

Regional Economic Integration and the Impacts on Growth, Poverty and Income Distribution: The Case of Vietnam[†]

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Abstract

Vietnam has recently accelerating the process of integration with the global and world economy in the context of increasing regionalization in East Asia. Vietnam has recently obtained WTO membership, and has participated in the free trade areas under negotiation between ASEAN and China, Korea and Japan. This paper employed a global CGE model to analyze the impacts on Vietnam of the ongoing regional economic integration, focussing on growth, poverty reductions and income distribution. The simulation analysis shows that the regional economic integration generally has positive impacts on Vietnam's economy, and it is both welfare enhancing and income-distribution improving for Vietnam. Household income and consumption increase, and poor and rural household groups benefit more than urban high income groups. A broader economic integration involving large trading partners of Vietnam could significantly increase the output and welfare gains for Vietnam, and most of the potential gain from free trade could be realized through the ongoing economic integration in East Asia.

1. Introductions

Twenty years have passed since Vietnam began profound social and economic reforms, which have transformed Vietnam from a centrally planned economy to a market one. Since the beginning days of the economic reforms, trade reforms and the open-door policies have constituted an integral part of overall economic reforms. The restrictions and limitations on trade activities have been steadily and progressively removed, and Vietnam has successfully developed trade and investment relations with countries in Asia, Europe and North America. Trade reforms have contributed to the rapid growth of exports and the overall economic growth.

Regional economic integration started in the latter half of 1990s with the obtaining ASEAN and APEC memberships, and has been accelerated in recent years. Vietnam has concluded the negotiation for WTO membership at the end of 2006, and has participated in the negotiation to form free trade areas between ASEAN and China, Korea and Japan. Future trade liberalization under the WTO and

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regional trading arrangements will have profound impacts on Vietnam's economy. Despite successful effort in liberalizing trade and investment regimes in the last decade, concern has remained over the possible consequences of the ongoing regional integration on economic growth, poverty reductions and income distribution.

This paper attempts to examine the impacts of the ongoing regional economic integration on Vietnam's economy using a global Computable General Equilibrium (CGE) model. The discussion will continue in section 2 analyzing the trade liberalization and regional economic integration in Vietnam. It is followed by section 3 examining poverty and income-distribution issues in Vietnam. The structure of the global CGE model is presented in section 4, and simulation scenarios are performed and discussed in section 5. Section 6 concludes the paper.

2. Trade liberalization and Economic Integration in Vietnam

Since the late 1980s, Vietnam's trade reforms have been progressed steadily, consisting of the creation and amendment of a system of taxation of imports and exports, the gradual removal of non-tariff barriers and progressive deregulation of trade regimes.¹ The tariff system has been simplified and rationalized, and tariff rates have been lowered. Quantitative restrictions on imports have been removed for the majority of commodities, with the exception of petroleum products, sugar and some other strategic products. As for exports, duties and quotas have been abolished for the majority of products. With the exception of some products regulated due to environmental, health or security concerns, quotas are only imposed on the export of garment and textiles to the United States and Canada. These quotas are imposed by the importing countries, and are determined in the bilateral trade agreements between Vietnam and these countries. The export quotas on garment and textiles will soon be removed as Vietnam has acquired WTO membership.

High tariff rates and non-tariff barriers are employed to protect consumer goods, while capital goods and production inputs are subject to low tariffs and very few non-tariff barriers. Effective protection provided to many industries is higher than that offered by nominal protection. Several studies have shown that many industries and consumer goods industries in particular have enjoyed very high degrees of effective protection.² Tariffs and non-tariff barriers are also employed to protect some intermediate inputs, which are being domestically produced, and infant industries such as cement, fertilizers, steel, petroleum and automobile. The protection of upstream industries, however, raises the price of intermediate inputs and negatively affects downstream industries and export activities.³

Together with unilateral reform measures, Vietnam has made important commitments to trade liberalization under various bilateral and multilateral agreements. Vietnam has acquired WTO membership at the end of 2006 with profound commitments to liberalization in various areas,

including the reduction of tariffs, the removal of non-tariff barriers and the opening of service sectors to foreign competition. Integration with the regional economy has been accelerated since the mid of 1995 with the participation in ASEAN free trade area (AFTA) and the Asian-Pacific Economic Cooperation forum in 1998. Together with other ASEAN members, Vietnam has participated in the formation of free trade areas between ASEAN and China, Korea and Japan. With various bilateral and multilateral agreements being implemented in the forthcoming years, Vietnam's integration with the regional and world economy will be further speeded up at unprecedented scale and depth.

Under the ASEAN free trade area (AFTA), Vietnam is obligated to reduce tariffs on intra-ASEAN trade to less than 5% by the year 2002. With the exception of some sensitive products to be liberalized in forthcoming years, Vietnam has fulfilled its obligation under the AFTA. After the successful implementation of AFTA, ASEAN members have made decision to set up the ASEAN economic community (AEC) by 2015, which attempts to make ASEAN become a single market and production base capable of competing with China and India in attracting foreign investment. The establishment of the AEC will require the complete removal of tariffs and the liberalization of investment regimes and service sectors.

In November 2001, China and ASEAN agreed to establish a free trade area within ten years, in which tariffs and non-tariff barriers will be removed by 2010 for China and six old ASEAN members, and by 2015 for four new ASEAN members, i.e. for Vietnam, Laos, Cambodia and Myanmar. The agreement to set up a free trade area between ASEAN and China has started a proliferation of FTAs in East Asia. Numerous FTAs on both bilateral and multilateral basis have been concluded or are under negotiation between ASEAN members with countries inside and outside East Asia. At the same time, discussion has been progressing on the formation of a broader free trade area in East Asian commonly termed as East Asian Economic community.

The Asia Pacific Economic Cooperation (APEC) grouping was established in 1989 with the objective of liberalizing and facilitating trade and investment. The goals of APEC, as defined in the APEC leaders Meeting in Bogor, Indonesia in November 1994, are to achieve free trade and investment for the region by 2010 for developed countries and 2020 for developing member countries. Under APEC liberalization, member countries are obliged to carry out liberalization measures that they propose in Individual Action Plans on a unilateral basis. However, unilateral liberalization has been progressed slowly, and effort has been made to promote economic cooperation in the APEC region, including the recent proposal on the establishment of a free trade area in Asia-Pacific region.

Since the early 1990s, East Asian countries have been the major trade and investment partners of Vietnam. Trade with Asian countries accounts for over 60% of Vietnam's imports and nearly a half of Vietnam's exports. Among East Asian countries, Vietnam's trade with its ASEAN neighbors has been relatively small and the ASEAN share in Vietnam's total trade has been on decline largely due to the decline in trade with Singapore.⁴ Other ASEAN members has increased their exports to Vietnam

during the implementation of the AFTA, and their share in Vietnam's imports has increased. However, it seems that Vietnam has not yet exploited the advantage of the tariff reduction in other ASEAN countries, and Vietnam's exports to these markets only increased modestly.

In contrast to the declining trade share with Japan and Korea, the two-way trade with China has been on a rapid increase since the mid 1990s. Export of Vietnam to China increased more than ten times, and imports from China increased by ten times during the last 10 years. China has recently passed Japan, which was Vietnam's largest trading partner in early 1990s, to become Vietnam's largest import markets. Given the fact that the two economies are growing fast, the trading relation between Vietnam and China is expected to further increase in coming years.

The declining share of trade with East Asian countries can be partly explain by the fact that Vietnam has increased its exports to markets outside the regions, and to the US and EU in particularly. The granting of the US's most favored nation status to Vietnam has boosted exports to

Table 1 Trade Direction of Vietnam 1995-2003

	1995	2000	2001	2002	2003
Exports					
Total value(million dollars)	5448.9	14483.0	15029.0	16706.1	20176.0
Composition of exports(% of total)					
ASEAN	18.3	18.1	17.0	14.6	14.7
Of which Singapore	12.7	6.1	6.9	5.8	5.1
Other ASEAN countries	5.6	12.0	10.0	8.8	9.6
NIEs	17.1	9.8	10.2	9.7	8.0
Japan	26.8	17.8	16.7	14.6	14.4
China	6.6	10.6	9.4	9.1	8.7
EU	12.2	19.6	20.0	18.9	19.1
US	3.1	5.1	7.1	14.7	19.5
Others	15.9	19.0	19.6	18.4	15.7
Imports					
Total value(million dollars)	8155.4	15636.5	16218.0	19745.6	25226.9
Composition of imports(% of total)					
ASEAN	27.8	28.5	25.7	24.2	23.6
Of which Singapore	17.5	17.2	15.3	12.8	11.4
Other ASEAN countries	10.4	11.2	10.4	11.3	12.2
NIEs	31.6	27.1	27.3	28.4	25.9
Japan	11.2	14.7	13.5	12.7	11.9
China	4.0	9.0	9.9	10.9	12.4
EU	8.7	8.4	9.3	9.3	9.8
US	1.6	2.3	2.5	2.3	4.5
Others	15.0	10.1	11.8	12.2	11.9

Source: Vietnam's Statistical Yearbook 2003. See Nguyen and Ezaki (2005), Table 1.

the US, which now becomes Vietnam's largest export market. Combined together, exports to the US and EU amounted to nearly \$8 billions in 2003, or equivalent to 40% of Vietnam's total exports. These are also the major markets for Vietnam's exports of labor-intensive products such as agricultural products, wearing apparel, textiles and footwear.

3. Poverty and Income Distribution

When Vietnam started economic reforms 20 years ago, it was a very poor country with income per capita of less than 200 \$US. Most Vietnamese people then lived under the poverty line with the estimated poverty incidence of over 70%. The rapid economic growth over the last decade has not only increased national income, but also sharply reduced the incidence of poverty. The percentage of poor people fell sharply to 50% in 1993, 37% in 1998 and 15% in 2002. The absolute poverty incidence based on the food poverty line also fell from 25% to less than 10% between 1993 and 2002.

Poverty incidence is unevenly distributed among regions and remains high in many rural areas. Most of poor people, around 90%, are living in rural areas, while the remaining 10% are urban dwellers (World Bank 1999). Poverty incidence is found very high in mountainous and remote regions, particularly in Northern Uplands and Central Highland. This fact indicates that focussing on rural development and allocating more resources toward poor regions are essential for further poverty reductions in Vietnam. In addition, the impressive achievements in poverty reduction seem vulnerable to the change in economic environment. As a considerable proportion of the poor lived just above the poverty line, and they could easily fall back to poverty with a small decline in income.

Vietnam has remained a relatively equitable country by international standard, and this is largely attributable to the equitable income distribution in rural areas. However, inequality has increased slightly during the years of rapid economic growth due to the widening income gap between rural and urban areas.⁵ Table 2 provides a profile of income distribution in Vietnam, and is processed using the new household survey conducted in 2002. Table 2 shows large income gaps among household groups. Income per capita of the richest urban group is almost 8 times higher than that of the urban poorest, while the figure for rural areas is 6.4. The share of the poorest decile groups in total income is only 3.4%, while the richest decile accounts for nearly 27% of total income. Sustaining the equality in income distribution remains a major policy challenges in the years to come as the regional income disparity is widening.

Underemployment has been a serious problem in both rural and urban areas. Based on the full-time annual work of 2000 hours, around 50% of urban workers and 70% of rural workers can be seen as underemployed.⁶ On average, a Vietnamese worker works only less than 1600 hours a year, suggesting an underemployment rate of more than 20%. The incidence of underemployment varies across regions and household groups. Underemployment is particularly high in rural areas due to the

Table 2 Income Distribution in Vietnam

	Unit	Total	Urban			Rural		
			Total	1st decile group	10th decile group	Total	1st decile group	10th decile group
			Household income	1000 VND	20972	10516.63	9009.418	53328.7
Share of household income	%	100.0	38.1	0.2	20.9	61.9	3.2	5.9
Composition of income by sources								
Self-employed agriculture	%	31.4	6.9	44.4	2.7	46.5	66.6	25.5
Self-employed non-agricultural	%	21.7	30.6	25.5	30.3	16.2	5.2	26.4
Wage income	%	30.5	42.3	20.0	42.8	23.2	19.8	21.0
Transfers	%	16.4	20.2	10.1	24.2	14.1	8.4	27.2
Income per capita	1000 VND	4510.3	7468.9	1650.6	12905.7	3624.6	1520.1	9790.8
Income ratio	Unit	1.0	1.7	0.4	2.9	0.8	0.3	2.2
Expenditure per capita	1000 VND	3414.1	5829.6	1120.2	10579.9	2691.1	1100.3	9265.3
Expenditure ratio	Unit	1.0	1.7	0.3	3.1	0.8	0.3	2.7
Annual working hours	Hour	1583.2	2034.7	1340.9	2276.8	1474.6	1404.6	1746.8
Average wage rate	VND/hour	3840.9	5537.0	1156.6	7809.9	2854.5	1613.2	5182.4
Wage ratio	Unit	1.0	1.4	0.3	2.0	0.7	0.4	1.3
Composition of employment by economic sectors								
Formal	%	14.8	29.5	6.1	38.8	10.0	2.7	24.8
Informal	%	85.2	70.5	93.9	61.2	90.0	97.3	75.2
Composition of employment by industry								
Agriculture	%	51.3	13.7	69.7	3.6	63.9	87.7	30.2
Industry and construction	%	19.5	27.3	10.3	27.4	16.8	7.1	21.7
Services	%	29.2	59.0	19.9	68.9	19.3	5.1	48.1

Sources: Authors' calculation. See Nguyen and Ezaki (2005), Table 2.

limited availability of arable land and off-farm jobs. Underemployment also severely affected urban poor and low-income groups. The incidence of underemployment partly reflects the composition of jobs. Low-income groups tend to involve mainly in agricultural activities, where production is subject to seasonality and the availability of land. The urban lowest income group spends nearly 70% of their working time on agriculture, while the figure for the rural lowest income group is 88%. Low-income groups also involve more in trade and other low-productivity and low paid activities in the informal sector. By contrast, higher income groups tend to work more in industries and formal services, where jobs are more stable and better paid.⁷

4. The Model Specification

The global CGE model employed in this paper is an extension of the global model developed by Nguyen and Ezaki (2005) to analyze the impacts of regional integration on Vietnam's economy. We extended the model by Nguyen and Ezaki (2005) basically in line with GTAP world model (Hertel (1997)) to allow for a greater regional and industrial disaggregation, a detailed treatment of taxes and subsidies, international capital mobility and transportation costs. The labor market for Vietnam is also further elaborated through the introduction of labor supply and unemployment. The current global CGE model specifies 20 industries and 16 regions. The regional classification is focussed on East Asia, consisting of all major economies in the region as well as the US, the EU and Oceania. Industrial activities are specified with an emphasis on the agricultural and manufacturing sectors, taking into consideration the diversified pattern of production and comparative advantage as well as the structure of protection in each individual country and region.

4.1 Country models

The global CGE model consists of 16 country models, which are linked together through international trade and foreign investment. Country models generally follow the standard neoclassical CGE model (Dervis et al., 1982). Output is a CES function of composite labor and capital with the assumption of imperfect substitutability. Sectoral output is supplied to foreign and domestic markets to maximize revenue with the assumption of the CET functional form. Product differentiation is also imposed on the demand side, in which domestically produced goods and imports are imperfectly substituted. This is modelled using the Armington structure, with the composite goods are CES functions of domestic goods and imports. The demand for imports is then derived from the cost minimization condition based on the relative prices of imports and domestic goods.

For countries and regions rather than Vietnam, the factor markets are modelled with the assumption of factor mobility and full employment. Three production factors are specified, consisting of capital, skilled labor and unskilled labor. Skilled and unskilled labor are combined in a Constant

Elasticity of Substitution (CES) function to form a composite labor input. The factor demand is first derived for capital and composite labor, and the latter is further divided into the demand for skilled and unskilled labor. With the assumption of full employment and factor mobility, the model is long-run in nature. In some simulations, however, we dropped the assumption of capital mobility to investigate the short-run impacts of regional integration.

In the country model for Vietnam, the skilled and unskilled labor is further divided into formal and informal sectors to capture the segmentation characteristic of the labor market. On the demand side, the demand for skilled and unskilled labor is further divided into the demand for the formal and informal sectors. On the supply side, households are endowed with fixed amount of skilled and unskilled labor, and they make decisions to supply to different economic sectors (formal and informal) and industries through a multi-level process, taking into account the changes in the return to labor. This is modeled with the assumption of the CET functional form, taking into account the changes in the sectoral wage rates.

In each country model, nine kinds of taxes and subsidies were specified, consisting of tariffs, export duties, production taxes, capital and output subsidies, and sales taxes imposed on consumer goods, intermediate inputs and capital goods. The detailed treatment of taxes and subsidies makes it possible to analyze other policy instruments in addition to tariffs. Government collects revenue from taxes and spends on investment and consumption in fixed proportions. One representative household is specified for each country and region rather than Vietnam. Household income consists of labor and capital income, and is allocated to savings and consumption using exogenous shares.

For Vietnam's country model, 20 household groups are classified to analyze the impact of regional integration on income distribution. Among these 20 groups, there are 10 urban groups and 10 rural groups, which are classified based on the level of income. Vietnamese households receive fixed proportions of sectoral capital income based on their initial supply of capital services. Labor income is determined based on the household supply of labor in each industry and corresponding wage rates. The household composition of sectoral labor income would change as labor moves between industries during trade liberalization.

4.2 International linkages

Country models are linked together through trade and investment flows. Domestic consumers and producers differentiate imports by sources, and this characteristic is also modeled with the Armington structure. At the aggregate level, total imports is a CES function of imports from different sources, and then the demand for imports from each sources is derived from the cost minimization condition. On the export side, exporters do not differentiate exports by countries of destination, that is, commodities supplied to foreign countries are seen as perfectly homogenous and are sold at the same price. The trade consistency is held so that total exports supplied by home countries are equal

to the sum of imports by foreign countries. International transportation services are incorporated, creating a wedge between the f.o.b prices in exporting countries and the c.i.f. prices in importing countries.

Trade liberalization changes the relative prices of production factors, thereby affecting foreign capital inflows. In this model, we employed an approach in the line with Hertel (1997) to account for the link between trade and investment. In this approach, the expected return on capital is assumed to decline with the addition to the capital stock at the rate determined by a flexibility parameter. Investment decisions are made in such a way that the rates of return on capital are equalized across countries and regions. Thus the change in global savings is allocated across country and regions to equalize the regional expected rates of return. In this treatment, investment only partially adjusts in response to the changes in the rate of return caused by trade liberalization. At a low value of the flexibility parameter in the absolute term, the expected rate of return to capital is not very sensitive to the change in capital stock, thus a large change in investment is required to equalize the expected rate of return to capital. A low flexibility parameter means a greater capital mobility and vice versa.

4.3 Equilibrium conditions

Equilibrium conditions consist of the conditions in factor, commodity and foreign exchange markets. In the factor market, we adopted the assumption of full employment, and factor prices serve as equilibrating variables. In the country model for Vietnam, the equilibrium in the labor market equates the demand for and the supply of labor for each industry and economic sector. Equilibrium in product markets equates the supply of domestic goods in each sector to the demand for domestically produced products, with domestic prices serving as equilibrating variables. The fiscal balance is implied in the treatment of the government sector, in which government consumption and savings are determined as fixed shares of government revenue.

In the foreign exchange market, the exchange rates are fixed for all countries and regions, and foreign savings are assumed to adjust to the change in demand for and supply of the foreign exchanges. Savings and investment are determined independently in each country or region but the savings-investment identity is guaranteed automatically by the local Walras' Law. We do not introduce the general price equation for each country or region to control its price level except for the United States, in which the general price level is fixed as the world numeraire by allowing for the global Walras' Law. All the exchange rates are fixed but the real exchange rates change because of the flexible domestic price levels relative to the world numeraire.

5. Simulation Analysis

5.1 Simulation scenarios

To run the model, we made use of GTAP database version 6.0 constructed for 2001.⁸ 57 industries and 87 regions originally specified in GTAP database are aggregated into 20 industries and 16 countries or regions in accordance with the model. In Vietnam's country model, the household sector is constructed using Vietnam's Living Standard Survey conducted in 2002. The survey data, which covers around 30000 households, are grouped into urban and rural households, which are further divided into income deciles. From the survey, we calculated household income and consumption. Employment data is also derived from the survey, using the number of working hours rather than workers.⁹ We classified as formal workers all the workers in state enterprises and foreign enterprises. The workers in agriculture, informal services and small-scale manufactures are considered as informal. The workers with educational attainment of over 9 years are classified as skilled, while the remainder are classified as unskilled. The survey data is then incorporated into GTAP data using a relatively simple procedure. Income shares are computed from the survey data, and are used to allocate the data on factor income and consumption taken from GTAP database to household groups and industries.

The global CGE model described in the above section is employed to analyze the impacts of regional economic integration on Vietnam's economy. Seven simulations have been performed, covering major integration options for Vietnam. They include the ASEAN free trade area (AFTA), the free trade areas under negotiation between ASEAN and China, Korea and Japan, APEC trade liberalization and global trade liberalization. We also conducted these simulations under different model structures to examine the role of different factors, including foreign investment, in the process of economic integration in Vietnam. The content of the simulations are described briefly in table 3.

Table 3 Simulation Scenarios

S0	Base run
S1	ASEAN free trade area(Vietnam, Indonesia, Malaysia, Philippines, Singapore and Thailand, ASEAN-6)
S2	China-ASEAN free trade area(China and ASEAN-6)
S3	Korea-ASEAN free trade area(Korea and ASEAN-6)
S4	Japan-ASEAN free trade area(Japan and ASEAN-6)
S5	East Asian free trade area(ASEAN-6, China, Korea, Taiwan, Hong kong and Japan)
S6	APEC trade liberalization(East Asian countries, the US and Oceania)
S7	Multilateral trade liberalization

In all simulations, we simply removed the tariffs imposed on the bilateral imports between the regions and countries in investigation. In the current version of GTAP database, non-tariff-barriers are

quantified and are combined with tariffs under the tariff item, making it possible to quantify the impacts of removing both tariffs and non-tariff barriers. In fact, FTAs do not necessarily lead to the complete removal of tariffs and non-tariff-barriers. The AFTA, for example, only requires tariffs in the ASEAN members to be reduced to under 5%. Exclusion and exemption have been also provided to certain agricultural products and strategic industries in recent FTAs in East Asia. Similar exemption and exclusion could be applied to the FTAs in negotiation between ASEAN and Japan, China, and Korea. By simply removing all tariffs, the simulation analysis attempts to look at the potential, rather than actual, impacts of regional integration.

5.2 Macroeconomic impacts of economic integration

The simulation results show that Vietnam would gain significantly in terms of output and welfare in all integration scenarios in investigation. Furthermore, the gains would increase when the scope of integration is broadened, involving more trading partners of Vietnam. In a standard single-country model, the gains come from the reallocation of resources toward more efficient industries. In a global CGE model, the welfare and output gains also come from the removal of tariffs in foreign markets and the inflow of foreign capital following trade liberalization also brings about additional benefits to the domestic economy. When regional integration is accompanied by increased foreign capital inflows, a higher level of investment will raise the welfare gain through its effect on both supply and demand side. The gains from regional integration thus depend in large part on the volume of trade and the level of protection at home and abroad. Greater gains in welfare and output would be produced when large trading partners of Vietnam are involved and highly protected industries are included.

In the first simulation on AFTA trade liberalization, Vietnam gains around 0.4% in terms of real GDP and 4.4% in private consumption. The gain for Vietnam increases substantially when China, Japan and Korea are included under the three ASEAN plus one scenarios. The gain in real GDP amounts to 0.9% in ASEAN-Japan FTA, 1.1% in ASEAN-Korea FTA, and 1.5% in ASEAN-China FTA. The increases in private consumption amount to 7.8%, 7.0% and 6.7% in simulations S2, S3, and S4 correspondingly. The gain for Vietnam further increases in S5, when a broader FTA in East Asia is taken into consideration. Real GDP increases by 3.4%, while the welfare gain amounts to 12.2%.

APEC trade liberalization investigated in S6, when the US and Oceania are included in addition to East Asian economies, does not significantly increase the benefit for Vietnam as compared to East Asian free trade area. This can be explained by the fact that the trade volume between Vietnam and the US was rather limited in 2001, when the database was constructed. Bilateral trade between the two countries has increased rapidly in recent years, making the US one of the largest trading partners and export markets for Vietnam. The simulation results for APEC trade liberalization could considerably underestimate the actual gain. In simulation S7, global trade liberalization is investigated with the removal of tariffs in all countries and regions. Global trade liberalization, and largely the

**Table 4 Macroeconomic Impacts of Regional Integration
(percentage changes from the base run)**

	Simulation Scenarios						
	S1	S2	S3	S4	S5	S6	S7
Basic model with international and sectoral capital mobility							
Real GDP	0.40	1.48	1.11	0.93	3.43	3.59	4.02
Consumption	4.39	7.78	6.97	6.68	12.15	12.11	13.53
Investment	4.17	9.48	6.07	5.99	12.47	12.54	12.82
Imports	5.73	11.05	9.95	10.11	18.48	18.77	22.23
Exports	3.27	4.73	6.83	7.21	10.30	11.05	14.51
Model with international capital immobility							
Real GDP	- 0.10	0.44	0.39	0.24	2.06	2.20	2.62
Consumption	3.31	5.57	5.32	5.06	9.03	8.96	10.20
Investment	- 2.27	- 2.88	- 3.76	- 3.58	- 4.91	- 4.97	- 5.98
Imports	2.87	5.47	5.63	5.87	10.67	10.91	13.88
Exports	4.76	7.48	9.23	9.50	14.42	15.22	19.16
Model with international and sectoral capital immobility							
Real GDP	- 0.13	0.26	0.16	0.00	1.56	1.63	1.83
Consumption	2.78	4.99	4.65	4.43	8.19	8.13	9.37
Investment	- 1.73	- 2.23	- 2.83	- 2.64	- 3.55	- 3.75	- 4.52
Imports	1.79	3.85	3.36	3.42	6.81	6.65	8.34
Exports	3.22	4.96	5.46	5.38	7.76	7.95	9.54
Basic model without tariff removal in trading partners							
Real GDP	0.24	1.12	0.91	0.57	2.83	2.82	2.65
Consumption	3.13	5.12	5.43	4.61	8.25	7.89	7.16
Investment	2.85	6.29	4.52	3.89	8.31	7.86	6.27
Imports	3.71	6.92	7.42	6.12	11.69	11.08	9.36
Exports	2.75	4.23	6.08	5.21	8.07	8.13	7.84

Sources: Authors' calculation.

inclusion of the EU, significantly raises the output and welfare gain for Vietnam. Real GDP increases by 4.0% while the increase in consumption and exports reach nearly 13.5% and 14.5% respectively.

One of the major motive for Vietnam and other ASEAN countries to pursuit regional economic integration is their expectation that trade liberalization and integration will make these countries more attractive to foreign investors. Regional integration can stimulate foreign investment inflows through the improvement in investment environment and the enlargement of export markets. The simulation analysis shows that all the FTAs in investigation lead to increase investment and foreign capital inflows in Vietnam. Regional integration raises the return to capital and induces the inflows of foreign

capital. The gains in real investment are considerable, ranging from 4.2% in S1 to over 12.8% in and S7.

The increased capital inflow resulting from regional integration also contributes to the overall gain in welfare and output. To examine the extent of contribution from the flow of FDI, we conducted the same set of simulations under the assumptions of international capital immobility and sectoral capital immobility. The results show that the inflows of FDI account for at least half of the gains in real GDP and consumption. The output and welfare gains further decline when capital are not allowed to move between industries. Real GDP even declines in the case of AFTA trade liberalization. These results could be seen as the short-term impacts of regional integration. The simulations with capital immobility highlight the importance of foreign investment and resource reallocation in realizing the opportunities brought about by regional integration. The tariff removal should be accompanied by necessary policies to stimulate domestic and foreign investment toward expanding industries.

Even Vietnam has completed its commitments to liberalization under the AFTA and participated in negotiations with China, Japan and Korea under ASEAN+1 free trade arrangements, reluctance and concern have remained over a broader integration in East Asia. Our simulation analysis shows that the gain for Vietnam would increase significantly when regional integration is expanded to cover the large trading partners of Vietnam such as China, Japan or Korea. Furthermore, among three ASEAN+1 scenarios, the China-ASEAN FTA could produce the biggest gains for Vietnam, in terms of output, welfare, investment and exports. This can be attributed to large trade between Vietnam and China as well as the high level of protection in China.

It is also of interest to note that most of the potential gains for Vietnam could be realized through the ongoing process of integration in East Asia. For example, around 86% of the gain in real GDP from global trade liberalization could be realized under the East Asian free trade area. The simulation on global trade liberalization does not show significant additional gains in consumption, exports or investment as compared to East Asian free trade area. The fact that Vietnam exports mainly to outside the region may not reduce the importance of regional markets for Vietnam's exports. Since agricultural products and labor-intensive manufactures are still highly protected in regional markets, opening these markets could be of great benefit to Vietnam. In addition, regional integration would not only broaden, but also diversify, the markets for Vietnam's exports.

To assess the importance of the tariff removal in trading partners, we conducted another set of simulations, in which we removed separately the tariffs imposed by Vietnam and the tariffs in foreign markets. The results show that the removal of tariffs in foreign markets contributes to 20% to 50% of the overall output and welfare gains. The opening of East Asian market also contributes in large part to the growth of exports and the inflows of foreign capital.

Table 5 Sectoral Impacts of Regional Integration
(percentage changes from the base run)

	Simulation Scenarios						
	S1	S2	S3	S4	S5	S6	S7
Crop	1.34	0.96	1.22	1.41	2.54	0.56	- 0.48
Livestock	1.03	2.01	1.28	1.27	2.09	1.97	2.27
Forestry	- 1.31	0.52	- 1.71	- 2.00	- 1.26	- 1.12	- 2.05
Fishing	2.00	3.41	2.34	2.46	3.57	2.84	2.45
Mining	1.03	2.01	0.64	- 0.15	0.32	2.71	0.46
Food processing	3.05	3.26	2.99	3.40	2.05	- 0.14	- 1.74
Beverage	- 1.24	0.94	- 0.27	- 0.09	2.22	2.12	2.73
Wood	- 2.71	- 2.60	- 3.38	- 3.64	- 4.98	- 4.91	- 6.05
Chemical	- 1.30	4.24	- 1.93	- 2.35	1.37	1.74	0.32
Automobile	- 0.54	- 3.69	- 27.03	- 21.68	- 32.86	- 32.85	- 33.72
Other transportation means	- 13.43	- 33.97	- 15.43	- 15.94	- 34.83	- 34.36	- 27.89
Electronics	- 3.57	- 4.91	- 4.40	- 5.30	- 7.78	- 8.25	- 10.51
Machine	16.72	13.30	15.16	10.63	7.63	7.34	3.18
Metal	- 0.20	- 3.19	- 2.62	- 3.32	- 8.12	- 7.33	- 9.13
Textile	6.90	14.33	28.08	36.60	52.61	56.46	76.82
Leather	2.00	2.10	7.37	6.00	10.28	11.75	22.69
Other manufactures	- 0.91	- 1.50	- 1.84	- 1.89	- 5.04	- 4.95	- 5.69
Utility	1.61	3.29	2.15	1.93	3.82	3.95	4.07
Construction	4.07	9.16	5.87	5.74	11.94	12.02	12.20
Services	- 0.89	- 1.57	- 1.49	- 1.51	- 2.61	- 2.53	- 2.91
Total	1.11	2.20	2.05	2.16	3.50	3.60	4.18

Sources: Authors' calculations.

5.3 Sectoral impacts of economic integration

Trade liberalization and regional integration will lead to a reallocation of resources toward more efficient industries. The industries that are highly protected before trade liberalization would decline, and labor and capital will move toward the expanding industries with comparative advantages. The sectoral impacts of economic integration depends the composition of trade and the level of protection at home and foreign markets, which are largely in line with the pattern of comparative advantage and the level of development of the countries and regions participating in free trade areas.

East Asian region are highly diversified in the level of economic development, and thus possessing different patterns of comparative advantage. Japan is the second largest country in the world and the sole developed economy in the region. Korea, Taiwan and Singapore, which completed the industrialization process 20 years ago, have been progressing to a high level of development and building up competitive capacity in automobile, electronics and other high tech industries. China and

some of ASEAN countries have been moving from agriculture and labor intensive industries toward more capital industries. Vietnam has remained in the early stage of development with the comparative advantage in agriculture and labor intensive products, which are also the major exports of Vietnam.

The sectoral impacts of regional integration on Vietnam generally follow its pattern of trade and comparative advantage. The expanding sectors in Vietnam are agriculture, food processing textile and leather. Contraction occurs in heavy, and often highly protected, industries, such as automobile, metal and electronics. The extent of contraction or expansion, however, varies with regional integration scenarios in consideration. In general, agriculture and labor-intensive industries in Vietnam expand more when developed countries are included. At the same time, this also causes a greater contraction in heavy and protected industries.

Agriculture and food processing expand in the first four simulations on regional integration in East Asia. However, the expansion in agriculture declines in the scenario of APEC trade liberalization when the US is included. Agriculture and processed food even experience a contraction in the scenario of global trade liberalization. As for textile, garment and leather, only a limited amount of exports is shipped to ASEAN countries and China, while most of the exports of garment and textile are directed toward the US and EU, and to lesser extent toward Japan. Only a moderate expansion in these labor-intensive industries is observed in S1 and S2, reflecting the fact that China and ASEAN countries are also major exporters of these products. The output gain, however, rise substantially with the inclusion of Japan, the US or EU. In addition to agriculture, leather and textile, construction also experiences a large expansion largely resulting from the increased capital inflows and investment.

Contracting industries consist of mostly heavy manufactures, most of which are highly protected in Vietnam. The largest contraction falls into automobile and other transportation means, but the negative impacts on these industries also vary with different integration scenarios. The automobile industry is not severely affected under the AFTA and the China-ASEAN free trade area, domestic production of automobile declines sharply when large producers and exporters of automobile like Japan or Korea are included. By contrast, other transportation means decline sharply in the FTAs with China and ASEAN countries, and this can be explained by the fact that these countries have a more competitive motorcycle industries compared to Vietnam. The electronics industry experiences a contraction in all simulations, but only to a moderate extent. A contraction also occurs in services, and is caused by the sharp decrease in government spending and public services.

The possible contraction in capital intensive industries gives rise to a concern that regional integration could force Vietnam into low-value added, labor intensive industries. It has been a policy of Vietnam to protect the infant industries, including automobile and motorcycle, to promote industrialization. Tariffs and non-tariffs barriers have been employed to attract foreign investors with the expectation that these industries will improve competitiveness and efficiency over time. With some exceptions, the Vietnam's infant industries have so far been a less successful story. In the

automobile industry, for example, there has been little progress in the competitiveness and cost reductions, and the localization ratio has remained low, thus limiting the spillover effect on the rest of the economy. It is questionable if these infant industries would be successful under the protection umbrella in the future. Furthermore, continuing the protection policy and standing outside regional economic integration could lead to a loss of markets for Vietnam's exports and the resulting loss in output and welfare, particularly for poor and low-income groups.

5.4 Impacts on income distribution and poverty

In CGE models, macroeconomic shocks are translated into income distribution impacts through the industrial output and the resulting changes in relative prices and factor remuneration. There are

Table 6 Impacts on Income Distribution
(percentage changes in household consumption from the base run)

	Simulation Scenarios						
	S1	S2	S3	S4	S5	S6	S7
Urban Households							
Group 1	5.13	7.70	8.17	8.90	15.01	14.90	17.85
Group 2	5.54	8.81	7.56	7.47	13.56	13.35	14.83
Group 3	5.97	9.62	8.30	8.23	14.94	14.57	15.92
Group 4	5.28	8.38	7.72	7.74	13.67	13.57	15.95
Group 5	5.57	8.68	8.03	7.97	14.16	14.21	16.01
Group 6	4.94	8.35	7.09	6.92	12.37	12.56	14.06
Group 7	4.56	7.46	6.72	6.62	11.60	11.63	13.12
Group 8	4.53	8.91	7.02	6.90	13.09	13.28	14.94
Group 9	4.03	7.00	6.48	6.26	11.17	11.38	12.99
Group 10	3.41	6.36	6.21	5.78	10.88	11.05	12.34
Total	3.82	6.91	6.46	6.14	11.36	11.52	12.94
Rural Households							
Group 1	6.08	8.48	7.83	7.76	13.80	12.98	13.63
Group 2	5.83	8.31	7.74	7.68	13.51	12.90	13.98
Group 3	5.46	8.32	7.48	7.47	13.46	12.98	14.22
Group 4	5.51	8.43	7.58	7.55	13.43	13.12	14.37
Group 5	5.22	8.01	7.46	7.34	13.03	12.78	14.41
Group 6	5.07	7.67	7.39	7.26	12.83	12.53	13.97
Group 7	4.88	7.41	7.57	7.24	12.90	12.74	14.25
Group 8	4.89	7.78	8.43	7.92	14.35	14.29	16.24
Group 9	3.76	6.11	5.99	5.69	10.16	10.18	11.50
Group 10	4.06	7.18	7.28	6.73	12.54	12.63	13.87
Total	4.88	7.55	7.41	7.16	12.83	12.62	14.04

Sources: Authors' calculation.

two channels through which macroeconomic policies affect household income and welfare. The first channel works through the changes in consumer prices resulting from trade liberalization. Consumers will have a gain when prices of consumer goods decline, and they lose otherwise. Since households have different patterns of consumption, trade liberalization will have different impacts on their welfare.

The second channel translates factor incomes to the income of individual households. Since the impacts of trade liberalization vary from industries to industries, it has different impacts on factor remuneration. The prices of the production factors that are intensively employed in the expanding industries would increase, and for those production factors involved mainly in the shrinking industries, the factor prices could decline. Since households have different compositions of factor endowment, their income will be differently affected by trade liberalization and the resulting changes in the production structure and factor prices.

Poor households in Vietnam are largely endowed with unskilled labor, and are mainly involved in agriculture, small-scale labor-intensive industries, construction and informal services. These are also the industries that benefit most from regional integration, leading to an increase in the demand for unskilled labor. In all simulations, the return to unskilled labor increases most, and is followed by the return to skilled labor and capital. The supply of unskilled labor also rises, whereas the supply of skilled labor decreases.

The impacts of regional integration on income distribution are presented in table 6. Since the impacts on income and consumption are similar in direction and magnitude, we reported only the changes in household consumption. The first five simulation scenarios of East Asian economic integration seem to improve income distribution and reduce poverty in both rural and urban areas. In these simulations, poor households gain more than the rich, and rural households have higher gains in income and consumption than urban households. The impacts on income distribution, however, become less positive when economic integration expands outside East Asian region. The inclusion of the US under the scenario of APEC trade liberalization seems to reduce the gain for low income groups. The contraction of agriculture and food processing in the scenario of global trade liberalization seems to worsen income distribution in rural areas with middle-income groups gaining the most.

6. Concluding remarks

In this paper, we have employed a global CGE model to analyze the impacts of regional economic integration on Vietnam, focusing growth, income distribution and poverty reductions. The simulation analysis shows that regional integration both enhances welfare and improves income distribution in Vietnam. Output expands in all the integration scenarios investigated, and is accompanied by a substantial increase in income and consumption for poor households. Regional integration could make Vietnam more profitable and attractive to foreign investors, and the greater capital inflows in turn

contribute significantly to the overall output and welfare gains.

The simulation analysis also shows that the gain for Vietnam could increase substantially by pursuing and promoting a broader economic integration in East Asia, covering major regional trading partners of Vietnam. The removal of tariffs and non-tariff barriers in regional markets could expand export opportunities for Vietnam and contribute significantly to the welfare and output gains. Furthermore, most of the potential gain from free trade could be realized under the process of regional integration in East Asian. It is thus beneficial for Vietnam to participate in the ongoing ASEAN+1 processes as well as the possible formation of a broader free trade area in East Asia.

Vietnam has so far weathered well process of trade liberalization under the AFTA, but future economic integration would bring about much greater impacts on Vietnam's economic development and industrialization. While agriculture, textile and leather could benefit from regional integration, other industries could suffer a serious loss, including certain highly protected infant industries. It is important to design an appropriate industrial policy under the context of increasing globalization and regionalization. Policies to promoting domestic and foreign investment are also required to realize the opportunities brought about by economic integration.

Notes

- 1 Vietnam's trade regimes have been the subject in several studies, such as CIE (1998). The non-tariff barriers that were present in Vietnam by 1999 are surveyed in detail in CIE (1999) and McCarty (1999)
- 2 See, for example, CIE (1998) and Fukase and Martin (1999) for the estimates of effective protection rates by industries.
- 3 Fukase and Martin (1999) show that exports-oriented industries suffers negative effective protection as protection given to intermediate inputs raises the cost of production.
- 4 It should be noted that Singapore, like Hong Kong, had acted as a sub-contractor for Vietnam's exports and imports in early 1990s. A significant share of trade with these two countries was re-exported to or re-imported from other countries. The decline in trade with Singapore reflect in part that Vietnamese exporters has become increasingly accustomed with the international market, and they can export without going through trading companies in Hong kong and Singapore.
- 5 According to World Bank (1999), the widening income gap between rural and urban areas accounted for 96% of total rise in inequality.
- 6 This is calculated based on the assumption of full-time work of 40 hours per week and 50 working weeks a year.
- 7 The formal sector consists of the state sectors and foreign-invested sector, while the rest of the economy can be considered as informal.
- 8 More details about GTAP database version 6 can be found in GTAP homepage (<http://www.gtap.agecon.purdue.edu/>).
- 9 This is to avoid the difficulties arising from the problem of multiple jobs and underemployment, which are widespread in rural and poor urban households. Since workers often have more than one job, using the number of working hours makes it easier to assess the sectoral composition of employment and the degree of unemployment.

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Appendix A Regional and Industrial Classification

Table A1 Regional Mapping

Regions and Countries	Description
1. Vietnam	Vietnam
2. Indonesia	Indonesia
3. Malaysia	Malaysia
4. Philippines	Philippines
5. Thailand	Thailand
6. Singapore	Singapore
7. China	China
8. Korea	Korea
9. Hong kong	Hong kong
10. Taiwan	Taiwan
11. Japan	Japan
12. India	India
13. Oceania	Australia, New Zealand and other Oceania countries
14. The United of States	The United States
15. European Union	Austria, Belgium, Denmark, Finland, France, Germany, England, Greece, Ireland, Italia, Luxemburg, Netherlands, Portugal, Spain, Sweden,
16. Rest of the World	Other countries

Table A2 Industrial Mapping

Industries	Description
1. Crop	Paddy rice, wheat, cereal grains nec, vegetable, fruit, nuts, oil seeds, sugar cane, sugar beet, plant-based fibers, other crops
2. Livestock	Cattle, sheep, goats, horses, other animal products, raw milk, wool, silk-worm, cocoons
3. Forestry	Forestry
4. Fishing	Fishing
5. Mining	Coal, oil, gas, other minerals
6. Food processing	Processed meat, vegetable, oils and fats, dairy products, processed rice, sugar, other food products
7. Beverages	Beverages and tobacco products
8. Wood	Wood products, paper, publishing
9. Chemical.	Petroleum, coal product, chemical products, plastic products, rubber, other mineral products
10. Automobile	Motor vehicles and parts
11. Other transportation means	Transportation equipments nec
12. Electronics	Electronic equipments
13. Machinery	Other machinery and equipment
14. Metal	Ferrous and non-ferrous metals
15. Textiles	Textiles and wearing apparel
16. Leather	Leather products
17. Other manufactures	Other manufactures
18. Utility	Electricity, gas manufactures and distribution, water
19. Construction	Construction
20. Services	Public and private services

Appendix B The Global CGE Model

B1. Equations of the Model

Price Relations

$$(1) \quad PMS_{irk} = PM\$_{ik} \times ER_r \times (1 + tm_{irk})$$

$$(2) \quad PM_{ir} = a_{S_r}^{-1} \left(\sum_k \omega_{S_k}^{1/(1+\theta_r)} PMS_{irk}^{\theta_r/(1+\theta_r)} \right)^{(1+\theta_r)/\theta_r}$$

$$\text{where } M_{ir} PM_{ir} = \sum_k MS_{irk} PMS_{irk}$$

$$(3) \quad PE_{ir} = PE\$_{ir} \times ER_r \times (1 + te_{ir})$$

$$(4) P_{ir} = a_{Mr}^{-1} (\omega_{Mr}^{1/(1+\delta_{ir})} PM_{ir}^{\delta_{ir}/(\delta_{ir}+1)} + (1 - \omega_{Mr})^{1/(1+\delta_{ir})} PD_{ir}^{\delta_{ir}/(\delta_{ir}+1)})^{(\delta_{ir}+1)/\delta_{ir}}$$

where $P_{ir}Q_{ir} = PM_{ir}M_{ir} + PD_{ir}D_{ir}$

$$(5) PX_{ir} = a_{Er}^{-1} (\omega_{Er}^{1/(1-\gamma_{ir})} PE_{ir}^{\gamma_{ir}/(\gamma_{ir}-1)} + (1 - \omega_{Er})^{1/(1-\gamma_{ir})} PD_{ir}^{\gamma_{ir}/(\gamma_{ir}-1)})^{(\gamma_{ir}-1)/\gamma_{ir}}$$

where $PX_{ir}X_{ir} = PE_{ir}E_{ir} + PD_{ir}D_{ir}$

$$(7) PVA_{ir} = PX_{ir}(1 - tp_{ir}) - \sum_j iocf_{ijr} PNM_{jr}$$

$$(8) PINDEX_{ir} = \sum_i cpcf_{ir} \times P_{ir}$$

Definition of Market Prices

$$(9) PCM_{ir} = P_{ir}(1 + tc_{ir})$$

$$(10) PGM_{ir} = P_{ir}(1 + tg_{ir})$$

$$(11) PNM_{ijr} = P_{ir}(1 + tn_{ijr})$$

$$(12) PKM_{ir} = P_{ir}(1 + tk_{ir})$$

$$(13) WKM_{iir} = WK_{iir}(1 + tw_{iir})$$

for $r \neq \text{Vietnam}$

$$(14) WKVM_{iir} = WK_{iir}(1 + tw_{iir})$$

for $r = \text{Vietnam}$

$$(15) RM_{ir} = R_{ir}(1 + tr_{ir})$$

Supply

$$(16) X_{ir}^S = a_{X_{ir}} (\omega_{X_{ir}} L_{ir}^{-\rho_{ir}} + (1 - \omega_{X_{ir}}) K_{ir}^{-\rho_{ir}})^{-1/\rho_{ir}}$$

$$(17) D_{ir}^S = a_{E_{ir}}^{\gamma_{ir}/(1-\gamma_{ir})} ((1 - \omega_{E_{ir}}) PX_{ir} / PD_{ir})^{1/(1-\gamma_{ir})} \times X_{ir}^S$$

where $X_{ir} = a_{E_{ir}} (\omega_{E_{ir}} E_{ir}^{\gamma_{ir}} + (1 - \omega_{E_{ir}}) D_{ir}^{\gamma_{ir}})^{1/\gamma_{ir}}$,

$$(18) E_{ir} = a_{E_{ir}}^{\gamma_{ir}/(1-\gamma_{ir})} (\omega_{E_{ir}} \times PX_{ir} / PE_{ir})^{1/(1-\gamma_{ir})} \times X_{ir}^S,$$

Labor Market (For Vietnam)

$$(19) L_{ir} = a_{X_{ir}}^{-\rho_{ir}/(1+\rho_{ir})} (\omega_{X_{ir}} PVA_{ir} / WM_{ir})^{1/(1+\rho_{ir})} \times X_{ir}^S$$

$$(20) WM_{ir} = a_{L_{ir}}^{-1} (\sum_l \omega_{L_{ir}}^{1/(1+\lambda_{ir})} WKM_{lir}^{\lambda_{ir}/(\lambda_{ir}+1)})^{(\lambda_{ir}+1)/\lambda_{ir}}$$

$$(21) LK_{lir} = a_{L_{ir}}^{-\lambda_{ir}/(1+\lambda_{ir})} (\omega_{L_{ir}} WM_{lir} / WKM_{lir})^{1/(1+\lambda_{ir})} \times L_{ir}$$

where $L_{ir} = a_{L_{ir}} (\sum_l \omega_{L_{ir}} LK_{lir}^{-\lambda_{ir}})^{-1/\lambda_{ir}}$

$$(22) WKM_{lir} = a_{LV_{ir}}^{-1} (\sum_v \omega_{LV_{ir}}^{1/(1+v_{ir})} WKVM_{vlir}^{v_{ir}/(v_{ir}+1)})^{(v_{ir}+1)/v_{ir}}$$

$$(23) LKV_{vlir} = a_{LV_{ir}}^{-v_{ir}/(1+v_{ir})} (\omega_{LV_{ir}} WKM_{lir} / WKVM_{vlir})^{1/(1+v_{ir})} \times LK_{lir}$$

$$(24) LHS_{vlir} = \alpha_{LHS_{vlir}}^{-k_{ir}/(1+k_{ir})} (\omega_{LHS_{vlir}} WKVM_{vlir} / WH_{lir})^{1/(1+k_{ir})} \bar{L}S_{vlir}$$

$$(25) WH_{lir} = \alpha_{LHS_{vlir}}^{-1} (\sum_l \omega_{LHS_{vlir}}^{1/(1+k_{ir})} WKV_{vlir}^{k_{ir}/(1+k_{ir})})^{(1+k_{ir})/k_{ir}}$$

Labor market (For other countries)

$$(26) L_{ir} = a_{X_{ir}}^{-\rho_{ir}/(1+\rho_{ir})} (\omega_{X_{ir}} PVA_{ir} / WM_{ir})^{1/(1+\rho_{ir})} \times X_{ir}^S$$

$$(27) \quad LK_{ir} = a_{L_{ir}}^{-\lambda_{ir}/(1+\lambda_{ir})} (\omega_{L_{ir}} WM_{ir} / WKM_{ir})^{1/(1+\lambda_{ir})} \times L_{ir}$$

$$\text{where } L_{ir} = a_{L_{ir}} \left(\sum_l \omega_{L_{il}} LK_{il}^{-\lambda_{il}} \right)^{-1/\lambda_{ir}}$$

Capital market

$$(28) \quad K_{ir} = a_{K_{ir}}^{-\rho_{ir}/(1+\rho_{ir})} ((1 - \omega_{X_{ir}}) PVA_{ir} / RM_{ir})^{1/(1+\rho_{ir})} X_{ir}^S$$

$$(29) \quad R_{ir} = \text{rentcf}_{ir} R_{ir}^e,$$

here $\text{rentcf}_{ir} = \text{constant}$

Income and saving

$$(30) \quad YH_r = \sum_i K_{ir} \times R_{ir} + \sum_{li} LK_{il} \times WK_{il} + \sum_i PR_{ir}$$

for $r \neq \text{Vietnam}$

$$(31) \quad YH_{hr} = \left(\sum_i ykcf_{hir} \times R_{ir} \times K_{ir} + \sum_{vli} WKV_{vlih} \times LHS_{vlih} \right)$$

for $r = \text{Vietnam}$

$$(32) \quad YHF_h = \left(\sum_i ykcf_{hir} \times R_{ir} \times K_{ir} + \sum_{vli} WH_{lh} \times LT_{lh} \right)$$

for $r = \text{Vietnam}$

$$(33) \quad YG_r = \sum_i tp_{ir} PX_{ir} X_{ir} + \sum_i tc_{ir} P_{ir} C_{ir} + \sum_i tg_{ir} P_{ir} G_{ir} + \sum_{ij} tn_{ij} P_{ir} iocf_{ijr} X_{jr} + \sum_i tk_{ir} P_{ir} ID_{ir} + \sum_{ik} tm_{ik} PM_{ik} MS_{ik} ER_r + \sum_i te_{ir} PE_{ir} E_{ir} + \sum_{li} tw_{li} WK_{il} LK_{il} + \sum_i tr_{ir} R_{ir} K_{ir}$$

$$(34) \quad SH_r = s_p \times YH_r$$

for $r \neq \text{Vietnam}$

$$(35) \quad SH_r = \sum_h s_{p_h} \times YH_{hr}$$

for $r = \text{Vietnam}$

$$(36) \quad SG_r = s_G \times YG_r$$

$$(37) \quad S_r = SH_r + SG_r$$

Consumers

$$(38) \quad C_{ir} = cpcf_{ir} \times (1 - s_r^c) \times YH_r / P_{ir}$$

for $r \neq \text{Vietnam}$

$$(39) \quad C_{hir} = cpcf_{hir} \times (1 - s_{hr}^c) \times YH_{hr} / P_{ir}$$

for $r = \text{Vietnam}$

$$(40) \quad C_{ir} = \sum_h C_{hir}$$

for $r = \text{Vietnam}$

$$(41) \quad C_r = \sum_i C_{ir}$$

$$(42) \quad PC_r = (1 - s_p) YH_r / C_r$$

Government

$$(43) \quad G_r = (YG_r - SG_r) / PG_r$$

$$(44) \quad G_{ir} = cgcf_{ir} G_r$$

$$(45) \quad PG_r = \sum_i cgc f_{ir} PGM_{ir}$$

External sectors

$$(46) \quad Q_{ir} = \sum_j X_{jr}^S \times iocf_{ijr} + C_{ir} + G_{ir} + ID_{ir} + V_{ir} + TMQ_{ir}$$

$$\text{where } Q_{ir} = a_{M_r} (\omega_{M_r} M_{ir}^{-\delta_{ir}} + (1 - \omega_{M_r}) D_{ir}^{-\delta_{ir}})^{-1/\delta_{ir}}$$

$$(47) \quad D_{ir} = a_{M_r}^{\delta_{ir}/(1+\delta_{ir})} ((1 - \omega_{M_r}) P_{ir} / PD_{ir})^{1/(1+\delta_{ir})} \times Q_{ir}$$

$$(48) \quad M_{ir} = a_{M_r}^{\delta_{ir}/(1+\delta_{ir})} (\omega_{M_r} P_{ir} / PM_{ir})^{1/(1+\delta_{ir})} \times Q_{ir}$$

Linkage between Countries or Regions

$$(49) \quad MS_{irk} = a_{S_r}^{\theta_r/(1+\theta_r)} (\omega_{S_{irk}} PMS_{irk} / PM_{ir})^{1/(1+\theta_r)} M_{ir}$$

$$\text{where } M_{ir} = a_{S_r} (\sum_l \omega_{S_{il}} MS_{irk}^{-\theta_r})^{-1/\theta_r}$$

$$(50) \quad E_{ir}^s = \sum_k M_{irk}$$

$$(51) \quad PM\$_{irk} = PE\$_{ik} (1 + tmr_{irk})$$

$$(52) \quad \sum_r F_{ir}^{\$} = 0$$

International transportation services

$$(53) \quad PTM.TMG = \sum_{irk} \frac{tmr_{irk}}{1 + tmr_{irk}} PM\$_{irk} MS_{irk}$$

$$(54) \quad TMQ_{ir} = a_T^{\tau/(1+\tau)} [\omega_{T_r} (P_{ir} / ER_r) / PTM]^{1/(1+\tau)} TMG$$

$$(55) \quad PTM = a_T^{-1} [\sum_{ir} \omega_{T_r}^{1/(1+\tau)} (P_{ir} / ER_r)^{\tau/(1+\tau)}]^{(1+\tau)/\tau}$$

Capital formation

$$(56) \quad I_r^n = PIMI_r$$

$$(57) \quad ID_{ir} = invcf_{ir} I_r$$

$$(58) \quad V_{ir} = invtr_{ir} X_{ir}^s$$

$$(59) \quad DEP_r = depr_r K_r^s$$

$$(60) \quad PIM_r = \sum_i invcf_{ir} PKM_{ir}$$

$$(61) \quad PI_r = \sum_i invcf_{ir} P_{ir}$$

International capital mobility

$$(62) \quad RA_r = R_r^s / PI_r - depr_r$$

$$(63) \quad RE_r = RA_r (K_r^s / KLAG_r^s)^\phi$$

$$(64) \quad RE_r = recf_r RGE$$

$$(65) \quad K_r^s = KLAG_r^s - DEP_r + I_r$$

GDP Identities

$$(66) \quad GDP_{Pr} = \sum_i C_{ir} PC_{M0_{ir}} + \sum_i G_{ir} PG_{M0_{ir}} + \sum_i iocf_{ijr} X_{jr} PN_{M0_{ir}} \\ + \sum_i V_{ir} PX_{0_{ir}} + \sum_i ID_{ir} PK_{M0_{ir}} \\ + \sum_{ik} MS_{irk} PM_{\$0_{irk}} + \sum_i E_{ir} PE_{\$0_{ir}}$$

$$(67) \quad GDP_{Pr} = \sum_i C_{ir} PC_{M_{ir}} + \sum_i G_{ir} PG_{M_{ir}} + \sum_i iocf_{ijr} X_{jr} PN_{M_{ir}} \\ + \sum_i V_{ir} PX_{ir} + \sum_i ID_{ir} PK_{M_{ir}} \\ + \sum_{ik} MS_{irk} PM_{\$_{irk}} + \sum_i E_{ir} PE_{\$_{ir}}$$

Equilibrium conditions

$$(68) \quad \sum_i K_{ir} = K_r^s$$

$$(69) \quad \sum_i L_{ir} = \bar{L}_r^s$$

$$(70) \quad \sum_h LHS_{vih} = LK_{vli}$$

for $r \neq \text{Vietnam}$ $r = \text{Vietnam}$

$$(71) \quad D_{ir}^s = D_{ir}$$

$$(72) \quad \sum_{ik} MS_{irk} \times PM_{\$_{irk}} - \sum_i E_{ir} PE_{\$_{ir}} - \sum_i TMQ_{ir} P_{ir} / ER_r - F_{\$_r} = 0$$

Walrasian law

$$(73) \quad \sum_i PD_{ir} \times (D_{ir}^s - D_{ir}) + (S_r + F_r - I_r^n - \sum_i P_{ir} \times V_{ir}) \\ + ER_r \times \sum_{ik} (MS_{irk} \times PM_{\$_{irk}} - \sum_i E_{ir} PE_{\$_{ir}} - \sum_i TMQ_{ir} P_{ir} / ER_r - F_{\$_r}) \equiv 0$$

$$(74) \quad \sum_r \sum_i PD_{ir} \times (D_{ir} - D_{ir}^s) / ER_r + \sum_r (S_r + F_r - I_r^n - \sum_i P_{ir} \times V_{ir}) / ER_r \\ + \sum_{ir} PE_{\$_{ir}} (\sum_k MS_{irk} - E_{ir}) + (PTM \times TMG - \sum_r (P_{ir} / ER_r) TMQ_{ir}) - \sum_r F_{\$_r} \equiv 0$$

B2. Model Notation**Sets**

i, j	industries
r, k	countries or regions
l	labor types
h	households

Price Variables

$PM_{\$_{irk}}$	world price of imports
PMS_{irk}	domestic prices of imports by sources of imports
PM_{ir}	domestic prices of imports
$PE_{\$_{ir}}$	world price of exports
PE_{ir}	domestic prices of exports
PX_{ir}	output prices

PD_{ir}	domestic prices of domestically produced products
P_{ir}	prices of composite goods
PN_i	value added prices by sectors
PCM_{ir}	market prices of consumer's goods
PGM_{ir}	market prices of public goods
PNM_{ir}	market prices of intermediate inputs
PKM_{ir}	market prices of capital goods
PI_r	investment price index
PIM_r	investment price index
PC_r	consumer price index
PG_r	price index of public goods
PTM	price index of international transportation services
W_{ir}	wage rates by sectors
WK_{ir}	wage rates by sectors and types of labour
WM_{ir}	composite market wage rates
WKM_{ir}	composite market wage rates by types of labour
$WKVM_{vir}$	market wage rates by economic sectors and types of labour
WH_{ih}	household wage rate by types of labour
P_{LEIS}	prices of composite leisure
P_{LEISK}	prices of leisure by type of labour
R_{ir}	capital rents
RM_{ir}	market capital rents
R_r^e	equilibrium capital rent
RA_r	net real rate of return to capital
RE_r	expected rate of return to capital
RGE	global expected rate of return to capital
ER_r	exchange rate

Quantity variables

X_{ir}^S	domestic output
L_{ir}	composite labor demand
LK_{ir}	labor demand by types of labor
LKV_{vir}	labor demand by types of labor and economic sectors
LT_{ih}	time endowment by types of labour and economic sector
LS_{ih}	labour supply by types of labour and economic sector
LHS_{vlih}	labour supply by economic sectors and industries

$LEIS_h$	household demand for composite leisure
$LEISK_h$	household demand for composite leisure by types of labour
K_{ir}	capital demand by sector
K_r^S	total supply of capital
$KLAG_r^S$	total capital stock in the previous period
Q_{ir}	composite good demand
D_{ir}	domestic supply of domestically produced products
E_{ir}	export supply
M_{ir}	imports
MS_{ir}	imports by country of origin
TMG	total demand for international transportation services
TMQ_{ir}	demand for international transportation services by countries and regions
C_{ir}	household consumption by sectors
C_r	total demand for household consumption
G_{ir}	demand for government consumption
G_r	total demand for government consumption
$F\$,r$	foreign savings
I_r	total real fixed investment
ID_{ir}	demand for capital goods
V_{ir}	demand for inventory investment
DEP_r	total depreciation expenditure
$GDPR_r$	Real GDP by countries

Nominal variables

YH_r	household income
YHF_h	full household income
YG_r	government revenue
SH_r	household savings
SG_r	government savings
S_r	domestic savings
I_r^n	nominal fixed investment
$GDPN_r$	nominal GDP by countries

Parameters

$a_{x_{ir}}$	scale parameters in production functions
$\omega_{x_{ir}}$	share parameters in production functions

ρ_{ir}	exponent parameters in production functions
a_{Lr}	scale parameters in labour demand functions
ω_{Lir}	share parameters in labour demand functions
λ_{ir}	exponents in labour demand functions
a_{Mr}	scale parameters in composite goods functions
ω_{Mr}	share parameters in composite goods functions
δ_{ir}	exponents in composite goods functions
a_{Sr}	scale parameters in import demand functions
ω_{Sir}	share parameters in import demand functions
θ_{ir}	exponents in import demand functions
a_{Er}	scale parameters in export supply functions
ω_{Er}	share parameters in export supply functions
γ_{ir}	exponents in export supply functions
$iocf_{ijr}$	intermediate input coefficient of good j in industry i
$ykcf_{hir}$	share of capital income accrued to household h
$ylcf_{hir}$	share of labor income accrued to household h
$subs_{ir}, subs_{hir}$	subsistence consumption
$bshr_{ir}, bshr_{hir}$	marginal budget shares
a_{LVir}	scale parameters in labor demand function
ν_{ir}	exponent parameters in labor demand function
c_{LEISh}	subsistence level of leisure
b_{LEISh}	marginal share
α_{LEISh}	scale parameters in leisure demand function
ω_{LEISh}	share parameters in leisure demand function
τ_{lh}	exponent parameters in leisure demand function
α_{LHS_h}	scale parameters in labor supply function
k_{lh}	exponent parameters in labor supply function
ω_{LHS_h}	share parameters in labor supply function
$cgcf_{ir}$	government consumption shares
$invcf_{ir}$	fixed investment shares
$invtr_{ir}$	ratios of inventory investment to real production
s_{pr}, s_{pir}	private saving rate
s_G	government saving rate
tm_{ir}	import tariff rates
te_{ir}	export duty rates
tc_{ir}	sale taxes on consumers' goods

tg_{ir}	sale taxes on public goods
tn_{ijr}	sale taxes on intermediate inputs
tk_{ir}	sale taxes on capital goods
tp_{ir}	production taxes/subsidies
tw_{iir}	labor taxes/subsidies
tr_{ir}	capital taxes/subsidies