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# Modeling Health in a CGE Framework: A Case Study of India

Nitesh Sahay
John Cockburn
Mitu Pathak

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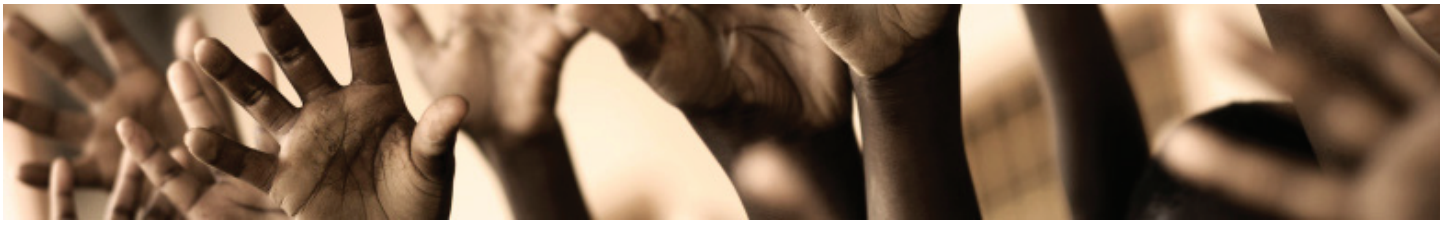

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# Modeling Health in a CGE Framework: A Case Study of India


## Abstract

Health is considered to be an extremely important component of human welfare. By the time India gained independence in 1947, achievement of good health had become an important national goal in its own right. Nevertheless, a vast public health infrastructure in India comprising of 145,000 Sub-centres, 23,000 Public Health Centres (PHCs) and 3222 Community Health Centres (CHCs) is estimated to be able to cater to only 20% of the Indian population. There have been numerous attempts to understand and analyze the causes underlying the failures of the health policies and thereby to provide meaningful solutions. While most of the earlier attempts to understand health look at the role of public and private institutions in the provision of health care, the focus of this paper is to identify the role that households play in determining their health status and the macroeconomic effects this decision can generate. The paper uses a CGE framework to simulate the effects of complete tariff liberalization in the presence / partial withdrawal / complete absence of health subsidy. Among major conclusions, this paper finds that complete subsidization of health reduces overall disparity by favoring rural households over urban. Withdrawal of health subsidy leads to domestic re-allocation of poverty pushing down the wage rates in agricultural sector, the main stay of rural households.



**Keywords:** Health, CGE, Health capital, Health Models, Public Health, Household Production Function

**JEL code:** D580, D130, C680, I12, I15 & I18


## Authors


**Nitesh Sahay**
PEP Researcher
Mumbai, India
nitesh.sahay@gmail.com

**John Cockburn**
PEP Executive Director
Quebec, Canada
john.cockburn@ecn.ulaval.ca

**Mitu Pathak**
PhD, Jawaharlal Nehru University
New Delhi, India
mitu.pathak@gmail.com


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# I. Introduction

Health is considered to be an extremely important component of human welfare. Over the years, there has been significant debate about the role that health plays in economic development. However, today it is universally accepted and argued that health is an important economic variable underlying economic development. In his book, *Economics of Public Health,* Weisbrod[1] points out the benefits of good health by underlining the losses resulting from ill health. As an example, he points out that sickness not only leads to direct production losses, but also produces secondary effects including greater vulnerability to other forms of disability. This implies that survival after a case of disease does not necessarily reflect the total economic costs associated with the disease. Apart from this, it can necessitate certain adjustments in the production process, making the total cost of sickness greater than the cost to the individual worker.

By the time India gained independence in 1947, achievement of good health had become an important national goal in its own right. Elimination of ill health found itself among the primary objectives of the Constitution of India. Qadeer[2] points out that immediately after 1949, conscious efforts began with respect to investment in health services. The national health policy elaborated in detail on the administrative and fundamental guidelines on the provision of health services. While the provincial states were considered responsible for the provision of health services, the role of the central government was to define policies and to provide a national strategic framework, financial resources and specified services such as medical education as well as services for people crossing international borders. The scale of these efforts was considered very large for a newly independent economy like India, and warranted large portions of already constrained public resources. India's burgeoning population was thus considered an important obstacle in securing good health for all. As a result, Rao (1994) states that India became one of the first nations in the world to initiate an official family planning program.

It is important to note that funding of health services became the driving force behind the successive experiments with health policies in the ensuing years. While the paper looks at these experiments in some more detail in the next section, it would be useful here to summarize the net impact of more than half a century of effort in this area, in the words of the Union Minister for Health and Family Welfare:[3]

"Since independence, we have created a vast public health infrastructure comprising of 145,000 Sub-centres, 23,000 Public Health Centres (PHCs) and 3222 Community Health Centres (CHCs). However, it is estimated that this vast infrastructure is able to cater to only 20% of the population, while 80% of healthcare needs are still being provided by the private sector. Poor access to health leads to avoidable incidence of morbidity, mortality and out-of-pocket expenses, often leading to indebtedness. In rural areas especially, there are pockets of under-served populations where the vicious circle of poverty, malnutrition and poor health reinforce each other."

There have been numerous attempts to understand and analyze the causes underlying the failures of the health policies and thereby to provide meaningful solutions. This paper will look into some of these in the next section. While most of the earlier attempts to understand health look at the role of public and private institutions in the provision of health care, the focus of this paper is to identify the role that households play in determining their health status and the macroeconomic effects this decision can

[1] Weisbrod (1961).
[2] Qadeer (2000).
[3] http://www.mohfw.nic.in/mesmin.html .

generate. The following section, i.e. the third section, outlines the features of the CGE model, describing the methodology and the specifications. It details the salient features of the model, namely: incorporation of household decisions regarding their health capital. The fourth section introduces the basic features of the Social Accounting Matrix (SAM) used for calibration. It also states the dimensions of the model. Section 5 states the simulation scenarios, and describes and analyses the results. Finally, the paper concludes with section 6.

## II. Understanding Health in India

In India, right from the beginning, health, along with other development indicators, was considered to be constrained by rapid population growth. Thus, the models on which the initial plan years were based were the ones describing a 'low-level equilibrium trap' and there were efforts right from early 1950s to bring India out of this 'trap'. Rao (1994) describes the Indian experience with health experiment as one which relied primarily on controlling the population growth trying to get out of the "…vicious cycle of poverty – high population growth rates – low savings – low productivity – poverty".

Population control programs captured maximum attention of the budgetary allocations in the post-independence era. As early as the 1970s, studies began to point out the need to shift the focus towards the prevalence of communicable diseases and nutritional problems among the poor.[4] Though refusing to diverge from the original population control centred growth path, the message became clear to state officials that the policies had not been yielding the predicted successes. In 1995, the status of health, in the words of Ministry of Health (Government of India), was described as follows: "The high rate of population growth continues to have an adverse effect on the health of our people and the quality of their lives. The mortality rates for women and children are still distressingly high; almost one third of the total deaths occur among children below the age of 5 years; infant mortality is around 129 per thousand live births. Efforts at raising the nutritional levels of our people have still to bear fruit and the extent and severity of malnutrition continues to be exceptionally high. Communicable and non-communicable diseases have still to be brought under effective control and eradicated. Blindness, leprosy and TB continue to have high incidence. Only 31 percent of the rural population has access to potable water supply and 0.5 percent enjoys basic sanitation."[5]

Efforts on disease control programs often remained in the shadow of the objective of population control. However, while these efforts did yield their proportionate share of success, the Report of the National Commission on Macroeconomics and Health (2005) broadly described a new dimension of emerging health problems:
The not so poor households live on the brink — ever vulnerable to having their life's savings and assets being irreversibly eroded. It is estimated that hospitalization expenditures result in the impoverishment of 330 lakhs persons annually, with adverse consequences on the future well being of their children as well.

The limitations of the Indian state in its impact on health become even clearer when looking comparing health statistics across nations. The following tables (table 1 and table 2) give comparative data on health indicators across nations.

[4] Sukhatme (1972) pointed out that an appreciable proportion of the population in India lacks sufficient protein in their diet.
[5] http://mohfw.nic.in/kk/95/ii/95ii0101.htm .

**Table 1: Comparative data on health indicators across nations**

| | Life expectancy at birth (years) | | | Healthy life expectancy (HALE) at birth (years)[6] | | | Infant mortality rate (per 1000 live births) |
|---|---|---|---|---|---|---|---|
| **Country** | Total | Male | Female | Total | Male | Female | Total |
| China | 71.1 | 69.6 | 72.7 | 64.1 | 63.1 | 65.2 | 30 |
| India | 61 | 60.1 | 62 | 53.5 | 53.3 | 53.6 | 68 |
| Indonesia | 66.4 | 64.9 | 67.9 | 58.1 | 57.4 | 58.9 | 35 |
| Japan | 81.9 | 78.3 | 85.2 | 75 | 72.3 | 77.7 | 3 |
| Malaysia | 73 | 70.7 | 75.3 | 63.2 | 61.6 | 64.8 | 6.2 |
| Nepal | 60.1 | 59.9 | 60.2 | 51.8 | 52.5 | 51.1 | 64.2 |
| Philippines | 68.3 | 67.2 | 72.5 | 59.3 | 57.1 | 61.5 | 29 |
| Republic of Korea | 75.5 | 71.8 | 79.4 | 67.8 | 64.8 | 70.8 | 6.2 |
| Singapore | 78.9 | 76.9 | 80.9 | 70.1 | 68.8 | 71.3 | 2.2 |
| Sri Lanka | 70.3 | 67.2 | 74.3 | 61.6 | 59.2 | 64 | 15.4 |
| Thailand | 69.3 | 66 | 72.7 | 60.1 | 57.7 | 62.4 | 21.5 |
| Vietnam | 71.3 | 70 | 73 | 61.3 | 59.8 | 62.9 | 26 |

**Table 2: Comparative data on maternal and child health indicators across nations**

| | Under-five mortality rate (per 1000 live births) | | | Total fertility rate (per woman) | Maternal mortality ratio (per 100,000 live births) | Low birth weight newborns[7] (percentage) | Children with low weight-for-age (percentage) |
|---|---|---|---|---|---|---|---|
| **Country** | Total | Male | Female | | | | |
| China | 36 | n/a | n/a | 1.8 | 50 | 2.4 | 10 |
| India | n/a | 87 | 95 | 3.1 | 407 | 23 | 47 |
| Indonesia | n/a | 45 | 36 | 2.4 | 307 | 7.7 | 27.3 |
| Japan | 4 | n/a | n/a | 1.3 | 7 | n/a | n/a |
| Malaysia | 9 | 10 | 8 | 2.9 | 30 | 13.1 | 12 |
| Nepal | n/a | 81 | 87 | 4.3 | 415 | 23.2 | 48.3 |
| Philippines | 38 | n/a | n/a | 3.1 | 96 | 16.7 | 30.6 |
| Republic of Korea | 7 | n/a | n/a | 1.2 | 15 | 4 | 3 |
| Singapore | 3 | n/a | n/a | 1.3 | 3 | 8.4 | 14 |
| Sri Lanka | n/a | 20 | 16 | 2 | 60 | 16.7 | 29.4 |
| Thailand | n/a | 32 | 26 | 1.9 | 13 | 8.1 | 8.5 |
| Vietnam | 35 | n/a | n/a | 2.3 | 165 | 7 | 30.1 |

Source: World Health Organization, Core Indicators, 2005
http://w3.whosea.org/EN/Section1243/Section1382/Section1386_9855.htm

[6] HALE: average number of years that a person can expect to live in "full health" by taking into account years lived in less than full health due to disease and/or injury. (WHO-http://www.who.int/whosis/indicators/2007HALE0/en/).
[7] Low birth weight newborns: percentage of liveborn infants that weigh less than 2500g, for a given time period (WHO- http://www.who.int/whosis/indicators/2007LBW/en/index.html).

A quick comparison across representative nations in Asia shows that India holds a position better than only Nepal. A low infant mortality rate indicates a decent situation for newborns in a country. This is not the case in India, where infant mortality is more than 20 times that of Japan, a developed nation. Compared to another middle income economy, its neighbour, Sri Lanka, infant mortality rate in India remains four times higher. A study shows that health in childhood and young adulthood are large and significant predictors of subsequent earnings (Case, Fertig and Paxson, 2003). A better indicator of childhood health, "children with low weight-for-age", also displays significant disparity between India and other Asian countries.

Disparity is significant within India as well. Table 3 below shows the infant mortality and total fertility rates in the states of India.

**Table 3: Health indicators across different states in India**

| States/Union territory | Infant mortality rate (2000) SRS | Total fertility rate (1999) SRS |
|---|---|---|
| **India** | 68 | 3.2 |
| **Major states** | | |
| **Andhra Pradesh** | 65 | 2.4 |
| **Assam** | 75 | 3.2 |
| **Bihar** | 62 | 4.5 |
| **Chhattisgarh** | 79 | |
| **Gujarat** | 62 | 3.0 |
| **Haryana** | 67 | 3.2 |
| **Jharkhand** | 70 | |
| **Karnataka** | 57 | 2.5 |
| **Kerala** | 14 | 1.8 |
| **Madhya Pradesh** | 88 | 3.9 |
| **Maharashtra** | 48 | 2.5 |
| **Orissa** | 96 | 2.7 |
| **Punjab** | 52 | 2.5 |
| **Rajasthan** | 79 | 4.2 |
| **Tamil Nadu** | 51 | 2.0 |
| **Uttar Pradesh** | 83 | 4.7 |
| **West Bengal** | 51 | 2.4 |
| **Smaller states** | | |
| **Arunachal Pradesh** | 44 | 2.8 |
| **Delhi** | 32 | 1.6 |
| **Goa** | 23 | 1.0 |
| **Himachal Pradesh** | 60 | 2.4 |
| **Jammu and Kashmir** | 50 | NA |
| **Manipur** | 23 | 2.4 |

| | | |
|---|---|---|
| **Meghalaya** | 58 | 4.0 |
| **Mizoram** | 21 | NA |
| **Nagaland** | NA | 1.5 |
| **Sikkim** | 49 | 2.5 |
| **Tripura** | 41 | 3.9 |
| **Uttaranchal** | 50 | |
| **UTs** | | |
| **Andaman and Nicobar Islands** | 23 | 1.9 |
| **Chandigarh** | 28 | 2.1 |
| **Dadra and Nagar Haveli** | 58 | 3.5 |
| **Daman and Diu** | 48 | 2.5 |
| **Lakshadweep** | 27 | 2.8 |
| **Pondicherry** | 23 | 1.8 |

Source: http://health.nic.in/fshpindi.htm, Department of Family Welfare, Government of India (2001)

As is evident from table 3, there are significant variations in infant mortality rates across states. For example, it is under 30 in eight of the states and union territories and more than three times higher (96) in Orissa. Though population has been the central focus of all family welfare programs, even here there are significant discrepancies. Looking at the total fertility rate, an indicator of the success of population control programs, we see that the total fertility rate is under 2 in Goa, Nagaland, Delhi and Kerala, while it is more than twice as high in Meghalaya, Rajasthan, Bihar and Uttar Pradesh. These discrepancies between states are further exacerbated by inadequate resources and efforts, which is partially a result of their weak bargaining power relative to other states.

Moreover, these disparities not only impact the welfare of the people, but they also have feedbacks which form a vicious cycle. For example, the national policy on population documents high infant mortality as one of the reasons behind high population growth rates in rural areas. Apart from welfare, low health affects productivity as well. A report has shown that annual productivity losses in India due to malnutrition are as high as US $10 billion. It also points out that 400 million Indians cannot afford medical care and that the cost of medical care is the second most common cause of rural indebtedness.[8]

These figures raise doubts over the efforts made by the Indian state to combat poor public health and low development. A cross-country analysis of public health expenditures as a percentage of GDP has shown that the Indian government spends among the lowest percentages of national income in the health sector. The Human Development Report (2006) points out that public health expenditures in India stood at a mere 1.2% of GDP in 2003 and Sainath (2007) shows that public health expenditures as a percentage of GDP in India is higher only than a handful of countries including Myanmar, Burundi and Azerbaijan.

There have been efforts to not only increase the health budget but also to ensure a cost effective approach to burdensome diseases to ensure that health expenditures effectively target marginalized segments of the population. Narayana (2004), however, states that this has not resulted in any improvement. Thus, health sector reforms focused

[8] INSAAF International (2001).

on twin key objectives: increased health budgets and the introduction of user fees. The central idea behind these initiatives was to implement public-private partnerships to meet health needs. Narayana points out that a number of states in India implemented the program correctly in the late 1990s. However, the plan failed to have the desired impact of increasing health spending. While these states were able to increase their capital component of health expenditures by borrowing from the World Bank, this was not met with a simultaneous increase in government revenues spent on health services. In fact, if implementation of user fees was taken into account, the fall in government revenue spending was higher in states which implemented reforms than in non-reforming states.

As the above discussion points out, health reforms cannot be effectively analyzed without an effort to understand wider macroeconomic developments. For example, the health reforms introduced in the Indian economy were not stand alone initiatives but formed part of a Structural Adjustment Program – a set of reform measures aimed at pushing the Indian economy towards the path of globalization, liberalization and privatization. This situation led to a need to undertake a separate set of health sector reforms alongside the process of liberalization to mitigate the potential negative impacts that liberalization could have on not-so-wealthy segments of the population. The mixed impact from these reforms is summed up in the findings of a research project entitled "Impact of Liberalization and International Trade Regimes on Access to Medicines and Health Services in India" undertaken by the Shastri Indo-Canadian Institute. It points out that the maternal mortality rate (MMR) increased from 434 / 100,000 lives births in 1993-94 to 619 / 100,000 live births in 1998-99. This was accompanied by an improvement in urban areas from 384 / 100,000 live births to 267 / 100,000 live births over the same time frame.

To sum up, in a liberalization scenario where certain segments of the population are not immune to an unfavourable redistribution of wealth, income and other infrastructure, the government has no option but to exercise various policy options to secure their basic minimum requirements. The essential focus of this paper is to explore one such policy alternative, namely provision of free-of-charge health care services to households and the macro-economic impact that it generates, by using a CGE model for India. This is by no means the first attempt to understand the implications of health in a CGE framework. Earlier attempts include Rutten, Blake and Reed (2004), who look at the macroeconomic impacts of changes in health provision in the United Kingdom via its effects on the labour market. The paper uses the impact of ill health on the labour supply to identify its consequent implications for household welfare and other general equilibrium effects. Using a similar approach, though applied specifically to the case of the AIDS epidemic in Mozambique, Arndt (2002) identifies the channels through which this public health concern generated both short- and long-term impacts on productivity, output and capital accumulation. Further, an earlier paper by Savard and Adjovi (1997) on Benin looks at health not only in terms of productivity enhancements brought about by good health but also by including the longevity gains that result from good health, thereby leading to long term production and welfare gains.

All of these papers look at the impact of good health on productivity, welfare and output, in the context of Indian conditions. However, an important aspect of health reforms, as mentioned above, is related to the idea of utility that households derive from having good health as compared to not having good health. In fact, the main idea of the user fees mentioned above is that providing health care at no cost to the user can lead to overuse in a context of scarce resources, a suboptimal outcome. This paper tries to explore the following question: if health care is actually provided as "free good",

would this help alleviate the distributional losses resulting from liberalization? The paper layers a liberalization scenario into the structure used to analyze the absence and presence of such a "free good" and aims to develop understanding of the channels whereby health capital has general equilibrium effects. The model, as mentioned above, highlights the presence of a household choice function *y* used to decide whether to invest in maintaining a healthy, rather than low-health, status of its workers.

## III. Model

This model is inspired by an education-based human capital model by Cloutier, Cockburn and Decaluwe (2005), where the authors introduce the idea of households being able to choose between different skill types available. This model looks at health as the form of human capital that is the object of the household decision in their choice function. This paper is thus an early attempt to incorporate health into a general equilibrium framework. In this model, health is considered as an investment good. It means that, on the one hand, households choose to obtain medicines and health treatments (i.e. to invest in health) because they provide certain productivity gains. This higher productivity is rewarded by firms through a higher wage for healthy workers in the labour market. On the other hand, this investment in health also implies a direct cost (e.g. cost of medicines, health consultation fees, etc.) that is either entirely supported by the household, entirely supported by the government or (probably the most credible hypothesis) paid in part by households and in part by the government.[9] Therefore, the real decision of households concerning health is based on a cost-benefit analysis of this investment. In the initial model, firms and the government only adjust their behaviour to this household decision.

Next, we describe household behaviour, followed by that of firms and government. The rest-of-the-world account is not mentioned since health is considered as a non-tradable good, and modeling of this account is therefore perfectly standard.

***Households***

Every representative household *j* derives utility from consumption of goods and attributes no value to leisure[10] in the following manner:

$$U_j = U(C_1,...,C_i,...,C_n)$$

where $U$ represent a Cobb-Douglas or Stone-Geary utility function that households maximize subject to their budget (income) constraint in order to determine their consumption, $C_i$, of each good *i*.

Households have certain amounts of healthy and low-health workers. In other words, part of their total labour is in a good health status and the other is not. Household incomes

[9] Eventually, other factors like sufficient food consumption, access to clean drinking water, etc. could also be linked to health consumption in order to imply that food can also affect a population's health status.
[10] An interesting extension of this model would be to include leisure, since one could think that investment in health has an opportunity cost in term of leisure time (as opposed to work time) used to exercise, to go to the doctor office, etc.

thus consist of remuneration to these two types of labour, dividends and transfers from the government and/or the rest of the world.

Households thus face, in addition to utility maximisation, the additional decision of choosing the share of the two labour types they want to hold. The model specifies that it is possible for households to invest in health and thus to affect their relative labour endowments by transforming low-health labour into healthy labour (or vice versa). The households' decision is approached in two steps. Households first choose the shares of healthy and low-health labour that maximize their labour income (and not utility) subject to an imperfect transformability of labour into healthy or low-health labour. In other words, the household problem, in terms of income, is

$$MaxYH_j = w\ (1+h)\ b_j LS_j + w\ (1-b_j)LS_j - c(1-g)P_h b_j LS_j + DIV_j + PindexTG_j + eTRow_j$$

$$s.c.\ \ LS_j = A_j^l \left\{ \beta_j^l \left[ b_j LS_j \right]^{\kappa_j^l} + (1-\beta_j^l)\ \left[ (1-b_j)LS_j \right]^{\kappa_j^l} \right\}^{1/\kappa_j^l}$$

or, written differently, they must choose their amounts of healthy and low-health workers

$$Max\, YH_j = w\ (1+h)\ LShh_j + w\ LSlh_j - (1-g)P_h LShh_j + DIV_j + PindexTG_j + eTRow_j$$

$$s.c.\ \ LS_j = A_j^l \left\{ \beta_j^l \left( LShh_j \right)^{\kappa_j^l} + (1-\beta_j^l)(LSlh_j)^{\kappa_j^l} \right\}^{1/\kappa_j^l}$$

where

- $YH_j$ ≡ Household *j*'s income;
- $w$ ≡ Wage rate;
- $h$ ≡ Productivity gain of being healthy (endogenous variable driven by firms' demand for healthy labour);
- $(1-g)$ ≡ Proportion of health treatment cost paid by households: $g = 0$ if health expenditures are entirely private, $g = 1$ if health expenditures are entirely public and $0 > g > 1$ if health expenditures are partly private and partly public;
- $P_h$ ≡ Price of health care services. This is assumed to be fixed as health is not considered as a traded good on the market;
- $b_j$ ≡ Share of individuals in household *j* who receive health treatment and are therefore considered as healthy workers;
- $LS_j$ ≡ Total (exogenous) potential labour supply of household *j*, i.e. the number of workers in the households;
- $LShh_j$ ≡ Healthy labour supplied by household *j*;
- $LSlh_j$ ≡ Low-health labour supplied by household *j*;
- $DIV_j$ ≡ Dividends;
- $TG_j$ ≡ Government transfers;

$Pindex$ ≡ Price index;
$THrow_j$ ≡ Transfers to household *j* from the rest of the world (ROW);
$e$ ≡ Exchange rate;
$A_j^l$ ≡ Scale parameters of the constant elasticity of transformation (CET) function;
$\beta_j^l$ ≡ Share parameters of CET function;
$\kappa_j^l$ ≡ Transformation parameters of the CET function.

The constraint represents the possibility of getting healthier. It indicates that households are only able to increase their shares of healthy workers (or to transform low-health labour into healthy labour) to a limited extent. The extent to which households are able to complete this transformation depends on the elasticity, i.e. the value of parameter $\kappa_j^l$.

When choosing $b_j LS_j$ and $(1-b_j)LS_j$ (or $LShh_j$ and $LSlh_j$) households are analyzing the trade-off between the benefits of having healthier labour, i.e. higher labour income because of higher productivity, represented by $whb_j LS_j$ or $whLShh_j$, and the direct cost of maintaining the healthy status of its healthy labour represented by $(1-g)P_h b_j LS_j$ or $(1-g)P_h LShh_j$. The resulting choice function is:[11]

$$LShh_j = \{[w(1+h)-(1-g)P_h]/w\}^{\tau_j^l}\left[\beta_j^l/(1-\beta_j^l)\right]^{\tau_j^l} LSlh_j$$

where $\tau_j^l = 1/(\kappa_j^l - 1)$ is the elasticity of transformation. Consequently, when the productivity gain associated with better health increases (reflected by a higher value of *h*), household *j*'s share of healthy workers increases; and, this share decreases when the cost of health investment $(1-g)P_h$ supported by households increases. The magnitude of these variations depends on parameter values and initial labour endowments (or initial human capital level).

Based on this choice, every household then allocates $b_j LS_j$ healthy workers and $(1-b_j)LS_j$ low-heath workers to different production activities. Once these quantities are determined, households then maximize their utility function subject to disposable income.

***Firms and branches of production***

Representative firms in each sector *i* use constant returns to scale technology and face perfect competition. They own a share of the capital stock in the economy. Remuneration to capital and transfers from the government and/or the rest of the world form these firms' income which is used to pay dividends to households, direct taxes to government and for savings.

Each sector produces output using capital, healthy labour, low-health labour and intermediate consumption. The health sector produces different health commodities $XS_h$ using the same production factors and intermediate consumption as other sectors. In

[11] This function follows from the first order condition of the preceding constrained maximization problem.

fact, all sectors produce goods using fixed proportions[12] of value-added and intermediate consumption while value added $VA_i$ is represented as a nested constant elasticity of substitution (CES) function of production factors as follows:

$$VA_i = A_i^{kl}\left\{\left[\alpha_i^{kl} CL_i^{-\rho_i^{kl}}\right] + \left[\left(1-\alpha_i^{kl}\right) KD_i^{-\rho_i^{kl}}\right]\right\}^{-1/\rho_i^{kl}}$$

where

$A_i^{kl}$ ≡ Scale parameter of the CES function;
$\alpha_i^{kl}$ ≡ Share parameter of the CES function;
$\rho_i^{kl}$ ≡ Transformation parameters of the CES function;
$KD_i$ ≡ Capital demanded by sector *i*;
$CL_i$ ≡ Composite labour of low-health and healthy labour;

$CL_i$ represents the aggregate labour demand among *i* sectors based on an average wage $wl_i$ for the two types of labour

$$CL_i = A_i^{kl\left(\alpha_i^{kl}-1\right)}\left\{\left[\left(\alpha_i^{kl} Pv_i\right)/wl_i\right]^{\sigma^{kl}}\right\} VA_i \ ,$$

where $Pv_i$ represents value-added price in sector *i* and the average wage rate of labour equation is

$$wl_i = \left[w\ LDlh_i + w(1+h)LDhh_i\right]/CL_i \ .$$

Moreover, the composite labour of low-health and healthy labour must also be defined as

$$CL_i = A_i^{ll}\left\{\left[\alpha_i^{ll} LDlh_i^{-\rho_i^{ll}}\right] + \left[\left(1-\alpha_i^{ll}\right) LDhh_i^{-\rho_i^{ll}}\right]\right\}^{-1/\rho_i^{ll}}$$

where

$A_i^{ll}$ ≡ Scale parameter of the CES function;
$\alpha_i^{ll}$ ≡ Share parameter of the CES function;
$\rho_i^{ll}$ ≡ Transformation parameters of the CES function;
$LDlh_i$ ≡ Low-health labour demanded by sector *i*;
$LDhh_i$ ≡ Healthy labour demanded by sector *i*;

Finally, relative demand for low-health and healthy labour must be specified as

$$LDlh_i = \left\{\left[\alpha_i^{ll}/\left(1-\alpha_i^{ll}\right)\right]^{\sigma_i^{ll}}\left[w(1+h)/w\right]^{\sigma_i^{ll}}\right\} LDhh_i$$

Consequently, firms' relative demand and households' relative supply of the two types of labour would determine the wage differential between healthy and low-health wages. In other words, equilibrium on the labour market would establish the value of *h*.

[12] The function is Leontieff-type.

Capital is either mobile or sector-specific while labour is (as is generally the case in medium term static models) mobile among sectors. Moreover, it is worth noting that household possibilities to invest in health represent a sort of mobility in labour categories. It is in part driven by firms' demand for the different types of labour, used with differing intensity in each industry, which affects relative labour remuneration.

***Government***

The behaviour of government is relatively simple. It receives income by collecting taxes paid by households, firms, and production sectors as well as tariffs and export taxes. It allocates this income among savings, expenditures and transfers to households.

Government expenditures cover part or all of health expenditures in the economy. The government expenditures function therefore looks like

$$CTG = \overline{GR_{i\neq h}Pc_{i\neq h}} + GN_h = \overline{GR_{i\neq h}Pc_{i\neq h}} + gXS_hP_h,$$

where

$CTG$ ≡ Total governmental expenditures;

$GR_{i\neq h}Pc_{i\neq h}$ ≡ Exogenous government expenditures on *i* goods other than in health;

$GN_h$ ≡ Governmental expenditures in health;

$g$ ≡ Proportion of health treatment cost paid by the government: $g = 0$ if health expenditures are entirely private, $g = 1$ if health expenditures are entirely public (i.e. health system is free for households) and $0 > g > 1$ if health expenditures are partly private and partly public;

$P_h$ ≡ Price of one unit of health commodities or treatment;

In terms of government budget closure, because $XS_h$ exactly covers household demand for health and since government expenditures on health can vary depending upon households' demand for health, government savings adjust in order to maintain a given government deficit.

***Equilibrium***

Equilibrium conditions are equality of demand and supply on each market and are reached through relative price and wage variations.

Equilibrium on the health market is reached when quantity $XS_h$ of health commodities produced, whether paid for by the government and/or the households, equals the amount of health demanded by households. In other words,

$$XS_h = \sum_j cb_j LS_j$$

On the labour market, total healthy and low-health labour demanded by production sectors must equal total healthy and low-health labour supplied by households. In other words, there is equilibrium on the low-health labour market when

$$\sum_j LSlh_j = \sum_i LDlh_i$$

and the healthy labour market equilibrium is reached when

$$\sum_j LShh_j = \sum_i LDlh_i$$

## IV. Data

The SAM used is the latest available for the Indian economy (2002-03), developed by Pradhan, Saluja and Singh (2005). This SAM is aggregated to include 4 sectors (agriculture, industry, services and public administration) and 2 household types (rural households *RH* and urban households *UH*). Table 5 summarizes the SAM by sector.

**Table 4: Summarizing the SAM (values in percent terms)**

| Sectors | Tariff rates | Import penetration ratio | Import share | Export orientation ratio | Export share | Share in total value added | Share of intermediate demand in absorption |
|---|---|---|---|---|---|---|---|
| **Agriculture** | 40 | 1.67 | 2.64 | 3.03 | 5.26 | 22.26 | 39.10 |
| **Industry** | 22 | 20.22 | 83.74 | 13.30 | 60.58 | 25.31 | 61.37 |
| **Services** | 17 | 3.55 | 13.62 | 8.09 | 34.16 | 46.24 | 44.55 |
| **Publ. admin** | | | | | | 6.19 | |

*Import penetration ratio*: share of imports in the sector's domestic output;
*Import share*: share of sector imports in total imports;
*Export orientation ratio*: share of exports in sectoral output;
*Export share*: share of sector exports in total exports;
*Share of intermediate demand in absorption*: share of intermediate consumption in total sectoral demand.

The aggregate structure of the Indian economy is reflected in the basic features of the SAM as highlighted in table 5. The government continues to protect agriculture with higher tariff structures than other sectors. The penetration of foreign goods is highest in the industrial sector, with more than one-fifth of demand being met by imports. Industry thus accounts for the bulk of total imports (column 3, table 5). It is interesting to note that, in spite of the current focus on the services sector as a major source of foreign exchange, industry continues to generate more exports than other sectors. However, when it comes to the share in national value added, the services sector contributes the highest proportion. It can also be seen that the strength of vertical linkages is strongest for the industrial sector, with more than 60 percent of its demand being met through intermediate consumption.

**Table 5: Income composition of households (%)**

| Household type | Labour with health capital | Labour without health capital | Capital | Public transfers | Remittances from abroad | Total |
|---|---|---|---|---|---|---|
| **Rural** | 20.02 | 26.62 | 44.28 | 7.56 | 1.52 | 100 |
| **Urban** | 58.65 | 5.98 | 22.48 | 6.34 | 6.55 | 100 |

Looking at the income profile of Indian households, it is interesting to note that income derived from capital as a percentage of total income is higher in rural areas than in urban areas (table 6). This is essentially due to the fact that urban areas include a large proportion of salaried people whereas rural areas include a large number of self-employed households. At the same time, while the second largest share of rural income comes from 'low-health' labour, this type of labour accounts for the lowest share of urban income.

# V. Simulation Design and Analysis

As discussed above, one of the recognized issues with liberalization is that many households, and particularly certain groups of households, are vulnerable to a deterioration of income. In an effort to resolve this issue, the government is exploring various options at its disposal to minimize the negative impacts of liberalization. One such initiative has involved public-private partnerships in the provision of health care services as opposed to completely public or private provision of health care. With this objective in mind, this paper explores the impact of complete tariff liberalization on rural and urban households under different modes of health care financing. While it is cumbersome to undertake a combined analysis of liberalization scenarios and health-care financing scenarios, carrying out separate analyses of liberalization and government coverage of health care would actually move away from our goal of evaluating the extent to which such health care funding can help counter some of the adverse effects of liberalization. The following are the three scenarios built into the health CGE model:

a. The government bears 100% of health expenditures incurred by rural and urban households to maintain some proportion of their labour endowments as healthy
b. Rural households continue to receive complete financing of their health expenditures while only 50% of total health expenditures of urban households are borne by the government
c. The state completely withdraws funding of health care expenditures for both household categories.

For each of these scenarios, the paper simulates the effects of liberalization relative to a base model case where households do not implicitly choose the number of low-health and healthy workers through health investments.

Before beginning with the simulation results, we present a brief introduction to the algorithm used to reach equilibrium and its application to solving the problem at hand.

## 5.1 Linkages between sectors

The system of equations in the paper represented by the CGE model is solved using a variant of the Newton-Raphson method.[13] The algorithm recursively solves the equations on each market separately until satisfactory convergence is reached regarding the equilibrium.

[13] For more details on Newton-Raphson Method refer to the following link: www.math.ubc.ca/~anstee/math104/104newtonmethod.pdf.

Each sector in a general equilibrium scenario is vertically linked through intermediate demand. They also influence each other through aggregate demand and supply market equilibrium. There are many possible pathways for an economy to move from one state to another in response to given changes. In that sense, it is too simplistic to show a single direction of causation between the forces underlying supply and demand. In the real world, different types of interactions between entities and market forces proceed over a period of time before the economy settles into a new growth path. Therefore, the purpose of analyzing simulation results is not so much to identify causation as it is to gain a better understanding of the various linkages and forces existing in an economy.

In this paper, it is hypothesised that any short run changes to initial equilibrium quantities or prices lead to changes in aggregate demand and supply forces. This in turn leads to new set of market clearing prices on product markets. However, this new set of prices (and corresponding levels of output) also imply changing profit and wage margins in each sector. The new wage levels then become instrumental in determining a new distribution of labour across the economy, which in turn determines output across different sectors. Furthermore, the new level of output in a given demand situation would trigger another round of price and then wage changes.

In short, labour demand depends on the share of value added of a given sector compared to other sectors. For the $i^{th}$ sector:

$$LD_i = \frac{\alpha_i \cdot PV_i \cdot V_i}{w}$$

Assuming the labour market is in equilibrium with a fixed amount of labour supply, we have:

$$LS = \sum_i LD_i$$

or:

$$LS = \frac{\alpha_1 \cdot PV_1 \cdot V_1 + \alpha_2 \cdot PV_2 \cdot V_2 + \cdots + \alpha_{23} \cdot PV_{23} \cdot V_{23}}{w}$$

Thus, equilibrium on product markets is reached in two steps. First, if the total value added increases, then given a labour supply LS this would imply an increase in the general wage rate in all sectors. Second, each sector would demand a given amount of labour in response to the new wage rate.

Contrary to the assumption of constant labour supply, this paper explores the alternative where households can determine their share of the two types of labour: healthy and low-health capital. This paper postulates a scenario where households respond to new equilibria on product and labour markets, triggering the entire process again, where they determine their labour endowments (of both the types) in order to maximize their total income.

To analyze the impact of changes in tariff rates, we can start by explaining the two ways that these changes cascade throughout the modelled economy. First, any increase (decrease) in tariff rates leads to higher (lower) import prices. If tariffs are slashed on imports, this would create greater demand for the imported products in that sector,

thereby creating a situation similar to that of excess supply in the market for domestic goods.[14] This effectively reduces production costs of those who use output from the particular sector as inputs into production processes, thereby creating greater surplus in these sectors, given existing prices. If aggregate surpluses rise, producers will earn additional profits and be in a position to pay higher wages to attract labour, thus increasing the income of households – a source of higher demand. Depending on which of the two forces (an increase in demand arising from lower production costs and thereby higher paying capacity of producers, or an increase in supply due to cheaper imports) is greater, a net decline or increase in demand relative to supply can be observed.

Lower tariff rates would impact demand in another way as well. As a component of government income, lower tariffs imply reduced government income, with a direct negative impact on aggregate demand. Three effects operate simultaneously: (i) a price effect: demand for domestic goods falls because they become relatively more expensive compared to imports; (ii) a positive income effect: aggregate demand (including domestic goods) rises as a result of higher income due to higher wages in certain sectors and; (iii) a negative income effect: aggregate demand falls due to a decline in government income.

The analysis of the impact in the simulations is divided into two parts for the sake of simplicity. To understand the effects on the composition of GDP in terms of sectoral outputs, one can look at the changes in each sector's share of value added in the economy. For example, suppose that a combination of prices changes in domestic and imported products leads to a reduction in the cost of intermediate production faced by a given sector in the economy. For a given level of expected revenues, this effectively means an increase in the share of value added (in nominal terms) in sectoral output available to the capitalists in that sector. Further, considering that capital is immobile in the short run, this would translate into greater hiring capacity. However, whether this greater hiring capacity would actually increase the number of workers in the sector would depend on its relative position in the economy. If value added increased by even more in some other sector, that sector would be able to attract more labour through higher wage increases than the first sector could afford; i.e., relative rather than absolute gains drive the reallocation of resources and sectoral changes in the composition of GDP.

While this is the case in the base simulation (where households do not decide the composition of their labour endowment), a simulation which confers upon households the ability to make decisions regarding the quantity of the two types of labour would behave differently. The difference essentially pertains to the changing composition of labour supply through household income maximization. More specifically, households can choose to convert their less healthy labour endowment into a healthier one by investing in its health capital. Conversely, it can also reverse this process by withdrawing from its regular health investment required to maintain a given stock of healthier labour. So, depending on the outcome of household income maximization, there would be a relative abundance of one type of labour over the other. This would obviously benefit sectors which use that type of labour relatively intensely.

[14] It has to be kept in mind that total domestic supply = imports + production for domestic purposes. Let us assume that demand for imports increases and the ex ante supply of imports also tends to increase immediately. As of now, if households' incomes have not increased and they are buying more imported goods, then domestic producers would see a drop in demand for their commodities.

Tables 7 through 16 look at the sector-specific changes in quantities demanded and supplied relative to the base model. The base simulation refers to a situation where households do not make any choices regarding the composition of their labour supply. In the main simulation, households can exercise this choice.

**Table 6: Change in output (%)**

| Sectors | Main simulation | | | Base simulation | | |
|---|---|---|---|---|---|---|
| | a | b | c | a | b | c |
| 1 | -0.15% | -0.43% | 0.37% | -0.02% | -2.54% | -10.04% |
| 2 | -1.99% | 3.80% | 9.74% | -2.01% | 4.75% | 17.91% |
| 3 | 0.58% | -3.21% | -12.97% | 0.51% | -2.45% | -8.15% |
| 4 | 4.45% | 5.36% | 0.65% | 4.35% | 7.14% | 12.14% |

Note: 1 = Agriculture; 2 = Industry; 3 = Services; 4 = Public administration

**Table 7: Change in value added (%, nominal)**

| Sectors | Main simulation | | | Base simulation | | |
|---|---|---|---|---|---|---|
| | A | b | c | a | b | c |
| 1 | -3.23% | -11.02% | -31.41% | -3.35% | -10.07% | -27.16% |
| 2 | -6.50% | 3.15% | 15.52% | -6.51% | 4.50% | 27.04% |
| 3 | -1.20% | -8.76% | -19.70% | -1.18% | -9.64% | -23.72% |
| 4 | 2.37% | 4.04% | 10.48% | 2.43% | 3.15% | 4.83% |

Note: 1 = Agriculture; 2 = Industry; 3 = Services; 4 = Public administration

**Table 8: Change in share of value added (%, nominal) in total value added (%, nominal)**

| Sectors | Main simulation | | | Base simulation | | |
|---|---|---|---|---|---|---|
| | a | b | c | a | b | c |
| 1 | -0.47% | -5.88% | -22.47% | -0.58% | -4.97% | -19.19% |
| 2 | -3.83% | 9.11% | 30.56% | -3.83% | 10.42% | 40.95% |
| 3 | 1.62% | -3.50% | -9.24% | 1.66% | -4.52% | -15.37% |
| 4 | 5.29% | 10.04% | 24.86% | 5.37% | 8.99% | 16.31% |

Note: 1 = Agriculture; 2 = Industry; 3 = Services; 4 = Public administration

**Table 9: Change in low-health labour demand (%)**

| Sectors | Main simulation | | | Base simulation | | |
|---|---|---|---|---|---|---|
| | a | b | c | a | b | c |
| 1 | -0.11% | 1.83% | 15.32% | 0.27% | -4.11% | -16.13% |
| 2 | -3.48% | 18.05% | 94.21% | -3.02% | 11.42% | 46.29% |
| 3 | 1.99% | 4.41% | 35.01% | 2.52% | -3.66% | -12.16% |
| 4 | 5.67% | 19.06% | 85.73% | 6.26% | 9.97% | 20.72% |

Note: 1 = Agriculture; 2 = Industry; 3 = Services; 4 = Public administration

**Table 10: Change in healthy labour demand (%)**

| Sectors | Main simulation | | | Base simulation | | |
|---|---|---|---|---|---|---|
| | a | B | c | a | b | c |
| 1 | -0.86% | -10.53% | -41.57% | -1.22% | -6.06% | -21.63% |
| 2 | -4.21% | 3.72% | -1.60% | -4.45% | 9.15% | 36.70% |
| 3 | 1.22% | -8.27% | -31.60% | 1.00% | -5.61% | -17.92% |
| 4 | 4.88% | 4.61% | -5.90% | 4.69% | 7.74% | 12.80% |

Note: 1 = Agriculture; 2 = Industry; 3 = Services; 4 = Public administration

**Table 11: Change in exports (%)**

| Sectors | Main simulation | | | Base simulation | | |
|---|---|---|---|---|---|---|
| | a | B | c | a | b | c |
| 1 | 4.08% | 11.94% | 43.51% | 4.45% | 6.49% | 11.22% |
| 2 | 6.05% | 12.01% | 18.30% | 6.05% | 12.84% | 26.32% |
| 3 | 5.02% | 5.13% | -3.00% | 4.88% | 7.53% | 12.01% |
| 4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

Note: 1 = Agriculture; 2 = Industry; 3 = Services; 4 = Public administration

**Table 12: Change in imports (%)**

| Sectors | Main simulation | | | Base simulation | | |
|---|---|---|---|---|---|---|
| | a | b | c | a | b | c |
| 1 | 54.88% | 37.68% | -4.46% | 54.55% | 40.72% | 7.50% |
| 2 | 2.57% | 8.85% | 15.16% | 2.54% | 9.98% | 24.29% |
| 3 | 10.95% | 2.79% | -9.85% | 10.95% | 2.13% | -13.03% |
| 4 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |

Note: 1 = Agriculture; 2 = Industry; 3 = Services; 4 = Public administration

**Table 13: Change in domestic production for domestic consumption (%)**

| Sectors | Main simulation | | | Base simulation | | |
|---|---|---|---|---|---|---|
| | a | b | c | a | b | c |
| 1 | -0.28% | -0.84% | -1.27% | -0.16% | -2.84% | -10.79% |
| 2 | -3.28% | 2.48% | 8.37% | -3.30% | 3.46% | 16.57% |
| 3 | 0.18% | -3.98% | -13.89% | 0.12% | -3.37% | -10.11% |
| 4 | 4.45% | 5.36% | 0.65% | 4.35% | 7.14% | 12.14% |

Note: 1 = Agriculture; 2 = Industry; 3 = Services; 4 = Public administration

**Table 14: Change in total domestic supply (%)**

| Sectors | Main simulation | | | Base simulation | | |
|---|---|---|---|---|---|---|
| | a | b | c | a | b | c |
| 1 | 0.83% | -0.03% | -1.34% | 0.95% | -1.94% | -10.38% |
| 2 | -2.04% | 3.83% | 9.81% | -2.06% | 4.84% | 18.20% |
| 3 | 0.62% | -3.70% | -13.72% | 0.56% | -3.14% | -10.23% |
| 4 | 4.45% | 5.36% | 0.65% | 4.35% | 7.14% | 12.14% |

Note: 1 = Agriculture; 2 = Industry; 3 = Services; 4 = Public administration

**Table 15: Change in wage rates (%)**

| Wage Rates | Main simulation | | | Base simulation | | |
|---|---|---|---|---|---|---|
| | a | b | c | a | b | c |
| wlh | -3.12% | -12.62% | -40.52% | -3.61% | -6.21% | -13.16% |
| whh | -2.39% | -0.54% | 17.40% | -2.16% | -4.26% | -7.06% |

Note: wlh = wage rate for low-health labour; whh = wage rate for healthy labour

## 5.2 Simulation (a)

The first simulation sees complete tariff liberalization on imports and 100% coverage of all health care expenditures incurred by households. The impact of tariff liberalization is seen in the form of reduced import prices as shown in tables 17 and 18.

**Table 16: Price changes: Base simulation (%)**

| Sectors | PM | PL | P | PC |
|---|---|---|---|---|
| 1 | -28.41% | -4.21% | -4.08% | -4.91% |
| 2 | -18.23% | -8.05% | -6.93% | -10.36% |
| 3 | -14.32% | -3.96% | -3.64% | -4.43% |
| 4 | | -4.17% | -4.17% | -4.17% |

Note: 1 = Agriculture; 2 = Industry; 3 = Services; 4 = Public administration; PM = Import price including tariffs; PL = Pre-tax price of goods produced domestically; P = Producer price; PC = Consumer price.

**Table 17: Price changes: Main simulation**

| Sectors | PM | PL | P | PC |
|---|---|---|---|---|
| 1 | -28.41% | -3.99% | -3.87% | -4.70% |
| 2 | -18.23% | -8.04% | -6.92% | -10.35% |
| 3 | -14.32% | -4.03% | -3.69% | -4.49% |
| 4 | .. | -4.26% | -4.26% | -4.26% |

Note: 1 = Agriculture; 2 = Industry; 3 = Services; 4 = Public administration; PM = Import price after the addition of tariffs; PL = Pre-tax price of goods produced domestically; P = Producer price; PC = Consumer price.

***Agriculture***

Agriculture comprises around 22 percent of total value added in the Indian economy (table 5) but just 5.26 percent of total export revenues. In the first simulation, agriculture sees a minor 0.02-percent decline in production (table 7) relative to the base scenario. This results from a strong 54.55-percent increase in agricultural imports (table 13) and a much smaller 4.45-percent increase in exports (table 12). Such a large increase in agricultural imports can be partly attributed to a lower base: the import penetration ratio is only 1.67 percent (table 5). It can be clearly seen that a reduction in import prices of agricultural products caused a shift in consumption from domestically produced goods

to imported ones. However, reduced intermediate consumption costs allow domestic firms to reduce their costs somewhat. The pre-tax price of goods produced domestically falls by 4.21 percent (table 17).

The main simulation (a) sees a 0.15-percent reduction in agricultural output relative to the base scenario (table 7). This can be explained by looking at the households' optimization factor which results in the new wage rates for the main simulation shown in table 16. In the base simulation (where households cannot change the composition of their labour endowment), the wage rate for low-health labour falls by 3.61 percent while that of healthy labour falls by 2.16 percent. Both of these declines are induced by a general reduction in price levels resulting from lower prices and higher quantities of imports relative to domestic demand. It is important to note that the larger difference between the two wage rates is sufficient to encourage households to invest in health. Thus, in the main simulation, households decrease their supply of low-health labour by substituting for a healthy labour supply. This is easily possible due to the government's complete financial backing of their health expenditures. However, as the other two sectors (industry and services) use healthy labour more intensively than the agricultural sector, output in the agricultural sector declines by more than in the base simulation. The relative scarcity of low-health labour relative to the base simulation (due to some of it being transformed into healthy labour) results in a smaller decline in its wage rate compared to the base simulation. The opposite is true for healthy labour.

***Industry***

The industrial sector is comprised of all major industrial and manufacturing activities, and is the second largest sector in terms of value added, at more than 25 percent of the total (table 5). It also has the highest share of imports (83.74 percent, table 5). This sector's output in the base simulation declines by slightly more than 2 percent (table 7) while its share in total value added declines by almost 3.83 percentage points (table 9). This decline is mostly due to a 2.54-percent increase in imports (table 13). Imports are a significant share of total industrial supply, so the 18-percent decline in prices of imported industrial goods (table 17) has a strong impact across the economy. There is an immediate substitution of domestic goods for imports, forcing domestic producers in the industrial sector to lower their prices by nearly 7 percent (table 17).

In the main simulation, when households exercise their choice regarding the level of healthy and low-health labour supply according to their optimization criteria, the decline in industrial output is only slightly less pronounced at 1.99 percent (table 7). As mentioned above regarding the agricultural sector, the greater premium paid to healthy labour relative to low-health labour (due to relatively higher wage rates, table 16) leads households to prefer to invest in increasing their health capital. This increases the supply of healthy labour at the cost of low-health labour. This has a dual positive impact in the industrial sector. First, the industrial sector uses healthy labour more intensively and can thus anticipate increased production. Secondly, the relative abundance of healthy labour ensures that it is available at a slightly cheaper rate. These two reasons combine to push industrial output up marginally.

***Services***

In the base simulation, the services sector sees a marginal 0.51-percent increase in production (table 7). There are two important reasons for this. First of all, the price shock

to the services sector is less than in the industrial sector. Second, the services sector stands up to the import shocks better than the industrial sector, primarily because of a low import penetration rate (3.55 percent) and a low import share (13.62 percent). These same factors also explain why the impact on prices is smaller than in the other sectors (for pre-tax local, producer and consumer prices, table 17).

In the main simulation, as discussed above, households try to maximize their gains from liberalization by increasing their stock of healthy labour. The industrial and services sectors both use healthy labour relatively intensively, and benefit from this situation. Not only is the services sector in a position to increase its output, but it can also do so while lowering prices due to the relative abundance of healthy labour (which pushes down the wage rate). However, this increase in supply only acts to further increase the supply-demand gap, a secondary factor contributing to downward price pressures. This can be seen when comparing the services sector price drops shown in tables 17 and 18.

***Households***

**Table 18: Income / consumption of households**

| Income / consumption | Main simulation | | Base simulation | |
|---|---|---|---|---|
| | Rural | Urban | Rural | Urban |
| Y | -2.60% | -2.24% | -2.71% | -2.15% |
| C1 | 2.20% | 2.58% | 2.31% | 2.90% |
| C2 | 8.64% | 9.04% | 8.54% | 9.16% |
| C3 | 1.98% | 2.35% | 1.81% | 2.39% |

Note: Y = Income; C1 = Consumption of agricultural sector output;
C2 = Consumption of industrial sector output; C3 = Consumption of services sector output.

A mixed picture is seen when looking at household income in rural and urban areas. Both of these representative households experience a decline in their income in the base simulation. However, as most rural households are dependent on low-health labour, their income declines by more than that of urban households (table 16). At the same time, each household category is able to increase their consumption of goods and services in each of the three sectors. This is because the decline in prices is sharper than the decline in income, leading to higher real income. Comparing consumption, a lower decline in income among urban households implies that they are able to raise their consumption by more than rural households.

Moving to the main simulation, table 19 shows that while rural households are able to reduce their losses (compared to the base simulation with no health decision), the decline becomes larger among urban households. This occurs due to the widening wage gap between low-health and healthy labour, leading most households to try to switch between the two. This leads to an increase in the supply of healthy labour and thus a decline in its wages. The opposite is true for low-health labour. Faced with a sudden decline in the amount of low-health labour, there is a relative increase in wages in this segment of the labour market. Rural households, which on an average have a greater supply of low-health labour, are the ones to gain from this change. As far as consumption is concerned, rural households increase their consumption of non-agricultural products. With respect to the agricultural sector, a relative increase in the wage rates of low-health labour (a large proportion of which is employed in the agricultural sector) induces cost inflation in the sector. This leads to a marginal decline in its demand as reflected by relatively slower growth in rural consumer demand for agricultural products.

## 5.3 Simulation (b)

Simulation (b) consists of complete tariff liberalization like the first simulation. In this scenario the government covers half, rather than all, of the health care expenditures in urban areas and the household covers the other half, while rural households continue to benefit from full coverage.

The changes in the quantities of output, imports and exports are broadly similar to simulation (a), the paper specifically explores the differences arising between these two simulations in both their nature as well as results.

**Table 19: Change in prices: Base simulation (%)**

| Sectors | PM | PL | P | PC |
|---|---|---|---|---|
| 1 | -28.41% | -8.36% | -8.10% | -8.92% |
| 2 | -18.23% | -7.59% | -6.54% | -10.01% |
| 3 | -14.32% | -8.88% | -8.12% | -9.12% |
| 4 | | -6.67% | -6.67% | -6.67% |

Note: 1 = Agriculture; 2 = Industry; 3 = Services; 4 = Public administration;
PM = Import price after the addition of tariffs; PL = Pre-tax price of goods produced domestically;
P = Producer price; PC = Consumer price.

**Table 20: Change in prices: Main simulation (%)**

| Sectors | PM | PL | P | PC |
|---|---|---|---|---|
| 1 | -28.41% | -10.91% | -10.55% | -11.39% |
| 2 | -18.23% | -7.76% | -6.69% | -10.14% |
| 3 | -14.32% | -7.58% | -6.94% | -7.88% |
| 4 | | -5.09% | -5.09% | -5.09% |

Note: 1 = Agriculture; 2 = Industry; 3 = Services; 4 = Public administration;
PM = Import price after the addition of tariffs; PL = Pre-tax price of goods produced domestically;
P = Producer price; PC = Consumer price.

***Agriculture, industry and services***

Here, comparing the base simulation in the (a) and (b) cases, it becomes clear that the supply-demand gap in the agricultural sector is greater in simulation (b) than in simulation (a). With the reduction in government financing of health care expenditures in urban areas, there is a decline in urban households' disposable income. This has a negative impact on demand in each of these three sectors, along with a sharper decline in prices to accommodate this fall in demand. The industrial sector, however, avoids the declines found in the other two sectors. This is because a withdrawal of government transfers to urban households implies higher government savings, and thus an increase in investment spending. Given the higher proportion of investment spending being directed towards industrial goods, this protects the industrial sector which actually experiences an increase in production activity (table 7).

In the main simulation (b), the price movements suggest that two sectors (agriculture and industry) suffer a larger supply-demand gap than in the base simulation (b). Prices fall by 10.91 percent in agriculture (compared to an 8.36-percent drop in the base scenario (b)) and by 7.76 percent in industry (a 7.59-percent drop in the in base scenario): see tables 20 and 21. The other two sectors (industry and public administration) actually witness smaller price declines (tables 20 and 21). To understand the results, keep in mind that a withdrawal of financial support for urban households' health care expenditures induces these households to shift from healthy labour to low-health labour. At the same time, as seen in table 16, the fall in wage rates in the base simulation (b) is steeper in the low-health labour force than in the high health one. This means that the rural households which continue to enjoy government support for their healthcare expenditures would be likely to invest in their health stock, resulting in a healthier workforce. Overall, a steeper fall in wages paid to low-health labour occurs due to a net increase in the size of the low-health labour force and a decrease in the healthy labour force. This positively impacts output in the agricultural sector, deepening the supply-demand gap. This gap is closed with a larger fall in agricultural prices as seen in tables 20 and 21. As for the other sectors, public administration and services use the healthy labour force much more intensively than the industrial sector. Thus, an overall decrease in the quantity of healthy labour leads to lower output, thus narrowing the supply-demand gap and explaining a smaller fall in prices (tables 20 and 21).

As far as trade is concerned, the fact that the cost of agricultural production comes down due to an abundance of one of its main resources, the low-health labour force, leads to a smaller rise in the sector's imports in the main simulation (b) (+38 percent) than in the main simulation (a) (+55 percent) as shown in table 13. The same linkage can be seen for agricultural exports, albeit in the opposite direction. Having the competitive advantage of lower costs, main simulation (b) results in more exports than in main simulation (a), as shown in table 12. For industry imports, given that the fall in prices is less in main simulation (b) than in main simulation (a), the opposite is observed: industry imports rise by more in both the main and base (b) scenarios than in the related (a) scenarios (table 13). Similarly in the case of the services sector, the price decline is much steeper in main simulation (b) (7.58-percent decline; table 21) than in main simulation (a) (4.03-percent decline; table 18). As a result, the imports which grew by nearly 11 percent (table 13) in main simulation (a) now only grow by around 3 percent in the main simulation (b). On the exports side, services sector exports become more competitive due to sharper declines in prices, while industrial sector exports expand along with greater industrial production (table 12).

***Households***

**Table 21: Income / consumption of households**

| Income / consumption | Main simulation | | Base simulation | |
|---|---|---|---|---|
| | Rural | Urban | Rural | Urban |
| Y | -5.66% | -26.54% | -5.10% | -29.25% |
| C1 | 6.46% | -17.10% | 4.20% | -22.32% |
| C2 | 4.99% | -18.25% | 5.45% | -21.38% |
| C3 | 2.41% | -20.25% | 4.42% | -22.15% |

Note: Y = Income; C1 = Consumption of agricultural sector output;
C2 = Consumption of industrial sector output; C3 = Consumption of services sector output.

An obvious outcome of the withdrawal of half of the government support for health care for urban households is visible in the form of drastic reductions in the income and

consumption of urban households. However, when comparing the base and main simulations, urban households are able to offset part of their loss by investing less to maintain a healthy household labour force. The healthy labour force (which becomes relatively scarcer) sees wages rise while the opposite holds for the low-health labour force. As the rural sector has a higher proportion of low-health workers in its labour force, this relative change in wages in effect leads to a transfer of income from urban to rural households.

At the same time, simulation (b) sees a much larger decline across households than in simulation (a) (both base and main: table 19 and 22). For urban households, this is mostly due to the withdrawal of government health subsidies, and in the rural sector it results from the relative expansion of the low-health labour force. The impact on consumption is mixed for rural households. Whereas household consumption of agricultural products and services rise by more in simulation (b) than in (a) due to a sharper decline in their respective prices, industrial consumption is lower in simulation (b). Urban households reduce consumption of goods from all sectors significantly, with strong declines relative to simulation (a).

## 5.4 Simulation (c)

The third and final simulation looks at complete tariff liberalization coupled with complete withdrawal of government subsidies to meet the health care costs of both rural and urban households.

**Table 22: Change in prices: Base simulation (%)**

| Sectors | PM | PL | P | PC |
|---|---|---|---|---|
| 1 | -28.41% | -18.94% | -18.30% | -19.18% |
| 2 | -18.23% | -7.04% | -6.07% | -9.58% |
| 3 | -14.32% | -17.41% | -15.85% | -17.28% |
| 4 | | -10.83% | -10.83% | -10.83% |

**Note:** 1 = Agriculture; 2 = Industry; 3 = Services; 4 = Public administration;
PM = Import price after the addition of tariffs; PL = Pre-tax price of goods produced domestically;
P = Producer price; PC = Consumer price.

**Table 23: Change in prices: Main simulation (%)**

| Sectors | PM | PL | P | PC |
|---|---|---|---|---|
| 1 | -28.41% | -29.97% | -28.86% | -29.93% |
| 2 | -18.23% | -7.66% | -6.60% | -10.06% |
| 3 | -14.32% | -9.84% | -9.00% | -10.04% |
| 4 | | -0.65% | -0.65% | -0.65% |

**Note:** 1 = Agriculture; 2 = Industry; 3 = Services; 4 = Public administration;
PM = Import price after the addition of tariffs; PL = Pre-tax price of goods produced domestically;
P = Producer price; PC = Consumer price.

***Agriculture, industry and services***

A complete reduction in government support to health care expenditures incurred by both rural and urban households leads to a sharp fall in their incomes and thus also in aggregate demand. This creates a situation of excess supply which induces lower prices. The reduction in prices is most pronounced in sectors with the largest supply-demand

gap. In base simulation (c) price drops are largest in the agricultural sector, with the services sector close behind (table 23). Industrial sector demand falls by the least. As with simulation (b), one of the main reasons for this is the increase in investment demand in the sector. This results from increased government savings (from cuts to health subsidies) coupled with the highest share of industrial sector output in investment demand. When households can change the composition of their labour endowments (as in main simulation (c)), the immediate impact is a drastic reduction in the quantity of healthy labour supplied (table 11, main simulation column (c)). This translates into a sharp increase in the wage rate of this category of labour (table 16, main simulation column (c)). In the base simulation (c), only the industrial sector, having experienced the smallest drop in demand for its products, is able to increase the amount of healthy labour used in the sector, leading to greater output (tables 11 and 7). Output in the services sector – the other intensive user of healthy labour – falls by nearly 8 percent (table 7) reducing demand for all types of labour. This contrasting situation can be attributed to the fact that demand for industrial goods primarily originates from the government sector, a relatively small user of services sector output. While in base simulation (c), production in the agricultural sector declines under falling demand, in main simulation (c), the marginal increase in agricultural sector output comes from its ability to absorb the abundant low-health labour force (tables 7 and 10). Although the percentage increase in low-health labour in the agricultural sector is smaller than other sectors, we must keep in mind the significant size of the low-health labour force engaged in agricultural production.

Comparing the results of main simulation (c) to the other two main simulations, an important point would be the qualitative impact that such a vast cut in government subsidies can produce. For example, zero cut in subsidies brought down agricultural output by 0.15 percent points (table 7). A medium reduction in subsidies amplified this to a 0.43-percent decline (table 7). However, a complete reduction in subsidies has actually pushed up agricultural output by 0.37 percent (table 7). Similarly, in the case of imports, agricultural imports decline in scenario (c) (table 13) as opposed to the increases seen in the other two scenarios, induced by a nearly 30-percent collapse in agricultural prices (table 24). Further, the cost to households of maintaining their labour force in a healthy condition is so large that the withdrawal of the government health subsidy that the equilibrium healthy labour force wage needed by a household is nearly 17 percent higher than at present (table 16). This fact gets further amplified when one bears in mind a drastic reduction in prices across sectors. The most important feature of the economic adjustment occurring due to such large scale withdrawal of health coverage, however, is the regression from a services sector-driven economy to a manufacturing- and primary sector-driven economy. This results from drastic falls in labour productivity across sectors to levels which can only be sustained independently in agricultural activities.

***Households***

**Table 24: Income / consumption of households**

| Income / consumption | Main simulation | | Base simulation | |
|---|---|---|---|---|
| | Rural | Urban | Rural | Urban |
| Y | -28.51% | -43.58% | -26.79% | -57.48% |
| C1 | 2.02% | -19.48% | -9.42% | -47.38% |
| C2 | -20.51% | -37.27% | -19.03% | -52.97% |
| C3 | -20.53% | -37.28% | -11.50% | -48.59% |

Note: Y = Income; C1 = Consumption of agricultural sector output;
C2 = Consumption of industrial sector output; C3 = Consumption of services sector output.

A look at the changes in income and consumption levels across households in both the base and main simulations highlights that the reduction in urban consumption is more pronounced than that of rural consumption. This is primarily due to the fact that the rural sector is mostly composed of the lower paid low-health labour force. The decline among urban households is magnified by the fact that its labour force is primarily in a healthy state, and through sheer numbers this implies that many households cannot afford to invest in the same level of health services after the withdrawal of government health transfers. In the main simulation, the only increase in household consumption is of agricultural products from rural households. This outcome results from a combination of a much sharper fall in agricultural prices and a marginal increase in agricultural production, coupled with a relatively less steep decline in rural household income.

# VI. Poverty and Welfare Analysis

## 6.1 Poverty analysis

The changes in the headcount ratio for different groups of households in the model are presented below. Other poverty measures referred to earlier in the paper are not presented as they paint a broadly similar picture.

**Table 25: Changes in poverty headcount ratio**

| Simulation | | Rural households | Urban households | All India |
|---|---|---|---|---|
| A | Main | -0.005% | -0.047% | -0.013% |
| | Base | -0.003% | -0.047% | -0.011% |
| B | Main | 0.016% | 7.907% | 1.444% |
| | Base | -0.004% | 9.906% | 1.789% |
| C | Main | 7.565% | 18.179% | 9.486% |
| | Base | 7.311% | 22.986% | 10.148% |

**Note:** RH = Rural households; UH = Urban households

The poverty table (table 26) above highlights two important features of the impact of liberalization. First, withdrawal of government subsidies increases poverty. Second, the households trade off with each other to reduce poverty.

Regarding the negative impact that withdrawing subsidies has on poverty, the Indian national poverty headcount ratio increases progressively over simulations (a), (b) and (c) in both the base and main simulations. This essentially implies that a withdrawal of government subsidies from health to other useful activities like real investment does not ease the pressure on households. In fact, the opposite appears to be the case. At the same time, it is worth noting that, for each of the (a), (b) and (c) simulations, the increase (decrease) in poverty is less (more) when households can make a choice regarding their labour composition (i.e. when moving from the base to the main scenario).

Looking at the second point, as mentioned above, households are generally able to reduce the poverty impact by re-optimizing the composition of their labour. However, this is not true in all household categories. In simulation (b), when urban households can make decisions regarding the quantities of each type of labour, they are able to hold the increase in poverty to 7.9 percent rather than 9.9 percent (table 26). This occurs by effectively increasing the supply of low-health labour, pushing down wages for this type

of labour and adversely impacting rural poverty. The 0.004-percent decline in rural poverty becomes a 0.016-percent increase. In other words, Indian urban households are in a position to export their poverty to their rural counterparts. The same story holds in the third simulation.

In the first simulation, the dynamics of the economic forces work a bit differently. Here, the government provides complete (100 percent) coverage of all health care expenditures of any household. As seen in table 16 on changes in wage rates in each labour category, rural households take advantage of the increasing premium for healthy labour by investing in their health capital. This marginally helps increase the poverty reduction in rural areas from 0.003 to 0.005 percent. However, there does not appear to be any significant transfer of poverty between rural and urban households in this case.

**Table 26: Changes in price index and income**

| Simulations | | PINDEX | YRH | YUH |
|---|---|---|---|---|
| (a) | Main | -2.76% | -2.60% | -2.24% |
| | Base | -2.77% | -2.71% | -2.15% |
| (b) | Main | -5.04% | -5.66% | -26.54% |
| | Base | -5.20% | -5.10% | -29.25% |
| © | Main | -6.21% | -28.51% | -43.58% |
| | Base | -7.76% | -26.79% | -57.48% |

**Note:** YRH = Income of rural households; YUH = Income of urban households; PINDEX = Price index

To better understand the impact on poverty, table 27 presents the data on changes in the price index and rural and urban household income. The fall in the price index becomes larger in magnitude over simulations (a), (b) and (c). As the government does not withdraw any support for health care in simulation (a), it can be seen as a reference scenario for price reductions following tariff liberalization. In other words, in simulation (b), the 5-percent reduction in the total price index (table 27) can be divided into two parts. First, about 3 percentage points of this reduction can be attributed to tariff liberalization. Secondly, the partial withdrawal of government health care subsidies which benefit urban households further pushes down prices by approximately another 2 percent. While the first reduction originates from lower production costs, the second results from weaker demand in conjunction with substitution towards less productive forms of labour. To put it more succinctly, while liberalization is expected to bring in better technologies, leading to higher productivity, if it is not adequately and wisely supported by government, the price reduction due to liberalization is sufficient to push both firms and households to look for cheaper production factors, potentially leading to slower long-run productivity growth.

## 6. 2 Welfare analysis

The next table (table 28) presents the welfare effects (measured as compensated variations) in each simulation.

**Table 27: Changes in welfare (%)**

| | Simulation (a) | | Simulation (b) | | Simulation (c) | |
|---|---|---|---|---|---|---|
| Households | Main | Base | Main | Base | Main | Base |
| RH | 3.71% | 3.64% | 4.22% | 4.62% | -14.59% | -12.92% |
| UH | 3.81% | 3.92% | -19.26% | -22.02% | -34.38% | -49.37% |

**Note:** RH = Rural households; UH = Urban households

Consistent with the story on poverty, it can be seen that the welfare of urban households is progressively lower in each of simulations (a), (b) and (c). Rural households, on the other hand, see higher welfare in simulation (b) than in simulation (a). However, even in their case, this situation becomes much worse when they have to bear the entire cost of their health care expenditures in simulation (c). For urban households, the story is clearly driven by their income losses due to the higher cost of maintaining their level of healthy labour, which is a large share of their labour supply. This is coupled with the fact that urban households also face declining income due to the shift towards lower health labour, which is mostly used in agricultural activities with lower productivity and remuneration. However, in the case of rural households, the decline in income they face is essentially due to an overabundance of low-health labour, a significant share of the rural labour force. This is especially true in simulation (b). Nonetheless, their welfare increases (table 28) despite reduced income (table 27) which is incompletely compensated for by lower prices (table 27, main simulation (b)). In base simulation (b), one of the factors assisting rural households to increase their welfare is the 5.2-percent fall in the overall price index, which exceeds the 5.1-percent fall in their income, implying an increase in their real income; base simulation (b), however, has no such supporting factors. The reason for their increase in welfare in main simulation (b) is the composition of their consumption. Agricultural products form a larger share of rural consumption than of urban consumption. As a result, the move towards a lower health labour force causes agricultural product prices to fall, benefitting rural households by more than the cost in terms of real income. Hence, a 4.22-percent increase in their welfare (table 28) in main simulation (b). Lower producer prices also explain part of how the increase in the welfare of rural households (4.62 percent, table 28) exceeds the marginal increase in their real income (see prices and income in table 27).

## VII. Conclusion

This paper tries to explore two aspects of health. First, it tries to determine the impact of imputing a choice function on a household regarding the composition of its labour. The paper uses health as a form of human capital, and labour is differentiated by high- (healthy) and low-health labour. Second, it looks at the mode of financing health care expenditures. It simulates three scenarios where health is either fully financed by the government, one where urban households pay for half of their health expenditures, or an extreme scenario where health care costs are entirely borne by households. We simulate these situations in a context of complete liberalization, i.e. 100-percent tariff reductions in every sector. The most important feature of the results is the redistributional impacts of such a choice function. When it is less expensive for households to invest in health, the modelled liberalization shows stronger gains in sectors which employ healthy labour relatively intensively, while the agricultural sector (the main employer of low-health labour) gains by less. This tendency leads to a relative rise in wages paid to healthy labour, prompting households to invest more in health so as to increase their supply of healthy labour. This leads to an increase in the supply of healthy labour and a decline in the overall supply of low-health labour. So, despite the relative increase, the increase in the overall supply of healthy labour negatively affects households with a healthy work force by reducing the wage rate for healthy labour. As is expected, this disadvantage is greater for urban households as they tend to hold a larger share of healthy labour.

However, when households are required to pay the entire cost of maintaining the health of workers, they face two sources of adverse impacts. First, liberalization brings down overall price levels, thereby reducing the potential premium on healthy labour. This acts as a disincentive for households who want to invest in health capital. The costs covered by these households rise, and the gains do not fully cover these additional costs. Investments in health capital thus decline and there is a shift towards a larger low-health labour force. Secondly, this decline in health capital causes households to take on the jobs they can get hired for, which are more likely to be in the agricultural sector or informal segments of the industrial sector. These are not currently highly productive jobs and this change thus negatively impacts the long-run earning potential of households and the entire economy.

Another important conclusion pertains to the contrasting outcomes of urban and rural households. This can be also referred to as a form of domestic reallocation of poverty. Urban households, which tend to have large shares of healthy labour when required to finance the full cost of maintaining their healthy workers, are in a position to reduce this adverse income impact by shifting towards a lower health labour force. This raises the supply of low-health labour in the economy, thereby reducing their wage rate, and implicitly making healthy labour relatively scarcer. This brings net benefits to urban households with their larger proportion of healthy workers. However, rural households and their lower health labour do not see sufficient gains from wages paid to healthy worker to fully compensate for the losses in wages paid to low-health labour. Thus, urban households can use their choice function to reduce their poverty, but this effectively transfers poverty to their rural counterparts.

The poverty and welfare effects of these two simulations are broadly similar except that rural households are less susceptible to poverty in this scenario because they consume more agricultural products. In other words, declining real rural income is partly (and sometimes fully) compensated for by a decline in agricultural prices. Conversely, urban households tend to gain more than rural households, particularly when households are not required to finance a high share of health investments.

This paper is an early attempt to incorporate health into a general equilibrium framework. While it does capture productivity aspects and costs of health, it neglects a detailed analysis of the production of health capital and the provision and sale of health care services in an economy. It assumes that health care services are provided by the state at a fixed price and are either financed by the state or by households themselves. It would be useful to replace this assumption with a more detailed description of the health care market and industry. To conclude, this paper introduces changing health quality, as determined by a household health investment choice function in response to a changing macroeconomic environment, into the supply of a health-differentiated labour factor. The limitations of the paper point to an obvious need to augment this approach further if practical applications are to be developed. In the process of doing so, it is important to keep in mind that health is always a micro phenomenon, but it is one which can have major quantitative and qualitative macro effects across an economy.

## References


Arndt. C. (2002), "HIV/AIDS, Human Capital, And Economic Prospects For Mozambique", TMD Discussion Paper No. 88, Trade and Macro Economics Division, International Food Policy Research Institute, Washington DC, USA.

Pradhan. B. K., Saluja. M. R. and Singh. S. K. (2005), *Social Accounting Matrix for India: Concepts, Construction and Applications*, Sage Publications, New Delhi/Thousand Oaks/London.

Case. A., Fertig. A. and Paxson. C. (2003), "From Cradle to Grave? The Lasting Impact of Childhood Health and Circumstance", Working Paper, National Bureau of Economic Research, Cambridge MA, No. 9788, June 2003.

Cloutier. M. H., Cockburn. J. and Decaluwé. B. (2005), "Education and Poverty in Vietnam: A Computable General Equilibrium Analysis".

Narayana. D. (2004), "Healthy Budget, Healthy People? The Impact of Health Sector Reforms on Public Spending and Health Outcomes in India", *Global Issues, Local Voices: Issue 3*, Global Development Network Fifth Annual Conference, Delhi.

INSAAF International Report (2001), "World Bank Funded Health Care – A Death Certificate For Poor". This report was released on Jan 2nd, 2001, by Justice Kuldeep Singh, former Chief Justice of India, at Chandigarh.

Ministry of Health, Government of India, National Health Policy, http://mohfw.nic.in/kk/95/ii/95ii0101.htm.

Qadeer. I. (1985), "Health Services System In India: An Expression Of Socio-Economic Inequalities", *Social Action*, 35:199-223, July-September 1985.

Qadeer. I. (2000), "Health Care Systems in Transition: The Indian Experience", *Journal of Public Health Medicine,* 22(1):25-32.

Rao. M. (1994), "An Imagined Reality: Malthusianism, Neo-Malthusianism And Population Myth", *Economic and Political Weekly*, January 29, p. 40-52.

Rutten. M., Blake. A. and Reed. G. (2006), "The Economic Impact of Health Care Provision: A General Equilibrium Assessment of Some Policy Options in the UK's NHS", *Research Paper* 2006/31, Leverhulme Centre for Research on Globalization and Economic Policy.

Sainath. P. (2006), "The Health of Nations", *India Together*, http://www.indiatogether.org/2006/jan/psa-health.htm.

Savard. L. and Adjovi. E. (1997), "Adjustment, Liberalization and Welfare, In Presence of Health and Education Externalities: A CGE applied to Benin", Centre de Recherche en Economie et Finance Appliquées (CREFA), Department d'Economique, Faculté des sciences sociales, Université Laval.

Sukhatme. P.V. (1972), "India And The Protein Problem", *Ecology of Food and Nutrition*, 1:268.

Weisbrod. A. B. (1961), *Economics Of Public Health: Measuring The Economic Impact Of Diseases*, Oxford University Press, London.