

When social goals meet economic goals: the double dividend of extending free access to healthcare in Uganda

Jean-Marc Montaud, Mahamadou Roufahi Tankari

► **To cite this version:**

Jean-Marc Montaud, Mahamadou Roufahi Tankari. When social goals meet economic goals: the double dividend of extending free access to healthcare in Uganda. 2013. hal-01880339

HAL Id: hal-01880339

<https://hal-univ-pau.archives-ouvertes.fr/hal-01880339>

Preprint submitted on 24 Sep 2018

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



**Centre d'Analyse Théorique et de
Traitement des données économiques**

**CATT WP No. 8
July 2013**

**WHEN SOCIAL GOALS
MEET ECONOMIC GOALS:
THE DOUBLE DIVIDEND OF
EXTENDING FREE ACCESS TO
HEALTHCARE IN UGANDA**

**Jean-Marc MONTAUD
Mahamadou Roufahi TANKARI**

When social goals meet economic goals: the double dividend of extending free access to healthcare in Uganda

Jean-Marc Montaud, UPPA, CATT

Mahamadou Tankari, IFPRI, CATT

Abstract

In recent years, the need for a better access to health services has become a social objective in many sub-Saharan African countries that seek to achieve the Millennium Goals for Development. Yet such pursuits raise questions about the appropriate balance between the social goals and economic objectives of poverty reduction policies, such that measures promoting agricultural growth might appear as a more effective strategies. This article explores how an improvement of health subsidies policy in Uganda experiment might meet both these social and economic goals. Focusing on the relationship between farmers' health and agricultural productivity, we use a computable general equilibrium model and a non-parametric micro-simulation model to predict the effect of this policy. The results show that it is likely to increase both households' access to health care and growth processes. They also show that in a context marked by scarce budgetary resources, it is possible to maximise the impact of this policy by reallocating subsidies toward the categories of health care with the greatest impacts on workers' productivity or toward rural households.

Keywords: Health policy, Poverty, Computable general equilibrium model, Micro-simulation

Classification JEL: I18, I32, C68, C81

I. INTRODUCTION

During the 2000s, poverty reduction became the primary focus of development policies in African countries, after two decades of policies nearly exclusively dedicated to macroeconomic and financial issues. Encouraged by international initiatives, such as the Heavily Indebted Poor Countries initiative or Millennium Goals for Development (MDG), African governments started promoting social services classified as ‘pro-poor’, such as education and health care. However, recently, a broader consensus has suggested that economic growth may be a necessary condition for sustainable poverty reduction, and that exclusive funding of short-term social programs rather than long-term productive investments, is not the most efficient way to maximise the impacts of scarce budgetary resources (Badiane and Ulimwengu, 2009; Benin et al., 2008; Killick, 2004; Kydd and Dorward, 2001; Paternostro et al., 2007; World Bank, 2003). From this perspective, the agricultural sector is an appealing potential target for maximising poverty reduction outcomes, considering its critical contribution to overall growth and its importance for ensuring the livelihood of poor people (Christiansen et al., 2011; Diao et al., 2010; Fan and Rosegrant, 2008; World Bank, 2008).

Uganda offers a good illustration of this trade-off between economic and social goals in poverty reduction efforts (Paternostro et al., 2007; Williamson and Canagarajah, 2003; World Bank, 2002). Successive Ugandan agricultural programs have called for more substantial investment policies while also facing scarce public funding, most of which was allocated to costly social policies with direct poverty benefits, including health care policies. For example, on 1 March 2001, in direct contrast with the spirit of the Bamako Initiative¹, Uganda abolished user fees for government health facilities² to reduce financial barriers to receiving health services. This policy substantially increased the use of public health facilities among the poor and confirmed that it could achieve MDG by 2015. Yet it also revealed some limitations, including arguments that better targeted subsidies specifically dedicated to the rural users or extended to providers who serve rural areas might have offered greater effectiveness (Pariyo et al., 2009; Ridde et al., 2012; Uganda Ministry of Health, 2010).

In this context, we seek to determine whether improvements in Ugandan health subsidies might offer a doubly effective poverty reduction strategy, meeting both short-term social needs and long-run economic objectives. Specifically, such a policy might not only improve the well-being of the poorest members of society but also enhance agricultural productivity (Badiane and Ulimwengu,

¹ The Bamako Initiative, sponsored by UNICEF and the World Health Organization and adopted by African ministers of health in 1987, aimed to increase access to primary health care by increasing the effectiveness, efficiency, financial viability, and equity of health services. Of the various elements of this initiative, a key component was the introduction of user fees to improve the sustainability of primary health care in Africa (Gibson, 1995)

² This abolition of user fees occurred at the same time as several other changes in the health sector, such as the decentralisation of responsibility for the delivery of health services to local authorities, restructuring the Ministry of Health (MOH), the introduction of the Uganda National Minimum Health Care Package (UNMHCP), autonomy for the National Medical Stores (NMS), community health insurance schemes, contracting with health workers, and hospital autonomy (see Pariyo et al., 2009).

2009; Malney and Sachs, 2002; World Bank, 2008). We use a computable general equilibrium model extended by a micro-simulation model, to perform numerical simulations of the impact of such health subsidies on poverty through their effects on production, employment, and income. The first section provides some insights from existing literature. The second section explains our main methodological choices. The final section presents the results of the numerical simulations in an attempt to identify which public health subsidy strategies might be most effective in terms of reducing poverty in Uganda.

II. BACKGROUND

Our analysis reflects the underlying hypothesis that a public health policy designed to improve access to health care for farmers can effectively increase agricultural efficiency and generate pro-poor growth processes. Each of these links has been explored previously in economics literature.

The potential benefits of agriculture in developing countries has been debated for years (for reviews, see Christiansen et al., 2011; Dethier and Effenberger, 2011; Diao et al., 2010). According to dualist development theories, some works still consider agriculture as an unproductive subsistence sector that cannot generate growth because of its poor productivity level, among other features. However, recently, increasing numbers of studies emphasise the critical contributions of agriculture to overall growth, due to its large size, dominant influence on the incomes of the poorest populations and high labour intensity (Tiffin and Irz, 2006; World Bank, 2008). From the MDG perspective, the focus even has shifted to whether promoting agriculture growth might generate sustainable poverty reduction (e.g., Christiansen et al., 2011; Diao et al., 2010; Loayza and Raddatz, 2010), whether indirectly from forward and backward demand or supply linkages of agriculture with other nonfarm sectors or directly through an increase in agricultural labour productivity.

Among the determinants of agricultural labour productivity, the health conditions of farmers represent a particular case that can be included in the more general issue of the link between health and economic efficiency. The existence of such link seems widely accepted in economic literature, though it remains difficult to identify and measure (e.g., Jack and Lewis, 2009; Sachs, 2001; Strauss and Thomas, 1998). Beyond the challenge of defining health status precisely, the difficulties stem from the complex bi-directional causalities of health and economic efficiency both at macroeconomic and microeconomic level. For instance economic growth has an evident positive impact on health, whether directly through income and demand effects or indirectly through general improvement in living conditions, such as better access to food or better sanitation facilities. But, on the other side, health has also a supply effect that various empirical studies attempt to capture by considering health expenditures as an investment in human capital (for overview see e.g., Mwabu, 2007 or McNamara et al., 2010) mostly by addressing the productivity of agricultural households (e.g., Ajani and Ugwu,

2008; Asenso-Okyere et al., 2011; Audibert and Etard, 2003; Ersado et al., 2004; Hawkes and Ruel, 2006; Ulimwengu, 2009)³.

Finally, the question of what kind of public health policy might be designed to promote households' health became a critical issue last years (e.g., Cleason and Wagstaff, 2004; Gupta et al., 2003; Nixon and Ulmann, 2006; O'Donnell et al., 2008) and the particular question of user fees has even raised recently, as African countries, breaking from the Bamako Initiative, have experimented with partial or universal abolition. However, this abolition seems still debated today (e.g., Hanson et al., 2006; Ridde et al., 2012). On the one hand, focusing on an efficiency perspective, some works doubt of the relevancy of such policy. They argue for instance that demand for health care is relatively inelastic with respect to price because factors such as proximity to health care providers, perceived quality of care or perceived illness severity, offer stronger determinants of health services uses than fees charged. These arguments also tend to emphasise the disruptive effects of free access, including declining quality or inappropriate management (e.g., lack of information about free services, unpredictable and insufficient funding, reimbursement delays, multiplicity of actors, existence of informal fees). On the other hand, focusing on an equity perspective, others works indicates that credit constraints limit households' ability to access fee-based services, even when they clearly would be willing to pay, such that the aggregate benefits of abolishing user fees exceed their estimated damages.

III. METHODOLOGY

3.1. Methodological choices

In order to deal with the complex relationships among public health policy, agricultural efficiency and poverty reduction, our first methodological choice is to adopt a computable general equilibrium model (CGE). Indeed, CGE modeling seems to be a significant complementary tool of empirical approaches⁴. Its Walrasian logic can account for bi-directional links of health, growth, and income through the effects of supply, prices, and demand. Moreover, its disaggregated nature enables us to focus on the agricultural sector or farmers. Finally, the normative character of CGE approaches can help clarify transmission channels between public spending and poverty and provide a method for evaluating their effectiveness. However, because the results of the CGE model are relevant only at the aggregate level of each household group, in line with the representative agent hypothesis, we extend our analysis with a micro-simulation model (MS) that uses a sequential top-down approach (Bourguignon et al., 2005). Within this framework, the CGE model simulates the impact of a public

³ According to the theoretical model of Pitt and Rosenzweig (1986), health is then often considered as a determinant of the level of production of farmers, by determining their quantity and quality of work or their ability to incorporate new technologies

⁴ Some CGE models even cite health issues in developing countries, such as in studies of the impact of HIV/AIDS on economic performances (e.g., Arndt, 2003; Arndt and Lewis, 2000, 2001; Arndt and Wobst, 2002) or externalities related to improved health conditions (Kouwenaar, 1986; Savard and Adjovi, 1997). No prior studies apply these models to Uganda's health care system.

health subsidy policy in Uganda, and the macroeconomic results are extended to the MS model, without any feedback effects, to estimate the impact at the individual level, particularly in terms of poverty.

Our second methodological choice pertains to the health public policy we consider in these simulations. The abolition of user fees experimented in Uganda since 2001 resulted in an substantial increase in uses of public facilities among the poor but it also revealed some room for improvements (Burnham et al., 2004; Deininger and Mpuga, 2004; Kajula et al., 2004; Nabyonga et al., 2005, 2008; Pariyo et al., 2009; Ridde et al., 2012; Rutebemberwa et al., 2009; Uganda Ministry of Health, 2010; Xu et al., 2006; Yates et al., 2006). The high cost of this universal policy has prompted financial losses for public facilities, as well as wide variance in the quantity and quality of services offered raising the question of better management and effectiveness of public expenditure. Nor has it completely eliminated barriers to access that challenge the poorest and most rural populations such as financial costs or long distances to health facilities. Fee abolition refers exclusively to first-level public health facilities⁵ and public hospitals still offer services for pay for those who can afford them and a survey by the Ministry of Health also revealed the presence of informal fees in public health centres (Uganda Ministry of Health, 2010). Ugandan National Household Survey (UNHS) data⁶ show then that spending in public centres still represents 21% of households' total health expenditures while spending in private not-for-profit (PNFP) facilities accounts for 43% and spending in private for-profit (PFP) facilities for 36%. In this context, given that Ugandan government has extended its support to PNFP facilities, which now receive funds amounting to 20% of the service they provide (Uganda Ministry of Health, 2010), and that such PNFP facilities are widespread, representing 41% of hospitals and 22% of small health centres, which complement the first-level public centres, mainly in rural areas, we envisage an extended real fee reduction for both public and PNFP facilities. Thus we consider two types of health sub-sectors: a profit sector, essentially formed by PFP (private health practitioners) and a non-profit sector formed by all public and PNFP facilities.

Finally, we note one last methodological choice: Previous literature has revealed that the effectiveness of public health expenditures depends on both allocation (i.e., how the recipients are distributed across the population) and efficiency (i.e., productivity or quality of health facilities). We do not address the latter but instead treat it as given. Our focus instead is on the allocation efficiency of public subsidies, which may vary in the CGE model by categories of households or health products, according to the impact on agricultural productivity and thus on poverty.

⁵ The Ugandan healthcare delivery system is highly decentralised into zones at the national, regional, district and sub-districts levels (Deininger and Mpuga, 2004). The health system is based on referrals; health centres, categorised into levels I–IV, cover geographic areas ranging from villages to counties and serve different functions (e.g., level I focuses on prevention and health education; level IV covers prevention, cure, rehabilitation and emergency surgeries). Curative services are provided by a mix of public and private facilities; the latter include not-for-profit, for-profit (private health practitioners) and traditional medicine providers.

⁶ This national survey included 7400 households, in which all members were surveyed.

3.2. CGE model

The CGE model encompasses an agricultural sector (15 activities), a non-agricultural sector (21 activities), a health sector (3 non-profit activities, 3 profit activities), five groups of households (3 urban, 2 rural) and a government agent. We present the relevant equations and variables in Appendix 1. On the supply side, each activity combines fixed capital with a composite (skilled and unskilled) labour factor. Incomes are distributed to different agents on the basis of their factor endowments. The government receives taxes too. On the demand side, households' consumption reflects a linear expenditure system function, and demand from the government is assumed to be exogenous. The prices, wage rate, and exchange rate provide the closure mechanisms for, respectively, product markets, the skilled labour market, and the external accounts market. Nominal investment is savings driven on the capital market. At this point, the logic of our CGE model is fairly standard. Its main originalities rely on the ways the agricultural sector is specified and the health topics are introduced.

Various specificities of the agricultural sector in the model reflect its forward and backward linkages with the rest of the economy and the ways it drives economic growth and poverty reduction. From the demand side, it exports goods to foreign markets with an exogenous price, but data show that it is less tradable than other activities. On domestic markets, agricultural goods are used for intermediate consumption by activities and final consumption by households. The latter should exhibit lower income elasticity for agricultural goods than for non-agricultural goods. When incomes rise, final demand for agricultural goods should increase at a slower rate than demand for other products (Engel's law). On the supply side, agricultural activities consume intermediate goods from all activities and only use unskilled workers, most of whom live in rural areas (*rural farmers*) or urban peripheries (*urban farmers*). We introduce a migration hypothesis to allow for labour movements to the non-agricultural sector, where the wages are fixed higher at initial equilibrium (+20%). This Harris-Todaro mechanism implies comparisons of average earnings in the agricultural sector and likely gains in the non-agricultural sector. Unemployment ensures the closure of the overall unskilled labour market in the economy.

A main innovation of our model is that we leave the total factor productivity of agricultural activities endogenous, linked to farmers' health. As suggested in economic literature, this element effectively determines farmers' ability to work, innovate, and experiment with new agricultural technologies (Fulginiti and Perrin, 1993, 1998). We do not model household health *per se* though; instead, we introduce it using the health-capital concept proposed by Grossman (1972, 2000). In this framework, each household produces its own health-capital, in accordance with a Cobb-Douglas function of the three types of health products it consumes (medical consultation, hospitalisation and drugs), and each category of consumption has a specific impact on productivity levels in agricultural activities. Because these products are produced through both non-profit and profit activities, households consume composites of medical care, according to an Armington specification. The share

of profit and non-profit products in each household's health consumption depends on the elasticity of substitution⁷ and relative prices. At this stage of the model, we introduce the public health policy, using the possibility of subsidising the price of non-profit products. These subsidies, funded by the Ugandan government, then can be assigned to each categories of health care for each household (rural or urban)⁸.

Most of model parameters can be calibrated directly from Uganda's 2007 Social Accounting Matrix (SAM-2007) built by Thurlow (2008). If such a calibration is not possible, we obtain the remaining parameters from extant literature, including other CGE models already established for Uganda⁹. However, because it is a central point of our analysis, the elasticity parameters between households' medical care consumption and productivity in agricultural activities are estimated using data from the Uganda National Households Survey conducted in 2005/2006 (UNHS-2005/2006). The econometric approach and results of the estimations are in Appendix 2.

3.3. MS model

The MS model is connected to the CGE model through the labour market. The underlying idea is that a macroeconomic shock may change the status of each household member on this market and therefore the nature and amount of their incomes. However, because of a lack of consistency between microeconomic data (UNHS-2005/2006) and macroeconomic data (SAM-2007), changes observed after running the CGE model cannot advance directly into the MS model, such that we must proxy for the new individual status. This estimated procedure is based on the non-parametric approach used by Ganuza et al. (2002). According to microeconomic data, individual earnings should be function of individual attributes (i.e., skills) and position on the labour market. The latter factor depends on overall market conditions, expressed in terms of the participation and unemployment rates of skilled and unskilled workers; employment structure by sector of activity and occupational category; overall and sectoral wage rates; and the average skill level of the workers. The distribution of individual income is a function of these labour market conditions and personal attribute distributions within households. Each change in these parameters thus should alter the distribution of per capita income. At this point, we note that the non-parametric approach does not explicitly include labour market individual behaviours, as would be common with parametric approaches¹⁰. Instead, it assumes that the impact of changes in labour market conditions on employment status and incomes of individual

⁷ Because we lack data, we assume all households substitute private health consumption for public consumption with the same elasticity. This assumption limits our analysis by preventing us from accounting for different behaviors across households. However, income elasticity for health products appears lower for rural households than for urban households.

⁸ The public supply of health products is well distributed geographically between Ugandan districts and sub-districts, so we assume it is possible to find different subsidies between rural and urban areas.

⁹ E.g. Blake et al. (2002), Dorosh et al. (2003), Dorosh and Thurlow (2009), Senoga and Matovu (2010).

¹⁰ Parametric approaches rely on labour market theories such as human capital, assignment, or labour market segmentation theory and include labour-supply or labour-demand behaviours (e.g., Bourguignon et al., 2005).

workers can be estimated with a random selection procedure. Macroeconomic changes simulated by the CGE model then enter the MS model, with random numbers assigned to individuals (classified on the basis of their individual attributes and labour market segments) to determine who undergoes a status change and what new types of income they perceive. On average, the predicted effects of these random changes should correctly reflect the final impact of global changes observed on the labour market at the macro level. Repeated several times with a Monte Carlo approach¹¹, these micro-simulations lead to average results with confidence intervals of 95% of the impact of the initial macroeconomic shock on individuals, such as inequality indices and poverty rates.

IV. THE IMPACT OF PUBLIC SPENDING ON HEALTH IN UGANDA

4.1 Simulations of increased public subsidies for all health products and types of households

The first group of simulations reveal the impact of an increase in government subsidies for all health products for different categories of households. The latter are distinguished by their residence area and different modes of integration in the Ugandan economy (see Table 1).

TABLE 1

Table 2 shows the results of these simulations at the macro level (Panel a) and micro level (Panel b). The first policy provides the baseline scenario: a comprehensive 25% increase in subsidies dedicated to all households and non-profit health products. The second and third policies instead target rural or urban households.

TABLE 2

Increasing subsidies for all households has a significantly positive impact on the Ugandan economy. At the macro level, it changes the relative prices between non-profit and for-profit health products and generates a substitution effect. The market adjustments lead to a decrease in the relative prices, to the benefit of non-profit products (-24.16%); an increase in the share of consumption of non-profit health products as a percentage of total household health care expenditures (+2.98%); and, overall, an increase in the volume of health consumption (3.09%). This last outcome has a dual effect on the rest of the economy: First, it stimulates the production of health activities, boosting the skilled jobs they demand and the income they distribute. Second, it increases the productive efficiency of households (+0.9%) and stimulates agricultural production (1.57%). Third, this health policy increases domestic production volume (0.32%) and household income (0.26%) while decreasing the price index (-0.70%). Unskilled employment declines (-0.21%), especially in rural areas (-0.40%). This change reflects the combined effects of increases in agricultural productivity and production, together with wage differentials between sectors that determine incentives for rural-urban migration.

¹¹ Vos and Sanchez (2010) recommend 30 simulations.

In this new macroeconomic context, the micro-simulations indicate an increase in average household income (4.42%) and a reduction in the overall incidence of poverty (-1.56%), in both rural areas (-1.54%) and urban areas (-2.83%). They also show that inequality grew significantly at the national level (5.16%) but more intensely in urban areas (6.20%) than in rural areas (3.88%). The policies targeted toward rural or urban households have comparable but logically reduced effects. Subsidising only rural households increased their consumption of health care (2.01%) and productivity, as well as overall production (0.31%), total income (0.22) and purchasing power due to the lower price index (-0.63%). The incidence of poverty thus decreased in rural areas (-1.29%), but it also fell in urban areas (-2.69%). When the subsidy was allocated exclusively to urban households, the macroeconomic impacts were equivalent but lower in extent, due to their minority weight in the economy. However, the reduction of poverty (-0.21%) was logically higher in urban areas (-1.10%) than in rural areas (-0.23%). Yet our simulation also shows that, paradoxically, urban households benefit less from this policy than from the indirect effects of a policy dedicated to rural households.

4.2. Simulations of increased public subsidies for specific health products for all households

By determining the impacts of public subsidises assigned to each of the three categories of medical care, for all households, we attempt to show that targeting a particular type of product does not have the same impact on the economy, because of the weighted differences in household consumption, level of subsidy or potential impacts on agricultural productivity. Table 3 shows that drug sales represented the main consumption category; consultation had potentially the greatest impact in terms of agricultural efficiency.

TABLE 3

For this analysis, we assigned the 25% increase in the government subsidy alternately to drugs, hospitalisation services or medical consultation services. Table 4 show the simulation macro (Panel a) and micro (Panel b) results. They confirm that these policies have distinct impacts on the economy.

TABLE 4

In terms of health, each intervention reduces relative prices, in favour of the public sector, and also prompts an overall reduction in the average price of health care, which increases medical consumption and agricultural productive efficiency. This effect is particularly important in the case of subsidy policies toward drugs, which have the greatest impacts on domestic production (0.15% versus 0.07% for hospitalisation and 0.10% for consultation). A similar effect arose for skilled employment (1.16% versus 0.67% and 0.27% respectively), unskilled employment (-0.11% versus -0.06% and -0.06%, respectively), household income (0.12% versus 0.07% and 0.05%, respectively) or prices (-0.31% versus -0.21% and -0.21%, respectively). The microeconomic analysis also reflects the positive

impact of these policies on household welfare. At the national level, per capita income varies positively at levels of 2.64%, 1.58%, and 0.75% for subsidies of drug, hospitalisation, and consultations, respectively. As in the previous simulations, these shifts again are accompanied by increased inequality though (3.09%, +1.58%, and +0.81%).

4.3 Maximising public spending effectiveness

The previous simulations revealed the impacts of different policies in absolute terms on poverty and households' health-capital. A comprehensive policy of public subsidies dedicated to all households and all products obviously would have the greatest impact. Similarly, policies targeted at rural households or drugs appear potentially successful. However, these results are not directly comparable in terms of the efficiency of public spending, because their extra budgetary costs remain endogenous in the model, as dependant variables pertaining to the demand of each household group for medical care. With this framework, we cannot address the critical question of how much \$1 worth of public health expenditures actually maximise growth and reduce poverty. Thus we introduce two indicators of public spending effectiveness, in terms of poverty reduction and health-capital accumulation. Each indicator compares the relative change in the poverty rate or health-capital level against the relative variation of the health policy cost. Table 5, Panel a, shows the values of these indicators for all previous simulations. In terms of household group choice, subsidising rural households appears to be a 'good governance policy' that maximises the efficiency of public spending. At the national level, the additional budgetary costs are 43.5% (nearly 137 billion shillings), and it leads to a reduction of 1.29% of the poverty rate and an increase of 0.87% of household health-capital. The other policies do not achieve equal effectiveness, even the comprehensive version. In terms of product choice, Table 5, Panel a, also shows that subsidising consultation services for all types of households is the most effective national strategy: It increases health government expenditures by only 5.99% (nearly 19 billion shillings) but leads to a significant reduction of 0.72% in the poverty rate and an increase of 0.47% in household health-capital. Finally, we consider the potential benefits of a mixed health policy that targets rural households and offers access to consultation services. The last group of simulations thus considers all combinations of household types and product categories. The main results in Table 5, Panel b, confirm the superior efficiency of a rural consultation approach for both poverty reduction and the accumulation of health-capital.

TABLE 5

V. CONCLUSION

Focusing on the relationship between households' medical spending and agricultural productivity, this study has explored the impact that a broader public policy of health subsidies may produce on agricultural performances and poverty in Uganda. The numerical simulations, performed with a CGE model extended by a MS model, confirm that increased public health subsidies may be doubly effective, by improving households' access to care and generating pro-poor growth. Our

findings further reveal that it is possible to maximise the impacts of such public spending by allocating subsidies to the products (i.e., consultation services) and households (rural) that induce maximum poverty-reduction outcomes.

These results also confirm the possibility that the Ugandan government can effectively deal with its current policy trade-off, between economic and social goals, even considering its strong budget constraints. In this context, we find room for a *growth–poverty convergence agenda* for public policies in Uganda (Badiane and Ulimwengu, 2009) that relies on optimised management of the budget allocations across different ministries to exploit potential synergies between social policies and direct productivity-enhancing investments. We also confirm that subsidising PNFP facilities to address the special health care needs of the poor can improve public spending. The Ugandan government and health development partners thus should pursue and encourage innovative solutions (e.g., public–private partnerships).

REFERENCES

- Ajani O.I.Y. and P.C. Ugwu (2008) ‘Impact of Adverse Health on Agricultural Productivity of Farmers in Kainji Basin North-Central Nigeria Using a Stochastic Production Frontier Approach’, *Trends in Agricultural Economics*, 1, 1–7.
- Arndt C. (2003) ‘HIV/AIDS, Human Capital, and Economic Growth Prospects for Mozambique’, Africa Region Working Paper Series, No. 48. Washington DC: The World Bank.
- Arndt C. and J.D. Lewis (2000), ‘The Macro Implications of HIV/AIDS in South Africa: A Preliminary Assessment’, *South African Journal of Economics*, 68:856-887.
- Arndt C. and J.D. Lewis (2001) ‘The HIV/AIDS Pandemic in South Africa: Sectoral Impacts and Unemployment’, *Journal of International Development*, 13: 427-449.
- Arndt C. and P. Wobst (2002), ‘HIV/AIDS and Labor Markets in Tanzania’, Trade and Macroeconomics Division Discussion Paper, N°102. Washington D.C.: International Food Policy Research Institute.
- Asenso-Okyere K., C. Chiang, P. Thangata and K. S. Andam (2011), ‘Interactions between Health and Farm-Labor Productivity’, IFPRI Food Policy Report N°23.
- Audibert M. and J.-F. Etard (2003) ‘Productive Benefits after Investment in Health in Mali’, *Economic Development and Cultural Change*, 51:760–782.
- Badiane O., and J. Ulimwengu (2009) ‘The growth-poverty convergence agenda: Optimizing social expenditures to maximize their impact on agricultural labor productivity, growth, and poverty reduction in Africa’, Discussion Paper No. 00906. Washington, D.C.: International Food Policy Research Institute.
- Benin S., J. Thurlow X. Diao, A. Kebba, and N. Ofwono (2008) ‘Agricultural growth and investment options for poverty reduction in Uganda’, IFPRI discussion papers 790, International Food Policy Research Institute (IFPRI).
- Blake A., A. McKay and O. Morrissey (2002) ‘The Impact on Uganda of Agricultural Trade Liberalisation’, *Journal of Agricultural Economics*, 53: 365–381.
- Bourguignon F., A.-S. Robilliard and S. Robinson (2005) ‘Representative versus real households in the macro-economic modeling of inequality’, in T. Kehoe, T.N. Srinivasan, J. Whalley (eds.), *Frontiers in Applied General Equilibrium Modeling: Essays in Honor of Herbert Scarf*, Cambridge University Press, Cambridge, p. 219-254.
- Burnham G.M., G. Pariyo, E. Galiwango E and F. Wabwire-Mangen(2004) ‘Discontinuation of cost sharing in Uganda’, *Bull World Health Organ* , 82(3):187-195.

- Christiansen L., L. Demery and J. Kuhl (2011) 'The (evolving) role of agriculture in poverty reduction--An empirical perspective', *Journal of Development Economics, Elsevier*, 96(2):239-254.
- Cleason M. and A. Wagstaff (2004) 'The Millennium Development Goals for Health: Rising to the challenge', The World Bank N°29673.
- Deininger K. and P. Mpuga (2004), 'Economic and welfare impact of the abolition of health user fees: Evidence from Uganda', *Journal of African Economies* 14(1): 55-91.
- Dethier J-J. and A. Effenberger (2011) 'Agriculture and Development: A Brief Review of the Literature', World Bank Policy Research Working Paper N° 5553. Washington, DC: World Bank.
- Diao X., P. Hazell and J. Thurlow (2010) 'The Role of Agriculture in African Development', *World Development, Elsevier*, 38(10):1375-1383.
- Dorosh P. A., E. Moataz and H. Lofgren (2003) 'Technical Change, Market Incentives And Rural Incomes: A CGE Analysis Of Uganda's Agriculture', Annual Meeting, August 16-22, 2003, Durban, South Africa, International Association of Agricultural Economists.
- Dorosh P. and J. Thurlow (2009) 'Agglomeration, migration, and regional growth: A CGE analysis for Uganda', IFPRI discussion papers N°848, International Food Policy Research Institute (IFPRI).
- Ersado L., G. Amacher and J. Alwang (2004) 'Productivity and Land Enhancing Technologies in Northern Ethiopia: Health, Public Investments, and Sequential Adoption', *American Journal of Agricultural Economics*, 86(2):321-331.
- Fan S. and M. W. Rosegrant (2008) 'Investing in agriculture to overcome the world food crisis and reduce poverty and hunger', Policy briefs 3, International Food Policy Research Institute (IFPRI).
- Fulginiti L. E. and R. K. Perrin (1993) 'Prices and Productivity in Agriculture', *the Review of Economics and Statistics*, 75(3):471-82.
- Fulginiti L. E. and R. K. Perrin (1998) 'Agricultural productivity in developing countries', *Agricultural Economics, Blackwell*, 19(1-2):45-51.
- Ganuzo E., P. R. de Barros and R. Vos (2002) 'Labour market adjustment, poverty, and inequality during liberalization', in: Vos , P. R. de Barros and L. Taylor (Eds.) *Economic Liberalization, Distribution and Poverty. Latin America in the 1990s*, Cheltenham (UK), Northampton (MA): Edward Elgar Publishers, 54-88.
- Gilson L. and A. Mills (1995) 'Health sector reforms in sub-Saharan Africa: lessons of the last 10 years', *Health Policy* , 32(1-3):215-243.
- Grossman M. (1972) 'On the Concept of Health Capital and the Demand for Health', *Journal of Political Economy*, 80(2):223-255.
- Grossman M. (2000) 'The Human Capital Model' in *Handbook of Health Economics*, 1(Part A):347-408.
- Gupta S., M. Verhoeven and E. R. Tiongson (2003) 'Public Spending on Health Care and the Poor', *Health Economics*, 12:685-696.
- Hawkes C., M. T. Ruel (2006) 'The links between agriculture and health: an intersectoral opportunity to improve the health and livelihoods of the poor', *Bull. WHO.*, 84:985-991.
- Heckman J. and R. Robb (1985) 'Alternative methods for evaluating the impact of interventions', in: J. Heckman and B. Singer, eds. *Longitudinal analysis of labor market data*, Econometric Society monograph series (Cambridge University Press, New York).
- Jack W. and M. Lewis (2009), 'Health Investment and Economic Growth: Macroeconomic Evidence and Microeconomic Foundations', in: M. Spence, and M. Lewis, ed., *Health and Growth*, Washington: World Bank.
- Hanson H, C James, B. McPake, D. Balabanova, D. Gwatkin, Y. Hopwood, C. Kirunga, R. Knippenberg, B. Meessen, S. S. Morris A. Preker ,Y. Souteyrand, A. Tibouti ,P. Villeneuve and K. Xu (2006) 'To retain or remove user fees?: reflections on the current debate in low- and middle-income countries', *Applied Health Economic Health Policy*, 5(3):137-153.
- Kajula P. W., F. K., J. Barugahare and S. Neema (2004), 'Political analysis of rapid change in Uganda's health financing policy and consequences on service delivery for malaria control', *International Journal of Health Planning and Management* , 19(S1):133-153
- Killick T. (2004) 'Politics, evidence, and the new aid agenda', *Development Policy Review*, 22:5-29.
- Kouwenaar A. (1986) 'A Basic Needs Policy Model: A General Equilibrium Analysis with Special Reference to Ecuador', Ph.D. thesis, Erasmus Universiteit Rotterdam.

- Kydd J. and A. Dorward (2001) 'The new Washington consensus on poor country agriculture: analysis, prescription and gaps: with particular attention to globalisation and finance for seasonal inputs', *Development Policy Review*, 19(4):467-478.
- Loayza N. and C. Raddatz (2010) 'The composition of growth matters for poverty alleviation', *Journal of Development Economics*, 93(1):137-151.
- Malney P. and J. Sachs (2002) 'The economic and social burden of malaria', *Nature*, 415: 680-685.
- McNamara P. E., J. M. Ulimwengu, and K. L. Leonard(2010) 'Do Health Investments Improve Agricultural Productivity?' Discussion Paper N° 01012, Washington , DC: International Food Policy Research Institute.
- Mwabu G. (2007) 'Health Economics for Low-Income Countries', in T. P. Schultz & J. A. Strauss, ed. *Handbook of Development Economics*. Amsterdam: Elsevier North Holland, 3305-3374.
- Nabyonga J., M. Desmet, H. Karamagi, P. Y. Kadama, F. G. Omaswa and O. Walker (2005) 'Abolition of cost-sharing is pro-poor: evidence from Uganda', *Health Policy Plan*, 20(2):100-108.
- Nabyonga J. H. Karamagi, L. Atuyambe, F. Bagenda, S. A Okuonzi, and O. Walker (2008) ' Maintaining quality of health services after abolition of user fees: A Uganda case study', *Health Services Research*, 8:102
- Nixon, J. and P. Ulmann, (2006) 'The Relationship Between Health Care Expenditure and Health Outcomes' *European Journal of Health economics*, 7:7-18.
- O'Donnell O., E. V. Doorslaer, A. Wagstaff and M. Lindelow (2008) 'Analyzing health equity using household survey data : a guide to techniques and their implementation', World Bank Washington DC.
- Pariyo G. W., E. Ekirapa-Kiracho, O. Okui, M. H. Rahman, S. Peterson, D. M. Bishai, H. Lucas and D. H. Peters(2009) 'Changes in utilization of health services among poor and rural residents in Uganda: are reforms benefitting the poor?' *International Journal for Equity in Health* 8(39).
- Paternostro S., A. Rajaram and E. R. Tiongson, (2007). 'How Does the Composition of Public Spending Matter?', *Oxford Development Studies, Taylor and Francis Journals*, 35(2):47-82.
- Pitt M. M. and M. R. Rosenzweig (1986) 'Agricultural prices, food consumption, and the health and productivity of Indonesian farmers', In *Agricultural household models*, ed. I.J. Singh, L. Squire, and J. Strauss. Baltimore: Johns Hopkins University Press.
- Ridde V., E. Robert and B. Meessen (2012) 'A literature review of the disruptive effects of user fee exemption policies on health systems', *BMC Public Health Review*,12:289.
- Rutebemberwa E., G. Pariyo, S. Peterson, G. Tomson and K. Kallander(2009) 'Utilization of public or private health care providers by febrile children after user fee removal in Uganda', *Malaria journal*, 8: 45-45.
- Sachs J. D. (2001) 'Macroeconomics and health: Investing in health for economic development', Report of the Commission on Macroeconomics and Health, Geneva, Switzerland: WHO.
- Savard L. and É. Adjovi (1998) 'Externalités de la santé et de l'éducation et bien-être : un modèle d'équilibre général calculable appliqué au Bénin', *L'Actualité Economique, Société Canadienne de Science Economique*, 74(3) :523-560.
- Senoga E. B. and J. M. Matovu (2010) 'Public Spending Composition and Public Sector Efficiency: Implications for Growth and Poverty Reduction in Uganda', Research Series N°66, Economic Policy Research Centre, Kampala, Uganda.
- Strauss J. and D. Thomas (1998) 'Health, nutrition and economic development', *Journal of Economic Literature*, XXXVI: 766-817.
- Terza J. V., A. Basu and P.J. Rathouz (2008) 'Two-stage residual inclusion estimation: Addressing endogeneity in health econometric modeling', *Journal of Health Economics*, 27 (3):531-543.
- Thurlow J. (2008) 'A 2007 Social Accounting Matrix for Uganda', International Food Policy Research Institute, Washington, D.C.
- Tiffin R. and X. Irz (2006) 'Is Agriculture the Engine of Growth?', *Agricultural Economics*, 35(1): 79-89.
- Uganda Ministry of Agriculture (2010) 'Agriculture Sector Development Strategy and Investment Plan', Kampala, Uganda.

- Uganda Ministry of Health (2010) 'Health sector strategic plan III, 2010/11-2014/15', Kampala, Uganda.
- Ulimwengu J. (2009) 'Farmers health and agricultural productivity in rural Ethiopia', *African Journal of Agricultural and Resource Economics*, 3(2):83–100.
- Vella F. (1993) 'A Simple Estimator for Simultaneous Models with Censored Endogenous Regressors', *International Economic Review*, 34(2):441-57.
- Vos R. and M. V. Sanchez (2010) 'A Non-Parametric Microsimulation Approach to Assess Changes in Inequality and Poverty', Working Paper N°94, DESA.
- Williamson, T. and S. Canagarajah (2003) 'Is there a place for virtual poverty funds in pro-poor public spending reform? Lessons from Uganda's PAF', *Development Policy Review*, 21:449–480.
- WHO Global Health Observatory, Ministry of Health, (2010), "Uganda Report".
- World Bank (2002) 'Uganda: Public Expenditure Review: Report on the Progress and Challenges of Budget Reforms', Report N° 24882 (Washington: The World Bank).
- World Bank (2003), The Heavily Indebted Poor Countries (HIPC) Debt Initiative: An OED Review; Report No. 25160; Washington DC
- World Bank (2008) 'Agriculture for development', World Development Report, Washington DC.
- Xu K., D. B. Evans, P. Kadama, J. Nabyonga, P.O. Ogwal, and A.M. Aguilar (2005) 'The elimination of user fees in Uganda: impact on utilization and catastrophic health expenditures', Discussion Paper N°4 – 2005, World Health Organization, Geneva.
- Xu K., D. B. Evans, P. Kadama, J. Nabyonga, P. O. Ogwal, P. Nabukhonzo and A. M. Aguilar(2006)'Understanding the impact of eliminating user fees: utilization and catastrophic health expenditures in Uganda', *Soc Sci Med* , 62(4):866-876.
- Yates J., R. Cooper and J. Holland (2006) 'Social protection and health : Experiences in Uganda', *Development Policy Review*, 24(3): 339-356.

APPENDIX 1. CGE MODEL

A. Institutional desegregation

| Non-agricultural activities | Agriculture | Public services (except Health) |
|------------------------------------|---------------------|--|
| Mining | Maize | Government administration |
| Food processing | Rice | Education |
| Beverages and tobacco | Other cereals | Other services |
| Textiles and clothing | Cassava | |
| Wood and furniture | Roots | Health services |
| Petroleum products | Pulses and oilseeds | Private drug sale |
| Chemical products | Horticulture | Private medical consultation |
| Machinery | Matoke | Private hospitalisation service |
| Other manufacturing | Tobacco | Non-profit drug sale |
| Construction | Cotton | Non-profit medical consultation |
| Electricity and water | Coffee | Non-profit hospitalisation service |
| Trade services | Other crops | |
| Hotels and catering | Livestock | Households |
| Transport services | Forestry | Rural farmers |
| Communications | Fishing | Rural Non farmers |
| Financial services | | Kampala metropolitans |
| Business services | | Urban farmers |
| Real estate | | Urban non farmers |

B. model sets

C All Activities or products

HP \subset C Private health services or activities
 HG \subset C Non – profit health services or activities
 NH \subset C Non – profit products or activities

AGR \subset C Agricultural products or activities
 NAGR \subset C Non Agricultural products or activities

CEX \subset C Exported or imported products
 CEXN \subset C Non Exported or imported products

SNM \subset C Non marketed products (except health products)

H Composite health products

M Households

C. Model equations

PRODUCTION BLOCK

Production process

1. $QX_c = A_c^p \cdot LD_c^{\alpha_c^p} \cdot \bar{K}_c^{1-\alpha_c^p} \quad \forall c \in C$
2. $LD_c = \frac{\alpha_c^p \cdot PVA_c \cdot QX_c}{W_c} \quad \forall c \in C$
3. $PVA_c = PX_c - \sum_{c'} PQ_{c'} \cdot ic_{c,c'} \quad \forall c \text{ et } c' \in C$

Agricultural total productivity

4. $A_c^p = A0_c^p \left(1 + \frac{HK - HK_0}{HK_0} \right) \quad \forall c \in AGR$
5. $HK = \left(\sum_m \gamma_{Agr}^m \cdot CQH_{Hmed}^m \right)^{\nu m} \cdot \left(\sum_m \gamma_{Agr}^m \cdot CQH_{Hhos}^m \right)^{\nu h} \cdot \left(\sum_m \gamma_{Agr}^m \cdot CQH_{Hcons}^m \right)^{\nu c}$

Composite labour

6. $LD_c = A_c^l \cdot \left[\alpha_c^l \cdot LDS_c^{-\mu_c^l} + (1 - \alpha_c^l) \cdot LDNS_c^{-\mu_c^l} \right]^{\frac{1}{\mu_c^l}} \quad \forall c \in NAGR$
7. $\frac{LDS_c}{LDNS_c} = \left[\frac{\alpha_c^l}{(1 - \alpha_c^l)} \right]^{\sigma_c^l} \cdot \left[\frac{WNS_{nagr}}{WS_{nagr}} \right]^{\sigma_c^l} \quad \forall c \in NAGR$
8. $W_c = \frac{\overline{WNS}_{nagr} \cdot LDS_c + \overline{WS}_{nagr} \cdot LDNS_c}{LD_c} \quad \forall c \in NAGR$
9. $LD_c = LDNS_c \quad \forall c \in AGR$
10. $W_c = WNS_{agr} \quad \forall c \in AGR$

Composite health products

11. $CQH_h^m = A_h^m \cdot \left[\alpha_h^m \cdot QHG_c^{m-\mu_h^m} + (1 - \alpha_h^m) \cdot QHP_{c'}^{m-\mu_h^m} \right]^{\frac{1}{\mu_h^m}} \quad \forall h \in H, c \in HG, c' \in HP \text{ et } m \in M$
12. $\frac{QHG_c^m}{QHP_{c'}^m} = \left[\frac{\alpha_h^m}{(1 - \alpha_h^m)} \right]^{\sigma_h^m} \cdot \left[\frac{PHP_{c'}^m}{PHG_c^m} \right]^{\sigma_h^m} \quad \forall h \in H, c \in HG, c' \in HP \text{ et } m \in M$
13. $PHQ_h^m = \frac{PHG_c^m \cdot QHG_c^m + PHP_{c'}^m \cdot QHP_{c'}^m}{CQH_h^m} \quad \forall h \in H, c \in HG, c' \in HP \text{ et } m \in M$
14. $PHP_{c'}^m = PQ_{c'} \quad \forall c' \in HP \text{ et } m \in M$
15. $PHG_c^m = PX_c - \overline{subv}_c^m \quad \forall c \in HG \text{ et } m \in M$

Output transformation

16. $QX_c = A_c^t \cdot \left[\alpha_c^t \cdot QE_c^{-\mu_c^t} + (1 - \alpha_c^t) \cdot QD_c^{-\mu_c^t} \right]^{\frac{1}{\mu_c^t}} \quad \forall c \in CEX$
17. $\frac{QD_c}{QE_c} = \left[\frac{\alpha_c^t}{(1 - \alpha_c^t)} \right]^{\sigma_c^t} \cdot \left[\frac{PDS_c}{PE_c} \right]^{\sigma_c^t} \quad \forall c \in CEX$
18. $PX_c = \frac{PDS_c \cdot QD_c + PE_c \cdot QE_c}{QX_c} \quad \forall c \in CEX$
19. $PE_c = \overline{EXR} \cdot \overline{PWE}_c \quad \forall c \in CEX$
20. $QX_c = QD_c \quad \forall c \in CEXN$
21. $PX_c = PDS_c \quad \forall c \in CEXN$

Imports and domestic sales

22. $QQ_c = A_c^m \cdot \left[\alpha_c^m \cdot QD_c^{-\mu_c^m} + (1 - \alpha_c^m) \cdot QM_c^{-\mu_c^m} \right]^{\frac{1}{\mu_c^m}} \quad \forall c \in CEX$
23. $\frac{QM_c}{QD_c} = \left[\frac{\alpha_c^m}{(1 - \alpha_c^m)} \right]^{\sigma_c^m} \cdot \left[\frac{PDD_c}{PM_c} \right]^{\sigma_c^m} \quad \forall c \in CEX$
24. $PQ_c = \frac{PDD_c \cdot QD_c + PM_c \cdot QM_c}{(1 - tv_{a_c}) \cdot QQ_c} \quad \forall c \in CEX$
25. $PM_c = \overline{EXR} \cdot \overline{PWM}_c \cdot (tm_c + 1) \quad \forall c \in CEX$
26. $QQ_c = QD_c \quad \forall c \in CEXN$
27. $(1 - tv_{a_c}) \cdot PQ_c = PDD_c \quad \forall c \in CEXN$
28. $PDD_c = PDS_c + icd_{com}^c \cdot PQ_{com} \quad \forall c \in C$

DEMAND BLOCK

Household consumption demand

29. $PQ_c \cdot CQN H_c^m = ch_h^m \cdot PQ_c + pmc_c^m \cdot \left[CFM^m - \sum_c ch_h^m \cdot PQ_c - \sum_h ch_h^m \cdot PHQ_h^m \right] \quad \forall c \in NH, h \in H \text{ et } m \in M$
30. $PHQ_h^m \cdot CQH_h^m = ch_c^m \cdot PHQ_c^m + pmc_c^m \cdot \left[CFM^m - \sum_c ch_h^m \cdot PQ_c - \sum_h ch_h^m \cdot PHQ_h^m \right] \quad \forall h \in H, c \in NH \text{ et } m \in M$

Intermediate demand

31. $DIQ_c = \sum_{c'} ic_{c,c'} \cdot QX_{c'} \quad \forall c \in NH \text{ et } c' \in C$

Investment demand

32. $INVQ_c = \varphi_c \cdot \frac{IT}{PQ_c} \quad \forall c \in NH$

Trade demand

33. $MC_{Com}^c = icd_{Com}^c \cdot QD_c \quad \forall c \in NH$

INCOMES AND SAVINGS BLOCK

Factors

34. $RLNS^{NAGR} = \sum_{c \in NAGR} \overline{WNS}_{nagr} \cdot LDNS_c$
35. $RLNS^{AGR} = \sum_{c \in AGR} \overline{WNS}_{agr} \cdot LDNS_c$
36. $RLS^{NAGR} = \sum_{c \in NAGR} \overline{WS}_{nagr} \cdot LDS_c$
37. $RK^{NAGR} = \sum_{c \in NAGR} (PVA_c \cdot QX_c - W_c \cdot LD_c)$
38. $RK^{AGR} = \sum_{c \in AGR} (PVA_c \cdot QX_c - W_c \cdot LD_c)$

Households

39.

$$YH^m = \lambda n s_{agr}^m \cdot RLNS^{AGR} + \lambda n s_{nagr}^m \cdot RLNS^{NAGR} + \lambda s_{nagr}^m \cdot RLS^{NAGR} + \lambda k_{agr}^m \cdot RK^{AGR} + \lambda k_{nagr}^m \cdot RK^{NAGR} + DIV^m$$

40. $YDH^m = (1 - ty^m) YH^m$

41. $SH^m = mps^m YDH^m$

42. $CFM^m = YDH^m - SH^m$

Firms

43. $YF = \lambda k^F (RK^{AGR} + RK^{NAGR})$

44. $SF = (1 - ty^F) YF - DIV^G - \sum_m DIV^m$

45. $DIV^G = divid^G \cdot YF$

46. $DIV^m = divid^m \cdot YF$

Government

47. $YG = TAXY + TAXM + TAXS + \lambda k^G \cdot (RK^{AGR} + RK^{NAGR}) + \overline{TRANS^{Row}} + DIV^G$

48. $TAXY = \sum_m ty^m \cdot YH^m + ty^F \cdot YF$

49. $TAXM = \sum_{c \in CEX} im_c \cdot EXR \cdot PWM_c \cdot QM_c$

50. $TAXS = \sum_c tv a_c \cdot PQ_c \cdot QQ_c$

51. $SG = YG - CFG$

52. $CFG = CFGNM + \sum_{c \in HG} \sum_m subv_c^m \cdot QHG_c^m$

53. $CFGNM = PX_{smm} \cdot \overline{CQNMGSmm}$

CLOSURE RULES BLOCK

Unskilled labour market

54. $WNS_{agr} = \frac{WNS_{nagr} \cdot \sum_{c \in NAGR} LDNS_c}{LNS^U + \sum_{c \in NAGR} LDNS_c}$

55. $LNS^U + \sum_c LDNS_c = \overline{LDNS^S}$

Skilled labour market

56. $LNS^U + \sum_{c \in NAGR} LDNS_c = \overline{LDNS^S}$

Commodities markets

57. $QQ_c = \sum_{c \in NH} CQNH_c^m + \sum_{c \in com} ica_{c,c} \cdot QX_c + INVQ_c + \overline{\Delta St_c}$
 $\forall c \in NH \text{ et } c \neq com \text{ et } c \notin SMM$

58. $QQ_{com} = \sum_c MC_{com}^c$

59. $QQ_c = \sum_m QHP_c^m \quad \forall c \in HP$

Non-profit services

60. $QX_c = \sum_m QHG_c^m \quad \forall c \in HG$

61. $QX_{smm} = \overline{CQNMGSmm}$

Current account balance

62. $\sum_{c \in CEX} EXR \cdot \overline{PWM_c} \cdot QM_c = \sum_{c \in CEX} EXR \cdot \overline{PWE_c} \cdot QE_c + \overline{Srow} + \overline{TRANS^{Row}}$

Savings-investment balance

63. $IT + \sum_{c \in NH} PQ_c \cdot \overline{\Delta St_c} = \sum_m SH^m + SF + SG + \overline{Srow}$

Price index and numerator

64. $Pindex = \sum_c \pi_c \cdot PQ_c$

65. $EXR = 1$

Total equations: 1042

D. List of variables and parameters

Endogenous variables (1041)

| | |
|-----------|--|
| PVA_c | Value-added activity price |
| PX_c | Aggregate producer commodities price |
| PDS_c | Offer price for domestic commodities |
| PDD_c | Demand price for domestic commodities |
| PE_c | Export commodities price |
| PM_c | Import commodities price |
| PQ_c | Composite commodities price |
| PHQ_h^m | Composite health commodity price for household m |

| | |
|-----------|--|
| PHP_h^m | Private health commodities price for household m |
| PHG_h^m | Public health commodities price for household m |
| $Pindex$ | Consumer price index |
| EXR | Exchange rate |
| QX_c | Quantity of aggregate commodity c output |
| QD_c | Quantity of domestic supply of commodity c |
| QE_c | Quantity of commodity c exports |
| QM_c | Quantity of commodity c imports |
| QQ_c | Quantity of composite commodity c |

| | | | |
|---------------|--|-------------|---|
| QHG_h^m | Quantity of consumption of public health commodity h by household m | SH^m | Household m savings |
| QHP_h^m | Quantity of consumption of private health commodity h by household m | CFM^m | Household m consumption expenditures |
| $CQNH_c^m$ | Quantity of consumption of non health commodity c by household m | YF | Firm income |
| CQH_h^m | Quantity of consumption of composite health commodity h by household m | SF | Firm savings |
| DIQ_c | Quantity of intermediate demand for composite commodity c | YG | Government income |
| $INVQ_c$ | Quantity of investment demand for composite commodity c | $TAXY$ | Income tax |
| MC_{Com}^c | Quantity of trade for composite commodity c | $TAXM$ | Import tax |
| $RLNS^{NAGR}$ | Non-skilled labour incomes in non-agricultural activities | $TAXS$ | Sale tax |
| $RLNS^{AGR}$ | Non-skilled labour incomes in agricultural activities | SG | Government savings |
| RLS^{NAGR} | Skilled labour incomes in non-agricultural activities | CFG | Government consumption expenditures |
| RK^{NAGR} | Capital incomes in non-agricultural activities | $CFGNM$ | Government non-marketed consumption expenditures |
| RK^{AGR} | Capital incomes in agricultural activities | IT | Nominal investment |
| DIV^m | Dividend perceived by household m | LD_c | Quantity of composite labour in activity c |
| DIV^g | Dividend perceived by government | $LDNS_c$ | Quantity of unskilled labour in activity c |
| YH^m | Household m income | LDS_c | Quantity of skilled labour in activity c |
| YDH^m | Household m disposable income | LNS^U | Unemployment of unskilled labour |
| | | LS^U | Unemployment of skilled labour |
| | | W_c | Labour wage rate in activity c |
| | | WNS_{Agr} | Unskilled labour wage rate in agricultural activities |
| | | $HealthK$ | Farmer household health |
| | | A_{agr}^p | Efficiency parameter rate in agricultural activities |

Exogenous variables

| | | | |
|--------------------------|---|-------------------------------|--|
| \overline{Srow} | Foreign savings | \overline{WS}_{nagr} | Skilled labour wage rate in non-agricultural activities |
| \overline{TRANS}_{Row} | Transfers from government to row | \overline{LDNS}^S | Quantity supplied of unskilled labour factor |
| \overline{PWE}_c | Foreign export commodities price | \overline{LDS}^S | Quantity supplied of skilled labour factor |
| \overline{PWM}_c | Foreign import price | \overline{CQNMG}_c | Quantity of government consumption of non marketed commodities |
| $\overline{\Delta St}_c$ | Stock change | $\overline{Subv}_{Healthg}^h$ | Price subvention of public health commodities |
| \overline{K}_c | Quantity of capital factor in activity c | | |
| \overline{WNS}_{nagr} | Unskilled labour wage rate in non-agricultural activities | | |

Parameters

| | | | |
|---------------|---|--------------|--|
| A_c^p | Production function efficiency parameter | α_c^l | Composite labour function share parameter |
| α_c^p | Production function share parameter | μ_c^l | Composite labour function exponent |
| $ica_{c,c}^l$ | Quantity of intermediate input c' per unit of product c | σ_a^l | Composite labour function substitution parameter |
| $A0_c^p$ | Initial production function efficiency parameter in agricultural activity | A_h^m | Composite function shift parameter for commodity h |
| HK_0 | Initial farmer household health capital | α_h^m | Composite function share parameter for commodity h |
| ψh | Health production function exponent | μ_h^m | Composite function exponent for commodity h |
| A_c^l | Composite labour function shift parameter | | |

| | | | |
|---------------|---|-----------------------|--|
| σ_h^m | Composite function substitution parameter for commodity h | ch_h^m | Subsistence consumption of health commodity h for household m |
| A_c^t | CET domestic-export function shift parameter | φ_c | Share of commodity c in total investment |
| α_c^t | CET domestic-export function share parameter | λns_{nagr}^m | Share of household m in income of unskilled labour factor in non-agricultural sector |
| μ_c^t | CET domestic-export function exponent | λs_{nagr}^m | Share of household m in income of skilled labour factor in non-agricultural sector |
| σ_c^t | CET domestic-export function substitution parameter | λk_{agr}^m | Share of household m in income of capital factor in agricultural sector |
| A_c^m | Armington domestic-import function shift parameter | λk_{nagr}^m | Share of household m in income of capital factor in non-agricultural sector |
| α_c^m | Armington domestic-import function share parameter | ty^m | Direct tax rate on household m |
| μ_c^m | Armington domestic-import function exponent | mps^m | Marginal propensity to save for household m |
| σ_c^m | Armington domestic-import function substitution parameter | λk^F | Share of household m in income of capital factor |
| tva_c | Sales tax rate | ty^F | Direct tax rate on firms |
| tm_c | Import tariff rate | $divid^G$ | Share of government in total dividend |
| icd_{com}^c | Quantity of trade input per unit of product c | $divid^m$ | Share of household m in total dividend |
| cnh_c^m | Subsistence consumption of non health commodity c for household m | λk^G | Share of government in income of capital factor |
| pmc_c^m | Marginal share of consumption spending on commodity c for household m | π_c | Weight of commodity c in the consumer price index |

APPENDIX 2. ESTIMATION OF HEALTH-CAPITAL FUNCTION PARAMETERS

The agricultural production function is assumed to be a Cobb-Douglas function, whose parameters depend on the health-capital of farmers (Fulginiti and Perrin, 1993, 1998), which itself is derived from a Cobb-Douglas function of their medical care consumptions (Grossman, 1972)

$$y = A \prod_{i=1}^n x_i^{\beta_i} \quad (1a)$$

$$\log A = \alpha_0 + \alpha \log HK + \mu_0 \quad (1b)$$

$$\beta_i = \gamma_{i0} + \gamma_i \log HK \quad (1c)$$

$$HK = B C^{s_C} D^{s_D} H^{s_H} \quad (1d)$$

where y is the production volume; x_i indicate the inputs; β_i refers to the output–input elasticity; A is the productivity scale parameter; HK indicates the farmers' health-capital; C, D and H indicate medical spending in consultation, drugs and hospitalisation, respectively; s_C, s_D, s_H the are health consumption elasticities; and B refers to the efficiency parameter of the health-capital function. Therefore,

$$\log y = \alpha_0 + \alpha_1 \log C + \alpha_2 \log D + \alpha_3 \log H + \sum_{i=1}^n \gamma_{i0} \log x_i + \sum_{i=1}^n \gamma_{i1} \log C \log x_i + \sum_{i=1}^n \gamma_{i2} \log D \log x_i + \sum_{i=1}^n \gamma_{i3} \log H \log x_i + \sum_{i=1}^n \mu_i \log x_i + \mu_0 \quad (2)$$

where α_j and γ_{ij} are fixed coefficients, and μ_i is an Independent and identically distributed random variable of input x_i .

The direct ordinary least square estimation of this model leads to biased estimates because of the censoring and endogeneity of the health care spending data. Thus, we apply Vella's (1993) proposed dual approach, which predicts endogenous variables from a Tobit model and generalised residual. We also conducted a bootstrap analysis for non-biased standard deviations. As suggested by Terza et al. (2008), we used Heckman and Robb's (1985) control function, which includes the residuals of the regression of each endogenous variable on the instruments and on other exogenous variables. Both approaches lead to similar results. Elasticities of agricultural productivity with respect to consultation, drugs and hospitalisation for each household are derived from the following formulas:

$$\psi_C = \sum_{i=1}^n \gamma_{i1} \log x_i + \alpha_1 \quad (3a)$$

$$\psi_D = \sum_{i=1}^n \gamma_{i2} \log x_i + \alpha_2 \quad (3b)$$

$$\psi_H = \sum_{i=1}^n \gamma_{i3} \log x_i + \alpha_3 \quad (3c)$$

Elasticities of agricultural productivity with respect to input

| Variables (in Log) | CF (Robust) | 2S (Bootstrap) |
|------------------------|------------------|------------------|
| Consultation | 0,29(0,0007)*** | 0,29(0,0007)*** |
| Drugs | 0,22(0,0007)*** | 0,21(0,0007)*** |
| Hospitalisation | 0,14(0,0004)*** | 0,13(0,0004)*** |
| Wage labour | 0,03(0,0001)*** | 0,03(0,0001)*** |
| Land | 0,42(0,0006)*** | 0,42(0,0006)*** |
| Family labour | 0,24(0,0004)*** | 0,24(0,0004)*** |
| Seed | -0,01(0,0001)*** | -0,01(0,0001)*** |
| Machine | 0,01(0,0002)*** | 0,01(0,0002)*** |
| Fertiliser | 0,07(0,0003)*** | 0,07(0,0003)*** |
| Constant | 10,74(0,0080)*** | 10,87(0,0075)*** |

*** $p < 0.01$. ** $p < 0.05$. * $p < 0.1$.

Source: own calculations from UNHS 2005/2006.

TABLES

Table 1. Shares of households by type of income (%)

| <i>Type of income</i> | Global | Unskilled labour | Skilled labour | Capital |
|----------------------------------|---------------|-----------------------------|---------------------------|----------------|
| <i>Type of household</i> | | | | |
| Rural households | 63,0 | 66,4 | 41,5 | 58,7 |
| <i>Rural farmers</i> | 48,5 | 52,9 | 23,1 | 42,2 |
| <i>Rural non farmers</i> | 14,5 | 13,5 | 18,4 | 16,5 |
| Urban households | 37,0 | 33,6 | 58,4 | 41,3 |
| <i>Urban farmers</i> | 8,3 | 6,5 | 19,9 | 8,8 |
| <i>Urban non farmers</i> | 10,1 | 9,3 | 14,6 | 11,4 |
| <i>Kampala metropolitans</i> | 18,6 | 17,8 | 23,9 | 21,1 |
| Total | 100,0 | 100,0 | 100,0 | 100,0 |

Source: own calculations from Ugandan SAM -2007.

Table2. 25% increase of public subsidies of all health care products for different types of households,

a. macro-simulation results: variation rate from initial equilibrium (%)

| | | All households | Rural | Urban |
|---|-------------------------|-----------------------|--------------|--------------|
| Production (volume) | <i>National</i> | +0,32 | +0,31 | +0,01 |
| | <i>Agricultural</i> | +1,57 | +1,51 | +0,11 |
| | <i>Non agricultural</i> | +0,01 | +0,02 | -0,01 |
| Index price | <i>National</i> | -0,70 | -0,63 | -0,06 |
| | <i>Agricultural</i> | -1,65 | -1,57 | -0,16 |
| | <i>Non agricultural</i> | -0,19 | -0,12 | -0,01 |
| Agricultural unskilled wage rate | | -0,49 | -0,42 | -0,12 |
| Unskilled employment | <i>National</i> | -0,21 | -0,19 | -0,04 |
| | <i>Agricultural</i> | -0,40 | -0,40 | -0,01 |
| | <i>Non agricultural</i> | -0,03 | +0,02 | -0,07 |
| Skilled employment | <i>National</i> | +2,09 | +1,78 | +0,72 |
| Households' income | <i>National</i> | +0,26 | +0,22 | +0,08 |
| | <i>Rural</i> | +0,16 | +0,14 | +0,04 |
| | <i>Urban</i> | +0,43 | +0,37 | +0,14 |
| <hr/> | | | | |
| Households' health consumption (volume) | <i>National</i> | +3,09 | +2,01 | +1,40 |
| | <i>Rural</i> | +2,61 | +2,99 | -0,40 |
| | <i>Urban</i> | +4,67 | -1,26 | +7,36 |
| Average price of medical care | <i>National</i> | -14,87 | -11,60 | -3,14 |
| | <i>Rural area</i> | -14,73 | -16,77 | +3,30 |
| | <i>Urban area</i> | -15,32 | +6,57 | -23,19 |
| Relative price of non-profit products/private care | <i>National</i> | -24,16 | -20,33 | -8,34 |
| | <i>Rural area</i> | -23,94 | -29,09 | +8,76 |
| | <i>Urban area</i> | -24,84 | +22,88 | -42,84 |
| Households' non-profit health spending/health spending | <i>National</i> | +2,98 | +2,16 | +0,40 |
| | <i>Rural</i> | +2,94 | +3,70 | -0,90 |
| | <i>Urban</i> | +3,08 | -2,22 | +6,06 |
| Households' productive health-capital | | +0,90 | +0,87 | +0,06 |

Source: Own calculations with GAMS.

b. micro-simulation results: variation rate from initial equilibrium (%)

| | Initial value | All households | Rural | Urban |
|--|----------------------|-----------------------|--------------|--------------|
| <i>National level</i> | | | | |
| Poverty rate | 32,88% | -1,56 | -1,29 | -0,21 |
| Gini index | 0,39 | +5,16 | +4,11 | +1,92 |
| Per capita income (thousands of Ugandan shillings) | 35,74 | +4,42 | +3,50 | +1,55 |
| <i>Rural area</i> | | | | |
| Poverty rate | 35,43% | -1,54 | -1,29 | -0,23 |
| Gini index | 0,35 | +3,88 | +2,97 | +1,21 |
| Per capita income (thousands of Ugandan shillings) | 31,90 | +3,09 | +2,44 | +0,99 |
| <i>Urban area</i> | | | | |
| Poverty rate | 19,42% | -2,83 | -2,69 | -1,10 |
| Gini index | 0,43 | +6,20 | +5,03 | +2,20 |
| Per capita income (thousands of Ugandan shillings) | 56,35 | +8,02 | +6,44 | +2,83 |

Source: Own calculations from UNHS 2005/2006.

Table 3. Respective weights of different types of health products

| | Consultation | Drugs | Hospitalisation | Total |
|--|---------------------|--------------|------------------------|--------------|
| Share in households' health consumption at initial equilibrium | 12,6% | 54,6% | 32,9% | 100,0% |
| Share in the total public subsidies at initial equilibrium | 10,1% | 56,2% | 33,7% | 100,0% |
| Elasticity impact on agricultural productivity | 0,29 | 0,22 | 0,14 | 0,35 |

Sources: own calculations from Ugandan SAM-2007 and UNHS 2005/2006.

Table 4. 25% increase of public subsidy, for different type of health care product for all households,

a. macro-simulation results: variation rate from initial equilibrium(%)

| | | Drugs. | Hosp. | Cons. |
|---|-------------------------|---------------|--------------|--------------|
| Production (volume) | <i>National</i> | +0,15 | +0,07 | +0,10 |
| | <i>Agricultural</i> | +0,76 | +0,37 | +0,42 |
| | <i>Non-agricultural</i> | +0,19 | +0,11 | +0,06 |
| Index price | <i>National</i> | -0,31 | -0,21 | -0,21 |
| | <i>Agricultural</i> | -0,82 | -0,39 | -0,48 |
| | <i>Non-agricultural</i> | -0,03 | -0,11 | -0,06 |
| Agricultural unskilled wage rate | | -0,27 | -0,14 | -0,10 |
| Unskilled employment | <i>National</i> | -0,11 | -0,06 | -0,06 |
| | <i>Agricultural</i> | -0,18 | -0,07 | -0,17 |
| | <i>Non-agricultural</i> | -0,04 | -0,04 | +0,05 |
| Skilled employment | <i>National</i> | +1,16 | +0,67 | +0,27 |
| Households' income | <i>National</i> | +0,12 | +0,07 | +0,05 |
| | <i>Rural</i> | +0,07 | +0,03 | +0,04 |
| | <i>Urban</i> | +0,22 | +0,12 | +0,07 |
| Households' health consumption (volume) | <i>National</i> | +1,74 | +1,00 | +0,33 |
| | <i>Rural</i> | +1,45 | +0,86 | +0,28 |
| | <i>Urban</i> | +2,70 | +1,48 | +0,48 |
| Average price of medical care | <i>National</i> | -8,51 | -5,13 | -1,48 |
| | <i>Rural area</i> | -8,36 | -5,13 | -1,44 |
| | <i>Urban area</i> | -9,00 | -5,12 | -1,61 |
| Relative price of non-profit products/private care | <i>National</i> | -15,00 | -9,32 | -2,98 |
| | <i>Rural area</i> | -14,70 | -9,37 | -2,90 |
| | <i>Urban area</i> | -15,94 | -9,13 | -3,24 |
| Households' non-profit health spending/health spending | <i>National</i> | +1,41 | +0,75 | +0,58 |
| | <i>Rural</i> | +1,34 | +0,73 | +0,62 |
| | <i>Urban</i> | +1,61 | +0,79 | +0,47 |
| Households' productive health-capital | | +0,83 | +0,40 | +0,47 |

Source: Own calculations with GAMS.

b. micro-simulation results: variation rate from initial equilibrium (%)

| | Initial value | Drugs | Hosp. | Cons. |
|--|----------------------|--------------|--------------|--------------|
| <i>National level</i> | | | | |
| Poverty rate | 32,88% | -1,13 | -0,87 | -0,72 |
| Gini index | 0,39 | +3,09 | +1,81 | +0,83 |
| Per capita income (thousands of Ugandan shillings) | 35,74 | +2,64 | +1,58 | +0,75 |
| <i>Rural area</i> | | | | |
| Poverty rate | 35,43% | -1,17 | -0,82 | -0,70 |
| Gini index | 0,35 | +2,22 | +1,14 | +0,31 |
| Per capita income (thousands of Ugandan shillings) | 31,90 | +1,87 | +1,08 | +0,48 |
| <i>Urban zones</i> | | | | |
| Poverty rate | 19,42% | -2,47 | -2,29 | -1,97 |
| Gini index | 0,43 | +3,65 | +2,04 | +0,88 |
| Per capita income (thousands of Ugandan shillings) | 56,35 | +4,73 | +2,74 | +1,23 |

Source: Own calculations from UNHS 2005/2006.

Table 5. Public spending effectiveness indicators

a. Different targeted policies

| | Global policy | Targeted policy on households | | Targeted policy on health products | | |
|---|---------------|-------------------------------|---------|------------------------------------|---------|--------|
| | | Rural | Urban | Drugs | Hosp. | Cons. |
| Additional cost | +54,39% | +43,50% | +17,22% | +30,56% | +17,93% | +5,99% |
| Poverty variation | -1,56% | -1,29% | -0,21% | -1,13% | -0,87% | -0,72% |
| Health-capital accumulation | +0,90% | +0,87% | +0,06% | +0,83% | +0,40% | +0,47% |
| Policy effectiveness on poverty* | 2,87 | 2,96 | 1,22 | 3,70 | 4,85 | 12,02 |
| Policy effectiveness on health* | 1,65 | 2,00 | 0,35 | 2,72 | 2,23 | 7,85 |

*The values are multiplied by 100 for ease of comprehension.

Source: Own calculations

b. Different mixed policies

| | Targeted to rural households | | | Targeted to urban households | | |
|---|------------------------------|---------|--------|------------------------------|--------|--------|
| | Drugs | Hosp. | Cons. | Drugs | Hosp. | Cons. |
| Additional cost | +24,25% | +14,51% | +4,78% | +9,97% | +5,36% | +1,90% |
| Poverty variation | -0,52% | -1,08% | -0,69% | -0,04% | -0,02% | -0,05% |
| Health-capital accumulation | +0,80% | +0,39% | +0,43% | +0,05% | +0,02% | +0,05% |
| Policy effectiveness on poverty* | 2,14 | 7,44 | 14,43 | 0,40 | 0,37 | 2,64 |
| Policy effectiveness on health* | 3,31 | 2,69 | 9,04 | 0,51 | 0,30 | 2,66 |

*The values are multiplied by 100 for ease of comprehension.

Source: Own calculations.