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Impact of education on poverty in Morocco: A computable general equilibrium micro-simulation analysis

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Abstract

This paper uses a micro-simulation computable general equilibrium (CGE) model to assess the impact of public spending on higher education on poverty in Morocco. The model incorporates data from 7063 households from the 2007 National Survey of Household Living Conditions (NSHLC). Two scenarios are studied: a 100% reduction in the unit cost of higher education borne by households, and a 50% reduction in public spending in this area. The study assumes that the investment behaviour of households is influenced by the proportion of the unit cost borne by the government. The results show that exempting households from any unit cost of higher education encourages them to invest more in education, thereby increasing their income, improving their well-being and reducing poverty and inequality. Conversely, reducing public investment in higher education leads to a reduction in household investment in education, leading to a fall in well-being and an increase in poverty and inequality.

Keywords: education, poverty, CGE model, morocco

JEL Classification: C68, I21, I32, O55

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1. Introduction

Over the last decade, the link between poverty and educational deprivation has emerged as an increasingly important area of research. Children from disadvantaged homes are often caught in a vicious circle from which they find it difficult to escape, as poverty is generally linked to difficulties at school. These children are often less prepared or even completely disadvantaged educationally, which puts them in a position of virtual failure compared with their peers in primary school. This situation leads to difficulties with social integration (Mihai et al., 2015). The eradication of poverty, including its most extreme forms, is the most important of the 17 sustainable development goals set by the United Nations. These objectives, integrated into the 2030 sustainable development programme, essentially seek to put an end to poverty and other forms of deprivation by promoting health and education, reducing social disparities and stimulating economic growth, while taking into account environmental challenges such as climate change and the preservation of natural resources (Sinaga, 2023). The main policy objective defined by the main development organisations has been to reduce poverty. It has been argued that economic change in Sub-Saharan Africa (SSA) can lead to rising income levels and a reduction in poverty (Teal, 2001).

In line with the findings of Hofmarcher (2021), improved education levels lead to increased employability, while progress in increasing employment rates has a significant impact on poverty reduction. Similarly, according to the findings of Zhang (2014) from a survey conducted in China, education increases people's income and employment prospects, lifting them out of poverty for future generations, provided that the cost of education does not exceed the growth in income generated by parents.

Poverty is a major problem today. Its effects persist despite numerous attempts by the government and non-governmental organisations (NGOs) to remedy it, particularly in the field of education. Economic conditions that limit access to the resources needed to meet basic needs, such as education, are known as poverty. It is often the result of unequal economic distribution, a lack of employment opportunities and limited access to basic services such as healthcare and education. (Suhendar et al., 2024). More than 700 million people worldwide, around 10% of the world's population, are affected by poverty, a serious problem for emerging and industrialised countries alike. Poverty hinders access to basic necessities such as drinking water, healthcare and education (Nations Unies, 2019). It will be difficult to put an end to this situation. Sachs (2005)) argues that poverty reduction requires investment in human capital, particularly in health and education. Lack of education is sometimes referred to as 'education poverty', although it is essential in the fight against human poverty. The main cause of education poverty is generally low income, which discourages investment in higher education. Consequently, lack of investment in education exacerbates the cycle of poverty (Thapa, 2015).

In recent years, Morocco has made significant progress in a number of sectors. In terms of the economy, aggressive sectoral policies have been put in place with the main aim of creating an inclusive, prosperous and competitive market. In order to increase foreign investment, these measures include tax reform, the negotiation of several free trade agreements and improvements to the business environment (Arbia et al., 2023a; Arbia et al., 2023b; Arbia & Sobhi, 2024). On the social front, attempts have been made to improve the quality of life of the population, notably by increasing the availability of basic social services such as electricity, roads, drinking water, healthcare and education, particularly in rural areas. Despite this progress, Morocco is currently facing new challenges, the main ones being the rapid development of the digital economy, widening disparities and climate change. In this context, improving the quality of the workforce is essential to overcoming these obstacles and achieving higher growth targets. This is why the Moroccan government continues to invest significantly in education and training in order to promote educational initiatives, particularly those that benefit disadvantaged communities. The aim of this study is to assess how household investment in post-secondary education affects income inequality and poverty. It is based on the idea that household investment choices are linked to government funding of higher education. The researchers examine the direct and indirect effects of these investments on poverty using a micro-simulated

general equilibrium model. The model is calibrated using information from the Social Accounts Matrix and the National Household Living Standards Survey. The report also examines the education system, the economic structure and public measures aimed at reducing inequality and poverty in Morocco. Finally, it summarises the results of the analysis and makes recommendations on how they may affect income distribution and household well-being. In order to achieve the above objectives, our main question is the following: How does investment in education in Morocco affect poverty?

The remainder of the paper is structured as follows: section 2 briefly presents a review of the literature, while section 3 sets out the empirical strategy and presentation of the model, and section 4 presents the main results. The study concludes with policy implications in section 5.

2. Literature review

The purpose of this section of the paper is to review the literature from two perspectives: (i) education and growth in economic thinking and (ii) education and poverty in the CGE model. Firstly, neoclassical economists view labour as a homogeneous entity and workers as a uniform workforce. They maintain that growth is mainly explained by the quantity of labour and physical capital, thus minimising the role of human capital in the production of wealth. However, Solow (1956) introduced a residual factor into the production function, recognising that exogenous factors such as technical progress and scientific development contribute to improving productivity. Becker (2009) and Schultz (1961) have reinforced this idea by presenting human capital as a productive investment, with education as an essential means of increasing productivity and wealth. Despite these advances, criticism persists. Spence (1973) questions the idea that education is purely an investment in human capital, proposing instead that it serves as a signal for employers to. This perspective, extended from filter theory (Arrow, 1973), suggests that education is used to sort individuals rather than to develop them. Other, more macroeconomic, critiques have also emerged, notably with the work of Lucas (1988) and Romer (2014), emphasising that growth is self-sustaining through technical progress, implying that human capital is an essential productive factor. Despite these advances, it is clear that the accumulation of human capital requires significant investment on the part of households. However, they often fail to take account of the social externalities of education in their decision-making. A policy of supporting public education could correct this imbalance by encouraging individuals to invest more in their human capital, which would benefit both themselves and society as a whole. Secondly, partial equilibrium analyses do not adequately capture all the economic and social effects of education. This is why Heckman et al. (1998) proposed a new model highlighting the various sources of increased inequality in the US economy. In this study, a general equilibrium model with overlapping generations is developed to differentiate labour input between unskilled and skilled workers. The sources of heterogeneity between these two groups depend on the initial skills of individuals and their level of education, which has a direct influence on income levels and personal investment behaviour in education. By reaching a predefined educational threshold, workers can move from one category to another within this form of education. Savard & Adjovi (1998) created a static computable general equilibrium model that distinguishes three categories of labour markets: the informal market, the modern market and the public services market. This research focused on the externalities of health and education on well-being in Benin. The results of the study show that the reduction in spending on health and education under the SAP has an adverse effect on household well-being, particularly for the poorest households. However, one of the shortcomings of the model is its inability to take full account of the roles played by health and education. In Tanzania and Zambia, two reputedly poor nations, Jung & Thorbecke (2003) examined the effects of investment in public higher education on poverty using a computable dynamic sequential general equilibrium model. They distinguished between three categories of workers. According to this paradigm, the availability of skilled labour is determined by two elements: public investment in education and individual initiatives to pursue their own education. The results imply that public spending on education can stimulate economic growth and reduce poverty, although these benefits differ between the two nations due to incipient disparities in capital and savings. In attempting to determine how the government should reallocate its public spending

between different investment choices, Agénor et al. (2003)) used a dynamic general equilibrium model to capture the different macroeconomic transmission channels through which public spending affects the economy, in particular poverty and income distribution. In this model, the authors identified two types of workers, assuming that individuals are born unskilled and proposing a skills acquisition function. The results show that investment in education does not substantially reduce poverty, mainly because of its impact on the supply of skilled labour and the lack of translation of productive opportunities into the private sector. In research using the methodology of Bourguignon et al. (2004) to assess the MDGs, Lofgren & Diaz-Bonilla (2006) examined the effects of several scenarios on Ethiopia's approach to the MDGs. This model links household income and labour market performance to the effectiveness of the education system. The models show that in order to achieve the MDGs, it is necessary to increase public investment and consumption.

In order to examine the effects of investment in public higher education on the labour market in South Africa, Maisonnave & Decaluwé (2010) created a recursive dynamic general equilibrium model with endogenous household labour endowments. The results indicate that even a small increase in public spending can have a significant impact on student behaviour and encourage job creation. Robichaud et al. (2014) used a computable, dynamic and recursive general equilibrium model with a micro-simulation technique to study the effects of increased public spending on education on growth and poverty in Uganda. The results show that investment in higher education improves educational attainment and reduces child poverty. Using a static multi-sector computable general equilibrium model, Cloutier et al. (2004) assessed the direct and indirect effects of public education policy on welfare, poverty and income distribution in Vietnam. Within this framework, the authors envisaged a flexible supply of skilled and unskilled labour for each type of household. The two main components of the education system are higher education, which helps unskilled workers to become skilled workers, and basic education, the volume of which is exogenous. Household demand for higher education is correlated with the difference in earnings between skilled and unskilled workers. The results suggest that a steady increase in public funding for higher education has led to an increase in the demand for education, an improvement in welfare and a reduction in family poverty. It should be noted, however, that the segmentation of households into several socio-economic groups in this model prevented us from identifying how the simulated policies affected poverty and inequality within each category.

3. Empirical strategy and presentation of the model

The objective of the study is to determine how education affects Morocco's efforts to reduce poverty. Therefore, in order to achieve our objective and structure the study, the general equilibrium model was selected. Several methods are used in the literature on computed general equilibrium models to examine how a policy or an external shock affects income distribution and poverty. The most common method involves dividing households into several homogeneous groups and calculating the average income of each group after the impact of the shock. If this average income is below the poverty line, the whole group is considered poor. The main disadvantage of this strategy is that it does not allow differences in income within each category to be identified. In order to overcome this limitation, scientists have recently developed different strategies that combine micro-simulation methods with computable general equilibrium models, which allow better account to be taken of the diversity of household situations.

With this in mind, the model used in this study is based on the PEP-1-1 model of Decaluwé et al. (2013), with two key modifications: first, we have adopted a micro-simulation approach instead of classifying households into different economic categories; and second, we have incorporated a set of household labour supply and higher education demand equations, as defined in the work of Cloutier et al. (2004), into the model in order to analyse the effects of education on poverty. In general, this model is both static and realistic. It depicts the Moroccan economy as a small open economy, accepting international prices as constants. The model differentiates between two types of workforce according to their level of education: skilled and

unskilled workers. It includes seven production sectors (agriculture, industry, construction, trade, transport, other private services and public administration). Finally, all economic agents must comply with their constraints, and prices adjust to balance supply and demand for goods and factors on the markets concerned.

Households receive their income from elements of production such as capital and labour. In addition, they receive transfers from other economic actors (government, business and the rest of the world) and contribute to payments to government in the form of taxes and social contributions, or make transfers to other actors. Household savings represent a fixed proportion of total disposable income. In a standard framework, each household has a fixed number of skilled and unskilled workers, with no possibility of influencing their income. According to Cloutier et al. (2004), the introduction of education into the model implies additional decision-making for households. Households determine the distribution of their adult members between the possible categories of labour, skilled or unskilled, with the possibility of converting unskilled labour into skilled labour through investment in higher education. Investment in basic education is taken as constant. Thus, household decisions are approached in two phases: utility maximisation and income maximisation.

In order to optimise utility, households decide on their consumption of goods (with the exception of the two educational services, which provide no utility to households) in order to maximise their satisfaction while respecting their budgetary constraints. Within this framework, the model is based on a Stone-Geary utility function from which the demand for goods is calculated. Thus, to maximise income, each household chooses the allocation of skilled (δ_h^q) and unskilled (δ_h^{nq}) workers that maximises its labour income, while allowing for an imperfect transformation constraint between skilled and unskilled labour. Moreover, the total number of active workers and students is assumed to be constant. Therefore, the total labour supply of each household (LS_h) is considered to be exogenous. Income maximisation is formulated in equation1, 2 and 3 respectively as follows:

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

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

$$\text{s.t}\mathrm{LS_h} = \mathrm{B_h^l}\left\{\beta_\mathrm{h}^\mathrm{l}\left(\delta_\mathrm{h}^\mathrm{nq}\mathrm{LS_h}\right)^{\mathrm{k^l}} + \left(1-\beta_\mathrm{h}^\mathrm{l}\right)\left(\delta_\mathrm{h}^\mathrm{q}\mathrm{LS_h}\right)^{\mathrm{k^l}}\right\}^{\frac{1}{\mathrm{k^l}}} \quad (3)$$

With, YH_h represents the income of household h; wnq indicates the wage rate of unskilled workers; wq measures the wage rate of skilled workers; δ_h^q indicates the share of skilled workers in household h; δ_h^{nq} reflects the share of unskilled workers in household h; LS_h indicates the potential labour supply of household h, i.e. the total labour supply of both categories of workers and students; PC_{eds} indicates the unit price of tertiary education; PC_{edb} indicates the unit price of basic education; $ED_{h,edb}$ measures the volume of basic education demanded; $\beta_{h,eds}$ indicates the share of unit expenditure on higher education financed by household h; s indicates the share of the working life of adults that must be devoted to higher education in order to become qualified (average of years required to complete higher education compared to the total number of years of working life of adults); B_h^l indicates the scale parameter of the constant transformation elasticity (CET) function, while β_h^l measures the distributional parameter of the CET function and finally $\mathrm{k^l}$ indicates the transformation

parameter of the CET function.

In equation 1, the income of unskilled workers is expressed as $\times \delta_h^{nq} \times LS_h$. Thus, it is the wage of unskilled workers wnq multiplied by the number of unskilled workers in the household. Analogously, the income of skilled workers is represented by $\mathrm{wq} \times (1-s) \times \delta_h^q \times LS_h$, resulting from the multiplication of the wage of skilled workers wq, the potential volume of skilled workers $\delta_{\mathrm{h}}^{\mathrm{q}} \times \mathrm{LS_h}$, and the share of the working life of skilled adults not devoted to higher education.

In addition, the quantity of potential skilled labour consists of the number of active $(1-s) \times \delta_h^q \times LS_h$ as well as the number of students in higher education, represented by $\delta_{\mathrm{h}}^{\mathrm{q}} \times \mathrm{LS_h}$. This specification assumes a long-run equilibrium where the household must, year after year, allocate percent of its potential skilled workforce to higher education to maintain its desired proportion of skilled workers δ_h^q. On the other hand, the opportunity cost, $wqs \times \delta_h^q \times LS_h$, depends on the skilled wage, as a few more years of education may increase labour compensation but reduce working life in the skilled labour market. Net household income depends on investment in higher education, $\times \beta_{h,eds} \times PC_{eds} \times \delta_h^q \times LS_h$. Higher education is assumed to have a fixed direct unit cost, $\acute{CEDT}_{h,eds}$, which varies between households. Part of this cost is financed by a public subsidy, assumed to be exogenous and uniform for all households, $\acute{CG}_{eds}$. The share of the cost of higher education borne by households is represented by the difference between the total cost and the public subsidy in equation 4 as follows:

$$\beta_{\mathrm{h,eds}} = \mathrm{C\acute{E}DT_{h,eds}} - \mathrm{\acute{C}G_{eds}} \tag{4}$$

Consequently, an increase (decrease) in the public subsidy leads to a decrease (increase) in the share of the direct unit cost borne by households. The cost of education is linked to the price of higher education PC_{eds}, which reflects fluctuations in production costs and demand in this sector.

Imperfect substitution between unskilled and skilled labour plays a crucial role in modelling investment in education. Equation 3 illustrates the ability to acquire skills, reflecting the constraint on households to have unlimited access to education and skills. In the absence of this constraint, households could specialise in one type of work rather than the other. Households' flexibility to adjust their skill composition depends on the transformation parameter k^l de of the (CET) function. When deciding on the proportion of skilled labour δ_h^q, households evaluate the trade-off between the benefits of skilled labour (a high potential wage) and the opportunity costs as well as the direct costs associated with higher education. The resulting choice function to maximise labour income can be formulated as follows in equation 5:

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

By virtue of the relationship $\tau^l = 1/(k^l - 1)$, defining the elasticity of transformation, we can anticipate that if the benefits associated with the availability of a highly skilled workforce (Cloutier et al., 2004) outweigh the costs associated with education (opportunity costs and direct costs), all other things being equal, households will tend to increase their proportion of skilled workers through investment in higher education. On the other hand, if the benefits are lower than the costs, households will adjust downwards their share of skilled workers as well as their commitment to education. Once the optimal share of skilled workers $(1-\delta_h^q) \times LS_h$ and a quantity of skilled labour$(1-s) \times \delta_h^q \times LS_h$, while the rest of the potential skilled workers, $s \times \delta_h^q \times LS_h$, devote themselves to study and remain inactive in the labour market. If the government decides to increase its subsidy to higher education, households will opt for increased educational investment. As a result, a decrease in the supply of unskilled labour

($\Delta\delta_h^{nq}$) and an increase in the supply of skilled labour ($\Delta(1-s)\delta_h^{nq}$) will occur. As a result, the total supply of labour will fall ($\Delta s\delta_h^{nq}$). The state receives income from public enterprises, household social contributions and international transfers (such as remittances from Moroccans resident abroad (MREs) and donations). It also collects direct taxes from households and businesses, as well as indirect taxes on domestic and imported products, and levies on industrial production. Its expenditure is divided between consumption of goods and services, transfers and savings. As part of its public spending, the government partially finances basic and higher education. As household demand for basic education is considered to be fixed, the proportion subsidised by the government is also considered to be exogenous. On the other hand, the proportion of tertiary education financed by government subsidy is deemed to be endogenous, as it depends on household demand for tertiary education. The government subsidises each unit of higher education consumed by households at a fixed amount (equation 6).

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

With, G_{eds} represents the consumption of higher education by the government, while LE_h denotes the demand for higher education by household h.

As far as production is concerned, two main factors are involved: capital and labour. Capital is assumed to be able to move from one sector to another, which implies that a single rate of return on capital is applicable to all industries. Labour, on the other hand, is segmented into two categories: unskilled workers, defined as those who have not completed secondary education, and skilled workers, defined as those who have completed secondary education or more. Workers can migrate from one industry to another, resulting in uniform pay for each type of work across all industries. The skill premium is determined by fluctuations in supply and demand for each category of work. For example, 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 fall. In the area of companies and production sectors, companies receive a share of capital income, some of which they redistribute to households in the form of dividends, pay taxes to the State and make transfers to other agents. Each sector uses a technology with constant output and is in perfect competition. The total output of each sector depends on the combination of value added and intermediate consumption, with value added being influenced by the composition of labour and capital. Public spending on higher education affects value added and total output by altering the proportion of skilled and unskilled workers, as well as the proportion of students attending higher education. In the area of foreign trade, the model assumes that all goods and services can be imported or exported, with the exception of basic and higher education. Imports and local products are considered as imperfect substitutes, according to the principle of Armington (1969), modelled by a constant elasticity of substitution (CES) function. These goods collectively form composite consumer goods. On the supply side, producers strategically allocate their output between foreign and domestic markets to maximise profits in each destination market, constrained by a constant elasticity of transformation (CET) function. The prices of goods exported or imported on the domestic market are assumed to be fixed and exogenous, determined by the dirham equivalent of world prices adjusted for nominal exchange rates, tariffs and taxes. The current account balance remains at its initial (exogenous) level in foreign currency, and the nominal exchange rate is fixed. Equilibrium in the model is characterised by equality of demand and supply in each market, which is achieved through price adjustments. Wages act as the adjustment variable in the labour market. The closure of the model designates the exchange rate as the numeraire, with public savings and the current account balance considered as fixed variables. Other variables, such as minimum consumption, labour supply, international import and export prices, inventory changes, unit costs of basic and higher education borne by households and the government, are generally considered exogenous and therefore remain constant. In the area of welfare, poverty and inequality, three sets of indicators are used to assess the impacts of shocks on households are represented as follows: (i) the change in equivalence (VE) which is used to assess household welfare, presented in equation 7 as follows:

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

In our analysis, we consider several important variables: the total consumption of households h, denoted by CTH_h; the total consumption of households h in the reference year, denoted by $CTHO_h$; the minimum consumption of the necessary good for households h, excluding basic and higher education, denoted by $CMIN_{ned,h}$; the consumer price of the necessary good, denoted by PC_{ned}; the consumer price of the necessary good in the reference year, denoted by PCO_{ned} and the marginal share of the necessary good in the cleaning demand function(h), represented by $\gamma_{ned,h}$. (ii) The poverty measures adopted in this model are based on indices developed by Foster, Greer and Thorbecke (FGT) in 1984. These indices follow the following general form represented in equation 8 as follows:

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

In our analysis, we consider several important variables: the total consumption of households h, denoted by CTH_h; the total consumption of households h in the reference year, denoted by $CTHO_h$; the minimum consumption of the necessary good for households h, excluding basic and higher education, denoted by $CMIN_{ned,h}$; the consumer price of the necessary good, denoted by PC_{ned}; the consumer price of the necessary good in the reference year, denoted by PCO_{ned} and the marginal share of the necessary good in the cleaning demand function(h), represented by $\gamma_{ned,h}$. (ii) The poverty measures adopted in this model are based on indices developed by Foster, Greer and Thorbecke (FGT) in 1984. These indices follow the following general form represented in equation 9 as follows:

$$P_\alpha = \frac{1}{n}\sum_{i=1}^{p}\left[\frac{(z-y_i)}{z}\right]^\alpha \quad (9)$$

In this study, we consider several important parameters for assessing household poverty. Firstly, household income is represented by the variable yi. Next, we have the poverty line, symbolised by z, which is the threshold below which a household is considered to be living in poverty. The total number of households is denoted by n. Finally, the variable i designates households whose income is below the poverty line. In reality, three poverty indicators are commonly used: incidence, gap and severity. These indicators are associated with the values (0, 1, 2) respectively, assigned to α. Moreover, (iii) the Gini index is a synthetic tool used to assess disparities in income, wages or living standards within a population or a country. It varies from 0 to 1, where an index of 0 represents perfect equality, meaning that all individuals have the same income, while an index of 1 indicates extreme inequality, where one individual has all the income. The higher the Gini index, the more pronounced the inequality, and equation 10 illustrates its formula as follows:

$$I_{Gini}(y) = \frac{1}{2n^2\bar{Y}}\sum_{i=1}^{n}\sum_{j=1}^{n}|y_i - y_j| \quad (10)$$

In our study, we consider several aspects that are essential for assessing the effects of public policies on poverty and inequality. First, we use the absolute difference between the incomes of households i and j, represented by $|y_i - y_j|$. Then, the average household income is symbolised by $\bar{Y}$. The model is solved for the reference year (2015). Following each change in public policy concerning the subsidies allocated to higher education, the model generates not only the classic macroeconomic results of a computable general equilibrium (CGE) model, but also the demands for each good by the 7063 households, their total expenditure in value, as well as their income vector. As pointed out by Agénor et al. (2003), the effects of macroeconomic policies on low-income households are manifested mainly through variations in income. Furthermore, in order to take into account the rural nature of poverty in Morocco, we analyse

the impacts of shocks on measures of poverty and inequality by stratifying households according to their place of residence. Two poverty lines are used: one for urban areas and the other for rural areas, as defined by the Haut-Commissariat au Plan (HCP) for 2007. To calculate and compare the FGT and Gini indices, we use the DASP (Distributive Analysis Stat Package) software developed by Araar & Duclos (2007).

4. Simulation results and discussion

To examine the impact of government spending on higher education on household welfare and poverty reduction, two alternatives are modelled and evaluated: ES1: A 100% total reduction in the household contribution to the overall unit cost of higher education; ES2: A 50% reduction in government subsidies to the overall unit cost of higher education. Analysis of the results will focus primarily on the decision to invest in education, household income, well-being, poverty and economic disparities.

4.1 Impact on the decision to invest in higher education

In Table 1, the decision to invest in education is conditioned by equation (1), which has four main channels of influence. (i) direct effect on costs, (ii) impact of the skill incentive, (iii) impact of the opportunity cost and (iv) influence of the university tariff. Firstly, the reduction in government allocations to higher education leads to an increase in the direct costs borne by households. In the initial framework, the contribution of households to the financing of higher education does not exceed 7.90%. With the 50% cut in public subsidies, this contribution rises to 53.94%. In the initial estimate, the entire cost of higher education is covered by the government, making household contributions insignificant. In addition, direct expenditure on higher education rises from 0.03 as a base unit to 0.17 in the second model. Second, households adjust their commitment in response to any increase in direct costs by reducing their investment and time allocated to higher education. Assuming that total labour supply remains constant, the reduction in the cohort of skilled workers is offset by an increase in the cohort of unskilled workers. In fact, the supply of skilled labour increased by 0.82% in ES1, while the supply of unskilled labour fell by 0.52%. Conversely, the supply of skilled labour fell by 4.37%, while the supply of unskilled labour rose by 2.76% in ES2. The reduction in the supply of skilled labour leads to an increase in the wages of skilled workers, while the increase in the supply of unskilled labour leads to a reduction in the wages of unskilled workers. From this point of view, these two phenomena jointly contribute to the rise in the skill premium, representing the ratio between the wages of skilled workers and those of unskilled workers. The scenario data reveal a slight decline in this premium in ES1 (1.25 compared with 1.26 in the base scenario) and an increase in ES2 (1.33). Thirdly, the opportunity cost is defined as the product of the skills premium and the proportion of working time invested in higher education. An increase in the skill premium increases the opportunity cost, and vice versa. Adding this cost to the direct cost reduces the net gain from investing in higher education. In ES1, the opportunity cost remains practically constant (0.16); however, it increases in ES2 (0.17) following the increase in the skill premium. Fourth, the price of higher education decreases by 1.73% in ES2, while it increases by 0.45% in ES1. It should be emphasised at this point that the effect of the price of higher education is incorporated into the overall effect of direct cost. Thus, the results obtained show an increase in total household and government demand for higher education in ES1 (1.50%) and a decrease in ES2 (6.83%). Consequently, it is difficult to predict the direct impact of the price of higher education on the net gain. In general, all four factors have a direct impact on the net gain from higher education. In ES1, the net gain increases by 1.05%, mainly due to the fall in direct costs. On the other hand, the net gain falls by 6.62% in ES2 due to the increase in direct costs borne by households, despite the increase in the qualification premium. These results show that the reduction in the public subsidy allocated to higher education leads to a reduction in the net gain. However, increasing this subsidy improves the net gain.

Table 1. Configuration and effects on education and work

	Base	ES1	ES2
Household contribution to higher education costs	7.90 %	0.00%	53.94%
Δ Overall demand for higher education	-	1.50%	-6.83%
Δ Higher education costs	1	0.45%	-1.73
Benefits and costs of higher education: After estimation			
Skills bonus	1.26	1.25	1.33
Opportunity cost	0.16	0.16	0.17
Direct charges	0.03	0.00	0.17
Net profit	1.08	1.09	1.01
Δ Net profit		**1.05 %**	**-6.62 %**
Allocation of work within households: rate of change (%)			
Δ Unskilled labour	61.35%	-0.52%	2.76%
Δ Skilled labour	34.02%	0.82%	-4.37%
Δ Total active workforce	95.36%	**-0.04%**	**0.21%**
Δ The students	4.64%	0.81%	-4.36%

Note. ES stands for model estimate.

4.2 Impact on household incomes

In order to analyse and fully grasp the impact of state involvement in the funding of higher education on the phenomenon of poverty, a preliminary exploration of the mechanisms of influence linked to the fluctuation of public subsidies on household incomes is essential. We therefore identify five main mechanisms influencing net household income. To elucidate these five mechanisms of influence on household income, equation 11 requires a decomposition of the variation in income using the total differential method presented in equation (2):

$$\begin{aligned}\Delta YH = \quad & [wq(1-s) - wnq] \times \Delta S_{q\times} LS \quad + \Delta wq(1-s)LS + \Delta wnq(1-s)S_q LS - \\ & \Delta PC_{eds} \times \beta_{eds} sS_q \times LS - PC_{eds} \times \Delta\beta_{eds} sS_q \times LS - \Delta PC_{eds} \times \beta_{eds} s\Delta S_q \times LS + \\ & \Delta \text{Capital income} + \Delta \text{Transfers received} \quad + \Delta \text{Cost of basic education} \end{aligned} \tag{11}$$

4.2.1. Effect of combining skills

The variation in potential skilled labour depends on two elements: the ratio of working time invested in higher education and the difference between the remuneration of skilled and unskilled workers. The equation for potential skilled labour can be reformulated as follows: [(1-s) (wq-wnq) - swnq] ΔSqLS. Thus, changing public subsidies to higher education has two distinct effects: on the one hand, a fall (or rise) in the number of skilled workers leads to a fall (growth) in household income equivalent to the wage premium (wq - wnq, assumed to be 20%) that these workers could earn during their working lives (1 -s). On the other hand, household income increases (decreases) due to the wages of unskilled workers that could have been invested in higher education. The combination of these two effects shows that the effect of the wage premium is relatively more important (less important) than that of the opportunity cost. Table 3 clearly shows that for ES1, the effect of potential skilled work is positive on household income (0.01%) because the effect of the wage premium (0.03%) is relatively greater than that of the opportunity cost (-0.02%). Similarly, for ES2, the wage premium increases household

income by 0.09%, while the opportunity cost reduces it by 0.15%. In this simulation, the potential effect of skilled labour on income is negative (-0.07%).

4.2.2. Salary effect

The variation in income also results from the impact on returns to work. In other words, the combined impact of the variation in each type of wage on household income depends on the initial endowment in each category of work. The overall analysis of the results obtained shows that: In ES1, the wage of skilled labour increases by 0.18% and that of unskilled labour decreases by 0.05%, which contributes to an increase in income of 0.14%. In ES2, the fall in skilled workers' wages (0.91%) is greater than the rise in unskilled workers' wages (0.28%), leading to a deterioration in household income of 0.64%.

4.2.3. Effect of the cost of higher education

The cost of higher education can be affected by several factors. The first concerns the variation in the unit cost of higher education borne by households. It should be noted that changes in this unit cost have a major impact on changes in net income. This unit cost contributes to a 0.35% improvement in household income in ES1 and a 1.93% reduction in ES2. The second factor concerns the variation in the price of higher education. The effect of this price is zero in ES1 and represents only 0.04% in ES2. The final factor concerns the variation in the share of skilled workers in the potential labour supply. The reduction (increase) in this share contributes to the reduction (increase) in the cost of higher education and therefore has a positive (negative) effect on income. In ES1, although the number of skilled workers increases, its impact on income remains negligible. On the other hand, the number of skilled workers decreases in ES2, which reduces the cost of higher education and therefore contributes to the 0.11% increase in income. In general, we see that the impact of the change in the price of higher education and that of the share of skilled workers remain minimal on the change in income.

4.2.4. Other effects on income

The model takes into account two other categories of household income: capital income and transfers received from other economic agents. In ES1, the effect of these incomes on household income is slightly positive (0.09%). In ES2, as with the other variables, other non-work income contributes negatively to the variation in income (-0.38%).

4.2.5. Cost of basic training

The final influence on income comes from the variation in the cost of basic education. It is essential to stress that, in this model, the volume and unit cost of basic education are assumed to be constant. Consequently, the impact of this cost is zero in the two scenarios considered.

In general, in Table 2, the combination of the various effects shows that the government's decision to cover all the costs of higher education improves household income (an increase of 0.56%). Conversely, a reduction in public funding for higher education is accompanied by a decrease in income (2.85%). Furthermore, a more detailed analysis of each household's income shows that of the 7,062 households studied, 98.67% of households benefit from an increase in their income in ES1, while the income of 99.03% of households decreases in ES2. Furthermore, the results indicate that urban households are the most affected by the changes induced by the shocks.

Table 2. Income mechanisms

	ES1	ES2
Effect of combining skills		
(1-s)×(Wq-Wnq)×ΔSq×LS	0,03%	-0,15%

(-s)×Wnq×ΔSq×LS	-0,02%	0,09%
Total	0,01%	-0,07%
Salary effect		
ΔWnq×(1-Sq)×LS	0,18%	-0,91%
ΔWq×(1-s)×SqLS	-0,05%	0,28%
Total	0,14%	-0,64%
Effect of the cost of higher education		
(−)ΔPCeds×Beta_eds×s×Sq×LS	0,00%	0,04%
(−)PCeds×ΔBeta_eds×s×Sq×LS	0,35%	-1,93%
(−)PCeds×Beta_eds×s×ΔSq×LS	0,00%	0,11%
Total	0,34%	-1,79%
Other effects on income		
Δ Capital income	0,04%	-0,17%
Δ Transfers	0,05%	-0,21%
Effect of the cost of basic education	0,00%	0,00%
Change in net profit		
ΔYH	0,56%	-2,85%

Source. authors' calculations.

4.3 Impact on well-being, inequality and poverty

Following a rigorous analysis of the impact of government intervention on the unit cost of higher education on household investment choices in this area, as well as its impact on income and other macroeconomic aggregates, this section will turn to an examination of the influence of government spending on higher education on household welfare, income inequality and poverty.

In assessing household welfare, our analysis focuses on the relationship between equivalent variation and income. The data presented in Table 3 reveals that, in general, household economic well-being increases by 0.5% in the ES1 scenario, while it decreases by 2.48% in the ES2 model. In terms of place of residence, it appears that the well-being of urban households is more affected by economic shocks. Thus, in ES1, the well-being of urban households increases by 0.55%, compared with an increase of 0.37% in rural areas. On the other hand, the decrease in well-being is more pronounced in urban than in rural areas in the ES2 (-2.48% versus -1.75%). However, it should be noted that the increase (or decrease) in income has a more significant impact than that of the consumer price index on the variation in well-being, as the results suggest. More specifically, our data shows that 99.26% of households experience an improvement in their well-being in scenario ES1, while over 99.59% of households experience a deterioration in their well-being in scenario ES2.

Table 3. Effect on well-being

	Δ (in %) ofPCI	Δ (in%) of income			% change in well-being as a function of income (EV/Income)		
		N	U	R	N	U	R
ES1	0.16%	0.55%	0.63%	0.41%	0.5%	0.57%	0.37%

ES2	-0.76%	-2.84%	-3.27%	-1.93%	-2.48%	-2.82%	-1.75%

Notes. N refers to the national territory, R to urban areas and R to rural areas.

With regard to the impact on inequality, the Gini coefficient, a statistical measure representing the distribution of income within a population, is an indicator that varies from 0 to 1. A coefficient of 0 means perfect equality, while 1 indicates total inequality where one individual has all the income and the others have none. Table 4 shows the results of the simulations on inequality. In the reference year, this coefficient was 45.66% at national level, 39.02% in rural areas and 46.53% in urban areas. It should be noted that rural areas show less income disparity, a trend often observed in developing economies.

The results of the first scenario ES1 reveal an improvement in income inequality at national level (-0.03%), in urban areas (-0.02%), and particularly in rural areas (-0.12%). However, the ES2 model leads to a decrease in the Gini coefficient at national level and in urban areas (-0.40% and -0.37% respectively), while it increases in rural areas (0.11%). This finding highlights the fact that the reduction in public subsidies in higher education affects the real income of disadvantaged households living in rural areas more significantly than that of non-disadvantaged households in the same areas.

Table 4. Estimation of the Gini coefficient

	Δ (in %) Gini		
	N	U	R
Base	45.66%	46.53%	39.02%
ES1	-0.03%	-0.03%	-0.12%
ES2	-0.40%	-0.37%	0.11%

Notes. N refers to the national territory, R to urban areas and R to rural areas.

Table 5 provides a comprehensive presentation of the poverty results for the two simulated shocks. In the reference year, the poverty rate is higher in rural areas (14.6%) than in urban areas (6.13%). This disparity persists regardless of the index used, with a significant difference between the rural and urban indices. The incidence of poverty is 2.3 times higher in rural areas, while the poverty gap is 2.8, and the poverty severity index is 3.3 times higher in rural areas than in urban areas.

It has previously been observed that reducing public spending on higher education has a negative impact on the propensity of households to invest in the acquisition of additional skills and qualifications, leading to a fall in income and well-being. On the other hand, full public coverage of the unit cost of higher education encourages households to invest significantly in education, which has a positive effect on their income and well-being. These two scenarios lead to opposite trends in poverty. For example, all poverty indices show a decrease under ES1, while ES2 leads to an increase in these same indices. In addition, it should be noted that the effects of shocks on the various indices are more pronounced in urban areas than in rural areas.

Table 5. Impact on FGT poverty indices

ΔPoverty rate (P0)	ΔPoverty gap (P1)	ΔPoverty severity (P2)
FGT0	FGT1	FGT2

	N	U	R	N	U	R	N	U	R
Base	9.68%	6.13%	14.6%	2.23%	1.23%	3.5%	0.79%	0.39%	1.27%
ES1	-1.77%	-3.07%	-1.73%	-1.95%	-2.6%	-1.71%	-2.19%	-2.91%	-1.96%
ES2	7.33%	13.8%	5.65%	8.49%	11.98%	7.42%	9.62%	13.42%	8.41%

Notes. N stands for national territory, U for urban and R for rural; FGT stands for Foster-Greer-Thorbecke.

The results of the analysis reveal that the ES1 scenario generates an improvement in household well-being, reflected in a reduction in poverty indices and a decrease in inequalities, both nationally and in urban and rural environments. It is therefore appropriate to assess the impact of this shock in greater depth using the growth impact curve (GIC). This methodology, developed by Chen & Ravallion (2003), provides a framework for analysing the effect of a policy on the different percentiles of the population's per capita income distribution. Figures 1 and 2 below provide a visual representation illustrating that the GIC is systematically positive. This suggests that ES1 has led to 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 us to establish conclusively the pro-poor nature of the policy simulated in the context of the ES1, at both national and urban level. Indeed, different quantiles show both upward and downward variations in per capita income.

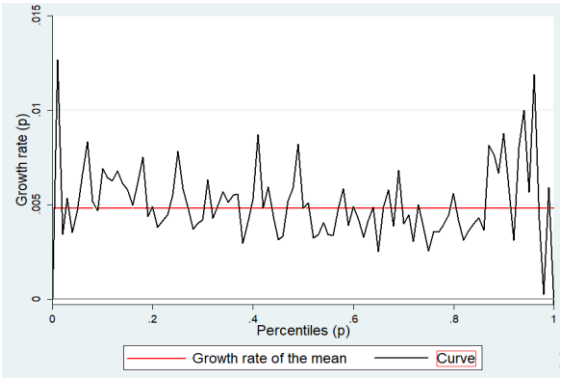


Figure 1. GIC curve for ES1 (National)

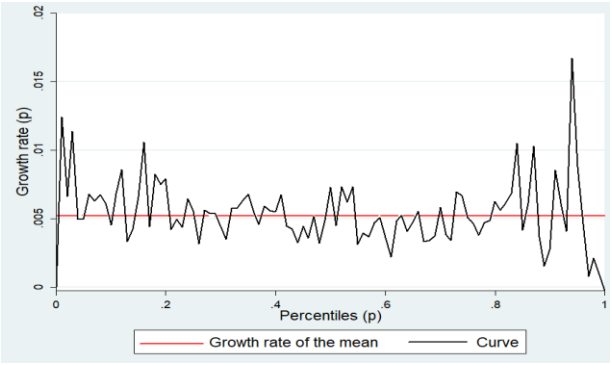
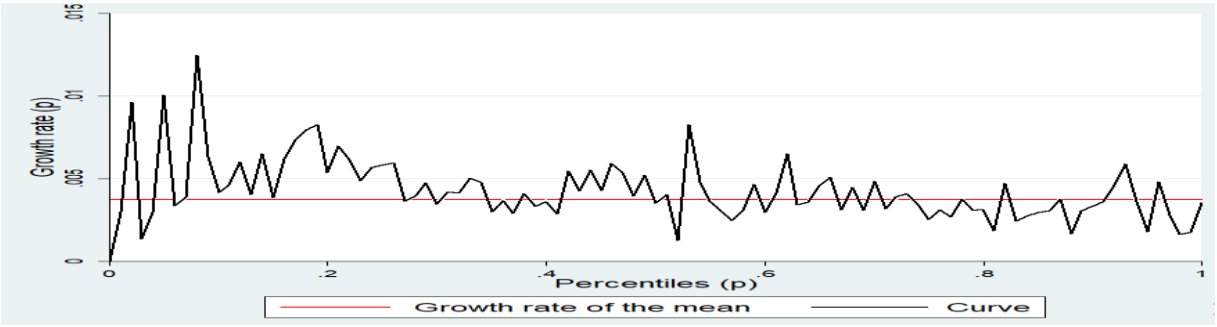


Figure 2. GIC curve for ES1 (Urban)

However, analysis of Figure 3 highlights the pro-poor nature of ES1 at the rural level. It is clear that the poorest 50% of households in this area benefit most from the policy, while the income growth rate of the wealthiest households is generally lower than the average growth rate. This study of growth incidence curves thus confirms the favourable impact of the policy of full government funding of the costs of higher education, particularly on rural households living in poverty. From an overall perspective, it is reasonable to conclude that in order to improve household economic welfare, reduce disparities and combat poverty, the government needs to increase its investment in financing the unit cost of higher education. This strategy could



encourage households to invest more in higher education, thereby improving their skills levels and consequently raising their incomes.

Figure 3. GIC curve for ES1 (Rural)

5. Conclusion

In recent years, the Moroccan government has stepped up its efforts to absorb the deficits accumulated since independence. Several strategies have been deployed to this end, aimed at boosting the national economy while promoting social and territorial equity. The Vision 2030 national strategy for education is one of these reform initiatives, aimed at optimising public intervention in the education sector and boosting the performance of the Moroccan education system. A wide-ranging debate emerged between the various speakers on the issue of financing education, highlighting two main currents: those in favour of free education services on the one hand, and those advocating a contribution by parents to school fees on the other. Each of these currents vigorously defends its arguments. However, decision-making on this crucial issue requires an in-depth analysis of the economic and social impact of these policies.

With this in mind, this study aims to quantify the impacts of a public policy aimed at adjusting the share of government subsidy in the financing of higher education on household investment behaviour in this sector, as well as on welfare, poverty and inequality. To this end, we have developed a computable and micro-simulated general equilibrium model of the Moroccan economy, with a high granularity for households. This model, calibrated with the most recent data available, is based on a 2015 social accounting matrix for Morocco and the results of the 2007 National Household Consumption and Living Standards Survey (NHCLSS). Two scenarios were simulated: the first envisages full government funding of higher education, while the second introduces a 50% reduction in public spending in this area.

The results highlight the fact that public policies that reduce the financial burden on households for higher education encourage them to invest more in education, thereby increasing their skills and, consequently, their income. This dynamic has a positive impact on well-being, poverty indicators and inequalities. However, further extensions are needed to enrich the model and deepen the analyses, in particular by taking into account two elements: (i) The model does not take unemployment into account and assumes that the total number of skilled workers available on the labour market is absorbed, which does not accurately reflect Morocco's economic reality, characterised by a high unemployment rate, particularly among young graduates. Incorporating unemployment into the model would allow us to grasp the real impact of investment in higher education on household income and poverty; (ii) the model is static and does not take into account all the temporal and dynamic effects of shocks. A dynamic recursive model would be a desirable alternative to fully understand the impact of government higher education funding decisions on poverty over time.

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