

## **CHALLENGES AND CHOICES IN POST-CRISIS EAST-ASIA:**

### **Simulations of Investment Policy Reform in an Intertemporal, Global Model**

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February 1999

#### **ABSTRACT**

The East Asian financial crisis exposed among other problems the excessive government interventions in credit allocation. This, together with poor supervision of the banking system, resulted in large volume of inefficient investment especially in the subsidized sectors. We argue that the crisis is an opportunity to reformulate the strategies of growth by way of eliminating politicized interventions on investment. In an intertemporal general equilibrium framework, we model the crisis as an exogenous investment technological shock and a financial shock generating excessive risk premia. We examine the adjustment processes of both the crisis-hit region and the world economies, and investigate the resource allocation and welfare outcomes of the removal of the investment subsidies. Our results suggest a contraction of GDP and investment immediately after the crisis, and significant welfare gains in the crisis-hit economies in return to elimination of the subsidies on firm's investment. Other developing countries and developed countries will be affected differently depending on their trade patterns with the crisis-hit economies.

**J.E.L Classification:** C68, F11, O41, O53

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**Key Word:** East Asian Crisis, Dynamic GE, Investment Policy

## **CHALLENGES AND CHOICES IN POST-CRISIS EAST-ASIA:**

### **Simulations of Investment Policy Reform in an Intertemporal, Global Model<sup>1</sup>**

#### **I. Introduction**

The East Asian financial crisis is currently cited as a central uncertainty confronting the global economy and the international commodity and capital markets. Growth is expected to be slower, risks are higher, and the flows of capital have been dislocated.<sup>2</sup> The crisis erupted in July 1997 when the Thai Baht was left to float and depreciated by 15%, giving way to a wave of contagion to Indonesia, Malaysia, Philippines, and South Korea. In Indonesia, the financial problems were compounded by a political crisis along with sharp increases in the price of basic consumer goods and rise in the rate of unemployment. In Korea as well, bankruptcies and unemployment rate were on the rise, where eight of the thirty largest industrial-trade conglomerates (Chaebols) filed bankruptcies in 1997. In Thailand, despite a bumper harvest and rising export prices, the severe contraction in industrial output led to a sharp rise in the unemployment rate to 6%.

No doubt, external adjustments in the region will necessitate significant financial re-structuring to accommodate the hostile conditions of a new environment with higher

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<sup>1</sup> We are grateful to Agapi Somwaru, Terry Roe, Lacker Jeffery, Ahmet Ertugrul, and to our colleagues at Bilkent, Minnesota and Richmond Fed for their critical comments; and to Ebru Voyvoda for her diligent research assistance. A previous version of the paper was presented at the 1999 Annual Meetings of the Allied Social Science Association, New York, in the IEFS Session "The East Asian Economies, before and after the Crisis." We are grateful to our discussant, Shantayanan Devarajan, and to the participants of the session for their valuable comments and suggestions.

<sup>2</sup> See, e.g., IMF (1997) World Economic Outlook, Interim Assessment, December. The Economist, April 11, 1998; and more recently, May 16, 1998.

interest rates, depreciation of real exchange rates, and lower domestic absorption.<sup>3</sup> Our main objective in this paper, however, is not limited to an anecdotal narration of the crisis, nor conjectures only on its possible effects on the global world economy at large. We extensively focus on the challenges and possible strategic reform choices faced by the crisis-hit governments. Our main motivation is that the outbreak of the crisis can as well be perceived as an opportunity by the respective governments to reformulate their patterns of growth and accumulation by way of eliminating inefficient (and often politicized) interventions in the allocation of investment credit.

The “East Asian Model of Industrialization” is traditionally associated by strategic export promotion policies with heavy reliance on government’s selective instruments towards setting well-defined guidelines for growth and export targets. The selected massive industrial-cum-trade conglomerates have served as the principal agents of this mission. Meanwhile, the banking system served, to a certain extent, as instruments of industrial promotion responding to the government’s strategic directives, rather than financial intermediaries in charge of allocating resources to most efficient uses. Throughout the process, the governments have used selective strategic instruments such as cheap credit provision, tax breaks, and discriminatory entry and exit barriers to the credit markets.

Effectively both the banks and the industrial conglomerates had intimate connections with each other, as well as with the government. Overall, however, the system was observed to suffer from inadequate supervision and a lax attitude over banks’ internal control; and in many cases there was no clear commercial assessment in granting

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<sup>3</sup> World Bank’s projections report an expected fall of about 7 percentage points in the overall GDP growth for 1998, in comparison to its projections in mid-1997. Accordingly, full recovery is expected to require

loans. It was natural to believe that the respective governments would not allow the banks to fail, and that there was full guarantee on deposits.

In retrospect, this process had an internal logic of its own in the early stages of the East Asian development, which traditionally has a high propensity to save and invest.<sup>4</sup> With relatively closed financial market, domestic investment demand could have been mainly satisfied by domestic savings, and the government policies would, in general, be effective in controlling the pressures on excessive investment demand. In the 1990s, however, the world capital markets have become increasingly integrated and the foreign capital transactions became sufficiently liberalized, as the interest ceilings in most of countries in the region were removed and entry restrictions were relaxed. Yet, prudential regulation lagged behind, and the governments failed to implement the necessary structural reforms on the banking system warranted by the new open macroeconomic environment. The banks found themselves in a haven of easy access to foreign funds that enabled them to incur short-term foreign debt very rapidly without properly evaluating the exchange risk. Thus, a major problem was that the newly liberalized banking system was operating under highly distorted incentives, and was far from responding to the signals of the resulting deterioration in the macroeconomic fundamentals.

On the other hand, government guarantees against default were maintained not only for the banks but also for the firms, as well. In this manner, firms in many instances have provided the main impetus for exacerbating the excess demand for investment.

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two to three years.

<sup>4</sup> See McKinnon and Pill (1997, 1998) for a more structural analysis; Amsden (1989), Bardhan (1990), and Westphal (1990) offer a thorough overview of the East Asian strategy of export-led growth in the context of Korean experience. Diao, Roe and Yeldan (1998), in turn, provide an endogenous growth modeling perspective to the “Asian model”.

Consequently, the internal logic of the East Asian model had witnessed a problem of moral hazard in that the banks and the new financial institutions borrowed excessively from abroad and financed unprofitable projects with an excessively high exchange risk.<sup>5</sup>

The crisis openly exposed the long time problems of the banking system in financing firms' investment strategies, and we argue that it can also be regarded as an opportunity to re-formulate the prospective growth strategies of the region under the new set of conditions of globalized commodity and financial markets. One of the major elements in post-crisis reform is how to reduce government intervention in the firm or bank investment decision processes. It is clear that such a reform as well as reforms of credit allocation and investment management would further encourage international and domestic competition, and hence, will affect economic growth of the region, as well as the world economy.

To analyze the possible general equilibrium outcomes of such a policy reform, we develop an inter-temporal (dynamic) multi-sector, multi-region (global) general equilibrium (GE) model. We primarily focus on the effects of extending the investment policy reform initiatives over the crisis region, as well as their repercussions on the global economy at large. The prevalence and nature of the linkages between globalization of the financial markets and regional capital accumulation patterns, and their effects on production, employment and income distribution can be easily captured with our modeling approach, and hence constitute the main indicators of our analytical focus.

The plan of the paper is as follows: In the next section, we provide a brief overview on the deteriorating macro economic conditions that eventually led to the

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<sup>5</sup> See, in particular, Krugman (1998) for an analytical exposure of the moral hazard motives behind the crisis. Krugman (1996) has also argued long before the outbreak of the Thai crisis that the Asian

outbreak of the crisis in 1997. Here we primarily focus on the culmination of the so-called problem of moral hazard, and the strategic role played by a poorly regulated and supervised banking system. In Section III, we introduce main elements of our analytical model, and discuss its distinguishing properties. We use the laboratory characteristics of the model in Section IV to simulate two sets of policy scenarios: first, on the evaluation of the general equilibrium effects of the crisis on the East Asian Economies; and second, on the investigation of the second best policy of removal of investment subsidies in the crisis hit region. We reserve Section V for concluding comments.

## **II. An Overview of the Macroeconomic Conditions Leading to the Crisis**

While there is no consensus on the definite causes of the crisis,<sup>6</sup> there is now surmounting evidence that the region's economies have been confronting a deteriorating macroeconomic environment since the early 1990s. We summarize some of the salient features of this episode in Table 1. Tables 2.1 and 2.2, on the other hand, quantify much of this deterioration.

<Insert Table 1 here>

<Insert Table 2.1-2.2 here>

First, several countries in the region experienced a real appreciation in their currencies over the 1990s, and by 1997 had sizable current account deficits (see Table 2.1). The mode of financing of these deficits was mostly through short-term foreign borrowing with a consequent rise in their stock of foreign liabilities. Concomitant with

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economies had no immunity against financial breakdowns.

<sup>6</sup> For a thorough review of the sources of the crisis, see Alba et. al. (1998), Corsetti et. al. (1998), Radeli and Sachs (1998); Krugman (1998). The celebrated web sites of Roubini ([www.stern.nyu.edu/~nroubini/asia/AsiaHomepage.html](http://www.stern.nyu.edu/~nroubini/asia/AsiaHomepage.html)), and of Krugman (<http://web.mit.edu/krugman/www/disinter.html>) are also excellent sources of reference.

this appreciation and foreign debt built-up, there was an autonomous rapid inflow of foreign capital into the region. The history of sustained economic growth for more than two decades had attracted foreign portfolio and direct investment. However, in the face of shallow and underdeveloped financial systems, this had put significant strain on the intermediation and productive use of these funds in the indigenous economies of the region.

Second, there was a marked slowdown in the rate of growth of exports and industrial output. This was mainly the combined result of the slow import demand of the developed countries, mainly of Japan; a recession in the global markets for electronics and semi-conductors; and policy shifts in most Asian economies imposing contractionary demand policies to contain inflationary pressures.

Third, the rapid inflow of capital and slowing of growth in the region unveiled a host of inherent structural problems in the financial systems. Specifically, there are three sets of problems: One regards the ownership structure of the financial intermediaries. In all crisis-affected Asian Countries, until very recently most of the banks were public-owned; entry was restricted, and in some it was practically nonexistent. Consequently, there was virtually no provision for bankruptcies or default. Another is the lack of supervision and regulation of the financial sector. Bank examinations are rare and often corrupt. There are either explicit or implicit government guarantees on all bank deposits. Finally, there is heavy government intervention in credit allocation. In most of these countries, special banks (such as development banks of Korea) are set up whose sole purpose is to lend policy loans to sectors viewed as responsible for “maximizing”

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<sup>^</sup> This specification has no real effect on the model results, since, alternatively, we could normalize all



economic growth, with no regard being paid to the expected rate of return. In Korea, for example, the banks were required to grant “policy loans” to specific sectors: heavy and chemical industries, shipping companies, and overseas construction firms in the 1970s, and small- and medium-sized firms since then. Policy loans historically have constituted between 40 and 50 percent of bank portfolios. At the end of 1996, commercial banks were said to have 4.5 trillions won of policy loans on their books, of which 56 percent were non-performing (Lacker and Li, 1998). Such vast government intervention led to cronism; hence the Suharto family in Indonesia, the Keietsu in Japan, and the Chaebol in Korea.

Under these conditions, the financial intermediaries whose liabilities are guaranteed by the respective governments naturally posed a serious problem of “moral hazard” mentioned above. This resulted in excessive borrowing and lending, mostly borrowing from abroad by the banking system without proper evaluation of the exchange risk.

In retrospect, existing data reflect that the rate of growth of bank lending to the private sector was well in excess of the rate of growth of GDP throughout the 1990s. Consequently, the ratio of bank lending to GDP grew more than 50% in Thailand and Philippines, by 27% in Malaysia, 15% in Korea and Indonesia. Furthermore, given the implicit public guarantees on the foreign liabilities of the banking system, the interest charges at home could have been kept low, the interest rate at which domestic banks could borrow abroad and lend at home was low, so that the domestic firms invested too much in projects that were marginal if not outright unprofitable. Hence, the percentage

of non-performing loans rose rapidly to reach 16% in Korea and Malaysia, 17% in Indonesia, and 19% in Thailand.

Given this background, we first introduce the foundations of our analytical GE model in the next section.

### **III. The model**

#### *III-1. Overview*

The model is based on the intertemporal general equilibrium theory with multi-region and multi sector specification, and draws in many ways upon the recent contributions of dynamic applied GE modeling by McKibbin (1993), Mercenier and Sampaio de Souza (1994), Mercenier and Yeldan (1997), and Diao and Somwaru (1997). The world economy is aggregated into three regions: the developing economy (*LDR*), the developed economy (*DR*) and the crisis-hit Asian economy (*CAR*). In each region, there are four production sectors, each of which produces a single aggregate commodity. The four aggregate production sectors are: (1) agriculture and food processes (*AGS*), (2) mineral, materials and intermediates (*MNS*), (3) other manufacturing (*MFS*) and (4) services (*SRS*). All the three regions are fully endogenous in terms of their producers and consumers' economic behavior. Furthermore, in a multi-region and multi-sector global model, commodity trade flows are kept track by their geographical and sectoral origin and destination. Countries are further linked by an Armington system so that sectoral commodities are differentiated in demand and supply by their geographical origin.

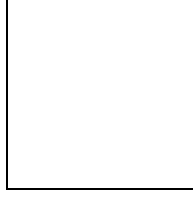
Firms in each region produce goods and conduct capital investment so as to maximize firm's valuation. Infinitely-lived households consume home produced and

imported goods to maximize an intertemporal utility function. Household income is consumed or saved in the form of equity in domestic firms or foreign bonds. Home firm equities and foreign bonds are assumed to be perfect substitutes. Through equity purchases by households, the world “pool” of savings is channeled to profitable investment projects without regard to the national origin of savings. Technological change and population growth are exogenous and hence are assumed to be zero in the model.<sup>7</sup> Detailed description of the model is as follows:

### *III-2. Firms and investment*

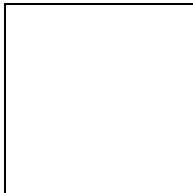
We assume that firms within each sector of every region can be aggregated into a representative firm. The representative firm operates with constant returns to scale technology. The value added production function for labor and capital is of Cobb-Douglas, while the intensities of intermediate goods are fixed. The representative firm chooses, at each time period, the input levels of labor and intermediate goods and makes investment decision to maximize the value of the firm. With constant returns to scale technology, the number of firms does not matter. Hence, we assume that the firm finances all its investment outlays by retaining profits so that the number of firm equities within each sector of a region remains unchanged.

A starting point for specifying the firm’s optimizing behavior is the condition of asset market equilibrium, i.e., the expected returns from holding the equity in the firms must be in line with those from holding a ‘safe’ asset, such as foreign bonds, at any time period:

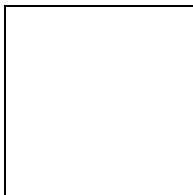


where  $r$  is the real interest rate,  $V_i$  is the market value of firm  $i$ ;  $div_i$  is the current dividend payments; and  $\Delta V_{i,t+1} - V_{i,t}$  is the expected annual gain on firm equity. Assuming an efficient financial capital market, each region faces the same world interest rate.

Firms' intertemporal decision problem can be restated more rigorously as follows: in each region's sector  $i$ , ( $i=1,2,\dots,4$ ), the representative firm chooses the optimal investment and labor employment strategies,  $\{I_{i,t}, L_{i,t}\}_{t=1,\dots,\infty}$ , to maximize the present value of all future dividend payments, taking into account expected future price of output, unit value of sector specific capital equipment, and labor wage,  $\{P_{i,t}, P_{I_{i,t}}, w_t\}_{t=1,\dots,\infty}$ , and the capital accumulation constraint. Formally,



subject to



where  $\beta$  represents the discount factor;  $I_{i,t}$  is quantity of new capital equipment built through investments at time  $t$ ;  $\delta_i$  is a positive capital depreciation rate; and  $a_t$  represents the capital adjustment costs and is assumed to be of the following form:

$$a_t = \frac{1}{2} \delta_i \left( \frac{I_{i,t}}{I_{i,t-1}} - 1 \right)^2 I_{i,t-1}.$$

The structure of newly produced capital equipment in terms of foregone sectoral goods is of Cobb-Douglas form. The foregone sectoral output used for investment purposes can be produced domestically or imported. Hence,  $PI_i$  can be written as a function of the (Armingtonian) composite prices:

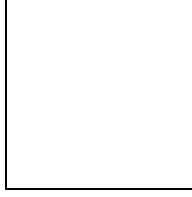
$$PI_i = \left( \sum_{j=1}^J d_j PC_j^I \right)^{1-I} \left( \sum_{j=1}^J d_j^* PC_j^I \right)^I$$

where  $PC_j$  is the price of the composite good,  $I$ ,  $0 < d_j < 1$ , and

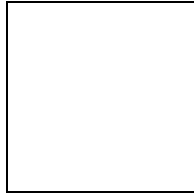
$$d_j^* = \frac{1}{1 + \tau_{ij}}$$

### III-3. The households and consumption/savings

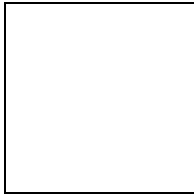
In each region the representative household owns labor and all financial assets, namely, the equity in domestic firms and foreign bonds, and allocates income to consumption and savings to maximize an intertemporal utility function over an infinite horizon:



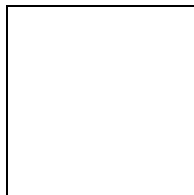
subject to the following current budget constraint: constraint:



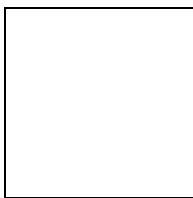
where  $\rho$  is the positive rate of time preference;  $TC_t$  is aggregate consumption at time  $t$ ;  $SAV_t$  is household savings,  $B_{t-1}$  is the stock of foreign assets, and  $r_t B_{t-1}$  is interest earned

from ownership of foreign bonds.  is the consumer price index, and  $TI_t$  is

lump sum transfer of government revenues from excise taxes and tariffs. We assume no government saving-investment behavior. “Government” spends all its tax revenues on consumption or as transfers to the households, and hence, public sector borrowing requirement is not explicitly modeled.  $TC_t$ , the instantaneous consumption, is generated from the consumption of final goods by maximizing a Cobb-Douglas function:

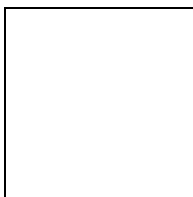


subject to



where  $C_{i,t}$  is the final consumption for good  $i$ , and the consumer shares,  $b_i$  satisfy  $0 < b_i < 1$ , and  $\sum b_i = 1$ .

The flow of savings,  $SAV_t$ , is the demand for new foreign bonds issued by other regions, which, under equilibrium, reflects current account balances of the region:



where a positive  $FBOR_t$  implies a surplus in the region's foreign trade.

#### *III-4. Government policies and distortions of financial system*

The government policy instruments include import tariffs, export taxes net of subsidies, indirect taxes imposed on production processes, and sales taxes on final consumption.<sup>8</sup> Our main purpose here is to capture the effects of the government interventions leading to over-investment in financially-dubious projects within the crisis-hit Asian economy. However, such information is not available in a quantifiable form in the original database. As discussed earlier, such government intervention has often taken the form of implicit insurance that is equivalent to a stock of contingent public liabilities that are not reflected by data on debt nor the deficit until the crisis occurred. Even though there were differences in the specifics of the policies pursued by the governments to

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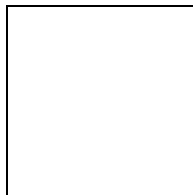
<sup>8</sup> Further information about these instruments along with their initial levels are included in the database used for conducting the calibration and "base-run" of the model. See Global Trade Analysis Project (GTAP) Database, version 3, in McDougall (1997).

enable the firms to expand their investment, they all led to the same outcome: excessive concentration of investments in certain key sectors of the economy.

We introduce three sources of deviations from a perfectly competitive global capital market configuration: (i) the existence of risk premia in the domestic real interest rate for the crisis-hit Asian economy; (ii) a tendency of the domestic financial (banking) system to overborrow – or what Mckinnon and Pill (1997) refer to as the “over-borrowing syndrome”, and Krugman popularized as “moral hazard”; and (iii) the prevalence of implicit subsidies to targeted sectors –manufacturing, in particular, for the case of *CAR*.

Abstract theory, in many instances, assumes that real interest rate parity holds continuously; that is, residents of a small open economy can borrow or lend instantaneously at an exogenously given world interest rate. There is a considerable body of empirical evidence suggesting, however, that this hypothesis is inappropriate, and that risk premia are part of the interest rates of the developing countries. Furthermore, in those countries where financial institutions are poorly regulated, opening up to capital inflows most often leads to excessive banking lending for misguided or speculative purposes, exposing the economy to even greater systemic financial risks (Mckinnon and Pill, 1998).

Given this stance, we follow on the classic Fisher (1930) identity and construct the following relationship between domestic and world interest rates:





where  $r_R$  denotes domestic (region R's) interest rate;  $r^*$  world interest rate in the international capital market;  $\Delta P_R$  changes in domestic (region R's) price level;  $\Delta P^*$  changes in world price level;  $\Delta \varepsilon_R$  changes in nominal exchange rate; and  $\pi_R$  the risk premium in the domestic (region R's) capital market.

Transforming, we obtain the real interest parity:

$$r_R = r^* + \frac{\Delta P_R}{P_R} - \frac{\Delta P^*}{P^*} + \pi_R$$

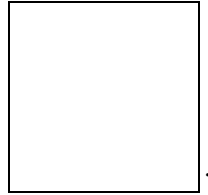
which is expressed in two components: deviations from relative purchasing power parity and a real risk premium. Note, however, that in the absence of nominal assets and currency, the model does not admit “nominal” exchange rates. Per contra, the *real* exchange rate is defined as the ratio of domestic versus foreign price levels (see, e.g., Obstfeld and Rogoff, 1996). Thus, the terms in the parenthesis vanish. In the conceptualization of our real model we have:

$$r_R = r^* + \pi_R$$

Therefore, deviations from world interest rate consist of only the real risk premium in the model.  $\pi_R$  is zero at the steady state but may be positive along the transition.

With investment risk, domestic banks may borrow from the external markets at the prevailing rate,  $r^*$ , but lend to domestic firms at the rate including risk premium,  $\pi$ . However, if prudential regulation and supervision are lacking, domestic banks may be able to assume “open foreign exchange position” and not cover the risk associated with

external borrowing. This will be particularly strengthened if the banking sector assumes that it will most like be bailed out in the event of a crisis. Thus, in the *CAR* region, we will further impose that at the sectoral level, the domestic interest rate is differentiated by the existence of a government-induced interest ceiling,

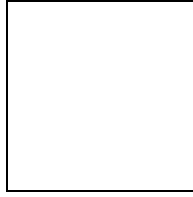


The government intervention via  $\gamma_{i,R}$  would allow domestic firms in some sector to avoid to pay risk premium on their external borrowing, as  $r_{i,R}$  may be lower than  $r^*$ . This would further lead to over-borrowing at the sectoral level, as the artificially lowered interest rate would encourage firms to increase their investment expenditures.

Finally, we introduce an “investment subsidy policy” to capture the basic features of the government interventions in firms’ investment strategies. The subsidy is thought to be granted only for the firms in the manufacturing sector (*MFS*), with no comparable provisions for the other three sectors.<sup>9</sup> To reduce the firm’s risk caused by investment in *MFS*, the subsidy is designed to lower firms’ capital installation (adjustment) costs in their investment process as well as a ceiling on the interest rate faced by the firms in *MFS*. More formally, let  $s_i$  be the subsidy rate on capital installation cost, the adjustment cost equation is redefined for the region of *CAR*:

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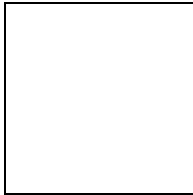
<sup>9</sup> In Korea, excess investment and associated profitability problem was concentrated in the manufacturing sector, in other countries such as Thailand, the focus was on the real estate sector (Huh, 1997). As the data about real estate sector are not available in the database used for this study, foregoing analysis may be regarded more suitable for the case of Korea.



where  $s_i$  is positive for *MFS* and zero for the remaining three sectors in *CAR*. This formulation captures most of the discretionary pro-industry bias implicit in the incentive system. The investment subsidy is financed by a lump sum tax on (or a lowered government transfer to) the households.

### *III-5. Equilibrium*

Intra temporal equilibrium requires that at each time period, (i) in each region, demand for production factors equal their supply; (ii) in the world, total demand for each sectoral good equal to its total supply; (iii) in the world, the aggregate household savings equal zero. In the steady state equilibrium, the following constraints must also be satisfied for each region:



## **IV. Analysis of Alternative Simulations**

We focus on two sets of issues and conduct two scenarios. The first scenario (*EXP-1*) is used to evaluate the general equilibrium effects of the crisis on the world economy. The *EXP-1* later is served as a “base” in the second scenario (*EXP-2*) which is designed to investigate the possible effects of eliminating government investment subsidy and moving interest ceiling in the crisis hit economy. That is, in *EXP-2*, in addition to

what we implement in *EXP-I*, the investment subsidy and ceiling on the interest rate in *CAR* will be removed.

#### *IV-1. EXP-I: General equilibrium outcomes of the crisis*

In their recent paper, Corsetti, Pesenti and Roubini (1998) undertake an extensive analysis of the crisis-hit Asian economies' macro economic environment and financial system before and throughout the financial crisis, and conclude that common domestic and international shocks hit several East Asian economies in the 1996-1997 period rather than a pure financial panic episode. Our first policy experiment pursues along this line of argument. However, in the absence of a full-fledged theory on financial-real economy linkages, we directly implement the real side consequences of the crisis on investment patterns, and shock the model to simulate the investment contraction. The East Asian financial crisis resulted in currency depreciation, increases in domestic interest rate and prices, more unemployment and increased bankruptcies in the crisis-hit Asian countries. All these will likely to cause investment to fall, and hence economic growth to slow down. Since the intertemporal GE is a real economy apparatus in which monetary terms and many financial assets are not explicitly recognized, it cannot capture the effects of currency depreciation on the world financial and asset markets directly.<sup>10</sup> Instead, we focus on the effects of the crisis on domestic investment in *CAR* by increasing the value of the risk premium and the difficulty in capital investment in this region.

Technically, we exogenously raise the value of the risk premium in Eq. (2) for *CAR* in the first five years, and then slowly lower it to the original level in the following five years. In addition, we shock the technological coefficient in the sectoral investment

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<sup>10</sup> However, the apparatus allows us to introduce the concept of real exchange rate as the ratio of domestic versus foreign commodity baskets. See, Obstfeld and Rogoff (1996, Chp. 4) for an analytical exposure.

functions in the *CAR*, such that the productivity of capital investment in the region falls temporally in the first 5 years, and then slowly recovers to the original level in the following 5 years. By so doing, investment falls in the *CAR*, which sets out diverse changes in other economic indicators, both for the *CAR* region and for the world (Table 3).

Outcomes of the first simulation are comparable with the World Bank's projections in that *CAR*'s GDP falls with a fall in its investment (the World Bank, 1998). With improvements in its terms of trade, *CAR*'s exports rise and imports fall. A trade surplus, together with a low level of investment, result in current account surpluses in the *CAR*.

The effects on the world economy as well as on the other countries are also captured by the model. The world GDP falls by 1.28 percent in the first year of the simulation. GDP in the developing economy (*LDR*) falls by 0.19 percent but slightly rises (0.07 percent) in the developed economy (*DR*) in the early periods of transition (Table 3). Such results are also consistent with the World Bank's projections, where it was argued that the crisis would affect developing countries more than the high-income countries. A fall in *LDR*'s GDP is mainly caused by a slight depreciation (about 0.53 percent) of its real exchange rate, measured by its domestic price index in terms of *DR*'s price index. With world merchandise price falling by about 3 percent, exports fall and imports rise in both *LDR* and *DR* regions during early period in the model. These cause *LDR*'s current account deficit to increase. For the *DR* region, changes in trade flows, together with foreign capital leaving from the crisis-hit economy (*CAR*), there are huge capital inflows (about \$180 billion) into the *DR* region in the early period of the model.

This result is consistent with what we observed in the U.S. and EU's capital markets in 1998 (Table 3).

<Insert Table 3 here>

With its intertemporal optimization feature, the model traces the entire transitional path until a new steady state is approached sufficiently. Without further shock and any risk caused by uncertainty in the future, the model shows that world economy will eventually recover from the shock of the Asian crisis, and the steady state level of world GDP will be slightly higher than its base level (a less than 0.8 percent increase, see Table 4). This result, of course, depends on the assumption that productivity loss in the crisis-hit region's capital investment will regain and hence the risk premium will fall in the following 10 years. In terms of the level of GDP, the shock is observed to be temporary for all the three regions. The gross domestic product of the crisis-hit economy (*CAR*) is expected to rebound its pre-crisis level when the model converges to the new steady state, while for the other two regions, GDP would rise by more than one percent in the new steady state. On the other hand, changes in trade flows are permanent for *CAR* and *DR*, i.e., in the new steady state, exports rise and imports fall in *CAR*, and exports fall and imports rise slightly in *DR*, while exports and imports both rise in the *LDR* region. (Table 4)

<Insert Table 4 here>

#### *IV-2. EXP-2: Effects of government investment policy on economic recovery*

In the second scenario, to study the possible effects of a change in government's investment policy, we eliminate government's investment subsidy and remove the

interest ceiling in the manufacturing sector. Of course, without an explicit banking sector, the model cannot capture the entire effects of a change in the government's investment policy, especially the intervention in banking system and banks' businesses. Note, however, that even though the model lacks an explicit banking system, it maintains an effective financial capital market and accommodates the main attributes of financial intermediation of a market economy in a theoretically consistent framework.

In the model, the investment subsidy is employed to reduce the capital adjustment cost while the interest ceiling reduces the risk of investment in manufacturing. The subsidy rate is chosen such that the total subsidy is equivalent to 2.2 percent of total investment while the interest rate ceiling results in the interest rate faced by the firms in *MFS* being 30 percent lower than the market rate in the *CAR*. The subsidy is received only by firms investing in the *MFS* sector, and it is set equivalent to 40 percent of capital adjustment costs of this sector.<sup>11</sup>

It is obvious that such a policy will distort firms' investment decisions, leading to overinvestment in the *MFS*, and possibly under-investing in other sectors, such as services. Hence, intuitively, removing such policy distortions would lower *MFS*'s investment and rise investment allocated in the other sectors. The simulation results of *EXP-2* show that investment in *MFS* does fall significantly, and rises in all other sectors. In Table 5, we document such sectoral investment changes in selected years, while full size transition paths for sectoral investment, together with change in sectoral output are

---

<sup>11</sup> According to Dalla and Khatkhate (1995)'s calculation, the interest subsidy involved in policy loans in Korea amounted to about 1 percent of GNP and 6.2 percent of government expenditure in 1991; the cumulative subsidy during 1981-1991 amounted to 2 trillion won per annum.

presented in Figures 1 - 4. In the last row of Table 5, we also report changes in the steady state levels of sectoral capital stock due to elimination of the investment subsidy.

<Insert Table 5 here>

We observe that with a fall in *MFS*'s investment after eliminating the investment subsidies, the size of *MFS*, in terms of its capital stock, contracts more than a quarter in the new steady state, while the size of service sector expands by 1 percent,<sup>12</sup> compared with those in the *EXP-1*. The rate of fall in *MFS*'s investment is accelerated, while the rise in the other three sectors' investment slows down over time along the transition. This causes total investment in the *CAR* to fall, as compared with those in the *EXP-1* environment (Table 8, row 1 and Figure 5). Thus, the effect of eliminating sector (*MFS*'s) investment subsidy on the economy-wide capital stock is negative (Figure 6).

We observe that, in terms of production level, the size of *MFS* does not contract as much as its capital stock. Comparing with that in *EXP-1*, output of *MFS* only falls by 23 percent in the new steady state when the investment subsidies on this sector is eliminated (Table 6 and Figure 3). The major reason is that, with less capital supply, the marginal product of capital in *MFS* rises by 22 percent in the first 10 years, and by 40 percent in the new steady state. This causes the *MFS* sector to employ more labor to substitute for capital in the production process.

<Insert Table 6 here>

Simulation results further show that even though *MFS*'s capital stock level falls due to slowing down of the investment allocated to this sector, increases in the marginal product of capital play a dominant role in determining its sectoral dividends. Hence,

---

<sup>12</sup> In the data, the sector of *MFS* accounted for less than 6 percent of GDP and total investment, while services accounted for more than 55 percent of GDP and total investment in the region of *CAR*.





net exporter for *AGS* in the *DR*'s market but a net importer for the same aggregate good in the *LDR*'s market. When *CAR*'s exports of *AGS* rise due to the elimination of investment subsidy, its exports of *AGS* to *DR* rise more than that to *LDR*. On the other hand, *CAR* is a net importer for *MFS* in the *DR* market, but a net exporter for the same aggregate good in the *LDR* market. When *CAR*'s exports of *MFS* fall, its exports of *MFS* to *LDR* fall more than that to *DR* (Table 7).

The foregoing discussion about the sectoral effects on *CAR*'s economy due to the elimination of investment subsidies already tells us that the *CAR*'s economy would become more efficient after the policy change. To see it clearer, we report some selected aggregate economic indicators in Table 8, together with the indirect effects on the other two regions caused by the policy change in the *CAR*.

Effects of removal of the investment subsidy on the *CAR*'s real GDP are negative along the entire transitional path. In comparing with that in *EXP-I*, the short- and long run negative changes in the level of *CAR*'s GDP are in the range of 1 to 3 percent.

We decompose changes in the regional GDP at a given year by the following:

$$\bullet \text{ EMBED Equation.3 } \bullet \bullet$$

where  $PVA_i$  is value-added price for output  $X_i$  and  $S_i$  is sectoral share in GDP. This equation implies that given sectoral contribution shares, total net change in a region's GDP is equivalent to the summation of changes in sectoral outputs and relative value-added prices. It is obvious that a fall in *MFS*'s output (about -23 percent in the steady state) is a major factor to cause *CAR*'s GDP to fall. However, as the marginal product of its sectoral capital rises, the value-added price for *MFS* rises by 27 percent (in the steady state) relative to other sectors' prices. This allows the *MFS*'s share in *CAR*'s GDP to rise

about 0.25 percent. On the other hand, even though outputs of the other three sectors rise in *CAR*, their relative prices fall, which also contributes to a contracted GDP level. For example, a significant fall (-8 percent) in the value-added price for the *SRS* (services) relatively to the other sectors' prices causes the share of *SRS* in GDP to fall by 0.8 percent, even though the output of *SRS* rises.

The social welfare gain for *CAR* from eliminating investment subsidy is captured by a positive change in the equivalent variation index. This index is calculated from the intertemporal utility function for the consumers and takes into account both the transitional and steady state effects of the policy change, putting more weight on the current consumption and less on the future. The equation that is used to calculate the welfare gain/loss is borrowed from Mercenier and Yeldan (1997) and can be found in the Appendix.

Changes in the *CAR*'s investment subsidy policy also affect the other regions' economy, as well as the world economy. Such effects are summarized in Table 8, column 2 - 4, while full size transition path for each region's total investment and capital stock are in Figures 5 and 6. In comparison with the simulation results of *EXP-1*, the effects on the developing economies are mainly negative, yet positive on the developed economies. Taking the comparison of the steady state equilibria as a case of illustration, *DR*'s total exports increase and imports fall. On the other hand, *LDR*'s capital stock contracts, total exports and imports both fall. These results are best understood when account is given to the fact that current data suggest *DR* to have a comparative advantage in *MFS*'s production and hence is a net exporter of *MFS* goods. The investment subsidy on the manufacturing sector in *CAR* is equivalent to an implicit export subsidy for *MFS*.

This allows *CAR* to compete with *DR* for exports of *MFS*. Once *CAR*'s investment subsidy in *MFS* is eliminated, both regions can fully exploit their comparative advantage, and hence *DR*'s manufacturing exports rise, leading to welfare improvements. On the other hand, *LDR* has comparative advantage on the exports of *AGS* and *MNS*. When *CAR* increases its exports and reduces imports of these two sectoral commodities, it has to compete with *LDR*, and hence *LDR* is likely to be hurt from such competition.

<Insert Table 8 here>

Compared with the effects of the crisis shock, the simulated investment policy reform conducted by *CAR* generates relatively modest aggregate effects in the short- and medium-run, especially on trade flows for both the crisis-hit economy, and on the other regions. The major reason is that the expected gains from the investment policy reform should mainly be a result of improving the economy's efficiency, i.e., gains in productivity growth. The model cannot capture such a gain, however, as it is based on the neoclassic growth theory in which productivity growth is regarded exogenous. Even taking into account this limitation, the long-term effects of the investment policy reform conducted by *CAR* in the model are quite impressive, no matter for the region which conducts the reform (*CAR*), or otherwise. In real life policy setting, one may encounter many other forms of distortions in the crisis-hit Asian economies in their industrial policies, banking systems, or capital markets. It can be expected that once such essential reforms are implemented by the countries of the region, adjustments in their economies as well as in the world will be much larger than what we simulate here.

## **V. Concluding Comments**

In this paper we have investigated the analytics of post-crisis adjustments of the East Asian crisis with the aid of an intertemporal general equilibrium model. In the absence of a full-fledged model of real-financial linked theoretical apparatus, we tried to capture the real side effects of the crisis by way of examining its consequences on investment demand. Our results revealed that in the short-run, the crisis-hit Asian region would suffer a loss of GDP of 8 percent, and a decline in total investment of 48 percent.

Next we analyzed the general equilibrium results of the possible policy reform on investment allocations conducted by the crisis-hit economy. By way of eliminating the implicit investment subsidy element on manufacturing, we tried to capture the efficiency gains associated with the removal of distortions on the firms' intertemporal decisions on capital accumulation. Since the investment subsidy is not explicitly observed in data, the direct income effects caused by eliminating the subsidy cannot be obtained. However, we still can obtain numerical inferences about the welfare consequences from the possible reform: in terms of equivalent variation, the reform strategy results in welfare gains of 0.35 percent over the crisis environment (*EXP-I*).

Steven and Sachs (1998) note that the East and Southeast Asian crisis is actually a "crisis of economic success." It is expected that the crisis-hit countries will be able to recover and reinvigorate their growth patterns, even though this may take time. On the other hand, the crisis may as well be read as an opportunity for these economies to re-examine the growth strategies that they pursued in their early economic development process, and enable them to conduct necessary policy reforms to reduce and eliminate the inefficient and often politicized interventions in the economy. Given the new constraints set by a more integrated world economy and a mobile international financial market,

some policies that might have played an important role in stimulating growth thus far are facing a new challenge. For instance, the triumvirate of government-banking system-industrial conglomerates, was designed initially to stimulate investment in certain strategic industries --such as telecommunications and automobiles. Under an economic environment in which capital market is relatively closed and the banks' lending ability was effectively constrained by domestic savings, close government-bank-firms linkages may be vital at mobilizing resources to allocate into a few priority infant industries, and allow these industries to grow rapidly and be able to compete in the international markets. Once the country's financial capital market is opened to the world capital market, the financial resource limitations are virtually removed. Under such an environment, however, the current international financial system can openly expose and almost simultaneously punish the countries' economic weaknesses. It is therefore essential, under the conditions of a financially globalized world economy, for countries to maintain consistent and coherent economic policies.

It is clear that understanding of all this macroeconomic phenomena with its microeconomic foundations within the context of a model with general equilibrium outcomes based on rational behavior and optimization is no easy task, and the current state of our knowledge is not yet developed to capture all this detail in a unified framework. However, we believe that, the intertemporal framework within an applied GE setting is a good head start to enhance our understanding on what is to be done given the macroeconomic fundamentals emerging from the crisis.

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**Table 1. Macroeconomic Fundamentals and the Banking System of East Asian Countries"**

..

**Macroeconomic**

..

*(1) on the good side...*

- strong GDP growth  
Average growth rate of 7% in the 1990s, slight slowdown in 1996.
- high investment rate  
Above 30% of GDP throughout the 1990s (except the Philippines), however most in non-traded sector.
- balanced government budget  
Fiscal balance of the central government in surplus or a small deficit as a share of GDP.
- low inflation  
Single-digit inflation rates throughout the 1990s for all the

..

*(2) on the bad side...*

- marked slowdown in exports  
Increasing trade imbalance for most countries especially since 1995.
- increasing current account imbalances  
Large and increasing current account deficits for most countries, Thailand and Malaysia largest and most persistent.
- appreciating real exchange rates  
A real appreciation of the pegged Asian currencies since 1995.
- accumulating short term foreign currency dominated debt  
The ratio of short-term external liabilities to foreign reserves over 100% in many countries."

..

**Banking**

..

- virtually no competition in business lending  
The majority of the banks government owned except in Thailand.
- widespread of policy loans  
Policy loans a big part of bank loan portfolios (averaging 30-40% in Korea and Indonesia)
- explicit and implicit government guarantee  
Traditionally bad loans consistently bailed out by the government.
- lack of bankruptcy law or lack of its enforcement  
Bankruptcy law nonexistent or not enforced in most of the countries.
- nontransparent accounting rules

Largely inconsistent with international standards, loose definition of nonperforming loans.”

..

**Table 2.1 Selected Macroeconomic Indicators of Some Asian Economies**

**GDP Growth**

..	1991
	1992
	1993
	1994
	1995
	1996
..	
Korea	
	9.13
	5.06
	5.75
	8.58
	8.94
	7.13
..	
Indonesia	
	6.95
	6.46
	6.50
	7.54
	8.22
	7.98
..	
Thailand	
	8.41
	7.77
	8.27
	8.85

	8.68
	6.66
..	

**Current Account (% of GDP), NIA definition**

..	
	1990
	1991
	1992
	1993
	1994
	1995
	1996

..

Korea

-

-

-

-

-

-

-

..

Indonesia

-

4.40

-

-

-

-

-

..

Thailand

-  
-  
-  
-  
-  
-  
-

..

**Real Exchange Rate, end of year data**

..

1990

1991

1992

1993

1994

1995

1996

..

Korea

97.1

91.5

87.8

85.2

84.7

87.8

86.8

..

Indonesia

97.4

99.6

	100.8
	103.8
	101.0
	100.5
	105.1

..

Thailand

102.2
99.0
99.7
101.9
98.3
101.7
107.6

..

Data Source: IMF and Corsetti, Pesenti and Roubini (1998)

**Table 2.2 Selected Measurement of the Banking System of Some Asian Countries**

**Market Shares, Korea, 1996**

..	Deposits
..	loans and
Commercial	23.3
..	27.4
Specialized	9.0
..	14.5
Non-bank financial	67.7
..	58.1

**Number and Market Shares of Total Banking Assets, Indonesia**

..	1982
..	1991
..	..
..	Share
..	Number
..	share
..	number
State	73.7
..	5
..	45.2
..	5

Private	11.3
	70
	37.7
	119
..	
Foreign and Joint-venture	7.0
	11
	7.7
	29
..	
development	8.0
	..
	9.3
	..
..	
Total	100
	86
	100
	153
..	

#### **Market Shares, Thailand, 1980 and 1992**

..	1980
	1992
..	
Commercial	82.0
	87.0
..	
Agricultural	1.6
	0.6
..	



Savings	1.2"
..	2.6"
Government Savings	7.7"
..	5.2"
Bank for Agricultural and Agricultural	4.7"
..	2.6"
Government Housing	2.8"
..	2.0"
Source: Lacker and Li (1998)	

### **Nonperforming Loans**

..	1997"
..	
Korea"	16%"
..	
Indonesia"	17%"
..	
Thailand"	19%"
..	

Source: BIS; Jardine Fleming.

**Table 3. General Equilibrium Outcomes Caused by a Fall in Investment**  
% change from the base



..	
..	
..	
..	
(change in	193.44"
	32.95"
	-
	-
	0.12"
	3.12"
	-
	-
	51.42"
..	
Total	8.39"
	-
	-
	-
	2.14"
	4.06"
	-
	-
	4.37"
..	
Total	
	-
	-
	4.42"
	1.94"
	0.89"
	0.85"
	7.15"
	-
	-
..	
Real exchange rate	
	-
	0.92"
	3.86"
	-
	0.26"
	0.64"
..	
..	
..	
..	

(1) In the steady state, current account has to balance. Negative numbers indicate current account deficits.

(2) The price index of DR is chosen as a numeraire.

**Table 4. Change in the Steady State's Equilibrium Caused by the Crisis**  
% change from the base

..	..
World	..
CAR	17.28
DR	11.77
LDR	11.61
..	..
Total	..
..	..
GDP	0.94
..	0.12
..	1.12
..	1.17
Total	0.77
..	2.59
..	-
Total	0.24
..	..
..	-
..	2.32
..	1.69

**Table 5. Change in Crisis-Hit Asian Economy's Investment after Eliminating Subsidies**

% change from the first scenario

..	..
..	..
..	AGR
..	MNS

..	<i>MFS</i> **	
	<i>SRS</i> **	
		year
	0.36**	
	1.56**	
	-	
	1.42**	
..		year
	-	
	-	
	-	
	4.42**	
..		year
	0.33**	
	0.37**	
	-	
	5.45**	
..		Steady
	-	
	-	
	-	
	2.72**	
..		Stock of capital
	..	
	..	
	..	
	..	
..		the Steady
	-	
	-	
	-	
	1.03**	
..		

**Table 6. Sectoral Effects on Crisis-Hit Asian Economy after Eliminating Subsidies**  
% change from the first scenario

..	<i>AGR</i> **
	..
	<i>MNS</i> **

..		..
..		<i>MFS</i>
..		..
..		<i>SRS</i>
..	Year	
..	SS	
..	Year	
..	SS	
..	Year	
..	SS	
..	Year	
..	SS	
..		Outputs
..	0.18	
..	0.86	
..	0.51	
..	-	
..	-	
..	-	
..	-	
..	0.60	
..		Exports
..	2.00	
..	3.84	
..	1.51	
..	3.32	
..	0.08	
..	-	
..	1.30	
..	4.14	
..		Imports
..	-	
..	-	
..	-	
..	-	
..	-	
..	13.93	
..	-	
..	-	

% change from the first scenario

## Exports

• •

• •

..

• •

• •

 $SS^{\cdot\cdot}$ 

• •

..

3.37\*\*

..



	<i>MFS</i>
	-
	-
	-
	0.12
	-
	-
..	
	<i>SRS</i>
	0.45
	2.30
	3.80
	1.23
	2.88
	4.16
..	
..	
	..
	..
	..
	..
	..
	..
..	
..	
	<i>Imports</i>
	..
	..
	..
	..
	..
..	
..	
	..
	<i>LDR</i>
	..
	..
	<i>DR</i>
	..
..	
..	
	Year
	Year
	SS
	Year
	Year

..	SS''
	<i>AGR''</i>
	-
	-
	-
	-
	-
..	
	<i>MNS''</i>
	-
	-
	-
	-
	-
..	
	<i>MFS''</i>
	-
	6.91''
	15.03''
	-
	6.05''
	13.92''
..	
	<i>SRS''</i>
	-
	-
	-
	-
	-
	-
..	



	..
	..
	..
..	
GDP	
	-
	-
	-
	-
	-
	0.02
	0.14
	0.37
	-
	0.89
	0.75
..	
Terms of	
	0.02
	0.31
	1.16
	0.03
	-
	-
	-
	-
	..
	..
	..
..	
Current Account	
..	
	..
	..
	..
	..
	..
	..
	..
	..
	..
..	
(change in	
	26.41
	13.50
	..
	-
	0.21
	..
	-
	-

	..
	..
	..
	..
..	
Total	
	1.36"
	-
	-
	-
	-
	-
	2.03"
	-
	2.09"
	-
	-
	0.08"
..	
Total	
	-
	-
	2.08"
	-
	-
	-
	1.24"
	0.02"
	-
	..
	..
	..
..	
Welfare Index	
	..
	..
	0.35"
	..
	..
	-
	..
	..
	-
	..
	..
..	

(1) See Appendix for the definition of welfare index.

## **Appendix: Equations and Variables in the Model**

### **A.1. List of equations**

#### The time-discrete intertemporal utility

(The elasticity of intertemporal substitution is chosen as one)

- EMBED Equation.2 •

#### Intertemporal Value of Firms

- EMBED Equation.2 • • EMBED Equation.2 •

### **Within period equations (time subscript is omitted)**

#### A.1.1 Armington Composite Functions

- EMBED Equation.2 •

- EMBED Equation.2 •

#### A.1.2 CET Functions

- EMBED Equation.2 • •

#### A.1.3 Value Added and Output Prices

- EMBED Equation.2 • •

#### A.1.4 Capital formation function

- EMBED Equation.3 • •

#### A.1.5 Factor Market Equilibrium

- EMBED Equation.2 • •

#### A.1.6 Private Demand System

- EMBED Equation.2 • •

#### A.1.7 Household Income

- EMBED Equation.2 • •

#### A.1.8 Commodity Market Equilibrium

- EMBED Equation.2 • •

#### A.1.9 Trade surplus

- EMBED Equation.2 • •

## Dynamic Difference Equations

### A.1.10 Euler Equation for Consumption

- EMBED Equation.2 • •

### A.1.11 Non-Arbitrage Condition for Investment

- EMBED Equation.2 • •

### A.1.12 Sectoral Capital Accumulation

- EMBED Equation.2 • , •

### A.1.13 Foreign Asset Formation (debt if negative)

- EMBED Equation.2 • , •

### A.1.14 Terminal Conditions (Steady State Constraints)

- EMBED Equation.2 • •

### A.1.15 Welfare Criterion (Equivalent Variation Index)

- EMBED Equation.2 • •



where,  $\bullet$  EMBED Equation.3  $\bullet \cdot \bullet$  is base year full consumption for good  $i$ . Thus, A.1.15 states that the welfare gain resulting from the policy shocks is equivalent from the perspective of the representative consumer to increasing the reference consumption profile by ( percent.

## A.2. Glossary

### A.2.1 Parameters

$(_{n,i}$	shift parameter in Armington function
$(_{n,i}$	shift parameter in CET function
$A_{n,i}$	shift parameter in value added function
$A_{n,k,i}$	shift parameter in capital good production function
$a_{n,i}$	share parameter in private consumption demand function
$(_{n,i}$	share parameter in value added function
$(_{n,i}$	share parameter in Armington function for own good
$(_{n,i}$	share parameter in CET function for own good
$d_{n,i,j}$	share parameter in capital good production function for input
$(m_{n,i}$	elasticity of substitution in Armington function
$(e_{n,i}$	elasticity of substitution in CET function
$IO_{n,i,j}$	input-output coefficient
$($	rate of consumer time preference
$(_{n,i}$	capital depreciation rate
$(_{n,i}$	capital installation adjustment cost parameter

### A.2.2. Exogenous variables

$L_n$	labor supply
$tm_{n,s,i}$	tariff rate
$tx_{n,s,i}$	indirect tax rate
$r$	world interest rate
$s_{n,i,t}$	investment subsidy rate

### A.2.3. Endogenous variables

$PWM_{n,s,i,t}$	world price
$PMM_{n,i,t}$	composite import price
$PEE_{n,i,t}$	composite export price
$PD_{n,i,t}$	own good price
$PX_{n,i,t}$	producer price
$PC_{n,i,t}$	composite good price
$PVA_{n,i,t}$	price of value added
$PI_{n,i,t}$	unit price of investment quantity
$q_{n,i,t}$	shadow price of capital
$div_{n,i,t}$	dividends
$Wl_{n,t}$	wage rate
$Wk_{n,i,t}$	marginal product of capital in sector
$L_{n,i,t}$	labor allocated to work
$X_{n,i,t}$	output of good
$C_{n,i,t}$	total absorption of composite good
$D_{n,i,t}$	own good
$M_{n,s,i,t}$	bilateral trade flow from region n to s
$MM_{n,i,t}$	composite import good
$EE_{n,i,t}$	composite export good
$TC_{n,t}$	aggregate private consumption
$CD_{n,i,t}$	private consumption demand for composite good
$INVD_{n,i,j,t}$	investment demand for composite good
$INTD_{n,i,t}$	intermediate demand for composite good
$Y_{n,t}$	household income
$SAV_{n,t}$	household savings
$K_{n,i,t}$	capital stock
$I_{n,i,t}$	investment quantity
$FB_{n,t}$	new purchases of foreign assets
$TI_{n,t}$	transfers (set at a given ratio of GREV)
$V_{n,i,t}$	value of the firm.

