The Effect of Trade Liberalization on Income Distribution in Vietnam - Dynamic CGE Approach

By

Truong Ba Thanh[1] and Nguyen Manh Toan[2]

Abstract

Using the computable general equilibrium (CGE) framework, this paper explores the links between trade liberalization and income distribution among household groups in Vietnam. For this purpose, a multi-sector dynamic CGE model and the corresponding Social Accounting Matrix (SAM) have been developed. In this model, forward-looking economic agents are assumed to optimize their consumption and investment behaviors over a long time span. The model also comprises twenty-five sectors, five household groups and thirteen factors of production, allows main sources of welfare change to be investigated. We found that under trade liberalization, the welfare of all groups will be positively affected by labor factor price changes and will be negatively affected by changes in the relative price of consumption goods. In the long-run, all household groups can enjoy an improvement in their welfare because the increase in the budget for consumption of all groups is large enough to outweigh the negative effect of changes in the prices. The simulation results also demonstrate both promise and danger of trade liberalization. It shows that the trade liberalization will enhance the economic growth and national welfare. However, at the same time, it may widen the income gap between rural and urban areas, among rural people as well as among urban people.

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I. Introduction

Trade liberalization and WTO accession - the key driving forces of globalization – are the most recent concerns in Vietnam. Along with domestic reforms since the initiation of the *doi moi* in 1986, Vietnam has started opening up the economy and undertaking international trade commitments. Despite the recent market reforms, however, Vietnam's economy is still highly protected with the average tariff rate at 16.2 % in 2000 (Jensen and Tarp, 2003). With the accession to WTO and the continued reforms toward market liberalization, further reduction of tariffs and protection will likely result in significant changes in investment, production structure, relative prices, consumption behavior, welfare and so on in Vietnam.

In general, reduction in barriers to the international trade gives opportunities to accelerate growth, enhance productivity through the process of specialization, promote competition and create incentives for increasing efficiency (World Bank, 2002). Although it is widely proven that trade liberalization policies are likely to impact positively on the economic situation at the national level, their effects at the industry level and on the welfare of various households may be different. Theoretically, industries with less protection may readily expand production and develop faster, while those which are not strong and competitive enough may face many difficulties in the international competition. Elimination of tariffs may significantly affect government revenue in developing countries, and indirectly impact each household group's income through the transfer process one way or another. As a result, reduction of the government budget, changes in the structure of the economy, and the adjustment of the relative price system may favor certain categories of households while they hurt the others. The benefits obtained by each household group from the trade liberalization are not the same. If the trade liberalization has a very adverse impact on the rural poor, it cannot be justified at least from the standpoint of poverty reduction (Fujii, 2003). This point is especially important in a country like Vietnam, where a substantial portion of the population is still leading poor lives in rural areas. Thus, trade policy should focus on both

efficiency and equality, i.e. how the benefits of such a policy are distributed among households. Recently, the link between trade liberalization and income distribution in developing countries is being more and more widely recognized (Francois, 1997).

In the case of Vietnam, a number of questions are raised. How well the country could organize and facilitate a socialist-oriented market economy with high economic growth while sustainably narrowing the income distribution gap between people? Can trade liberalization enhance growth and promote equity? What policy interventions are needed to make the trade liberalization more equitable and sustainable? In an effort to answer these questions, many contributions have been made, such as studies of Fukase and Martin (1999), Phuong (2001), Huong (2002), Chan and Dung (2001, 2002), Binh (2002), Henning and Tarp (2003), Fujii (2003), and Dung and Ezaki (2005). Using the Computable General Equilibrium (CGE) frameworks, these papers focused on the distributional impact of tariff reduction on household welfare under a plausible revenue-neutral government budget closure. The databases for these studies are mainly GTAP, the 1996 Input-Output Table for Vietnam and the 1997-1998 Vietnam Living Standard Survey.

Despite of the rapid emergence in applying CGE models to income distribution issues, all the prevailing models are static in nature, and are ill-suited for analyzing long-run effects. In addition, the conclusions of the above mentioned studies are similar in the sense that trade liberalization helps to improve the welfare of the whole nation, as supported by standard trade theories, but quite different regarding income distributional effect among households. Huong (2002) indicated that rural households gain relatively more than the urban ones, helping to narrow the income gap between rural and urban areas. Income equality among rural household groups will also be improved. In contrast, Chan and Dung (2001, 2002) argued that trade liberalization is pro-rich and pro-urban. A similar conclusion is drawn by Henning and Tarp (2003), who found that elimination of import tariffs increases rural poverty more visibly.

Because of the contrasting results in previous studies, further investigation is required on whether trade liberalization will increase or decrease inequality in Vietnam. This study develops a dynamic CGE model, with an estimation of trade parameters for Vietnam and a construction of a corresponding Social Accounting Matrix (SAM) database, to further analyze the main factors that have strong impacts on the welfare of different household groups under the trade liberalization process.

II. Basic structure of the Dynamic CGE Model

Computable General Equilibrium (CGE) models have become a powerful tool in analyzing a number of varied trade policy issues (Francois and Kenneth, 1997). It can be seen as a bridge between theorists, planners and policy makers (Dervis et al., 1982). Trade liberalization policies are one of the most frequently discussed issues in CGE analyses. Trade protection with tariffs and quantitative restrictions bring about distortion of resource allocation by favoring demand for domestic products rather than imports, and by increasing outputs of some specific sectors under protection. CGE analyses can quantify how much removal of tariff and quantitative restrictions will reallocate resources between domestic and foreign sources and among different sectors, and how much welfare will improve (Hosoe, 2001). In addition, in most of previous studies related to dynamic CGE models, the total national income is assumed to be distributed to a single representative household. Therefore, these models are not suitable for simulating the effect of an economic policy on income distribution among various household groups.

This study attempts to develop a multi-household dynamic CGE model for Vietnam's trade liberalization. It allows quantification of the long-run effects of income and price changes, induced from tariff reduction, on welfare of each household group. The dynamic model is expanded from the multi-sector and multi-household static one constructed in initial step of this study. A fundamental point of departure of the dynamic model from the static one is the incorporation of inter-temporal structure of consumption and investment decision in the dynamic model. While the static CGE model examines one-period sectoral reallocation of resources, the dynamic model allows analyzing the path of transitional dynamics toward a new steady state after an initial shock. In addition, in contrast to the static model, the dynamic counterpart is characterized by the inclusion of driving forces, such as the growth of labor, to move the economy from period to period. According to Selim (2004), impact of a policy reform like trade liberalization, which is dynamic in nature, is supposed to be better captured by dynamic CGE model rather than a static one.

The multi-household characteristic can be seen as a unique feature of this study's dynamic model, which comprises five household groups, twenty-five sectors of production, and thirteen primary factors, in which labor is disaggregated into twelve categories. The model is simulated for alternative policy scenarios, in which tariffs are reduced to five percent, while either direct or indirect tax rates are allowed to adjust endogenously in order to satisfy a fixed government revenue target. The study then tries to explore the link between trade liberalization and the welfare of specific household groups.

The Dynamic CGE model is a multi-sector, multi-household, competitive, small/price-taking open economy model. The model is an extension of the static model presented in Truong and Nguyen (2006). The inter-temporal structure of the dynamic model is developed based on the works of Go (1994), Devarajan and Go (1998), Diao, Yeldan and Roe (1998). For the purpose of presentation, it is convenient to specify the Dynamic CGE model in terms of three blocks of equations, each of which describes a particular aspect of the equilibrium conditions. These are: the dynamic (inter-temporal) equilibrium block, the intra-temporal equilibrium block, and the steady state equilibrium block.

II.1 The Inter-Temporal Equilibrium Block

II.1.1 *Household consumption and saving*

The model includes several groups of households, which are represented by subscript *r* in the following equations. The household's utility maximization problem is assumed to be a two-level activity:

At the first level, each "dynasty" household chooses the time path of consumption and saving that maximizes the discounted sum of utilities:

$$\max \sum_{t=1}^{\infty} N_{rt} \left(\frac{1}{1+\rho} \right)^t u(U_{rt}), \tag{1}$$

where ρ is positive and is the rate of time preference, $u(.)$ is instantaneous utility at each time period, U_{rt} is instantaneous aggregate consumption per capita. N_{r0} is

$$N_{rt} = N_{r0}(1+n)^t, \tag{2}$$

where N_{r0} is the initial population of group *r*, *n* is its growth rate.

The form of the instantaneous utility in this model is a simple logarithmic function:

$$u_{rt} = \ln U_{rt}. \tag{3}$$

The household maximize (1) subject to an inter-temporal budget constraint:

$$\sum_{t=1}^{\infty} \mu(t) N_{rt} CPI_{rt} U_{rt} \le \sum_{t=1}^{\infty} \mu(t)(Y_{rt} - SAV_{rt} - i^* \cdot H\_DEBT_{rt}) \tag{4}$$

where $CPI_{rt}U_{rt}$ is the value of aggregate consumption expenditure per capita in each group, Y_{rt} and SAV_{rt} are the income and savings of all household in each group, $i^* \cdot H\_DEBT_{rt}$ is interest payment on outstanding foreign debt of each household group, $\mu(t)$ is the discount factor from time *t* to time 1 and CPI_{rt} is the consumer price index such that

$$CPI_{rt}U_{rt} = \sum_j P_{jt} \frac{C_{jrt}}{N_{rt}} = \frac{1}{N_{rt}} \sum_j P_{jt} C_{jrt}. \tag{5}$$

The Lagrangian of the inter-temporal problem is

$$L = \sum_{t=1}^{\infty} N_{rt}\left(\frac{1}{1+\rho}\right)^{t} u(U_{rt}) + \lambda\left[\sum_{t=1}^{\infty}\mu(t)(Y_{rt} - SAV_{rt} - i^{*}\cdot H\_DEBT_{rt}) - \sum_{t=1}^{\infty}\mu(t)N_{rt}CPI_{rt}U_{rt}\right]$$

from which the Euler equations

$$\frac{CPI_{r,t+1}U_{r,t+1}}{CPI_{rt}U_{rt}} = \left(\frac{1+r_{t+1}}{1+\rho}\right) \tag{6}$$

are obtained.

Households allocate their income flows to interest payments on outstanding foreign debt, consumption and savings. The current period budget constraint for the household is hence:

$$CPI_{rt}U_{rt} = \frac{1}{N_{rt}}\left(Y_{rt} - SAV_{rt} - i^{*}\cdot H\_DEBT_{rt}\right). \tag{7}$$

From these, a sequence of aggregate household consumption and savings are determined:

$$\frac{Y_{r,t+1} - SAV_{r,t+1} - i^{*}\cdot H\_DEBT_{r,t+1}}{Y_{rt} - SAV_{rt} - i^{*}\cdot H\_DEBT_{rt}} == \left(\frac{1+r_{t+1}}{1+\rho}\right)(1+n),$$

At the second level of the consumer's problem, the instantaneous aggregate consumption per capita in each group is dispersed to its sectoral component so as to maximize the following:

$$U_{rt} = \frac{1}{N_{rt}}\prod_{j}(C_{jrt} - \eta_{jr})^{\alpha_{jr}}, \tag{8}$$

where C_{jrt} represents the consumption level of good *j* at period *t*; η_{jr} is minimum levels of consumption , α_{jr} is the marginal budget share for the commodity *j*.

II.1.2 *Firms and investment*

Even though we assume that the households own the stock of capital, it is convenient to separate the investment behavior from household's consumption/saving decisions by constructing an independent investor that is presumed to maximize the inter-temporal profits of capital investment. The aggregate capital stock is managed by the independent investor who decides investment and passes all profits to the households. The investor chooses a time path of investment to maximize the discounted profit of each sector over an infinite horizon:

$$MaxV_{j0} = \sum_{t=0}^{\infty}\mu(t)\left(wk_{jt}K_{jt} - J_{jt}\right) \tag{9}$$

subject to capital accumulation constraints:

$$K_{j,t+1} - K_{jt} = I_{jt} - \delta_{j}K_{jt}\ , \tag{10}$$

which says that, at each point of time, the sectoral capital stock increases by the amount of investment and decreases by the amount of depreciation, wk_j is the rental price for capital in the sector *j*, δ_j is the depreciation rate, I_{jt} is gross addition to the sector's physical capital. J_{jt} is the investment expenditure, which is affected by the replacement cost of capital PI_t as well as adjustment costs $\theta(.)$:

$$J_{jt} = I_{jt} PI_t [1 + \theta(.)]. \tag{11}$$

In this model, for simplicity we take the per-unit adjustment cost to be proportional to *I/K*. Then the equation (11) becomes

$$J_{jt} = I_{jt} PI_t \left[1 + \frac{I_{jt}}{K_{jt}} \right]. \tag{12}$$

The replacement cost of capital, PI_t, is the price of an investment basket at time *t*. We assume that the technology to produce capital equipment exhibits constant return to scale, hence the unit cost to produce an investment basket is uniquely determined by the price of the *n* final goods:

$$PI_t = \sum_j P_{jt} h_j \tag{13}$$

In order to solve the problem of (9) and (10), we form the following Hamiltonian

$$\mathrm{H} = \mu(t) \left[wk_{jt} K_{jt} - I_{jt} PI_t \left(1 + \frac{I_{jt}}{K_{jt}} \right) \right] + \lambda_{jt} (I_{jt} - \delta_j K_{jt}), \tag{14}$$

where λ_{jt} is the shadow price of investment in sector *j* at time *t*. It represents the contribution of a unit of capital at time *t* to the value of the firm measured at time zero (the contribution of the constraint to the objective function), the "present value shadow price." The first-order conditions are as follows:

(i) *The **control variable**, I_{jt}, is chosen to maximize H at each point in time:*

$$\frac{\partial H}{\partial I_{jt}} = \mu(t) \left[- PI_t - 2PI_t \left(\frac{I_{jt}}{K_{jt}} \right) \right] + \lambda_{jt} = 0,$$

$$PI_t \left(1 + 2 \frac{I_{jt}}{K_{jt}} \right) = \frac{\lambda_{jt}}{\mu(t)}. \tag{15}$$

We define the "current value shadow price:"

$$q_{jt} = \frac{\lambda_{jt}}{\mu(t)}. \tag{16}$$

Then

$$PI_t\left(1+2\frac{I_{jt}}{K_{jt}}\right)=q_{jt} \tag{17}$$

The left-hand side is the marginal cost of investment at period *t*, i.e., $J'(I_{jt})$.The right-hand side is the marginal value of capital in the same period, i.e., the marginal benefit of investment. Thus the first-order condition of the maximum principle leads to a very simple investment rule: At every period of time, firms will invest up to the point that marginal cost equals marginal benefit.

From (17), the firm carries out the amount of investment that satisfies the following equation:

$$I_{jt}=\frac{K_{jt}}{2}\left(\frac{q_{jt}}{PI_t}-1\right). \tag{18}$$

(ii) *The **costate variable*** λ_{jt} must obey the following no-arbitrage condition:

$$\lambda_{jt}-\lambda_{j,t-1}=-\frac{\partial H}{\partial K_{jt}}=-\mu(t)\left[wk_{jt}+PI_t\left(\frac{I_{jt}}{K_{jt}}\right)^2\right]+\lambda_{jt}\delta_j,$$

$$\frac{1}{\mu(t)}(\lambda_{jt}-\lambda_{j,t-1})=-wk_{jt}-PI_t\left(\frac{I_{jt}}{K_{jt}}\right)^2+\frac{1}{\mu(t)}\lambda_{jt}\delta_j\ . \tag{19}$$

From (16) we also have:

$$q_{j,t-1}=\frac{\lambda_{j,t-1}}{\mu(t-1)}=\frac{\lambda_{j,t-1}}{\mu(t)(1+r_t)}$$

$$\frac{\lambda_{j,t-1}}{\mu(t)}=q_{j,t-1}(1+r_t) \tag{20}$$

Substituting (16) and (20) into (19) yields:

$$q_{jt}-q_{j,t-1}(1+r_t)=-wk_{jt}-PI_t\left(\frac{I_{jt}}{K_{jt}}\right)^2+q_{jt}\delta_j$$

The no-arbitrage condition is then:

$$r_t q_{j,t-1}=wk_{jt}+PI_t\left(\frac{I_{jt}}{K_{jt}}\right)^2+(q_{jt}-q_{j,t-1})-q_{jt}\delta_j\,. \tag{21}$$

II.1.3 *Foreign debt at the national level*

Different from the static CGE model, foreign debt is endogenously determined in the model. The difference between capital investment and the total household and government savings is covered by the increase (or decrease) in foreign debt:

$$DEBT_t = DEBT_{t-1} + \left[\sum_j J_{jt} - \sum_r SAV_{rt} - s^g T_t (1 - tr^p)\right], \qquad (22)$$

In the case $\sum_j J_{jt} - \sum_r SAV_{rt} - s^g T_t (1 - tr^p) > 0$, the economy has to borrow from abroad for domestic investment. When $\sum_j J_{jt} - \sum_r SAV_{rt} - s^g T_t (1 - tr^p) < 0$, some part of savings is used for debt repayment.

II.1.4 *Capital stock owned and debt owed by each household group*

A. Capital stock owned by each household group

Because there are many groups of households in the economy, identification of capital stock owned and foreign debt owed by each group over time is one of important features of the multi-household dynamic CGE model. It is necessary to distinguish between the value of capital stock used in each sector and the net financial asset owned by each household group. In principle, at any point of time the sum of sectoral capital stock, which is also referred as national capital stock, should be equal to the total capital stock owned by all groups of households:

$$\sum_j K_{jt} = \sum_r H\_Kstock_{rt} \ , \qquad (23)$$

where H_Kstock_{rt} is the amount of capital stock owned by group *r* at time *t*. We assume

$$H\_Kstock_{r,t+1} = H\_Kstock_{r,t}(1-\delta) + \frac{SAV_{rt}}{\sum_r SAV_{rt}} \sum_j I_{jt} \ , \qquad (24)$$

where increase in the capital stock of each household group is proportional to the group's share in total savings. The depreciation rate is assumed to be the same for all households. We define d_{rt}^K, the share of stock owned by household group *r*, as

$$d_{rt}^K = \frac{H\_Kstock_{rt}}{\sum_r H\_Kstock_{rt}} . \qquad (25)$$

B. Foreign debt owed by each household group

The total national debt should be equal to the sum of foreign debt owed by each household group

$$DEBT_t = \sum_r H\_DEBT_{rt} . \qquad (26)$$

Borrowing for investment and trade deficits increase foreign debt in our model. We distribute the debt to household groups in proportion to their savings:

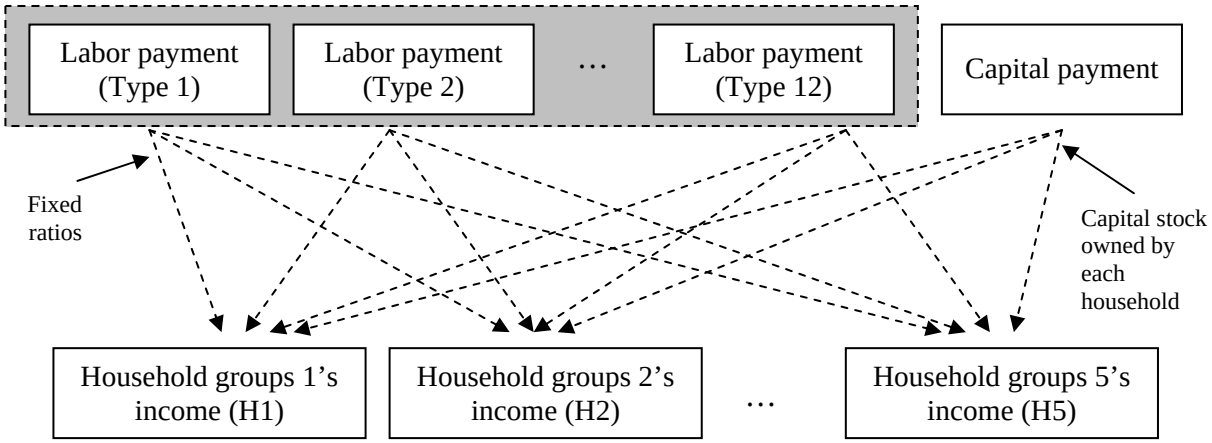
$$H\_DEBT_{rt} = H\_DEBT_{r,t-1} + \frac{SAV_{rt}}{\sum_r SAV_{rt}} \left[\sum_j J_{jt} - \sum_r SAV_{rt} - s^g T_t (1 - tr^p)\right] \qquad (27)$$

II.2 The Intra-Temporal (General) Equilibrium Block

The intra-temporal equilibrium block describes the relationship among economic entities within a period of time. The theoretical structure of the intra-temporal equilibrium block is very similar to those in the static CGE model described in Truong and Nguyen (2006).

An important difference between dynamic and static models is that capital income is paid based on the amount of capital stock owned by each household group. Therefore, not only change in a factor payment but also savings behavior will directly impact the relative incomes of each household group. The distribution mechanism from thirteen primary factors to five household groups is shown in Figure 1:

Figure 1: **Distribution of Factor Payments to Household Groups in the Dynamic Model**



II.3 The Steady State Equilibrium Block.

To arrive at a solution, both the inter-temporal and general equilibrium conditions have to be satisfied simultaneously. In addition, all quantities have to grow at the same rate in the steady state.

II.3.1 *Condition for general equilibrium*

At every point of time, the usual general equilibrium conditions require:

(i) Material balance in the demand and supply of all goods (in the good markets);

(ii) The demand for each category of labor equals its total supply (labor markets);

(iii) The balance in the inflow and outflow of foreign currency (exchange market).

II.3.2 *Steady state condition for sectoral capital stock*

On the steady state equilibrium path, where all prices are constant and all real economic variables grow at a constant rate, capital stocks must grow fast enough to sustain the population growth. This condition can be expressed as:

$$I_{jT} = (\delta_j + n) K_{jT} \ , \qquad (28)$$

where subscript *T* denotes the terminal period, or the period when the economy reach the steady state.

II.3.3 ***Steady state condition for capital stock owned by each household group***

In order to keep the capital stock owned by each household group growing at the same rate in the steady state, the following conditions must hold:

$$H\_Kstock_{r,T+1} = H\_Kstock_{rT}(1-\delta) + \frac{SAV_{rT}}{\sum_r SAV_{rT}} \sum_j I_{jT} \tag{29}$$

and

$$H\_Kstock_{r,T+1} = H\_Kstock_{rT}(1+n) \tag{30}$$

Substituting (30) into (29) yield:

$$H\_Kstock_{rT}(\delta+n) = \frac{SAV_{rT}}{\sum_r SAV_{rT}} \sum_j I_{jT} \ . \tag{31}$$

From Equation (25) we have

$$H\_Kstock_{rT} = d_{rT}^{K} \sum_r H\_Kstock_{rT} \ . \tag{32}$$

Substituting (32) into (31) and relating to (23) we have:

$$d_{rT}^{K}(\delta+n)\sum_j K_{jT} = \frac{SAV_{rT}}{\sum_r SAV_{rT}} \sum_j I_{jT} \ . \tag{33}$$

The condition (28) implies that $\sum_j I_{jT} = (\delta+n)\sum_j K_{jT}$. Therefore

$$d_{rT}^{K} = \frac{SAV_{rT}}{\sum_r SAV_{rT}} \ , \tag{34}$$

which states that in the long-run, the share of capital stock owned by each household group should be consistent with their share in savings.

II.3.4 ***Steady state condition for foreign debt***

The condition for debt in the steady state can be derived from Equation (4.24):

$$DEBT_T = DEBT_{T-1} + \left[\sum_j J_{jT} - \sum_r SAV_{rT} - s^g T_T (1-tr^p)\right], \tag{35}$$

where

$$DEBT_T = DEBT_{T-1}(1+n) \ . \tag{36}$$

Substituting (36) into (35) we have:

$$\begin{aligned} DEBT_T &= \frac{DEBT_T}{1+n} + \left[\sum_j J_{jT} - \sum_r SAV_{rT} - s^g T_T (1-tr^p)\right] \\ &= \left(\frac{1+n}{n}\right)\left\{\left[\sum_j J_{jT} - \sum_r SAV_{rT} - s^g T_T (1-tr^p)\right]\right\}. \end{aligned} \tag{37}$$

This guarantees that in the steady-state, total foreign debt and debt owed by each household group grow at the constant rate *n*.

II.3.5 ***Steady state condition for interest rate***

The following equation, which guarantees that at the steady state household income, savings and consumption level grow at the rate *n*

$$r_T = \rho \ .$$

Since the model can not be solved for an infinite number of periods, it is needed to specify the post-terminal conditions. The standard approach is to assume that the economy reaches a steady state in given, *T*, periods (Selim, 2004). Using the sensitivity test of Devarajan and Go (1998), we found and selected $T = 40$ for our model. The model's equations are listed in the appendix.

II. 4 The Data

II.4.1 The Social Accounting Matrix of Vietnam

An important task in the implementation of a CGE model is identifying and organizing data into a social accounting matrix (SAM). The SAM provides a closed form, economy-wide accounting of linkage between activities (and/or commodities), factors, households, domestic institutions and foreign institutions in a tabular format.

The first SAM of Vietnam was published by the United Nations in the mid-1990s. It was too much aggregated and relied on outdated 1989 10 sector I/O table. Various contributions to this area have made later including a study of Bautista (2000), a working paper by Nielsen (2002) and a thesis by Huong (2000). In 2001, under an institutional collaborative program co-organized by the Central Institute for Economic Management of Vietnam (CIEM) and the Nordic Institute of Asian Study (NIAS), the 1999 SAM of Vietnam was constructed. (CIEM/NIAS, 2001). This is an important step for studying and applying SAM multiplier analysis and CGE model in Vietnam.

The 1999 Vietnam SAM covers 97 activities (commodities), 13 factors of production (labor and capital with labor disaggregated distinguished by rural-urban, gender and three skill levels), and five household types (rural farmers, rural self-employed, non farm rural wage-earners, urban self-employed, and urban wage earners). Enterprises are also divided into three groups (state owned, non-state private and foreign invested companies). In addition, trade is disaggregated among 94 trading partners.

In 2002, with an effort to up-date and revise the 1999 SAM, CIEM/NIAS published a new, improved version of SAM for the year 2000. This SAM's structure is basically the same

as that of the 1999 SAM. The main difference is that it includes some latest economic data for the year 2000.

Many official and reliable data sources were used in constructing the 1999 and 2000 SAM, including the 1997-1998 nationally representative household survey (GSO, 2000), official information related to the UN System for National Account (SNA) for the year 1990-2000 period (GSO, 2001), COMTRADE database, and so on. Both the SAMs relied on the 1996, 97 sector Input-Output table, which is the most up-dated one at the moment these SAMs were constructed and revised.

The availability of the 2000 Input-output Table of Vietnam in 2003 has given us an opportunity to update the SAM for calibrating our CGE models. The 2000 I-O Table consists of 112 sectors with up-to-date data and reflects the current structure of the economy well (GSO, 2003).

For the purpose of this study, a new version of 2000 SAM was revised based on the latest aggregated 25 sector 2000 I-O Table combined with the aggregated 25 sector CIEM/NIAS's 2000 SAM and other sources of data.

II.4.2 Trade parameters

One of the most debated issues in the CGE literature concerns the validity of the key behavioral parameters used in the calibration process. In fact, CGE modelers seldom estimate these parameters empirically, preferring to borrow from the handful of estimates available in the literature. However, these estimates usually are of countries other than the one the CGE model is trying to represent. Estimating key parameters is very crucial since CGE results are sensitive to the value of parameters (Jean-Pascal, 2004).

Following Judge and Miller (1996) and Channing Arndt el al. (2002) and Jean-Pascal (2004), the study uses the robust econometric technique - the Generalized Maximum Entropy (GME) - to estimate CES and CET parameters of Vietnam. All the parameters estimated are used in the static and dynamic CGE models.

III. The Model Simulation and Results

III.1 The Analytical framework

Following are the main differences of the dynamic model from the static one:

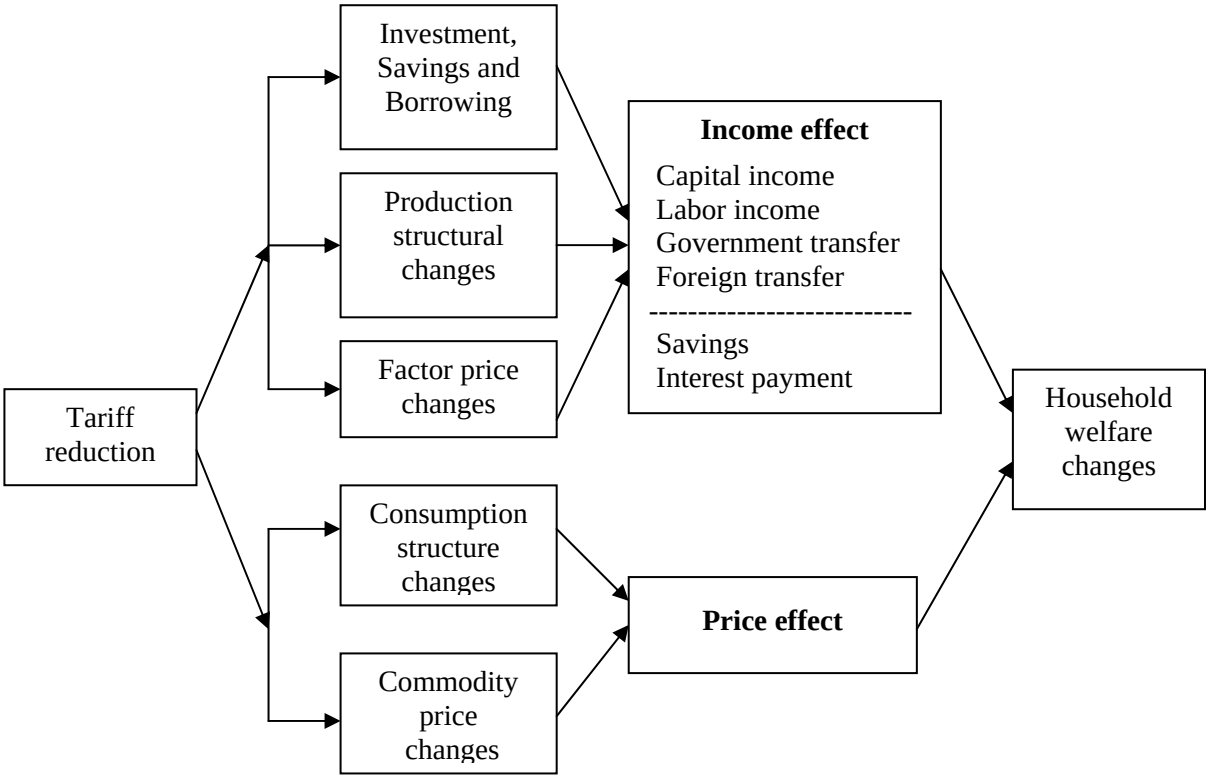
(1) The dynamic model takes into account the forward-looking behaviors of households and producers. It not only helps to identify changes between the new and initial steady state after an initial shock but also allows analyzing the transitional dynamics toward the new steady state. We can, therefore, simulate and investigate long-term effects of an economic policy.

(2) While the static model simplifies the relationship between savings and investment, assuming that investment equals the amount of savings, and household budget for consumption and savings are just fixed proportions of their total income, the dynamic model allows forward-looking households to choose the time path of consumption, savings, investment and debt that maximize the discounted sum of lifetime utility.

(3) Ownership is an important feature of the multi-household dynamic model, in which capital income is distributed to each household group based on their accumulation of capital stock. Foreign debt is also distributed to each household group, depending on their levels of borrowing and consumption.

The determinants of welfare change in the dynamic model are shown in Figure 2. Tariff reduction does not only affect the production structure and factor prices, but also lead to changes in investment, savings and debts.

Figure 2: **Determinants of Welfare in the Dynamic Model**



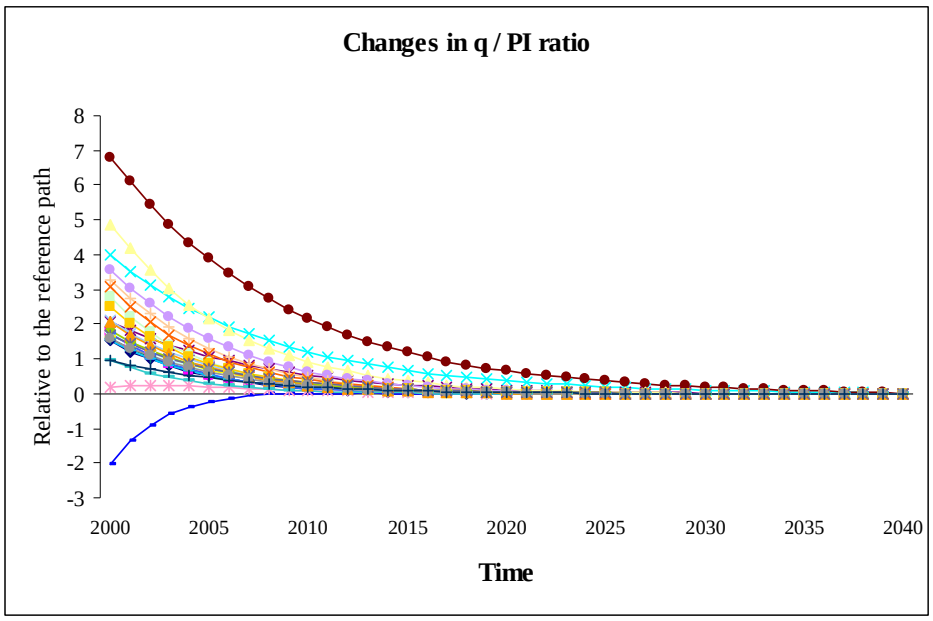
In the simulation, tariffs of more than 5 % are reduced to 5 %. All other parameters are kept unchanged. The model is solved using GAMS. Since the model can not be solved for an infinite number of periods, it is needed to specify the post-terminal conditions. The standard approach is to assume that the economy reaches a steady state in given, *T*, periods

(Selim, 2004). Using the sensitivity test of Devarajan and Go (1998), we found and selected $T = 40$ for our model.

III.2 The Effect on Investment, Savings, Capital Stock and Capital Income

Trade liberalization affects investment activity through the changes in in q/PI ratio. The simulation result indicates that for all the sectors except the cigarettes and tobacco products, the ratios increase after the liberalization (Figure 3).

Figure 3: **Changes in q / PI Ratio**



Source: *Author's calculations from the model simulation*

In the new steady state, although the q/PI ratios in all sectors return to the based year level, most of the sectors are still invested more than the investment made in the based year due to the increase in capital stock accumulated during the investment process. As a result, the whole country expects to be invested 8,263 billion VND more than that in the initial steady state in the long-run.

Changes in investment affect directly the accumulation of capital stock. At the national level, the total capital stock will increase by 73,686 billion VND, or approximately 7% in the long-run (Table 1). The increase in the national capital stock is an important source of income from capital. However, the simulation result shows that the capital income increase in the long-run is 5.3% and is less than the stock increase. This is because the rate of return on capital will decrease as a result of the investment price fall. Labor-intensive

sectors, such as fishery, mining and quarrying, processed seafood and by products, textile, garment, leather, trade, transport services, will invest more than the others.

In our model, forward-looking households determine optimal level of savings and borrowing so as to maximize the discounted sum of lifetime utility. Urban self-employed, rural farmer and rural self-employed households are predicted to own more stock and earn more income in the long-run, while wage-earner households in both rural and urban areas will own less and earn less.

In the long-run, households that have larger capital stock can earn more, but have to save or borrow more to keep their stock. Urban self-employed households, who obtain the largest improvement in capital income, will also increase the savings most in the long-run, while both urban and rural wage-earner reduce their savings. In addition, the urban self-employed and rural farmers have to incur more foreign debt than the rural and urban wage-earner households.

Table 1: **Change of Capital Stock, Capital Income and Savings by Households**

Unit: Billion VN dong

No	Household	Capital stock		Capital income		Savings	
		Change	%	Change	%	Change	%
1	Rural Farmers	34,068	7.16	3,446	5.45	2,114	5.67
2	Rural Self-employed	8,131	6.04	778	4.36	482	4.57
3	Rural Wage-earners	-225	-0.52	-120	-2.11	-64	-1.91
4	Urban Self-employed	31,605	10.05	3,465	8.30	2,009	8.52
5	Urban Wage-earners	107	0.13	-163	-1.46	-83	-1.26
	Total	**73,686**	**7.00**	**7,405**	**5.30**	**4,547**	**5.52**

Source: *Author's calculations from the model simulation*

The simulation result also shows that investment rate will rise faster than savings rate. This creates a large gap between savings and investment. It is predicted that there is a boom in foreign investment to make up the savings shortage.

III.3 The Effect on Industrial Structure, Wage Rate and Labor Income

III.3.1 *The Effect on Industrial Structure*

Many labor-intensive sectors are expected to increase their outputs significantly after trade liberalization. Other sectors also have opportunities to expand their output and export volumes. The comparison of sectoral output, import and export between the initial and the new steady state is presented in Table 2.

From the simulation results, we predict that the output of the processed seafood and by products sector increases most, the rate of which increase is about 39 % in the long run.

Table 2: **The Effect of Tariff Reduction on Output, Import, Export**

No	Sector	Output			Import			Export		
		Share	Change	%	Share	Change	%	Share	Change	%
1	Crops cultivation	10.88	839.87	0.81	1.07	73.37	2.52	7.35	6.81	0.04
2	Livestock and poultry	2.70	287.78	1.12	0.01	0.24	0.65	0.33	12.38	1.53
3	Forestry	0.81	90.66	1.18	0.41	45.42	4.05	0.25	-6.68	-1.10
4	Fishery	2.75	4,374.31	16.75	0.03	35.52	40.74	1.95	754.28	16.03
5	Mining and quarrying	6.26	4,010.63	6.75	0.90	-106.84	-4.40	21.12	3,756.42	7.36
6	Processed seafood and by products	2.16	8,000.90	38.99	0.21	202.57	36.30	6.95	6,984.32	41.57
7	Alcohol, beer, water and soft drinks	1.27	9.10	0.08	0.20	201.84	38.08	0.08	0.76	0.39
8	Cigarettes and tobacco products	0.89	-538.85	-6.41	0.74	1,874.64	93.82	0.07	9.76	6.20
9	Other food manufactures	9.51	683.28	0.76	2.53	678.58	9.89	6.62	107.99	0.67
10	Chemical manufacturing	1.03	176.85	1.81	7.86	219.74	1.03	0.35	19.05	2.22
11	Non-metallic mineral, ferrous metals	2.01	827.69	4.34	7.43	524.66	2.61	0.95	132.99	5.79
12	Machinery and equipment	2.07	3,107.96	15.84	17.88	2,221.44	4.58	6.69	2,674.06	16.54
13	Rubber and plastic products	1.32	415.27	3.33	4.80	374.55	2.88	0.37	33.66	3.76
14	Vehicles	2.35	-547.28	-2.46	8.48	2,623.87	11.42	0.53	66.36	5.20
15	Textile, garment	4.75	4,562.34	10.13	9.96	1,526.87	5.66	11.20	3,110.64	11.48
16	Leather	3.32	2,215.48	7.05	2.80	265.46	3.50	7.70	1,427.51	7.67
17	Wood and wood products	1.09	192.97	1.86	0.44	13.51	1.12	1.99	101.52	2.11
18	Other manufacturing products	15.60	-1,337.61	-0.90	24.82	10,679.24	15.88	4.40	199.26	1.87
19	Electricity , Gas and Water supply	2.05	618.36	3.18	0.20	11.43	2.10	0.00	0.00	0.00
20	Trade	8.90	3,429.47	4.06	0.03	1.88	2.47	6.63	1,024.03	6.39
21	Hotels, restaurants and tourism	2.80	745.65	2.81	1.70	-5.60	-0.12	5.66	493.62	3.60
22	Transport services	1.91	1,176.61	6.51	1.71	16.55	0.36	3.68	762.45	8.57
23	Communication services	1.16	382.79	3.49	0.12	8.47	2.66	0.96	91.36	3.95
24	Financial services	1.26	166.08	1.39	2.59	189.18	2.70	2.06	43.61	0.87
25	Public services and other services	11.15	-964.15	-0.91	3.09	63.51	0.76	2.13	-109.80	-2.13
	Total		**32,926.16**	**3.47**		**21,740.08**	**8.02**		**21,696.36**	**8.97**

Source: *Author's calculations from the model simulation*

Fishery sector will also expand significantly, at the rate of 16.75 %. Because fishery provides the main inputs for the processed seafood and by products sector, the increase in production of the latter will strongly affect the demand for the products of the former. Mining and quarrying, machinery and equipment, textile, garments, leather, trade and transport services are also sectors that will enjoy a high increase in their outputs. Cigarettes and tobacco products, vehicles, other manufacturing products, public services and other services sectors face the risk of contraction.

In accordance with the decrease in the outputs, significant increases in import volumes of other manufacturing products, vehicles, cigarettes and tobacco products sectors are predicted. Imports of textile, garments, machinery and equipment sectors, which are predicted to expand, will also increase significantly. This is because of material imports for processing these products. As a result, for both substitution and complementation purposes, imports of manufacturing will increase (by 8.95%), much higher than that in agriculture and service, (0.72% and 1.10% respectively). Besides, resources are expected to be relocated into labor-intensive manufacturing sectors and these sectors expand their export significantly.

III.3.2 *The Effect on Wage Rate and Labor Income*

The demand for all categories of labor is expected to increase and result in wage rate rise. Due to the significant expansion of fishery, mining and quarrying sectors, the wage rate of rural male unskilled laborers rises at the highest rate, approximately 6 % in the long-run (Table 3). Wage rates of other rural laborers increase at the smaller rates than the urban ones. The wage rate of urban female medium-skilled laborers is expected to increase by as large as 5.87% in the long-run, due to the remarkable expansion of female labor-intensive sectors, such as processed seafood and by products, textile, garment, leather and trade.

Table 3**: The Effects on Wage Rate**

Unit: percent

Labor	**Male**		**Female**	
	Rural	Urban	Rural	Urban
Unskilled	5.92	4.82	4.66	4.67
Medium-skilled	4.55	5.20	4.13	5.87
High-skilled	4.16	5.39	4.59	5.42

Source: *Author's calculations from the model simulation*

III.3.3 *The Effect on Labor Income by Households*

The above mentioned changes in wage rates directly affect the income of each category of labor and thus impact the labor income of households. The long-term effect is presented in Table 4.

Table 4**: The Long-term Effects on Labor Income by Household Groups**

Unit: Billion VN dong

No	Household	Labor income	
		Change	**%**
1	Rural Farmers	4,567	5.25
2	Rural Self-employed	1,588	5.40
3	Rural Wage-earners	959	5.07
4	Urban Self-employed	1,897	4.93
5	Urban Wage-earners	1,964	5.03
	Total	**10,975**	

Source: *Author's calculations from the model simulation*

III.4 The Effect on Household Budget for Consumption

The impacts of trade liberalization on sources and allocations of income of each household group are described in Table 5. In this table, the change in budget for consumption is calculated by subtracting the changes in savings and interests from that in the total income. At the national level, the total budget for consumption increases by 5,809 billion VND or 1.96%, in comparison with that in the based year. Budgets for consumption of all the household groups are improved, as indicated in Table 5.

Table 5: **The Effect of Trade Liberalization on Source and Allocation of Income**

Unit: Billion VN dong

	Change \ Household	Rural Farmers	Rural Self-employed	Rural Wage-earners	Urban Self-employed	Urban Wage-earners	Whole country
Source of income	1. Capital income	3,446	778	-120	3,465	-163	**7,405**
	2. Labor income	4,567	1,588	959	1,897	1,964	**10,975**
	3. Government transfer	-1,006	-168	-60	-547	-138	**-1,919**
	4. Foreign transfer	211	12	25	36	102	**386**
	5. Total change	**7,219**	**2,210**	**804**	**4,850**	**1,765**	**16,847**
Allocation of income	6. Savings	2,114	482	-64	2,099	-83	**4,547**
	7. Interest	2,965	789	157	2,261	321	**6,491**
	8. Sub Total	5,078	1,270	93	4,360	238	**11,039**
	9 .Budget for consumption	**2,140**	**939**	**712**	**490**	**1,527**	**5,809**
	10. Percentage of change	**1.65**	**2.63**	**3.15**	**0.86**	**3.02**	**1.96**

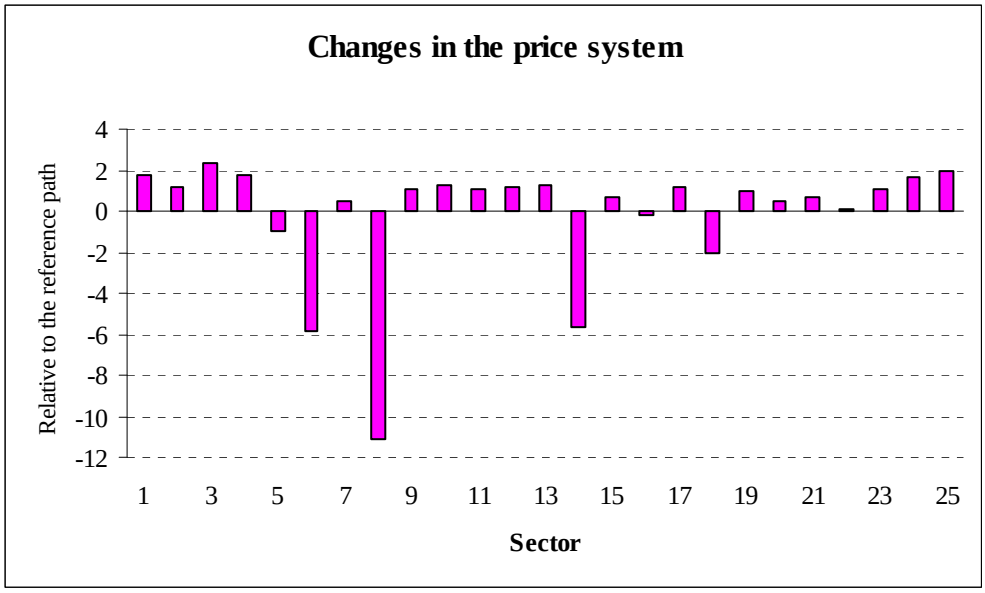
Source: *Author's calculations from the model simulation*
(5) = (1) + (2) + (3) + (4)
(8) = (6) + (7)
(9) = (5) – (8)

However, difference in the degree of improvement is clearly observed. Although receiving the highest amount of capital income, urban self-employed and rural farmer households have to pay a large amount of interest for foreign debt, resulting in smaller increase in the budget. There is a tendency that household groups with large labor income shares will have a higher improvement in their budget. This is due to the fact that in the long-run, wage rates will increase remarkably, while the rate of return on capital declines by 1.6%.

III. 5 The Effect on Commodity Prices and Household Consumption

Figure 4 and Table 6 predict that relative prices change remarkably. The prices of cigarettes and tobacco products, processed seafood and by products, vehicles and other manufacturing products will relatively fall. Other goods and services, in particular forestry products, public services and other services, crops cultivation, other food manufactures, become relatively expensive. A change in the exchange rate increases the export prices by 1.39%. It also pushes the import prices of currently less protected sectors.

Figure 4: **Changes in the Relative Price System at the New Steady State**



Source: *Author's calculations from the model simulation*

Table 6: **The Effect of Tariff Reduction on Relative Prices**

No	Sector	PD[a]	PM[b]	P[c]	PE[d]	P*[e]
1	Crops cultivation	1.82	0.77	1.78	1.39	1.74
2	Livestock and poultry	1.17	1.39	1.17	1.39	1.17
3	Forestry	2.52	1.39	2.37	1.39	2.44
4	Fishery	1.76	-7.32	1.72	1.39	1.69
5	Mining and quarrying	-1.60	1.39	-0.94	1.39	0.97
6	Processed seafood and by products	-5.38	-8.72	-5.83	1.39	0.21
7	Alcohol, beer, water and soft drinks	1.22	-12.78	0.52	1.39	1.22

8	Cigarettes and tobacco products	-4.51	-29.99	-11.10	1.39	-4.39
9	Other food manufactures	1.44	-2.75	1.07	1.39	1.43
10	Chemical manufacturing	1.05	1.39	1.29	1.39	1.08
11	Non-metallic mineral, ferrous metals	0.62	1.39	1.04	1.39	0.71
12	Machinery and equipment	-1.10	1.39	1.21	1.39	0.95
13	Rubber and plastic products	1.15	1.39	1.28	1.39	1.17
14	Vehicles	-2.10	-8.77	-5.70	1.39	-1.90
15	Textile, garment	-0.40	1.39	0.67	1.39	0.68
16	Leather	-1.18	1.39	-0.23	1.39	0.34
17	Wood and wood products	1.15	1.39	1.19	1.39	1.26
18	Other manufacturing products	0.11	-6.21	-2.08	1.39	0.20
19	Electricity , Gas and Water supply	0.97	1.39	0.98	1.39	0.97
20	Trade	0.48	1.39	0.49	1.39	0.66
21	Hotels, restaurants and tourism	0.38	1.39	0.65	1.39	0.90
22	Transport services	-0.52	1.39	0.11	1.39	0.42
23	Communication services	1.05	1.39	1.06	1.39	1.12
24	Financial services	1.85	1.39	1.62	1.39	1.66
25	Public services and other services	2.05	1.39	2.00	1.39	2.02

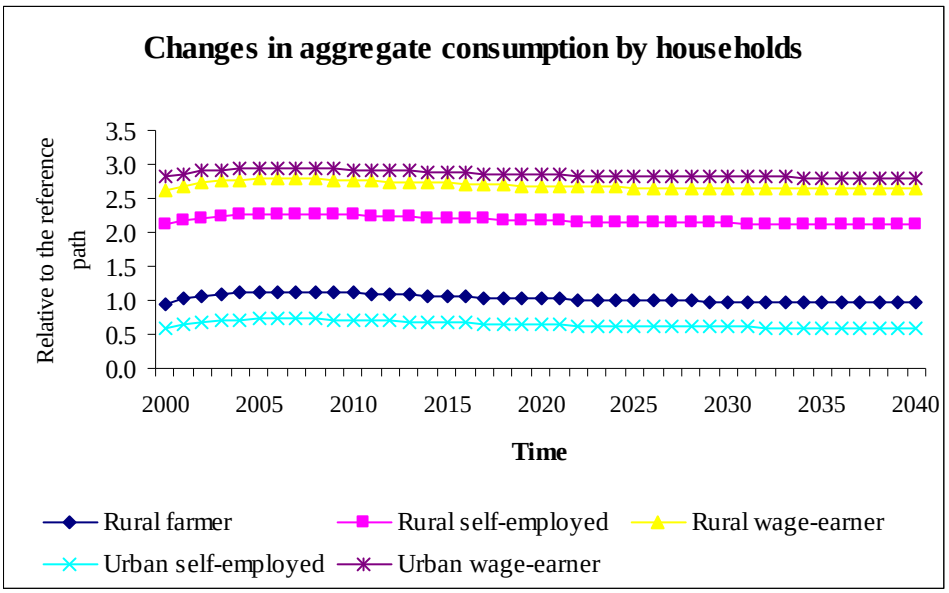
Source: *Author's calculations from the model simulation*
[a] Domestic prices; [b] import prices; [c] composite prices faced by consumers; [d] export prices; [e] aggregate prices faced by producers

Increases in the relative prices of forestry, public services, crops cultivation and other food manufactures will hurt households, in particular the rural ones. Urban households tend to suffer less than rural counterparts.

III. 6 The Effect of Trade Liberalization on Household Welfare

Changes in consumption budget and relative prices that we saw in the previous section are the factors determining a household's consumption. Because the changes in the relative prices hurt rural households more than urban ones, rural households' consumption

Figure 5: **Changes in aggregate consumption by household groups**



tends to be negatively affected more. Our simulation shows that, although rural wage-earner's budget increases more than the urban wage-earner, the improvement of aggregate consumption of the former lags behind that of the latter (Figure 5).

We use the discounted Hicksian Equivalent Variations (EV) to measure the long-run changes of each group's welfare. It is defined as

$$EV_r = \sum_{t=1}^{T} \mu(t) \frac{U_{tr} - U_{0r}}{U_{0r}} Y_{0r} + \sum_{t=T+1}^{\infty} \mu(t) \frac{U_{tr} - U_{0r}}{U_{0r}} Y_{0r}$$

$$= \sum_{t=1}^{T} \mu(t) \frac{U_{tr} - U_{0r}}{U_{0r}} Y_{0r} + \mu(T) \left(\frac{1}{r_T} \right) \frac{U_{Tr} - U_{0r}}{U_{0r}} Y_{0r}$$

where the subscript *r* stands for a particular category of household, U_{0r} and Y_{0r} are utility and income at the initial based year, U_{tr} is utility at period *t*, r_T is interest rate at the steady state.

Table 7 and Figure 6 show that, all household groups can enjoy an improvement in their welfare in the long-run. This is because the increase in the budget is large enough to outweigh the negative effect of price changes. It is seen, however, the income gap among rural household groups will be larger, which is consistent with the result obtained from the static model.

Table 7: **The Effect of Tariff Reduction on Household Welfare**

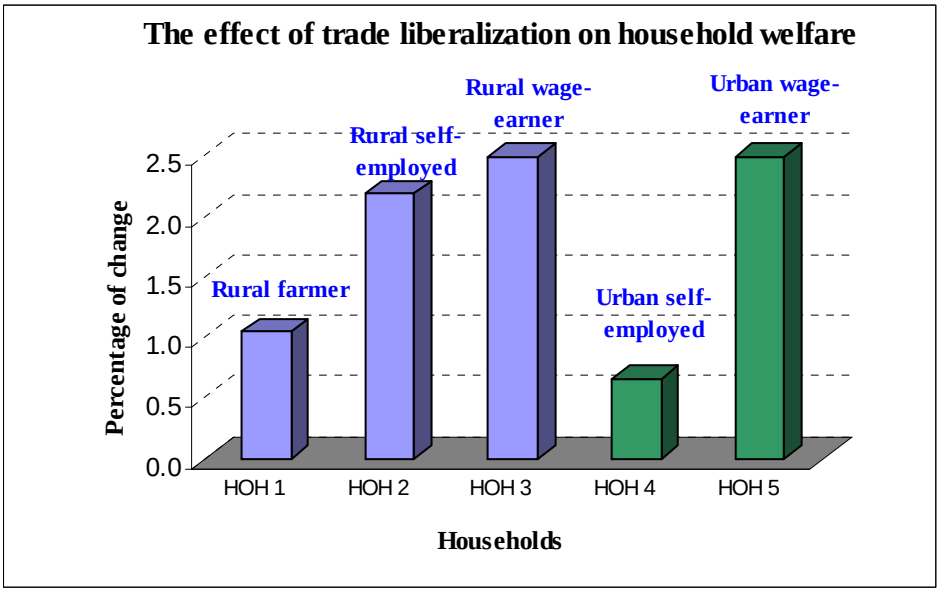
Unit: Billion VN dong

No	Household	Population share[a]	Welfare change	%
1	Rural Farmers	65.82	22,664	1.05
2	Rural Self-employed	6.44	13,049	2.20
3	Rural Wage-earners	5.31	10,177	2.71
4	Urban Self-employed	12.17	6,272	0.66
5	Urban Wage-earners	10.26	24,158	2.88
	Total		**76,321**	

Source: *Author's calculations from the model simulation*

According to the result, while the urban wage-earners gain most, the urban self-employed households receive just the lowest rate of improvement in their welfare (2.88% vs. 0.66%). It is thus predicted that the income gap between the urban households becomes wider. This is because households that rely more on capital income will face more disadvantages due to the decrease in the rate of return on capital. Our evidence supports the conclusions of Chan (2002) and Jensen (2003), who state that the liberalization seems to increase the inequality among urban people.

Figure 6: **Long-term Effect of Trade Liberalization on Welfare of Households**



Source: *Author's calculations from the model simulation*

Static model's prediction, which points out that income gap expands between rural and urban areas, is supported. This is because rural farmers, the majority in rural areas, just receive the relatively low level of improvement in their welfare.

III. 7 The Effect on Household Welfare with Different Tax Policies

To isolate the effect of tariff reduction on household welfare, all the parameters other than tariff rates were kept unchanged in the previous analyses. The reduction of tariffs, however, significantly affects the government revenue. Our dynamic model predicts that tariff reduction brings about a 7.43% government revenue decline initially, but the rate reduces to 4.92% in the long-run when the adjustment process is completed. Government transfer to household will also decrease accordingly. Therefore, it is more natural to assume that the government will somehow make up the revenue loss. The government can raise direct or indirect tax rates, borrow from abroad, and create money for example (Huong, 2003).

In this section, we examine and compare the following scenarios:

Scenario 1: Only the reduction of nominal tariff rates (down to 5%). In this experiment, no adjustments are made in domestic indirect or direct tax rates to bridge the deficit. This is the basic scenario whose result is presented and analyzed in the previous sections.

Scenario 2: The reduction of nominal tariff rates along with adjustments of direct tax rates on capital to maintain the government revenue unchanged.

Scenario 3: The reduction of nominal tariff rates along with adjustments of direct tax rates on labor to maintain the government revenue unchanged.

Scenario 4: The reduction of nominal tariff rates along with adjustments of indirect tax rates to maintain the government revenue unchanged.

Table 8 compares macroeconomic impacts. In general, Scenarios 1-3 seem to be better in terms of the growth of GDP, output, import, export, investment and capital stock. They, however, will increase foreign debt larger than Scenario 4.

Table 8: **Macroeconomic Impacts of Trade Liberalization with Different Tax Policies**

(Percentage changes compared to the base)

Figures	**Scenario 1** (No adjustment on other taxes)	**Scenario 2** (Increase direct tax on capital)	**Scenario 3** (Increase direct tax on labor)	**Scenario 4** (Increase indirect tax)
GDP	3.15	3.12	3.11	1.44
Output	3.47	3.23	3.34	0.76
Imports	8.02	7.68	7.78	5.11
Exports	8.97	8.60	8.73	5.34
Government budget	-4.92	0.00	0.00	0.00
- Tariff	-42.60	-42.79	-42.73	-44.28
- Indirect taxes	2.69	2.39	2.46	13.79
- Direct tax on capital	5.30	32.85	5.28	2.01
- Direct tax on labor	5.40	5.21	305.74	1.92
Savings	4.21	3.18	3.03	0.56
Investment	7.00	7.04	6.99	3.71
Capital stock	7.00	7.04	6.99	3.71
Foreign debt	15.69	15.29	15.69	8.68

Source: *Author's calculations from the model simulation*

Surprisingly, in the first three scenarios, although almost the same movement of the macroeconomic variables can be observed, changes in welfare show different across the household groups (Table 9 and Figure 7).

Table 9: **Changes in Welfare by Scenarios**

(Percentage change compared to base)

Household group	**Scenario 1** (No adjustment on other taxes)		**Scenario 2** (Increase direct tax on capital)		**Scenario 3** (Increase direct tax on labor)		**Scenario 4** (Increase indirect tax)	
	Change	%	Change	%	Change	%	Change	%
Rural farmer	22,664	1.05	810	0.04	50,246	2.33	2,983	0.14
Rural self-employed	13,049	2.20	5,311	0.89	19,510	3.29	1,985	0.33
Rural wage-earner	10,177	2.71	8,105	2.16	12,402	3.31	1,291	0.34
Urban self-employed	6,272	0.66	-11,993	-1.26	629	0.07	2,507	0.26
Urban wage-earner	24,158	2.88	19,041	2.27	-46,403	-5.53	7,367	0.87
Total	**76,321**		**21,274**		**36,384**		**16,133**	

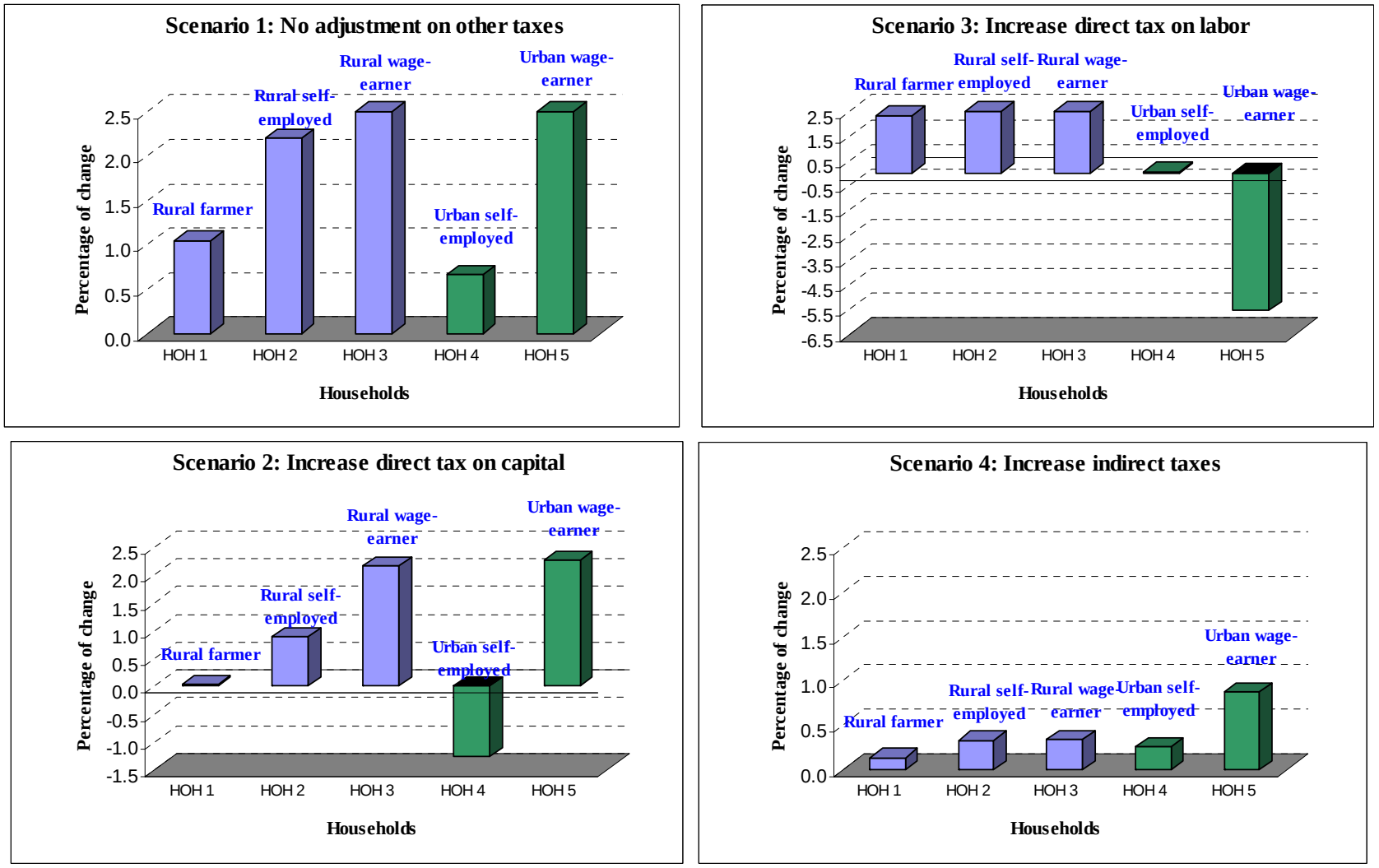
Source: *Author's calculations from the model simulation*

In the first scenario, where adjustment on other taxes are not allowed, most of macroeconomic figures are improved significantly, all household groups are better-off, the national welfare increases most (76,321 billion VND), wage-earners (in both rural and urban areas) and rural-self employed households gain more than the rural farmers and urban self-employed households, income gap between rural and urban areas as well as among households in rural and urban areas become wider, the government deficit increases by 4.92% in the long-run, and foreign debt also rises significantly. An implicit assumption was that the government can cut its expenditures flexibly. If they raise money, it seems that the result will be different.

When the increase in direct tax on capital is selected (Scenario 2), however, the outcome is different. Although all macroeconomic figures improves similarly, national welfare increases just slightly (21,274 billion VND), rural farmers' welfare almost remains the same, and urban self-employed households are worse-off while the others are better-off, wage-earner households (in both rural and urban areas) gain the most, income gaps between households are expanded more seriously than in the first scenario, and foreign debt also increases significantly.

The government can choose to raise the direct tax rate on labor instead (Scenario 3). If this happens, all macroeconomic figures are improved similarly, national welfare improvement will relatively large (36,384 billion VND), and all the rural households gain at high level while urban wage-earner households lose (because the current direct labor tax system aims at high skilled laborers who are working in urban area), income gap between urban and rural can be narrowed, and foreign debt increases significantly.

Figure 6.33: **The Effect of Trade Liberalization with Different Tax Policies on Household Welfare**



If indirect taxation is selected, prices will be distorted and gains from tariff reduction will be smaller. The total welfare just increases by 16,133 billion VND, relative changes in welfare among household groups are very similar to the first scenario, and foreign debt increases at the lower level than in the three above scenarios.

IV. CONCLUSION

Using the dynamic Computable General Equilibrium framework, this study tries to explore the link between trade liberalization and income distribution among Vietnamese household groups in the long-run. We found that under trade liberalization, the welfare of all groups will be positively affected by labor factor price changes and will be negatively affected by changes in the relative price of consumption goods. In the long-run, all household groups can enjoy an improvement in their welfare because the increase in the budget for consumption of all groups is large enough to outweigh the negative effect of changes in the prices. The simulation results also demonstrate both promise and danger of trade liberalization. It shows that the trade liberalization will enhance the economic growth and national welfare. However, at the same time, it may widen the income gap between rural and urban areas, among rural people as well as among urban people.

Efforts have also been paid to the investigation of the structural changes in the long-run in output, import and export. The study points out that the trade liberalization has differential impacts on different sectors in the economy. In general, many labor-intensive sectors growth rapidly at the expense of some capital-intensive manufacturing sectors. The model predicts that the tariff reduction leads to an investment boom and rapid expansion in foreign debt. This is because a fall in the investment price index positively affects the total investment. This is also the reason of the increase in the borrowing from abroad.

This study also examines and compares the impacts of tariff reduction in association with government tax policy alternatives for satisfying a fixed government revenue target. As is expected, the effects of trade liberalization on the welfare of each household group depend strongly on the government polices dealing with deficit caused by tariff reduction. Replacement of tariff by the direct taxes seems to be more desirable than replacement with the indirect taxes, though it will cause a considerable increase of foreign debt, and the highest improvement of the total national welfare will be obtained if

the government can cut expenditure or find some sources of finance without increasing other taxes.

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Appendix : THE SYSTEM OF EQUATIONS OF THE DYNAMIC CGE MODEL

A. INTERTEMPORAL EQUILIBRIUM BLOCK

A.1 Consumption and interest rate

(for each of *r* household categories, subscript *r* is skipped)

$$\frac{Y_{t+1} - SAV_{t+1} - i^* \cdot H\_DEBT_{t+1}}{Y_t - SAV_t - i^* \cdot H\_DEBT_t} = \left(\frac{1+r_{t+1}}{1+\rho}\right)(1+n)$$

$$r_t = (1+i^*)\frac{ER_{t+1}}{ER_t} - 1$$

A.2 Investment (for each of *n* sectors, subscript *j* is skipped)

$$I_t = \frac{K_t}{2}\left(\frac{q_t}{PI_t} - 1\right)$$

$$r_t q_{t-1} = wk_t + PI_t\left(\frac{I_t}{K_t}\right)^2 + (q_t - q_{t-1}) - \delta q_t$$

$$K_{t+1} - K_t = I_t - \delta K_t$$

$$J_t = I_t PI_t\left(1 + \frac{I_t}{K_t}\right)$$

A.3 Foreign debt

$$DEBT_t = DEBT_{t-1} + \left[\sum_j J_{jt} - \sum_r SAV_{rt} - s^g T_t(1-tr^p)\right]$$

$$H\_DEBT_{rt} = H\_DEBT_{r,t-1} + \frac{SAV_{rt}}{\sum_r SAV_{rt}}\left[\sum_j J_{jt} - \sum_r SAV_{rt} - s^g T_t(1-tr^p)\right]$$

A4. Ownership

$$H\_Kstock_{r,t+1} = H\_Kstock_{r,t}(1-\delta) + \frac{SAV_{rt}}{\sum_r SAV_{rt}} \sum_j I_{jt}$$

$$d_{rt}^{K} = \frac{H\_Kstock_{rt}}{\sum_r H\_Kstock_{rt}}$$

A.5 Growth of exogenous variables:

$$\overline{L}_{l,t+1} = \overline{L}_{l,t}(1+n)$$
$$\overline{F}_{g,t+1} = \overline{F}_{g,t}(1+n)$$
$$\overline{F}_{pr,t+1} = \overline{F}_{pr,t}(1+n)$$

B. GENERAL EQUILIBRIUM BLOCK

(Within period equations, time subscript *t* is skipped)

B.1 Production

$$L_{lj} = \left(\frac{PV_j}{W_l}\right)\beta_{lj} V_j \qquad (j=1,2,\ldots,n;\ l=1,2\ldots,k)$$

$$V_j = \overline{A}_j \prod_t L_{lj}^{\beta_{lj}} K_j^{\beta_{Kj}} \qquad (j=1,2,\ldots,n)$$

$$X_j = \frac{V_j}{v_j} \qquad (j=1,2,\ldots,n)$$

$$X_{ij} = a_{ij} X_j \qquad (i=1,2,\ldots,n;\ j=1,2,\ldots,n)$$

$$\pi_j = P_j^* X_j (1-t_j^i) - \sum_i P_i X_{ij} - \sum_l W_l L_{lj} \qquad (j=1,2,\ldots,n)$$

$$wk_j = \frac{\pi_j}{K_j} \qquad (j=1,2,\ldots,n)$$

B.2 Government Revenue and Household Income

$$T = \sum_l W_l \overline{L}_l t_{Ll}^d + \left(\sum_j \pi_j\right) t_K^d + \sum_j X_j P_j^* t_j^i + \sum_j M_j ER \cdot PW_j^m t_j^m +$$
$$\sum_j E_j ER \cdot PW_j^e t_j^e + ER \cdot \overline{F}_g$$

$$Y_r = \sum_l \overline{L}_l W_l (1-t_{Ll}{}^d) d_{rl}{}^L + (\sum_j \pi_j)(1-t_K{}^d) d_r^K + T \cdot tr^p d_r{}^T + ER \cdot \overline{F}_{pr}$$

B.3 Demand

$$C_{jr} = \frac{\alpha_{jr}\left(Y_r - i^* \cdot H\_DEBT_r - SAV_r\right)}{P_j} \qquad (j=1,2,\ldots,n;\ r=1,2,\ldots,h)$$

$$Inv_j = \frac{h_j \sum_j J_j}{PI} \qquad (j=1,2,\ldots,n)$$

$$G_j = \frac{k_j T (1-tr^p)(1-s^g)}{PG} \qquad (j=1,2,\ldots,n)$$

$$Q_j = \sum_i X_{ji} + \sum_r C_{jr} + G_j + Inv_j \qquad (j=1,2,\ldots,n)$$

$$D_j = \overline{B}_j^{\sigma_j - 1} \omega_j^{\sigma_j} \left(\frac{PD_j}{P_j}\right)^{-\sigma_j} Q_j \qquad (j=1,2,\ldots,n)$$

$$M_j = \overline{B}_j^{\sigma_j - 1} (1-\omega_j)^{\sigma_j} \left(\frac{PM_j}{P_j}\right)^{-\sigma_j} Q_j \qquad (j=1,2,\ldots,n)$$

$$E_j = \overline{N}_j^{-1-\phi_j}(1-\gamma_j)^{-\phi_j}\left(\frac{PE_j}{P_j^*}\right)^{\phi_j} X_j \qquad (j=1,2,\ldots,n)$$

B.4 Domestic supply

$$S_j = \overline{N}_j^{-1-\phi_j}\gamma_j^{-\phi_j}\left(\frac{PD_j}{P_j^*}\right)^{\phi_j} X_j \qquad (j=1,2,\ldots,n)$$

B.5 Market equilibrium block

$$\sum_l L_{lj} - \overline{L}_l = 0 \qquad (l=1,2,\ldots,k)$$

$$D_j - S_j = 0 \qquad (j=1,2,\ldots,n\text{-}1)$$

$$\left(\sum_j P\overline{W}_j^m M_j + \frac{i^*}{ER}\sum_r H\_DEBT_r\right) -$$

$$\left\{\sum_j P\overline{W}_j^e E_j + \frac{1}{ER}\left[\sum_j J_j - \sum_r SAV_r - s^g T(1-tr^p)\right] + \sum_r \overline{F}_{pr} + \overline{F}_g\right\} = 0$$

B.6 Price

$$PM_j = ER \cdot P\overline{W}_j^m(1+t_j^m) \qquad (j=1,2,\ldots,n)$$

$$PE_j = ER \cdot P\overline{W}_j^e(1-t_j^e) \qquad (j=1,2,\ldots,n)$$

$$P_j = \overline{B}_j^{-1}\left\{\omega_j^{\sigma_j} PD_j^{1-\sigma_j} + (1-\omega_j)^{\sigma_j} PM_j^{1-\sigma_j}\right\}^{\frac{1}{1-\sigma_j}} \qquad (j=1,2,\ldots,n)$$

$$P_j^* = \overline{N}_j^{-1}\left[\gamma_j^{-\phi_j} PD_j^{\phi_j+1} + (1-\gamma_j)^{-\phi_j} PE_j^{\phi_j+1}\right]^{\frac{1}{\phi_j+1}} \qquad (j=1,2,\ldots,n)$$

$$\sum_j P_j \frac{Q_j}{\sum_j Q_j} = 1$$

$$PV_j = \frac{P_j^*(1-t_j^i) - \sum_i P_i a_{ij}}{v_j} \qquad (j=1,2,\ldots,n)$$

$$PI = \sum_j h_j P_j$$

$$PG = \sum_j k_j P_j$$

C. STEADY-STATE EQUILIBRIUM BLOCK

$$I_{jT} = (\delta_j + n)K_{jT}$$

$$d_{rT}^K = \frac{SAV_{rT}}{\sum_r SAV_{rT}}$$

$$DEBT_T = \left(\frac{1+n}{n}\right)\left\{\left[\sum_j J_{jT} - \sum_r SAV_{rT} - s^g T_T(1-tr^p)\right]\right\}$$

$$r_T = \rho$$

A3. LIST OF PARAMETERS AND VARIABLES USED IN THE CGE MODELS

Table A1: **List of Parameters**

δ_j	Depreciation rate
ρ	Rate of time preference
n	Population growth
σ_j	Elasticity of substitution
ω_j	CES share parameter for domestic good consumed
$\overline{B}_j$	CES efficiency parameter
ϕ_j	Elasticity of transformation
γ_j	CET share parameter for domestic good supplied
$\overline{N}_j$	CET efficiency parameter
β_{lj}	Labor elasticity of production
β_{Kj}	Capital elasticity of production
$\overline{A}_j$	Production function efficiency parameter
a_{ij}	Input coefficient
v_j	Value added coefficient
α_{jr}	Household's budget share for consumption
η_{jr}	Minimum level of consumption
s^g	Government saving rate
h_j	Share of investment expenditure
k_j	Share of government consumption expenditure
$t_L^{\,d}$	Direct tax rates on labor
$t_K^{\,d}$	Direct tax rates on capital
$t_j^{\,m}$	Import tax rates
$t_j^{\,e}$	Export tax rates
Tr^p	Government transfer rate to household
d_{rt}^L	Distribution rate of labor
d_{rt}^T	Distribution rate of government transfer

Table A2: **List of Endogenous Variables**

r_t	Domestic interest rate at time *t*
SAV	Household saving
$DEBT$	Foreign debt
H_DEBT_r	Debt incurred by household group
H_Kstock_r	Capital stock owned by household group
d_{rt}^K	Distribution rate of capital
I_j	New investment
J_j	Investment expenditure
wk_j	Rate of return on capital
q_j	Shadow price on capital
X_j	Output of sector *j*
X_{ij}	Intermediate input
L_j	Labor input
K_j	Capital stock
V_j	Value added
π_j	Profit of sector *j*
Y_r	Household income
T	Government revenue
C_j	Household consumption
G_j	Government consumption
Inv_j	Demand of good *j* for investment
Q_j	Total domestic demand
D_j	Demand for domestic goods
M_j	Import
E_j	Export
S_j	Supply for domestic usage
W_l	Wage rate
PD_j	Price of domestic goods
PM_j	Price of imported goods
PE_j	Price of exported goods
P_j	Price of composite good
P_j^*	Aggregate price of output
ER	Exchange rate
PV_j	Price of value added
PI	Price index of investment basket

PG	Price index of government consumption basket
t_j^i	Indirect tax rates

Table A3: **List of Exogenous Variables**

i^*	World interest rate
$\overline{L}_l$	Labor supply
$\overline{F}_g$	Foreign transfer to government
$\overline{F}_p$	Foreign transfer to household
$P\overline{W}_j^m$	World price of imported good
$P\overline{W}_j^e$	World price of exported good
FDI	Foreign Direct Investment (*in the static model*)