular on the promotion of human capital, support for categories in a difficult situation and the launch of a new generation of income and jobs initiative.

4. Literature Review

4.1 Education and Growth in Economic Thought

For neoclassical economists, labor is a homogeneous factor, and workers are an undifferentiated workforce. They considered that the quantity of labor and physical capital are the only explanatory factors for growth; therefore, they have misunderstood the role that human capital can play in the production of wealth. To explain the magnitude of growth observed in the 1950s, Robert Solow (1956) introduced a third factor into the Cobb-Douglas function: the residual factor or the residue. Solow considered that this factor consists of a number of exogenous elements which contribute to improving the productivity of the factors of production. This residue is determined in particular by technical progress, the quality of workers and scientific development. The work of T. Schultz (1961) has further confirmed the links between investment in human capital and economic growth. Schultz sees education and training as an essential means of improving productivity and increasing wealth. Along the same lines and drawing on Schultz's contributions, Gary Becker (1975) considered human capital as an asset and a stock capable of producing an income which is nothing other than the remuneration of investment in education.

Becker's analysis assumes that investment in human capital results from a cost-benefit calculation on the part of the economic agent. It is a rational trade-off between the benefits expected from years of education and the costs they entail. In accordance with human capital theory, Mincer (1958) developed an equation to measure the return to an additional year of study by its marginal effect on wages. He showed that, at equilibrium, everyone is indifferent between the choice of continuing their studies or entering the job market immediately.

However, several criticisms have been made of these theories both theoretically and empirically. Theoretically, these criticisms are focused in particular on the lack of taking into account the different kinds of education externalities. In this context, Spence (1973) has shown that education plays a role of "signal". In other words, Spence made the assumption that education is not an investment to increase human capital but a simple means of selection. This signal theory is an extension of the filter theory. According to this latter approach, initially presented by Kenneth (1973), the diploma constitutes proof of the qualities of individuals. Therefore, education is not used to increase the capacities of individuals but to identify them in order to be able to filter them.

On the other hand, a more macroeconomic approach has been developed by a number of economists in order to take into account all the externalities of education. In this context, Romer (1989) and Lucas (1988) emphasize, through their contributions to the theory of endogenous growth, that growth is self-sustaining thanks to technical progress which is considered as an endogenous factor. Thus, the human capital is viewed as productive input, like physical capital and labor. The model developed by Mankiw, Romer and Weil (1992) shows that the economic growth results from the contributions of this input, and the different growth rates between countries are explained, basically, by differences in the rate of the accumulation of human capital.

On the other hand, it is evident that the accumulation of human capital requires that households must invest massively in education. However, when comparing the costs and returns of education, households do not integrate the social externalities of education into their trade-off. At a social level, this leads to an inadequate investment in human capital and therefore, in the long term, to inefficient growth. In this context, a public education support policy may encourage the agent to bring his investment effort to an appropriate level, which takes account of the external effect.

4.2 Education and Poverty in CGE Model

Partial equilibrium analyzes do not adequately capture all of the economic and social effects of education. For this reason, Heckman et al. (1998) have proposed a new model that highlights the different sources of the increase in inequalities in the US economy. In this study, a general equilibrium model with overlapping generations is developed by disaggregating the labor factor between unskilled and skilled workers. The sources of heterogeneity between these two groups depend on the initial skills of individuals and their levels of education, which directly affects income levels and personal behavior in investing in education. Indeed, education allows, in this model, to migrate workers from one category to another by making them reach a predetermined training threshold.

In another study devoted to the externalities of health and education on welfare in Benin, Savard and Adjovi (1998) developed a static computable general equilibrium model in which three types of labor market are identified: the informal market, the modern market and the civil servant market. The results of this study show that cutting spending on health and education under the SAP has a negative impact on the welfare of households, especially the poor. The weakness of this model, however, is its inability to integrate all aspects of the role of education and health.

In a Computable, Dynamic and Sequential General Equilibrium Model, Jung and Thorbecke (2001) studied the impact of increased public spending in education on poverty in two countries considered as poor: Tanzania and Zambia. The authors distinguish between three categories of workers. In this model, the supply of educated labor is determined by two factors: public spending on education and the efforts of individuals to educate themselves. This effort is expressed in terms of the opportunity costs that the individual incurs when he decides to educate himself. The representative agent compares the benefits (i.e., the present value of future income streams to be obtained by completing a higher level of education) with its opportunity cost (the income lost at because of time going to school). The results obtained from the various simulations suggest that increasing public spending on education can contribute to economic growth and poverty reduction. However, these results also show that the effects of these simulations differ between the two countries; mainly because of the initial state of each country in terms of capital stock and savings.

In trying to determine how the government must reallocate its public spending between the different investment choices (between investment in infrastructure, in education or making direct transfers to households...), Agénor et al. (2002) used a general financial and dynamic equilibrium model to capture the different macroeconomic transmission channels through which public spending affects the economy in general, and more particularly poverty and the distribution of income. In this model, the authors identify two types of workers. The authors assume that individuals were born unskilled, and they propose a function of acquiring skills and competences. The results of this study show that investing in education does not reduce poverty substantially; and this is mainly due to the fact that this investment provides unskilled urban workers with incentives to acquire high skills which directly affect the supply of skilled labor, and consequently leads to increased unemployment of skilled workers. In addition, and unlike investment in infrastructure, investment in education does not translate across the border into productive opportunities in the private sector. However, the model assumes that only unskilled urban workers can access education, while the households most affected by poverty and the least skilled are generally rural inhabitants. Furthermore, the specification of the acquisition function does not follow from the behavior of households. The latter remain entirely passive.

Based on the model developed by Bourguignon et al. (2004), designed to assess the Millennium Development Goals (MDGs) and estimate the cost and time required to reach these goals, Logfren and Diaz-Bonilla (2006) analyzed the consequences of alternative scenarios on Ethiopia's MDG strategy. The model proposes that student performance depends on the quality of education, the welfare of

households, the level of public infrastructure, wage incentives and health status. This approach offers the advantage of linking the performance of the education system to the labor market with its impact on the wage differential and household incomes. Simulations have shown that expansion in public consumption and investment is necessary to reach the MDGs.

To analyze the impact of an increase in public education spending on the labor market in South Africa, Maisonnave and Decaluwé (2010) developed a recursive dynamic CGEM in which the endowments of labor of households are supposed to be endogenous and the composition of the labor force of each household can vary over time. Thus, this model proposes that each of the labor markets is characterized by a surplus of labor and the unemployment rate can therefore vary for each of the job categories. The results of this study show that a marginal increase in public spending can have more pronounced effects on student behavior. This increase in public spending promotes job creation and consequently leads to an increase in household income. In general, the authors confirm that a public policy aimed at improving household skills can be an important factor in the fight against poverty for the most disadvantaged groups.

To assess the impact of the increase in public education spending on growth and poverty in Uganda, Rabichaud, Tiberti and Maisonnave (2014) develop a computable, dynamic and recursive general equilibrium model with a micro-simulation approach. Within this framework, the microeconomic model is designed to capture the effects of simulated policies on poverty and income distribution. The labor factor is divided into two categories: the unskilled worker who has not completed the first cycle, and the skilled worker who has completed at least the first cycle. The results of this study show that increased spending in education improves all indicators related to the quality of education and leads to a reduction in child poverty.

Finally, Cloutier, Cockburn and Decaluwé (2005) carry out, using a multi-sectoral and static computable general equilibrium model, an evaluation of the direct and indirect repercussions of public policies in education on welfare, poverty and income distribution in Vietnam. In this model, the authors specify a flexible supply of skilled and unskilled household labor for each household category. The education system is divided into two: basic education, which is exogenous in volume, and higher education, which transforms unskilled workers into skilled workers. The demand for higher education by households depends on the relative wages of skilled workers compared to unskilled workers. The results obtained show that the uniform increase in public spending in higher education leads to a higher demand for education, an improvement in welfare and a reduction in household poverty. However, it is important to note that households in this model are disaggregated into several socio-economic categories, which does not detect the effects of simulated policies on poverty and inequality within each category.

5. The Model

In the literature on Computable General Equilibrium Models, there are several approaches to analyze the effects of a policy or an external shock on poverty and income distribution. The most popular approach is

to specify several homogeneous groups of households and calculate the mean income of each group obtained after the shock. If this mean income is below the poverty line, the entire group is considered poor. The major drawback of this technique is its inability to detect changes in income within each group. It is to overcome this drawback that researchers have been using, in recent years, alternative approaches allowing both to capture macroeconomic transmission channels with EGC models and to take into account the heterogeneous nature of households via detailed information provided by micro-simulation techniques.

In this perspective, the general structure of the model adopted in this study is based on that developed by Décaluwé et al. (PEP-1-1 model of 2013) with two specific adaptations: 1- instead of disaggregating households into several economic categories, we used the micro-simulation approach, 2- to detect the effects of education on poverty, we integrated into the model the block of equations relating to labor supply and demand for higher education by households, as developed in the work of Cloutier et al. (2004). In general, the model is real and static in nature. The Moroccan economy is represented as a small open economy i.e. taking international prices as given. The model has two categories of labor according to their level of education: unskilled workers and skilled workers. It includes 7 branches of production (agriculture, industry, construction, trade, transport, other private services, public administration). Basic and higher education are assumed to be produced only by public administration. All agents must respect their constraints and prices adjust in order to balance the supply and demand of goods and factors in their respective markets.

5.1 Households

Households receive their income from the factors of production, namely capital and labor. They also receive transfers from other economic agents (government, firms and the rest of the world) and participate in payments to the government in the form of taxes and social security contributions or in transfers to other agents. Household savings represent a fixed proportion of total disposable income.

Under a standard approach (without education), each household has fixed endowments of skilled and unskilled labor. In this case, households have no control over their income. Drawing on the work of Cloutier et al. (2004), investment in education is taken into account in the model; and therefore, households have to make an additional decision. They determine the proportion of its adult members that they wish to hold in the form of each of the possible labor categories (skilled or unskilled). In other words, households can transform unskilled labor into skilled labor through investment in higher education. Investment in basic education is assumed to be fixed (Note 10). Households' decisions are therefore treated in two stages: maximizing utility and maximizing income.

- Maximization of utility:

Households choose their consumption of goods (other than the two education services that provide no utility to households) in order to maximize their utility subject to budgetary constraints. In this context, the model retains a "Stone-Geary" utility function from which the demands for goods are derived

- Maximizing income:

Each household chooses the proportion of skilled (δ_h^q) and unskilled (δ_h^{nq}) workers who maximize their labor income subject to an imperfect transformation constraint between skilled and unskilled labor. In addition, the total number of active workers and students is assumed to be fixed (Note 11). So, the total labor supply by each household (LS_h) is considered to be exogenous.

The income maximization equation is written as follows:

$$\underset{\delta_h^q}{Max} YH_h = wnq\delta_h^{nq}LS_h + wq(1-s)\delta_h^qLS_h - s\beta_{h,eds}PC_{eds}\delta_h^qLS_h + revenu\ hors\ travail + ED_{h,edb} \quad (1)$$

$$\text{s.t} \qquad \delta_h^{nq} = 1 - \delta_h^q \quad (2)$$

$$\text{s.t} \qquad LS_h = B_h^l\left\{\beta_h^l\left(\delta_h^{nq}LS_h\right)^{k^l} + \left(1-\beta_h^l\right)\left(\delta_h^qLS_h\right)^{k^l}\right\}^{\frac{1}{k^l}} \quad (3)$$

Which;

YH_h: Household income h;

Wnq: Wage rate of unskilled workers;

Wq: Wage rate of skilled workers;

δ_h^q: Share of skilled workers in household h;

δ_h^{nq}: Share of unskilled workers in household h;

LS_h: Potential labor supply of household h, i.e. the total supply of workers of both categories and students;

PC_{eds}: Unit price of higher education;

PC_{edb}: Unit price of basic education;

$ED_{h,edb}$: The volume of basic education demanded;

$\beta_{h,eds}$: Share of the unit cost of higher education financed by the household h;

s: Share of adult's active adult life time that must be spent in higher education to become skilled (mean of years to complete higher education compared to the total number of years of life active adult) (Note 12);

B_h^l: Scale parameter of the elasticity transformation function constant (CET)

β_h^l: Distributive parameter of the CET function;

k^l: CET function transformation parameter.

In equation 1, the income of unskilled workers is represented by $wnq\delta_h^{nq}LS_h$. Then, this income corresponds to the unskilled wage wnq multiplied by the number of unskilled workers in the household. Similarly, the income of skilled workers $wq(1-s)\delta_h^qLS_h$ is the product of the wages of skilled workers wq, the volume of potential skilled workers $\delta_h^qLS_h$as well as the share of the active adult life of skilled workers not devoted to higher education.

Furthermore, the quantity of potential skilled labor is the sum of the number of active skilled workers $(1-s)\delta_h^qLS_h$, and the number of students in higher education, represented by s$\delta_h^qLS_h$. This specification implies a long-term equilibrium within which the household must, year after year, have s percent of its potential skilled labor in higher education to maintain its desired proportion δ_h^q of skilled workers. On

the other hand, the opportunity cost, $wqs\delta_h^q LS_h$ is a function of the qualified salary because a few additional years of study increase, on the one hand, the remuneration of work but decrease, on the other hand, the length of working life in the skilled labor market. The household's net income depends on the amount invested in higher education $s\beta_{h,eds}PC_{eds}\delta_h^q LS_h$. It is assumed that higher education has a fixed direct unit cost (for example: school fees, transport, school supplies, etc.), $CE\acute{D}T_{h,eds}$, which varies between households. Part of this total unit cost is financed by the public subsidy; assumed to be exogenous and of the same amount for all households $C\acute{G}_{eds}$. The share of the direct unit cost of higher education borne by households is represented by the difference between the total unit cost and the public subsidy:

$$\beta_{h,eds} = CE\acute{D}T_{h,eds} - C\acute{G}_{eds} \tag{4}$$

Consequently, an increase (a reduction) in the public subsidy leads to a reduction (an increase) in the share of the direct unit cost financed by households. The cost of education is indexed by the price of higher education PC_{eds}, which captures the variations in the costs of producing higher education and the variations in its demand.

The imperfect substitution between unskilled and skilled work plays an essential role in modeling investment in education. This is how equation 3 represents the possibility of acquiring qualifications. It reflects the inability of households to acquire skills and to educate themselves without limitation. Without this constraint, households can specialize in one or the other work category. The ease with which households can change their qualification mix depends on the transformation parameter k^l of the function (CET).

When choosing the share of skilled labor δ_h^q, the household analyzes the trade-off between the benefits of having more skilled labor (a high potential wage rate) on the one hand, and the opportunity cost and the direct costs related to higher education on the other hand. The resulting choice function of maximizing work income is:

$$\frac{\delta_h^q}{\delta_h^{nq}} = \left(\overbrace{\underbrace{\frac{wq}{wnq}}_{Skill\ premium} - \underbrace{\frac{swq}{wnq}}_{Opportunity\ cost} - \underbrace{\frac{s\beta_{h,eds}PC_{eds}}{wnq}}_{Direct\ cost}}^{Net\ gain} \right)^{\tau^l} \left[\frac{\beta_h^l}{1-\beta_h^l} \right]^{\tau^l} \tag{5}$$

Which,

τ^l: Elasticity of transformation and $\tau^l = \frac{1}{(k^l - 1)}$

So, if the benefit of having more skilled labor (skill premium) (Note 13) is greater than the costs of education (opportunity and direct cost), one would expect, all else being equal, that households increase their endowment in skilled labor through investment in higher education. On the other hand, if the gain is less than the costs, households would reduce their share of skilled labor and their investment in education.

Once the optimal share of skilled workers δ_h^q is determined, the household offers production activities a quantity $(1 - \delta_h^q)LS_h$ of unskilled labor and a quantity $(1 - s)\delta_h^q LS_h$ of skilled labor, while the rest of

the potential skilled labor $s\delta_h^q LS_h$ is studying and inactive on the labor market. When the government decides to increase its subsidy in higher education, households decide to increase their investment in education, then there would be, on the one hand, a fall in the supply of unskilled labor $\Delta\delta_h^{nq}$ ans on the other hand, an increase in the supply of skilled labor $\Delta(1-s)\delta_h^{nq}$, consequently the total labor supply would decrease by $\Delta s\delta_h^{nq}$.

5.2 Government

The government collects capital income from public firms, transfers from households in the form of social contributions and transfers from the rest of the world (MRE transfers, donations). In addition, it collects direct taxes paid by households and firms and indirect taxes on local and imported products as well as taxes on the production of industries. Its expenditure is divided between the consumption of goods and services, transfers and savings. Among public expenditure, the government partially funds basic education and higher education.

Household demand for basic education is assumed to be fixed. Therefore, the proportion subsidized by the government is also exogenous. On the other hand, the share of higher education financed by the public subsidy is assumed to be endogenous because it depends on the demand for higher education from households. The government subsidizes each higher education unit consumed by households with a fixed amount.

$$G_{eds} = \sum_h (1-\beta_{eds}) LE_h \tag{6}$$

Which,

G_{eds}: Government consumption of higher education;

LE_h: Demand for higher education by the household h.

5.3 Production Factors

There are two factors of production: capital and labor. Capital is assumed to be mobile across sectors, implying that there is only one rate of return on capital for all industries. The labor is divided into two categories: unskilled workers (who have not completed the college secondary cycle) and skilled workers (who have completed the college secondary cycle or more). Workers are mobile between industries, resulting in a unique remuneration for each type of labor in all industries. The skills premium is determined by variations in demand and supply for each labor category. Indeed, an increase in household demand for higher education would lead to an increase in the total supply of skilled workers, and a decrease in the supply of unskilled workers; as a result, the skills premium would decrease.

5.4 Firms and Production Sectors

The representative firm receives a share of the capital income. It pays dividends to households, pays taxes to the government, and makes transfers to other agents. The rest is kept in the form of savings.

All sectors are expected to use constant return technology and are in perfect competition. The total output of each sector is determined by a combination, according to a Leontief-type function, of added value and total intermediate consumption. The latter is the result of a fixed proportion of different types of input. The value added is represented by a constant elasticity of substitution (CES) function between composite

labor and capital. Composite labor is, in turn, represented by a CES function between unskilled labor and skilled labor. Under these conditions, it is clear that public spending on higher education would influence the value added and total production of the economy; and this through their impact on the share of unskilled and skilled labor supply as well as on the share of (inactive) students who are in higher education classes.

5.5 Foreign Trade

It is assumed that all goods and services can be imported or exported, excluding basic and higher education. Imports and local products are imperfect substitutes according to a constant elasticity of substitution (CES) function (Armington principle, 1969) and jointly form composite consumer goods. With regard to supply, producers make an optimal distribution of their production between external and domestic markets, so as to maximize the profit made in each destination market under the constraint of constant elasticity of transformation (CET) function.

The domestic prices of exported or imported goods are assumed to be fixed and exogenous. They are equal to the dirham equivalent of world prices after taking into account nominal exchange rates and the tariffs and taxes. The current account balance is maintained at its initial (exogenous) level in foreign currency. The nominal exchange rate is also assumed to be fixed.

5.6 Equilibrium and Closure Conditions

The general equilibrium is defined by the equality of demand and supply on each market which is achieved through variations in prices. Thus, the wages are the adjustment variables in the labor market.

The Closure of the model defines the exchange rate as numeraire, with public savings and the current account balance as fixed variables. Other variables are generally considered to be exogenous and therefore fixed. These are: minimum consumption, labor supply, international prices of imports and exports, volume of inventory changes, unit cost of basic education supported by each household, value of basic education financed by the government, the total unit cost of higher education for each household as well as the unit cost of higher education subsidized by the government.

5.7 Welfare, Poverty and Inequality

Three sets of indicators are used to measure the effects of shocks on household welfare, poverty and inequality:

- The variation in equivalence (VE): is used to measure the welfare of households. It is written as follows:

$$EV_h = \left[\prod_{ned}\left(\frac{PCO_{ned}}{PC_{ned}}\right)\right]^{\gamma_{ned,h}}\left[CTH_h - \sum_{ned} CMIN_{ned,h}PC_{ned}\right] - \left[CTHO_h - \sum_{ned} CMIN_{ned,h}PCO_{ned}\right] \quad (7)$$

Which,

CTH_h: Total household consumption h;

$CTHO_h$: Total household consumption h in the base year;

$CMIN_{ned,h}$: Minimum consumption of good ned (all other goods basic and higher education);

PC_{ned}: Consumer price of the good ned;

PCO_{ned}: Consumer price of the good ned in the base year;

$\gamma_{ned,h}$: Marginal share of the good ned in the demand function of cleaning h.

- Poverty indices: In this model, the indices developed by Foster, Greer and Thorbecke (FGT) in 1984 are used. These indices have the following general form:

$$P_\alpha = \frac{1}{n}\sum_{i=1}^{p}\left[\frac{(z-y_i)}{z}\right]^\alpha \quad (8)$$

Which,

y_i: Household income;

z: The poverty line;

n: The number of households;

i: Households with an income below the poverty line.

In practice, three poverty measures are used: incidence, gap and severity. They correspond, respectively, to the values 0, 1 and 2 assigned to α.

- The Gini index: which is a synthetic indicator making it possible to measure inequalities of income, wages or standards of living in a population or within a country. It varies between 0 and 1. The index 0 corresponds to perfect equality and the index 1 means that all household or individual income is zero except one. The higher the Gini index, the higher the inequality. This index is written as follows:

$$I_{Gini}(y) = \frac{1}{2n^2\bar{Y}}\sum_{i=1}^{n}\sum_{j=1}^{n}\left|y_i - y_j\right| \quad (9)$$

Which;

$\left|y_i - y_j\right|$: The difference between the income of household i and that of household j;

$\bar{Y}$: average household income.

The model finally resolved for the reference year (2015). And after each shock relating to the public decision in terms of the subsidy allocated to higher education, the model produces the classic macroeconomic results of a CGE Model, but also the demands for each good by the 7062 households, the vector of their spending total in value as well as the vector of their income, because as noted by Agénor et al. (2003) the effects of macroeconomic policies on the poor operate mainly via changes in income.

In addition, to take into account the fact that poverty in Morocco is a rural phenomenon, the analysis of the impacts of shocks on poverty and inequality measures is carried out by stratifying households according to their place of residence. Consequently, two poverty lines are used: one for the urban area and the other for the rural area. These thresholds are those published by HCP for the year 2007. DASP (Distributive Analysis Stat Package) software (Araar Abdelkrim and Jean-Yves Duclos (2007)) is used to calculate and compare the FGT indices and the Gini index.

6. Simulations and Analysis of Results

In order to analyze the impact of public spending in higher education on household welfare and poverty, two scenarios are simulated and interpreted:

SIM 1: Reduction of 100% of the share paid by households in the total unit cost of higher education;

SIM 2: 50% reduction in the share of public subsidies in the total unit cost of higher education.

The analysis of the results will focus mainly on the decision to invest in education, on household incomes and on welfare, poverty and inequality.

6.1 Impacts on the Investment Decision in Higher Education

The investment decision in education is determined by equation (1) with 4 main impact channels:

6.1.1 Direct Cost Effect

The reduction in public spending in higher education leads to an increase in direct costs supported by households. In the baseline scenario, the share of households in the cost of higher education does not exceed 7.87%. With the reduction of the public subsidy by 50%, the share of households increases to 53.91%. In SIM1, the full cost of higher education is funded by the government. Hence, the share of households becomes zero. In addition, the direct cost of higher education increases from 0.02 in the baseline scenario to 0.16 in SIM 2.

6.1.2 Skills Premium Effect

Households respond to any increase in direct cost by reducing their investment in higher education and by reducing their time spent in higher education. Since the total supply of workers is assumed to be fixed, the decrease in skilled workers is offset by the increase in unskilled workers. In fact, the supply of skilled labor increased by 0.81% in SIM1; while the supply of unskilled labor decreased by 0.51%. On the other hand, the supply of skilled labor decreased by 4.36% and that of unskilled labor increased by 2.75% in SIM2. The result of the decline in the supply of skilled labor is the increase in wages of skilled workers. Likewise, the increased supply of unskilled labor leads to lower wages for unskilled workers. In this case, these two effects jointly lead to the growth of the skill premium, which represents the ratio between the wage of skilled labor and the wage of unskilled labor. The results of the scenarios show that this premium has experienced a slight decrease in SIM1 (1.24 compared to 1.25 for the base scenario) and an increase in SIM2 (1.32).

6.1.3 Opportunity Cost Effect

The opportunity cost corresponds to the skill premium multiplied by the share of active life invested in higher education. The increase in the skill premium increases the opportunity cost and vice versa. This cost plus the direct cost decreases the net gain from investment in higher education. In SIM1, the opportunity cost remains almost stable (0.15); however, it progresses in SIM2 (0.16) following the increase in the skill premium.

6.1.4 Effect of the Price of Higher Education

We note that the price of higher education decreases by 1.72% in SIM2. On the other hand, it experiences an increase of 0.44% in SIM1. At this point, it is important to emphasize that the effect of the price of higher education is integrated into the overall effect of direct cost. Thus, the results obtained indicate that the total demand for higher education by households and the government increases in SIM1 (1.48%) and decreases in SIM2 (6.81%). Therefore, it is difficult to predict the direct impact of the price of higher education on net gain.

In general, these four effects have a direct impact on the net gain of higher education. In SIM1, the net

gain increases by 1.04% mainly due to the decrease in direct costs. On the other hand, the net gain decreases by 6.60% in SIM2 because of the increase in direct costs supported by households despite the increase in the skill premium. These results show that the reduction in the public subsidy intended for higher education leads to a reduction in net gain. However, the increase in this subsidy improves the net gain.

Table 3. Structure and Impacts on Education and Labor

	Base	SIM 1	SIM 2
Share of households in the cost of higher education	7.87 %	0.00%	53.91%
Δ Total demand of higher education	-	1.48%	-6.81%
Δ Cost of higher education	1	0.44%	-1.72
Benefits and costs of higher education: After simulation			
Skill premium	1.25	1.24	1.32
Opportunity cost	0.15	0.15	0.16
Direct cost	0.02	0.00	0.16
Net gain	1.08	1.09	1.01
Δ Net gain		**1.04 %**	**-6.60 %**
Distribution of labor within households: percentage of variation (%)			
Δ Unskilled labor	61.35%	-0.51%	2.75%
Δ Skilled labor	34.02%	0.81%	-4.36%
Δ Total active labor	95.36%	**-0.04%**	**0.21%**
Δ Students	4.64%	0.81%	-4.36%

Source: simulation results.

6.2 Impact on Household Income

To analyze and understand the impact of the government's share in the cost of higher education on poverty, it is first necessary to study the channels of influence of the variation in public subsidy on household incomes. Five main channels of influence can be identified that relate to household net income.

To trace these five channels of influence on household income, it is necessary to decompose the variation in income by taking the total differentiation of equation (2):

$$\begin{aligned}\Delta YH \approx\ & [wq(1-s) - wnq]\Delta S_q LS \\ & + \Delta wq(1-s)LS + \Delta wnq(1-s)S_q LS \\ & - \Delta PC_{eds}\beta_{eds}sS_q LS \\ & - PC_{eds}\Delta\beta_{eds}sS_q LS \\ & - \Delta PC_{eds}\beta_{eds}s\Delta S_q LS\end{aligned}$$

$$+\Delta Capital\ income + \Delta Transfers\ received$$
$$+\Delta Cost\ of\ basic\ education$$

The percentage of the change in each component of income is presented in Table 3 below.

6.2.1 Skills Mix Effect

The variation in potential skilled labor depends on two elements: on the one hand, the share of working life invested in higher education and, on the other hand, the difference between the wage rate of skilled workers and that of the unskilled. We can rewrite the potential qualified labor equation as follows: [(1-s) (wq-wnq) -swnq] ΔSq LS. As a result, increasing or reducing the public subsidy in higher education would have two distinct effects: On the one hand, the fall (or increase) in the volume of skilled workers leads to the decrease (growth) in the income of households by an amount equivalent to the wage premium (wq – wnq that is assumed to be equal to 20%) that workers can earn during their active working life (1 -s). On the other hand, household income increases (decreases) thanks to the wages of unskilled workers that they can earn during their share of working life which could have been invested in higher education. The overall result of combining these two effects is that the effect of the wage premium is relatively greater (lower) than that of the opportunity cost.

Reading the table below clearly shows that for SIM1, the potential skilled work effect is positive on household income (0.01%) because the effect of the wage premium (0.02%) is relatively large compared to the opportunity cost effect (-0.01%). In the same way, we can see that, for SIM2, the wage premium increases household income by 0.08% while the opportunity cost contributes to its decrease by 0.14%. In this simulation, the potential skilled labor effect on income is negative (-0.06%).

6.2.2 Wage Effect

The change in income also results from the effect on labor yields. In other words, the combined impact of the variation of each type of wage on household income depends on the initial endowment in each category of labor. The overall analysis of the results obtained shows that: In SIM1, the skilled labor wage increases by 0.17% and that of the unskilled decreases by 0.04%, which contributes to an increase in income of 0.13%. In SIM2, the fall in the wage rate of skilled workers (0.90%) is greater compared to the rise of that of unskilled workers (0.27%), which leads to a deterioration in household income by 0.63%.

6.2.3 Cost of Higher Education Effect

The cost of higher education can be affected by a number of factors. The first concerns the variation in the unit cost of higher education supported by households. It should be noted that the variation in this unit cost has the major impact on the variation in net income. This unit cost contributes to the improvement of 0.34% of household income in SIM1 and to its decrease of 1.92% in SIM2. The second factor is the change in the price of higher education. The effect of this price is zero in SIM1 and only amounts to 0.03% in SIM2. The last factor relates to the change in the share of skilled workers in the potential supply of workers. The reduction (increase) in this share contributes to the decrease (increase) in the cost of higher education and therefore has a positive (negative) effect on income. In SIM1, although the volume of skilled labor increases, its impact remains negligible on income. On the other hand, the number of

skilled workers decreases in SIM2, which reduces the cost of higher education and therefore contributes to the increase in income by 0.10%. In general, we find that the impact of the change in the price of higher education and that of the share of skilled workers remains minimal in the change in income.

6.2.4 Other Income Effects

The model takes into account two other categories of household income: capital income and transfers received from other economic agents. In SIM1, the effect of this income on household income is slightly positive (0.07%). In SIM2, and like the other variables, other non-labor income contributes negatively to the variation in income (-0.36%)

6.2.5 Cost of Basic Education Effect

The last impact on income results from the variation in the cost of basic education. It is important to note that the volume and unit cost of basic education are assumed to be fixed in the model. Therefore, the impact of this cost is zero in the two scenarios.

In general, the combination of the different effects shows that the government's decision to cover all of the costs of higher education improves household income (an increase of 0.55%). On the other hand, a reduction in public funding in higher education is combined with a decrease in income (2.84%).

Furthermore, a more detailed analysis of the income of each household shows that out of the 7,062 households studied, 98.65% of households benefit from an increase in their income in SIM1, on the other hand, the income of 99.02% of households decreases in SIM2. In addition, the results obtained indicate that urban households are the most affected by the changes brought by the shocks.

Table 4. Income Channels

	SIM 1	SIM 2
Skill mix effect		
(1-s)(Wq-Wnq) Δ SqLS	0,02%	-0,14%
(-s)Wnq Δ SqLS	-0,01%	0,08%
Total	0,01%	-0,06%
Wage effect		
Δ Wnq(1-Sq)LS	0,17%	-0,90%
Δ Wq(1-s)SqLS	-0,04%	0,27%
Total	0,13%	-0,63%
Cost of higher education effect		
Δ PCeds*Beta_eds*s*Sq*LS	0,00%	0,03%
PCeds* Δ Beta_eds*s*Sq*LS	0,34%	-1,92%
PCeds*Beta_eds*s* Δ Sq*LS	0,00%	0,10%
Total	0,34%	-1,79%
Other income effects		

Δ Capital income	0,03%	-0,16%
Δ Transfers	0,04%	-0,20%
Cost of basic education effect	0,00%	0,00%
Change in net income		
Δ YH	0,55%	-2,84%

Source: simulation results.

6.3 Impact on Welfare, Inequality and Poverty

After analyzing the impact of the government's share in the unit cost of higher education on the decision of households to invest in higher education as well as its effects on income and other macroeconomic aggregates, this section will be devoted to exploring the impact of public spending on higher education on household welfare, income inequality and poverty.

6.3.1 Impact on Welfare

To measure household welfare, we study the relationship between equivalent variation and income. The table below shows, generally, that the economic welfare of households increases (0.49%) in SIM1 and decreases (2.47%) in SIM2. By place of residence, the welfare of urban households is more sensitive to the effects of shocks. Thus, welfare in urban areas increases by 0.55% compared to 0.36% in rural areas in SIM1. On the other hand, the loss of welfare is greater in urban areas than that recorded in rural areas in SIM2 (-2.47% against -1.74%). However, the results obtained illustrate that the increase (decrease) in income is greater than the increase (decrease) in the consumer price index, which explains the results the variation in welfare.

In more detail, the results obtained indicate that 99.25% of households experience a gain in their welfare in SIM1. On the other hand, more than 99.58% of households experience a loss of their welfare in SIM2.

Table 5. Impact on Welfare

	Δ (in %) of PCI	Δ (in %) of income			(in %) of welfare (VE/Income)		
		National	Urban	Rural	National	Urban	Rural
SIM 1	0.15%	0.55%	0.62%	0.40%	0.49%	0.55%	0.36%
SIM 2	-0.75%	-2.83%	-3.26%	-1.92%	-2.47%	-2.82%	-1.74%

Source: simulation results.

6.3.4 Impact on Inequalities

The Gini coefficient is a statistical measure which makes it possible to account for the distribution of income within the population. This coefficient is a number varying from 0 to 1, where 0 means perfect equality and 1 means perfect inequality (one person has all income and all the others have no income). Table 6 presents the impacts of simulations on inequalities. In the base year, this coefficient rises to

45.65% at the national level, 39.01% in rural areas and 46.52% in urban areas. Indeed, the rural environment turns out to be the least unequal, which is a fairly frequent result in developing countries. SIM1 results show that income inequality is improving at the national level (-0.02%), in urban areas (-0.02%) and more particularly in rural areas (-0.11%). However, SIM2 makes it possible to reduce the Gini coefficient at national level and in urban areas (-0.39% and -0.36% respectively), but this coefficient increases in rural areas (0.10%). This highlights the fact that the real income of poor households living in rural areas decreases more significantly than that of non-poor rural households following the reduction of public subsidies in higher education.

Table 6. Impacts on the Gini Coefficient

	(in %) Gini		
	National	Urban	Rural
Base	45.65%	46.52%	39.01%
SIM 1	-0.02%	-0.02%	-0.11%
SIM 2	-0.39%	-0.36%	0.10%

Source: simulation results.

6.3.5 Impact on Poverty

Table 7 presents all the results obtained in terms of poverty for the two simulated shocks. In the base year, the poverty rate was higher in rural areas (14.59%) than in urban areas (6.12%). This finding relating to rural poverty is verified regardless of the index chosen, with a large gap between the rural and urban indices. Indeed, the poverty incidence is 2.3 times higher for the rural environment; this difference is 2.8 for the poverty gap, while the poverty severity index turns out to be 3.3 times higher in rural areas than in urban areas.

It has already been found that the reduction in public spending on higher education has a negative effect on households' decision to invest in acquiring more skills and qualifications, which leads to a decrease in income and a decline in welfare. On the other hand, government coverage of the total unit cost of higher education encourages households to invest massively in education, which positively affects household incomes and welfare. These two simulations have opposite effects on the evolution of poverty. Thus, all poverty indices show a decrease in SIM1. On the other hand, SIM2 leads to an increase in these indices. In addition, it is remarkable that the effects of shocks on the different indices are more pronounced in the urban than in the rural.

Table 7. Impacts on the FGT Poverty Indices

	Poverty rate (P0) FGT0			Poverty gap (P1) FGT1			Poverty severity (P2) FGT2		
	National	Urban	Rural	National	Urban	Rural	National	Urban	Rural
Base	9.67%	6.12%	14.59%	2.22%	1.22%	3.49%	0.78%	0.38%	1.26%
SIM 1	-1.76%	-3.06%	-1.72%	-1.94%	-2.59%	-1.70%	-2.18%	-2.90%	-1.95%
SIM 2	7.32%	13.79%	5.64%	8.47%	11.97%	7.41%	9.61%	13.41%	8.40%

Source: simulation results.

Finally, it emerges from the analysis of the results that SIM1 is the one positively impacting household welfare, improving poverty indices and generating a reduction in inequalities, both at national level and in urban and rural areas. Therefore, it is interesting to deepen the analysis of the impact of this shock using "growth incidence curve (IGC)". This curve, developed by Chen and Ravallion (2003), allows to analyze the impact of a policy on the different percentiles of the distribution of income per capita of the population.

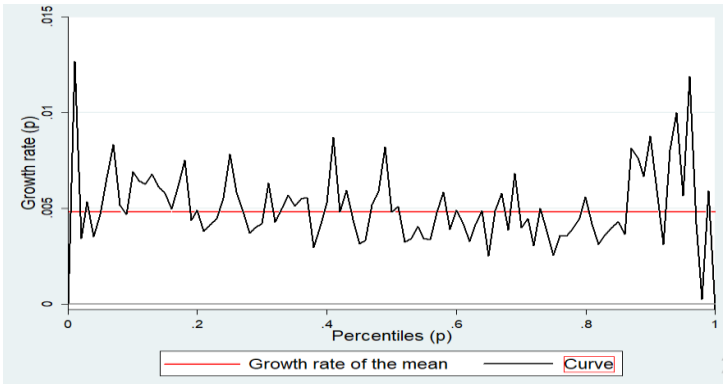

Figure 4. SIM1 Growth Incidence Curve (National)

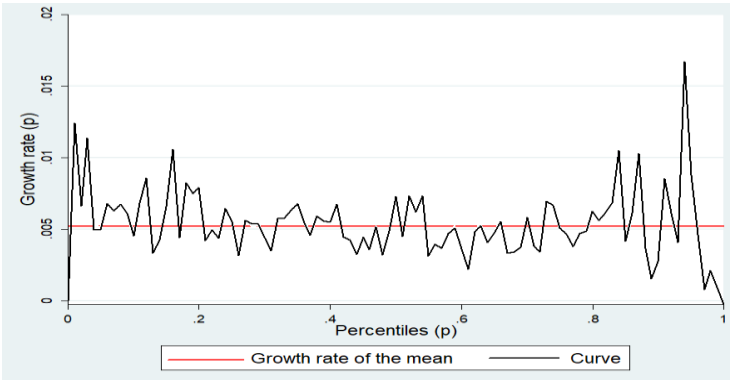

Figure 5. Growth Incidence Curve of SIM1 (Urban)

The two figures above allow to illustrate graphically, the GIC is everywhere positive, which indicates that SIM1 was accompanied by an improvement in the standard of living of all social strata, from the poorest to the richest. However, the evolution of the two curves does not allow to conclude the pro-poor character of the policy simulated in SIM1, both at national and urban level. Different quantiles are experiencing increases and decreases in per capita income.

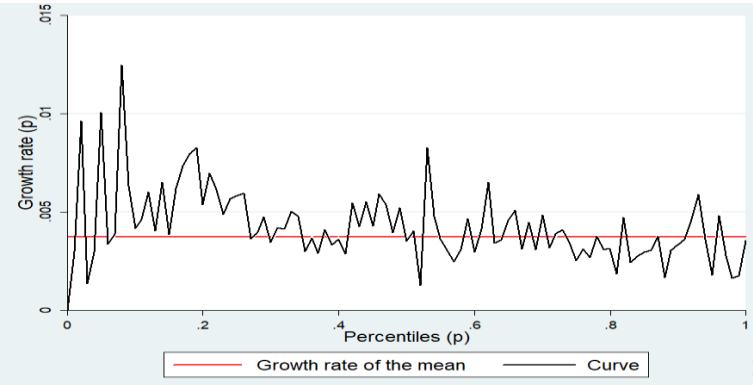

Figure 6. SIM1 (Rural) Growth Incidence Curve

However, Figure 6 shows the pro-poor character of SIM1 at the rural level. It is obvious that the poorest 50% of households in this area benefit better from this policy, while the income growth rate of the wealthiest households is generally lower than the average growth rate.

This analysis of the growth incidence curves therefore allows to confirm the favorable impact of the policy of financing all the costs of higher education by the government, in particular on poor rural households. In general, it can be deduced that to improve the economic welfare of households, reduce inequality and fight poverty, the government must intervene by increasing its share in the unit cost of higher education. This policy can encourage households to invest more in higher education, which will improve their level of skill and therefore affect their income positively.

7. Conclusion

In recent years, the Moroccan government has continued to multiply efforts to make up for the deficits accumulated since independence. In this context, several strategies have been implemented that aimed at developing the national economy and more particularly at ensuring social and territorial equality. The national vision 2030 strategy for education is one of these reform projects and consists of optimizing public intervention in the education sector and improving the outcomes of the Moroccan school. Indeed. a great debate took place between the various speakers on the question of financing education. Two main trends have emerged. On the one hand, the defenders of free education services. And on the other hand, those who call for tuition fees to be paid by the parents of the students. It is obvious that each current presents its arguments and defends its thesis with acuity. However, decision-making on this type of issue requires quantifying and analyzing the economic and social impact of these policies.

In this context, this study attempted to capture the effects of a public policy consisting in increasing or reducing the share of the public subsidy in the financing of higher education on the behavior of households in terms of investment in higher education, and therefore, on welfare, poverty and inequality. To achieve this, a micro-simulated computable general equilibrium model of the Moroccan economy is developed where the household agent is very disaggregated. This standard model has been calibrated using the most recent and available data; a social accounting matrix of Morocco relating to 2015 and the results of the ENNVM of 2007. Two simulations are carried out: the first consists in financing the totality of the costs of higher education by the government. and the second introduces a 50% reduction in public spending on higher education. The results obtained show that a public policy which makes it possible to reduce the costs assuming by households in higher education encourages them to invest more in education, which increases their skills and consequently their income. This has a positive impact on welfare, poverty indices and inequalities. Of course, other extensions remain necessary to introduce them into the model in order to refine the results and deepen the analyzes. These are mainly the following two facts:

- The model does not deal with unemployment. It assumes that the total number of skilled workers available on the labor market is absorbed. However, this assumption does not reflect the reality of the Moroccan economy, which is characterized by a high unemployment rate, particularly among young graduates. Therefore, integrating unemployment into the model would capture the real effect of investment in higher education on household income and poverty;
- This model is static does not capture all the temporal and dynamic effects of shocks. A dynamic recursive model is a desirable alternative to fully understand the impact of government decisions on the funding of higher education on poverty over time.

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Notes

Note 1. The World Bank has considered that: Investing in human capital is essential both to increase the pool of potential entrepreneurs in Morocco and to address the skills mismatch. The World Bank report on "Creating markets in Morocco: Diagnosis of the private sector" (p. 10). Published in June 2019.

Note 2. The National Education Account 2003-2004, Ministry of national education (p. 65).

Note 3. The National Education Account 2003-2004, et national education in figures 2018-2019, Ministry of National Education.

Note 4. CSEFRS, Résultats des élèves marocains en mathématiques et en sciences dans un contexte international: TIMSS 2015, Rapport thématique 2018.

Note 5. Social indicators of Morocco, HCP 2018, pp. 269-272.

Note 6. Social indicators of Morocco, HCP 2018, p. 77.

Note 7. This scale is based on the following question, addressed to heads of households: “In what social level do you classify your household in comparison with what prevails in your social environment, is it among the very wealthy, the relatively wealthy, the middle , the relatively poor or the very poor?”

Note 8. Social indicators of Morocco, HCP 2018, p. 78.

Note 9. Guidance note, Indices and indicators of human development: 2018 statistical update; UNDP representation in Morocco September 14, 2018.

Note 10. In Morocco, the primary school enrollment rate is around 99%. So, it is reasonable to treat this variable as exogenous.

Note 11. Unemployment and child labor (under 15) are not taken into account in this model.

Note 12. The normal time devoted to higher education is on average around 6 and 7 years (3 years for the qualifying secondary cycle and 3 to 4 years for university studies in order to obtain a license). As life expectancy in Morocco is 75 years, and adult life begins at 15 years, the share of working life (after basic education) to be devoted to higher education to qualify is assumed to be 12% (7 / (75-15) = 7/60 = 11.67% = 12%).

Note 13. In this model, the return on investment which corresponds to the return to education on the labor market is equal to that used in the study by Cloutier et al. (2004), i.e., 25%. Then, the qualified wage rate wq is normalized in units and the unskilled wage rate wnq is equal to 0.8.