The Road to Economic Recovery in Asia

- A Recursive Dynamic CGE analysis

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(Draft, comments welcome)

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I. Introduction

The terrible financial crisis in Asia is clearly in recent memory, as it only began in 1997. Based on positive indicators observed in Thailand, Korea and other Asian countries, since the summer of 1999, many people forecast a recovery of Asia's economy. Included in these indicators are: the exchange rates, stock market indexes, foreign currency reservations and economic growth rates; all showing strong increases in many recovering Asian countries.

Firstly, exchange rates in direct crisis-affected countries (Korea, Thailand, Indonesia, Philippines, and Malaysia) reached a bottom level in first half of 1998, and rebounded afterwards.

(**Insert Table 1 here**)

Secondly, the stock market has slowly recovered in almost all the Asian economies. Exemplified this is a doubling of index levels, over the past twelve months, in both the Thai and Malaysian stock markets; while the main indexes in Soul and Singapore are now above where there were in the middle of 1997, when the collapse began. Before the Asian crisis, the stock index in Korea measured 705 points. By September 1998, the index level had decreased to 292 - a loss of almost 60%. As of September 1999, Korea's stock market index has returned to 869, a stunning 23% higher than prior to the financial crisis.

Thirdly, the foreign currency reserves in Asian countries have also shown steady recovery. For example, the foreign currency reserves reached a bottom level of $22.1 billion US in Korea in January 1998. During the recovery foreign currency reserves have continuously increased, reaching $64.9 billion US by October 1999, a considerably higher level than the $30.6 billion US before the financial crisis.

Fourthly, after hitting a bottom level in 1998, the economic growth rates in the Asian countries improved in 1999. For example, in June 1999, the Korean industrial product increased by almost 30% allowing some economists to forecast that the economic growth rate in Korea in 1999 could reach 9%. At the same time, Asian exports increased significantly, with the ratio of Current Account to GDP in Thailand, for instance, measuring -8% in 1997, being turned around into a surplus in 1998 of 11%.[1]

(**Insert Table 2 here**)

During the crisis of the past two years, most Asian countries have adjusted their financial system. The exchange rates, foreign currency reserves, and stock market indexes rebounded from bottom levels, helping Asia to attain a relatively stable macro-economic environment for further development, even as

1 See Economist, p16, Aug.21, 1999.

different economic growth among Asian countries was observed.

As described above, it seems that another economic boom in Asia is eminent, however, has the Asian economies fully recovered?

In fact, the economic recovery to date appears sadly exaggerated. Currently, the major problem for Asian economic recovery is not on the supply or production side but on the demand side. To achieve a full recovery in Asia, a strong demand for Asian products is crucial. Currently, the domestic demand is still very weak in the two largest Asian economies - Japan and China. In addition, the domestic consumption and investment in other Asian countries are also not recovered to its pre-crisis level yet. On the external demand side, even as Asian countries have attempted to better develop markets in North America and Europe, there exists a limited capacity to absorb additional Asian exports (both U.S and EU have widened their trade deficit with Asia economies during the last two years). This has resulted in the stiffening of competition amongst Asia and other developing areas.

It is very important to study the deeper reason for the insufficiencies in aggregate demand in Asian economies. The domestic demand in Japan has been stagnated since the middle of the 1990s. The increase of domestic demand in Japan is not only crucial for the economic recovery of Japan, but also crucial for providing markets for other Asian countries. Japan, needs to be the engine for Asia's economic recovery. However, if Japan devalues its currency, it will increase exports of Japanese products in the short term; but it will further weaken aggregate demand for other Asian economies. The Asian market as a whole will shrink again, thus delay Japan's own economic recovery. On the other hand, if China devalues its currency, a substantially lower world prices for many manufacturing goods will force other Asia countries to make a very difficult choice. In order to maintain their export share in the third country market, they will have to devaluate their currency, and the devaluation of currency will increase the costs of re-payment of foreign debts, which will result in their financial system dipping into trouble once again.

This paper uses a recursive dynamic Computable General Equilibrium (CCE) model to quantitatively discuss the road to economic recovery in Asia. It evaluates the economic impact of currency devaluation in Japan and China and a recovery of private consumption growth in Japan to rest of the Asian economy. We show that an increase in Japan's domestic consumption will generate strong positive effects on other Asia economies' recovery, while a devaluation of Japanese yen or Chinese RMB (Ren Min Bi or Yuan) will likely set back the on going recovery process in Asia

The rest of this paper is organized into the following sections: the second section discusses the non-performing loans in Japan's financial system, and its effects on Japanese consumption and investment. Next section describes trade dependence and structure for China and its major trade partners and the possible impact of RMB devaluation. The fourth section brief describes the basic structure of the CCE model used in this study. Fifth section describes the simulation scenarios and discussion of the simulation results. The final section makes some concluding remarks concerning Asian economic recovery.

II. Key to Recovery: Domestic Demand in Japan

2.1 Relation between Japan and Asian economy

In general, people believe that the financial crisis in Asia started in July 1997 in Thailand. In fact, the starting point of the financial crisis in East Asia should be attributed to the bursting of the Japanese bubble economy in 1990. The bursting of the economic bubbles in Japan generated huge amounts of non-performing loans in the financial sectors resulting in massive capital flight into other countries in this region.[2] The economic boom from 1990 to 1997 in East Asia helped Japan stabilize its economy. However, the financial crisis of 1997 led straight back to Japan, and put its economy into a long-term depression, forcing Japan to seek economic reform. Considering that Japan's economy is the largest in Asia, it is necessary for the Japanese economy to recover before the Asian economy can be fully recovered.

Japan's economy is very important to its neighbour countries in Asia. Total export to Japan was 12% of GDP in Malaysia and 5~7% of GDP in Indonesia, Thailand and Singapore. Shrinking of Japanese market strongly affects the exports from Asian countries. On other hand, because the economic relations between Japan and Asian countries became more and more closed, 31.3% of Japan's export went to Asian countries in 1990, 37.7% in 1993, 40.1% in 1994, 43.7% in 1995, and 44.1% in 1996, the financial crisis in Asia strongly limited the Japan's export.[3] After the financial crisis Japan's export to Asian countries reduced significantly. The total export from Japan to the five Asian countries (Korea, Indonesia, Thailand, Malaysia and Philippines) decreased almost 50%. Japan cannot stimulate its economy through exports as it did before the crisis.

2 The Japan's investment outflows began after 1965 and increased moderately from 1960s to middle of 1980s. During

2.2 Depressed Domestic Demand in Japan

The key of economic recovery in Japan is to increase the domestic consumption and investment. Normally, disposable income, wealth, and expectation are the three major elements to determine household consumption level. Unfortunately all the three elements negatively effected Japanese domestic consumption simultaneously in recent years.

(1) Income Decreased

High unemployment rate

The unemployment rate has continuously increased in Japan, where the official unemployment rate in June 1998 reached a post-war record of 4.3%. The unemployment rate in Japanese statistics does not include "discouraged workers" who would work if there were jobs available but have given up looking. The total number of discouraged workers has been estimated as high as 10% of "people not in labor force"[3]. If the statistical methods used in most Western countries were applied, Japan's unemployment rate would have measured 9.4% in July of 1998. Because the unemployment rate was high, while household income decreased, this resulted in a fall in consumption.

Declined wage rate

During the last few years, income kept falling as companies tried to reduce personnel expenses through wage cuts. Meanwhile, corporations have been curtailing personnel costs by shifting employment from full-time, full-benefit, male workers to lower paid, zero-benefit, part-time female workers.

Declining overtime work

A usual important part of Japanese income is overtime income, but due to high inventories, many Japanese firms were forced to significantly reduce the amount of available overtime working hours, the overall effect was a further reduction in household income.

(2) Negative wealth effect

After the burst of the bubble economy, the nominal value of wealth of the Japanese population (stocks, housing and other real estate) have reduced significantly. These negative wealth effects

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1973 - 85, nearly half of all GDP growth in Japan came from growth in trade surplus.
3 See Osamu Nariai, "Japan's Economic Restructuring: The ROE Revolution", 1998.

decreased consumption.

The surplus capital accumulated in the Japanese financial sector after 1985 was due to the perpetually high savings rate in Japan.[4] This allowed the banks to actively supply loans to the real asset sector. The total amount of banking loans increased 10% annually during the period of 1985-1987, fueled by increases in loans to the real estate sector by more than 20%. From 1987 to 1990 the money supplies (M2 + CD) in Japan increased more then 10% each year.[5] Because of low interest rate and rich money supply, financial speculations became increasingly active.

Since 1986, the scale of price increases in real assets has surprised many people. For example, the 1988 prices of corporate real estate in Tokyo were 350% higher than prices in 1983. In addition, housing prices also experienced increases of 300% in many metropolitan areas. Assuming that the average land price per square metre in 1980 was 100, the price increased to 153.6 in 1985 and 625.9 in 1990 in six of Japan's largest cities, including Tokyo, Osaka and Nagoya.[6]

The average land price in Japan doubled from 1986 to 1990. In 1990 the total value of land was almost five times higher than the GDP. Even though the area of land in the USA is 25 times larger than that in Japan, the land value in Japan was four times higher.[7] Adding to the problem was that more than half of all Japanese families owned property, and when the price of land increased, most Japanese believed that the value of their assets would double or triple within few years, which stimulated real estate and stock market and further attract corporate speculators.

As the real estate market prices soared the stock market continued to soar on record gains. Beginning in 1985, Japan's stock index was around 12000 and started to realize increases by 1986, resulting in a level of 39000 at the end of 1989. The total value of the stocks increased from 224.2 trillion Yen to 890 trillion Yen, a tripling in only four years. The value of stocks and real estate increased the capital gain almost equaling GDP during the period of 1986 to 1989.

In 1987, 40% of Toyota's profit came, not from its auto products, but rather, from the revenues of financial speculation. The ratio of non-operating revenue was even higher in other large corporations, for example, 60% at Matsushita, 65% at Nissan, 63% at Sony and 134% at Sanyo. By the second half of the

4 Japan's national saving rate stayed high, household saving increased to almost 22% of disposable income in middle of 1970s. Since 1986, Japan has run a huge current account surplus each year, $80 billion in a peak year, and Yen to dollar rate jumped from 245 Yen in December 1985 to 120 Yen in December 1989.
5 See Hayakawa, "Japanese Financial Markets", 1996.
6 Data sources: Oizumi, E.,"Property Finance in Japan", Environment and Planning, 1994, Vol.26, P200.

1980s, Japan was piling up an unprecedented large current account surplus and the recycling of the surplus capital took on additional channels - international portfolio investment and direct investment. Thirty seven percent of personal savings were channeled to overseas markets.[8]

The Japanese bubble burst in 1990. Using the base price of real assets in 1993 as 100, the price of corporate real estate had decreased from its highest point of 350 in 1990 to 96.3 in 1997, a total decrease of 20.3% in 1996, and 14.8% in 1997. Housing prices had decreased from 300 to 135.4 in the same period.

(3) Pessimist expected income

There is a long history of a lifetime employment system in many Japanese firms, and when these firms faced bankruptcy during the financial crisis, the result was the lay-off of workers. This significantly shook job security confidence, and future income expectations.

Due to the devaluation of the stock market (from its peak 39000 in 1989 to 14000 in 1992[9]) and property prices in 1992, the value lost in Japan was equal to 80% of GDP of that year. Since the Japanese bank was the largest investor in the stock market, it also became the biggest loser in the bubble economy. The collapse of the stock market generated many bad loans within the banking system, resulting in very large losses in capital revenue. How many non-performing loans were generated in the Japanese financial system by the bubble economy? Because of low transparency in the Japanese financial sector, the official data on bad loans in Japan was ambiguous. The banks were holding somewhere between 87 and 140 trillion-yen in questionable loans. The Economist estimated bad debts at Japan's banks amounted to perhaps 30% of GDP in 1998 [10]. However, when one major financial institution went bankrupt or one high level official who was in charge of the financial sector stepped down, usually through the newspaper the public was surprised to find that the values of bad loans had significantly increased, sometimes expanding more than ten times. Thus the non-performing loans became long term trouble for Japan's economy.[11]

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7 The total area is 9.37 million square kilometers in the USA and 0.37 million square kilometers in Japan.
8 See Hayakawa "Japanese Financial Market", 1996.
9 See Konya, Fumiko, The Rise and fall of the Bubble Economy: An Analysis of the Performance and Structure of the Japanese Stock Market", in The Structure of the Japanese Economy, (ed.) Okabe, Macmillan, 1994.
10 See Finance and Economics: Japanese Property, Economist, August 22nd, 1998, p60 and "Time to wake up", Economist, September 26, 1998, p21.
11 From 1956-1973, the annual GDP growth rate was 9.3% in Japan, then, the GDP growth rate decreased slowly to 4.1% at 1975-1991. The GDP growth rate continues to decrease 1% from 1992-1999 and shrank to 0.4% in 1999. Japan's economy has fallen into recession.

Since the burst of the bubble economy in 1990, the Japanese government, corporate firms and financial sectors have continuously released optimistic estimations of quick economic recovery and return to economic boom; however failed promises resulted in a complete loss of resident confidence in government and in the financial sectors.

Falling prices caused by depressed domestic demand continued to undermine corporate sales, while falling disposable income, decreasing values of wealth, and increasing unemployment rate, uncertainty over job security, and pessimistic expected income further undermined domestic consumption in Japan.

2.3 Decreased Investment

Japan's investment decreased due to the bust of the bubble economy. During the late 1980s, over-investment was very popular in Japan. After burst of the bubble economy, many investment projects lost money. The expected return on investment decreased significantly, forcing many individuals to become increasingly conservative, resulting in a decline of new investments. Small companies usually invested approximately 50% in Japan. Effected by the financial crisis, many small Japanese firms have had financial troubles, some even teetered on bankruptcy, resulting in small enterprise investment to fall by 25.8% in 1998. Of the major components of real GDP, the capital investment fell most drastically by 8.8 % in 1998.

Since the domestic market was relatively inactive and the shrinking of overseas markets, there was a rapid increase of Japanese inventories to the highest level in 23 years. This forced Japanese enterprises to reduce manufactured production by 18.8% in 1998, while inventories remained the same. Also, construction was continuously downsized. The total houses sold in June 1998 decreased 8.3% compared to one year ago. In July, there was further decrease by another 18%. The Japanese government planned to spend 16.6 billion dollars to stimulate the economy. Among that, 7.7 billion was used to public construction while reducing the interest rate at the same time. However, the reduction of the interest rate and increased government expenditure did not stimulate private consumption. Many Japanese continuously reduced their consumption in order to pay back their loans; thus both monetary and fiscal policies had little impact.

2.4 Japan's postpone strategy

When the stock and real estate market collapsed in Thailand, Malaysia and Indonesia in 1997, it immediately caused the collapse of the banking system and induced economic chaos. However, after the economic bubble burst in 1990, the Japanese economy still operated for a quite long period of time. Why?

The degree of impact of the economic bubble depended on tolerance of the society. The stronger the economy, the larger the tolerance. Since huge assets had been accumulated in past decades, the Japanese economy could tolerant strong impacts. Japan's foreign currency reservation was $213.9 billion in November 1998, with a total value of overseas net assets of $958.7 billion – both the highest in the world. Meanwhile, Japan was the biggest debt owner in the world, and held more than $300 billion of U.S. Treasury Bills. The personal savings in Japan was 1200 trillion-Yen (almost $9, 500 billion), equal to two years GNP in 1998. Among it, the deposit at post-saving system managed by the government was as high as $1,830 billion.[12]

The rich financial resource made it possible for Japan to survive for quite long period before economic collapse. Considering the fact that the Japanese manufacturing industry was very competitive in the world market, Japan kept a very high surplus from its automobile and electronic exports. Moreover, the government has to a large extent, controlled the bank-dominated system; therefore, the Japanese government could administer much of the financial resources of the society and support the large banks and enterprises that encountered financial trouble.[13]

After 1995, even some medium-size financial institutions were forced to claim bankruptcy; the Japanese government tried their best to protect the largest top 20 banks. Even though the burst of bubble economy had already shown the evils of Japan's financial sector and the necessity for reform, the Japanese government tried several ways to delay the reform. On one hand, the Japanese government continuously spread optimism and tried to maintain people's confidence on financial sector. On the other hand, they tried to increase the profit generated by manufacturing sectors and insert it into the banking system in order to avoid the financial crisis.

The Japanese government postponed the necessary reforms and protected the culprits - large banks and corporations. In fact, they were waiting for the next economic boom that would bring more

12 See Cargill, T. Hutchison, M., and Ito, T. "Deposit Guarantees and the Burst of the Japanese Bubble Economy", Contemporary Economic Policy, 14:7, 1996.

13 See Merton Miller, "Alternative Strategies for Corporate Governance", in Wen and Xu edited "Reformability of

contracts to Japanese industry and utilize industry profits to cover the non-performing loans. Unfortunately, a financial crisis in Asia arrived instead of economic prosperity. When many Asian countries fell into serious financial crisis, Japan's overseas markets shrank significantly. Meanwhile, the values of Japan's investment in these countries seriously devalued. The financial crisis attacked Russia and Brazil in 1998 and further retreated Japan's export market. The uncertainty of the international market worried the Japanese who were avoiding reform of its financial system and forced them to start economic reform under very tough domestic and international atmosphere. The delay of the reform to the Japanese financial sector not only held up the economic recovery in Japan but also bring uncertainty to East Asian economies.

There are many excellent economists in Japan. They understand the serious of such problems. However, worry about their political frailty, the top level of government officials did not pay enough attention to growing concern. The top officials always made very optimistic forecasts about the time schedule and speed of economic recovery through all kinds of news-medium since 1990. Their dream was to duplicate the economic miracles of the past decades. Although these predications were false for most cases, they did believe in optimal forecasting. At the corporate level, most Japanese had ideas on how to manage the crisis of market competition, but were sadly unprepared for the impeding financial crisis.

2.5 Reform on Japan's financial sector

The basic characteristic of Japan's financial sector is the bank-driven governance system. Enterprises are organized like a family. Enterprises hold stock between each other, and emphasize the employment relationship inside the firm, using the seniority and long-term employment system. This system emphasizes cooperation rather than competition. Of course, this was good for Japan's economic development after the Second World War, and this played an important role in allowing Japan to catch up with Europe and the U.S. However, Japan's economy has already matured, and the older system cannot meet the new challenges.

The bank-driven governance system is in fact the cooperation between enterprises, banks, and the government. The bank takes important responsibilities in regards to the enterprises. If the banking

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China's State Sector", World Scientific, 1997.

system can function normally, then of course higher the efficiency of the system will be. Under Japan's model, the large banks serve both as leading creditors and major controlling shareholders. Under the bank-driven model it is very possible to induce over-investment. The over-investment and over-loan problem in the bank system may easily induce the bubble economy. The performance of Japanese banks in the financial crisis was not as good as their counterparts in the U.S. and other European countries, who use a stockholder-driven governance model. The stockholder-driven model is better suited to resisting the financial crisis.

By virtue of the fact that the bank owns stock in the enterprises, any losses of the enterprises may spread to the bank. If the bubble economy bursts, the bank immediately loses much capacity for payment. The Japanese bank-owned assets are not only very small but also in shortage of variety. Also, if the large enterprises have problems, it will influence the interests of the main-shareholding bank, and thus the bank will try to protect the enterprises from bankruptcy. Following the same logic, if the large bank has some problems, it will affect the financial stability of the country, and then the central bank will make every effort to bail out the bank. Of course, under this system, many warning massages to the financial sector may be distorted. There is often only the appearance of stability when there indeed lurks severe economic crisis upon the horizon.

Moreover, the Japanese financial sector is in lack of transparency and monitoring mechanisms. The central bank of Japan has no power to make independent monetary policy, and in many cases, controlled by the Japanese government. From the forming of the bubble economy to its collapse, Japanese banks did not tighten the money supply. This was a very serious strategic mistake. All these problems made for a weak banking system.

Even the cost of reforming banking system in Japan is very high, the long-term pain is worse than short-term. The Japanese government issued huge amounts of bond (which equal to around U.S.$500 billion) in 1999 and tried to use the funds to bailout the financial institutions with heavy non-performing loans. Meanwhile, in order to reduce the pressure of non-performing loans, a new Transition Bank system has been introduced. All the measures could help the weak banking system to survive loner time, but they cannot solve the underlying fundamentals. Do not allow large banks to go to bankrupt only works for the short term but makes no sense for long-term economic development. Moral hazard may encourage the large banks with high non-performing loans take even higher risky investment strategy, and increase the uncertainty for the future. How to allow some large banks bankrupt and maintain the

social stability is a great challenge to Japanese economy. The recovery of the Asian economy needs the success of the reform in the Japanese financial sector.

III The Stability of Chinese RMB

Since the financial crisis the exchange rate has collapsed in many Asian countries. Only Mainland China and Hong Kong can maintain a stable exchange rate. The stability of exchange rates in Hong Kong and Mainland China provide an important condition for the economic recovery in Asia. Meanwhile, it generates large pressure on China.

Chinese exports have continuously decreased since December 1998. For example, exports decreased 1.9% in December 1998, another 10.8% in January 1999, 10.2% in February, 3.6% in March, and 7.3% in April 1999. Some Chinese officials and economists suggested that China should devalue its currency in order to increase exports. For example, several economists in Taiwan, even forecast that if Mainland China had a current account deficit in 1999, and economic growth rate will fall below 7%, then China will devaluate RMB around 15%.[14]

What is the effect on the Asian economy if the Chinese currency devalues?

(**Insert Tables 3 and 4 here**)

Table 3 presents sectoral structure of exports for Asian developing countries and Table 4 provides the structure of China's exports by destination. They show that China's exports is concentrated in manufacturing sectors (over 80%). Of which, labor intensive and electronic products constitute more than 60% of China's exports to industrial countries. Manufactured intermediates and other machinery also become major export products (took over 25% of China's total exports) in recent years. Other Asian countries also export similar goods and Chinese exports are very competitive with such products exported from other Asian countries to the third market. If China actively devalues its currency it will create great competitive pressure on other Asian countries exports. The current economic recovery in Thailand, Korea and some other Asian countries is partially based on the stability of Chinese RMB. Because China did not devalue, Korea and Thailand had re-gained their competitiveness in the international market after they devalued their currency. However, if China devalues, it will reduce their

14 See "Euro-Asia Information", No. 10, October 1999.

competitiveness significantly and force them to devalue their currency again, and this will likely trigger another negative cycle of competitive devaluation among Asian countries. Therefore, it will be interest to quantitatively estimate the extent of effects on trade performance by other Asia countries if China devalues its currency.

IV Structure of the CGE Model

The global CGE model used in this chapter is an extension of the CGE models that had been used in Noland, Robinson and Wang (1999) to a recursive dynamic setting. It is part of a family of models that have been used widely to analyze the impact of global trade liberalization and structural adjustment programs. It focuses on real trade flows, trades balances, world prices, and real exchange rates. It incorporates considerable detail on sectoral output and trade flows — both bilateral and global. However, we obtain this structural detail at the cost of not explicitly modeling financial markets, interest rates, or inflation, i.e. it is not designed to generate quarterly macroeconomic forecasts. It could be linked to a macro model that includes asset flows and generates macro scenarios. Given a macro scenario by a macro econometric model, our model could then be used to determine the resulting real trade flows and sectoral structural adjustments for each region in a recursive dynamic framework — given a path of future world economic growth, it generates the pattern of output and trade resulting from world economic adjustment to the shocks specified in the alternative macro scenarios.

The model uses seventeen fully endogenized regions and sixteen production sectors in each region to represent the world economy. The seventeen regions are: (1) the United States, (2) Canada, (3) European Union (EU) (15 member countries), (4) Japan, (5) Australia, (6) New Zealand, (7) Korea, (8) Taiwan, (9) Hong Kong, (10) China, (11) Singapore, (12) Malaysia, (13) Thailand, (14) Philippines, (15) Indonesia, (16) South Asia (Indian, Bangladesh, Nepal, Pakistan, and Sri Lanka), (17) Rest of the World.

The Sixteen sectors are: (1) agriculture, (2) forestry and fishery (3) processed food, (4) mineral and energy, (5) beverage and tobacco, (6) textile, (7) wearing apparel, (8) other light manufactures, (9) wood and paper products (10) manufactured intermediates, (11) motor vehicles and parts, (12) other transport equipment, (13) electronic equipment, (14) other machinery, (15) utility, housing and construction, and (16) transportation and services, a portion of which is allocated to international

shipping. The correspondence between sectors in our model, GTAP database and ISIC are listed in Table-A10.

There are six primary factors of production: agricultural land, natural resources, capital, agricultural labor, unskilled-labor, and skilled-labor. Skilled- and unskilled-labor have basic education in common, but skilled-labor are usually have more advanced training. While the agricultural labor are those who have little or no education and work only in farm sectors. Primary factors are assumed to be mobile across sectors, but immobile across regions.

4.1 Production and Demand structures

In each region, there is one representative competitive firm for each sector, which produces one product. Production technology is characterized by two-level nested CES functions. At the first level, firms use two types of inputs: a composite primary factor and an aggregate intermediate input according to a CES cost function. At the second level, the split of intermediate demand is assumed to follow a Leontief specification, with no substitution among intermediate inputs. Technology in all sectors exhibits constant return to scale, implying constant long-run average and marginal costs.

Agents in each region view products from different regions as imperfect substitutes (the Armington assumption). The private household in each region maximizes a Stone-Geary utility function over the sixteen composite goods and savings, which leads to the Extended Liner Expenditure System (ELES) of household demand. Household savings are treated as a demand for future consumption goods with zero subsistence quantity (Howe, 1975). An economywide consumer price index is specified as the price of savings and represents the opportunity cost of giving up current consumption in exchange for future consumption (Wang and Kinsey, 1994). Government spending, and investment decisions in each region are based on Cobb-Douglas utility functions, which generate constant expenditure shares for each composite commodity. In each region, firm intermediate inputs, household consumption, government spending, and investment demand constitute total demand for the same Armington composite of domestic and imported goods from different sources. A two-level nested CES aggregation function is specified for each composite commodity in each region. Total demand is first divided between domestic and imported goods, and then the expenditure on imports is further divided according to geographical origin under the assumption of cost minimization. Complete trade flow matrices for all regions are part of the model

solution.

There is an international shipping industry in the model to transport products from one region to another. Each region is assumed to allocate a fraction of the output of its transportation and service sector to satisfy the demand for shipping, which is generated by interregional trade. The global shipping industry is assumed to have a unitary elasticity of substitution among supplier sources. The margins associated with this activity are commodity/route specific. In equilibrium, the total value of international transportation services at the world price equals the sum of the export proportions of the service sector's output from each region.

The government in each region is assumed to impose import tariffs, export subsidies, and indirect taxes, all in ad valorem terms. Tariff and tax (subsidy) rates vary by sector and by destination.

4.2 Equilibrium, Exchange Rate and Macro Closure

Within each region, the model solves for domestic commodity and factor prices that equate supply and demand in all goods and factor markets. The model also solves for world prices equating supply and demand for sectoral exports and imports across the world economy. In addition, for each region, the model specifies an equilibrium relationship between the balance of trade and the real exchange rate (which measures the average price of traded goods, exports and imports, relative to the average price of domestically produced goods sold at the domestic market), given world prices and regional export supply and import demand functions. An exogenous change in a particular region's exchange rate will reverberate across the world economy, affecting the aggregate trade balances and/or real exchange rates of all seventeen regions as they adjust their trade flows and structures of production to achieve a new equilibrium. However, as with other CGE models, the model only determines relative prices. The United States is specified as the reference economy, with both its aggregate price level and exchange rate fixed exogenously. All relative world prices and trade balances are measured in terms of real U.S. dollars. Because traded and non-traded goods are assumed to be imperfect substitutes by sectors, changes in relative world market prices are only partially transmitted to domestic markets. The model thus incorporates a realistic degree of insulation of domestic commodity markets from world markets, but the links are still important and provide the major mechanism by which external shocks are transmitted across regions.

The equilibrium exchange rate determined by the model for each region can be interpreted as the real effective exchange rate (REER) deflating by the ratio of the regional domestic goods price index and the U.S. domestic goods price index. It is important to emphasize that the exchange rate variable in the model is not a financial exchange rate, since the model has no assets or asset markets. Under appropriate numeraire selection, however, it is equivalent to the real exchange rate defined as the ratio of a price index of all traded goods (imports and exports) to a price index of all non-traded goods (domestically produced goods sold at the domestic market). When the price index of home goods is selected as the numeraire, the percentage change in the real exchange rate is equal to the percentage change of the exchange rate variable in the model. In a multi-region model where all world market prices are endogenous, the equilibrium real exchange rate is affected by changes in the international terms of trade facing a region. Devarajan, Lewis, and Robinson (1993) and Wang (1994) discuss this issue. It represents the equilibrium real exchange rate that is consistent with a given trade balance.

For each region, the model includes the three macro balances: savings-investment, balance of trade (in goods and non-factor services), and government expenditure-receipts (government deficit). The three balances are not independent and the determination of these macro balances is the subject of traditional macroeconomic models. In terms of our real trade model, which does not include financial markets or variables typical of macro models, the determination of these macro aggregates is specified by exogenously determined rules. The macro adjustment mechanism constitutes the macro "closure" of the model.

The specification of a macro closure is to select rules by which macro balances are brought back to equilibrium when exogenous shocks disrupt the benchmark equilibrium during an experiment. A macro scenario is imposed on the CGE model, which then traces out the sectoral implications of the assumed macro behavior (Devarajan, Lewis, and Robinson, 1990). The macro closure is not based on a specification of optimizing behavior by rational agents in the model, but reflects a simplified description of the results of a macro adjustment process that is not specified in detail.

In the aggregate, as noted above, there is a functional relationship between the balance of trade (in goods and non-factor services, or the current account balance) in each region and the real exchange rate. If the real exchange rate depreciates, the price of traded goods increases relative to the price of domestically produced goods sold on the domestic market. Exports increase, imports decrease, and the

trade balance will improve. Given our assumption that aggregate investment is determined as a share of GDP, changes in the trade balance, which directly affect foreign savings, are assumed to have only a partial effect on aggregate investment in the region. Instead, they lead to an equilibrium adjustment in the domestic savings rate, which partially offsets the change in foreign savings.

4.3 Inter-period linkages and recursive dynamics

The inter-period linkages are imposed as follows: along the dynamic path, determinants of growth are given by four factors: rate of labor force growth, accumulation of physical capital stocks, changes of labor force skill composition (migration between rural and urban unskilled labor, increase in the skilled labor force), and the rate of total factor productivity (TFP) growth. We also assume there is a capital and intermediate goods imports embodied technology transfer among regions, which links a region's TFP growth with its imports of capital and technology intensive products. The technology transfer is assumed to flow in one direction - from more developed regions to less developed regions.

The labor force growth rate is set exogenously. It was calculated from the International Labor Office's population and labor force projections from 1990 to 2010 at five-year intervals. The projection takes the demographic structure and participation rates of each region into consideration.

Capital stock in each simulation period equals the last period's capital stock plus total investment minus depreciation. No optimal behavior is assumed for investment and capital accumulation. All net investments in the previous period are assumed to become new production capital in the next period.

Accumulation patterns for capital stock depend upon the depreciation rate and gross investment rate; the later is set exogenously based on Oxford macro econometric model. However, household savings, government surplus (deficit), and foreign capital inflow (foreign savings) are assumed to be perfect substitutes and collectively constitute the source of gross investment in each region.

Household saving decisions are endogenous in the model. It represents future consumption goods for the household with zero subsistence quantity (by assuming inter-temporal separable preferences, ELES demand system). Government surplus (deficit) is the difference between government tax revenue and its spending; the later is fixed as percentage of each region real GDP based on Oxford model's projection. There is no expectation in the model.

Foreign capital inflow or outflow is determined by the accumulation of the balance of trade, which is also fixed as percentage of real GDP in each region (also based on Oxford model) except the United States. The model does not include financial markets and portfolio investment. The trade balance is the only sources for foreign savings (can be inflow or outflow). No explicit specification of Foreign Direct Investment (FDI). However, it is counted by trade flows, because in order to convert FDI into production capital stock, technology and equipment have to be purchased via domestic or international trade.

Agricultural labor and urban unskilled labor are not substitutable in production, but are linked by rural-urban migration flows. These flows are endogenous in the model and are driven by the rural-urban wage differential and structural changes in production and trade. The increase in the skilled labor force is based on the growth in the stock of tertiary educated labor in each region estimated by the World Bank (Ahaja and Filmer, 1995), which provides an indication of changes in the numbers of those qualified for employment as professional and technical workers. That is, as tertiary education grows, the share of skilled labor force will grow correspondingly.

There are an economy-wide and a set of sector specific TFP growth variables for each region in the model. The economy-wide TFP variable is solved endogenously by setting the real GDP growth rate in each region exogenously, based on projections from the Oxford model in the baseline. Then the economy-wide TFP variable is fixed in each region when alternative scenarios are simulated, in such case the growth rate of real GDP and the sector specific TFP variables that links productivity and imports are solved endogenously.

Similar to Hertel et. al (1995), the MFA quotas rents are assumed to be captured by exporting countries as export taxes, and these export tax rates are adjusted endogenously to equate with quotas. Such a treatment assumes that all quotas are binding constraints at the equilibrium.

The base year equilibrium data set is constructed around a World Social Accounting Matrix (SAM) estimated for 1995 based on the Global Trade Analysis Project (GTAP) database (version 4, Hertel, 1997). Details of this type of multi-region SAM and its construction from the GTAP Database are described in Wang (1994). The three major macro economic variables (gross investment, government spending, and balance of trade) are all specified as percentage of GDP based on projection by Oxford

macro econometric model. Major assumptions used to calibrate baseline scenario are summarized in Table 5 The model is implemented in GAMS (Brooke, et. al. 1988) and solved in levels. A detailed algebraic specification of the model is given in the Appendix.

(**Insert Table 5 here**)

V Simulation Design and the Results

5.1 The Impact of a Recovery of Japan's Private Consumption

As discussed earlier, the growth rate of average private consumption was 4.4% in Japan during 1985 to 1990 periods but declined to less than 1% in recent years. If this growth rate recovers to its historical level, it will generate a positive effect on the economic recovery in both Japan and other Asian countries. To show the importance of such a recovery in Japan, we first use the model to evaluate the impact on Asian economies if Japan maintains an annual growth rate of 4.4% in nominal private consumption during 2000 to 2010.

Major simulation results are presented in Tables 6 and 7. Table 6 summarizes major aggregate economy-wide effects. The growth in Japanese private consumption will have strong positive stimulus to the world economy. The average annual growth rate of world real GDP would roughly 2 percentage point higher and the total accumulated world real GDP growth would be 35 percent higher at 2010 than that in the baseline scenario. Asia countries would benefit more from such a demand-led growth start in Japan. The induced additional growth rate is much higher in Asia countries than the world average because of large market for their exports in Japan. Over the whole simulation period, it generates about 73% additional export growth for China, 53% for Malaysia, 45% for Singapore, 42% for Thailand, 39% for Taiwan, 37% for Hong Kong, and about 33% for Korea and Indonesia. It also create additional manufacturing jobs for agricultural labor in Asia developing countries, there would be 2 million more agricultural labor enter manufacturing sector in Indonesia and 11 million more in South Asia countries during the simulation period.

Those gains to economic growth from such a demand-led growth started from Japan are mainly come from three sources that reinforce each other: 1) extended Japanese market absorb exports from rest of the world, especially Asia countries that suffered for over production capacity since late 90s, direct increase real GDP and household income for most countries in the world; 2) the higher income leads to

higher saving and investment so that more physical capital stock available in each regional economy (there will be 30% more physical capital for China, about 20 % more for Taiwan and Malaysia, and 17 % more for Indonesia); 3) higher production level and accelerated capital formation require more intermediate inputs, especially capital and technology intensive products from industrial countries, which speeding import embodied technology transfer among nations, led higher TFP growth.

(**Insert Tables 6 and 7 here**)

Table 7 presents the impact of an expansion of Japanese private consumption on each country's trade performance in absolute real terms each year in the simulation period. It shows that if private consumption in Japan recovers to its historical level, it will create a large market for products from other Asian economies and provide a solid foundation for Asian economic recovery. Japan also gain significantly from such a process, because in order to export more to Japanese market, Asia countries have to import more from Japan, their largest suppler for intermediate and capital intensive products.

5.2 Devaluation of Chinese RMB

The global CGE model was also used to simulate the impact of China's actively devaluating its currency.

Assume China devaluates 10%, 20%, and 30% from the current exchange rate. Suppose productivity, government budget, tax rate, labor supply, tariffs, all maintain the same level for Asian countries during the process of simulation. Also we assume non-tariff barrier such as the import quota for textile products (MFP) remain the same and the monetary and fiscal policies of Asian countries does not change after the external shock. The result from the CGE simulation is shown in Tables 8 and 9.

(**Insert Tables 8 and 9 here**)

From Table 8, we can see that after the Chinese currency devaluates 10%, China's exports will increase $35.8 billion U.S. which is 17%. Imports will decrease $16.6 billion U.S. which is a decrease of 10%. Trade surplus will increase $52 billion. If China devaluates 20%, then its exports will increase $72.4 billion, which is an increase of 34%, and imports will decrease $30 billion, or 18%, trade surplus will increase $102 billion U.S. The foreign trade situation in China will be improved after devaluation; however, the devaluation of Chinese currency will significantly shrink the export market for other Asian countries. Other Asian country exports will decrease. Their trade situation will become worse.

Table 9 shows the results of the simulation and the impact of China's devaluation on exports of

Asian countries by sectors. If Asian countries maintain the same exchange rate, exports of light industry products and textile industry products will be shocked very seriously. For example, the light industry export in Korea will be reduced by 6% and the apparel product will be reduced by 7.3%. The light industry product export from Indonesia will be reduced by 7% and apparel products will be reduced by 6%.

In other words, because the Chinese currency does not devaluate the Asian country can recover their exports. The results of this simulation could be used to measure the contribution to the Asian economic recovery made by China if it does not devaluate its currency.

In fact, in the above simulation we did not consider the non-tariff barrier from the Western market to Chinese exports. So it will exaggerate the gain from the devaluation of Chinese currency because there are import quotas to Chinese textile products. Even if the Chinese currency does devaluate, but it may not increase their exports to North America and European markets. Consider this point we introduce the non-tariff barrier into the model in another simulation. Suppose the non-tariff barrier remains at the current level and we assume that China devaluates its currency 10%, 20% and 30% and list the results in Tables 10 and 11.

(**Insert Tables 10 and 11 here**)

Because the non-tariff barrier of Western countries mostly exists in the textile market, therefore, after we consider the import quota to Chinese textile product, the impact of China's devaluation to the export of textile products from other Asian countries is reduced slightly. But the pressure on other light industrial products will increase. For example, after considering the quota to textile exports, if China's currency is devaluated by 10%, the light industry product export from Korea will be reduced by 6.1% and the light industry export in Indonesia will be reduced by 7%.

No doubt, if China actively devaluates its currency it will generate great pressure to other Asian countries. After the financial crisis, in order to rebuild the financial system, pay back the foreign debt, increase the foreign currency reservation, recover the financial credit in the international financial market, it is emergent for Asian countries to increase their exports. Assume the foreign trade surplus turns to deficit, it will seriously affect the people's confidence for economic recovery. The unemployment rate in Asian countries still remains high, and the shock from foreign trade will worsen the unemployment situation. Of course, in order to maintain their exports, Asian countries have to devaluate their currency.

The next scenario simulates if Asian countries maintain their exports constant, to what degree should their currency be devaluated? From Table 12 we can see that after the devaluation of Chinese currency, all Asian countries will face pressure to devaluate.

(**Insert Table 12 here**)

After the financial crisis, the financial system in many Asian countries is still very weak, and people's confidence is not very strong. If there is pressure to devaluate, it could very easily induce another financial crisis. The degree of the devaluation will be much higher than the result in our model in order to maintain the balance of foreign trade. In conclusion, maintaining stability in China's currency is a very important condition for economic recovery in Asia.

5.3 Devaluation of Japanese Yen

During the financial crisis in Asia the exchange rate of the Japanese Yen decreased significantly. The ratio between the U.S. dollar and the Japanese Yen was 1:148 setting a historical record in August 1998. The devaluation of the Japanese Yen of course increased Japan's exports, but it shocked the Asian economy very seriously. Many economists have questioned whether devaluation will save the Japanese economy. We use the CGE model to simulate the impact of Japanese Yen devaluation to other Asian countries' imports and exports. The results of this simulation are listed in Table 13.

(**Insert Table 13 here**)

From this Table, we can see that when the Japanese Yen devaluated 10%, China's exports would be reduced by $0.6 billion U.S. which represents 3% of total exports. There was very little change to imports. The shock to Korea was more serious, as exports would be reduced by $0.6 billion U.S. which represents 6.3% of total exports. All Asian countries' exports will be reduced in different scales.

(**Insert Table 14 here**)

Table 14 shows the shock of Japanese devaluation to the different sectors in the Asia. The most serious shock was to the forest and the manufacturing industry in China. The trade in service sectors and light industry in Korea would be seriously shocked. The car industry and trade service sectors in Indonesia were seriously shocked after the Japanese devaluation.

If the Japanese Yen devaluates, Asian countries, in order to maintain their exports; will have to devaluate also. Table 15 lists the degree of devaluation for all Asian countries.

(**Insert Table 15 here**)

From Table 15 we can see that Japan currency devaluation has a stronger impact than the devaluation of China's currency. Japanese currency devaluation could increase Japan's exports in the short term, and release the pressure on the unemployment rate in Japan. After Japan devaluates its currency, it will generate a very negative effect on other Asian countries, and reduce the export capacity of Asian countries. Of course, Japanese Yen devaluation will induce the other Asian countries to devaluate in order to survive and maintain their exports. Therefore, the Asian market will shrink again and these shocks will feedback to Japan because the Asian market is a very important part of the Japanese economy. The shrinking of this market will generate major economic problems for the recovery of the Japanese economy itself.

VI. Conclusion

There are three basic characteristics in current economic adjustment and recovery process in Asian. (1) imports decreased significantly; (2) exports increase gradually; (3) exchange rate rebound slowly. They induced a gradually increase of foreign currency reserves in Asian economies. Since imports in those crisis affected Asian countries were significantly reduced, the market demand in Asian still has not been fully recovered. Aftermath of the financial crisis, Asian countries need extend their export markets to earn hard currency, to pay back the debt, to rebuild the foreign currency reserves, and to offset the shrinking domestic market because decline of income. Increasing exports is a necessary condition for all crises affected Asian economies to recover. Because the export structure in Asian countries is quite similar, the competition for market share in third countries will be tougher.

Because domestic consumption in Japan is the largest component of the Asian market, the recovery of Japanese domestic demand, especially its private consumption and investment will have a strong positive effect for Asian economies. Only Japan can provide the scale of export market for other Asian countries. However, the experience in past few years have shown that Japanese economy cannot be stimulated by only reducing interest rates and increasing government spending, because interest rate in Japan is already reduced close to 0% and government expenditures have been increased dramatically. Those policies did not stimulate domestic consumption and investment growth. Japan should pay more attention to stimulate and rebuild its domestic market, relies on domestic demand-led economic growth. The current stagnation in private consumption growth in Japan is partially due to the large amount non-performing loan in Japan's banking system. Reforming the financial system and restore people's

confidence is the most important condition for private consumption and investment to regain its historical steam. Japan should not use devaluation to increase external demand and pass the crisis to other Asian countries, because devaluation of the Japanese Yen will shrink the Asian market further thus weaken the foundation of Japanese economy in the long run.

The stability of Chinese currency is already a great contribution to the Asian economy. China should try every way possible to maintain the stability of its currency before a full recovery of Asian economy. If China devaluates its currency, there will be strong substitution effect on exports from other Asian countries, and will reduce the export market for other Asian economies. This will create an additional burden for other Asian countries, which still face many difficulties and struggle for recovering their economies. Suppose Asian countries have to devaluate again because of the devaluation of RMB, it is very likely to trigger another round competitive devaluation and financial turmoil in Asian since the tolerance and confidence in many Asian countries are still very weak currently.

Our simulation results have shown clearly that devaluation of currency, whether it is Japan or China, can not result in economic recovery in Asia because it cannot create the most needed market for Asia products as a whole. Stimulating domestic demand, especially private consumption and investment, gradually upgrade production ladder to technology-intensive products are the key measure towards economic recovery in Asia.

Some economists believe that the major reason for the financial crisis in Asia is the rapid economic growth in Asia during past two decades depends mainly on the increase of factor inputs, and such external economic growth cannot sustainable in the long run. However, change the mode of economic growth implies enhancement in productivity, increase investment in education and R&D, and improvement in operation and management. All those cannot be accomplished in a short term. It is a long run objective. There are two most important points in the short run: (1) speed up the reform of the financial system in Japan, restore consumer confidence and increase domestic demand to create market for Asian economy as a whole. (2) Speed up the reform of state-owned enterprises in China, control the size of the non-performing loan in Chinese banks, and try every way possible to maintain the stability of the RMB. Thus avoiding the new crisis that may be induced from a devaluation of Japanese Yen or Chinese RMB. As long as the reform of China's state sector and Japan's financial system could proceed forward step-by-step, we should be optimistic about the economic recovery in Asia.

Appendix Algebraic Specification of the Global CGE Model

This appendix provides a detailed mathematical specification of the seventeen-region, sixteen-sector recursive dynamic CGE model for world production and trade used in this Chapter.

Notation:

Regions are defined in set R and indexed by r or s;

Sectors are defined in set I and indexed by i or j;

Agricultural sectors are defined as a subset of I: IAG(I);

Natural Resource based sectors are defined as a subset of I: RES(I);

Primary factors are defined in set F and indexed by f;

Conventions:

Uppercase English letter indicates variables, unless they have a bar on top, in which case that variable always set exogenously. Greek letter or lower English letter refers to parameters, which need to be calibrated or supplied from exogenous sources. When multiple subscripts of a variable or parameter come from the same set, the first one represents the region or sector supplying goods; the next one represents the region or sector purchasing goods.

Price Equations

Equations 1-11 are price equations in the model. Equations 1 and 2 define the relationship between border (world) prices and internal prices, while equations 3, 4, 6 , 7, and 8 define price indices for aggregate imported goods, Arminton goods, composite value-added, and the firm's output with and without production taxes, respectively. In equations 3, 4, 6, and 7, the price indices are the unit cost functions, while in equation 8 they are unit revenue functions, all of which are dual to the corresponding unit quantity aggregator functions. For example, equation 7 is the result of cost minimization by the representative firm in each sector with respect to its aggregate factor and inputs, subject to a CES production function. Since CES functions are used as the building blocks of the basic model, and this quantity aggregator function is homogeneous of degree one, the total costs can be written as total quantity multiplied by unit cost (Varian, 1984, p28). This implies that the average cost, under cost minimization, is independent of the number of units produced or purchased. Thus, the unit cost function also

stands for the price of the composed commodity. Equation 5 defines the unit price for aggregate inputs, which is the IO coefficient weighted sum of all the value of its contents. Equation 9 states the domestic consumer price is the Arminton goods price plus sales taxes. Equation 10 specifies an economy-wide consumer price index, which is used as price of household savings. Equation 11 defines the numeraire in the model.

$$PWE_{isr} = (1 + te_{isr}) \times (\frac{1}{ER_r}) \times PE_{ir} \tag{1}$$

$$PWM_{isr} = (1 + trs_{isr}) \times PWE_{isr} \tag{2}$$

$$PM_{ir} = \frac{1}{\mu_{ir}} \times \{\sum_{s \in R} \xi_{irs}^{\sigma t_i} \times [(1 + tm_{irs} + tn_{irs}) \times ER_r \times PWM_{irs}]^{1-\sigma t_i}\}^{\frac{1}{1-\sigma t_i}} \tag{3}$$

$$PX_{ir} = \frac{1}{\Gamma_{ir}} \times \{\sum \alpha_{ir}^{\sigma m_i} \times PD_{ir}^{1-\sigma m_i} + (1 - \alpha_{ir})^{\sigma m_i} \times PM_{ir}^{1-\sigma m_i}\}^{\frac{1}{1-\sigma m_i}} \tag{4}$$

$$PN_{jr} = \sum_{i \in I} io_{ijr} \times PX_{ir} \tag{5}$$

$$PV_{ir} = \frac{1}{\Lambda_{ir} \times tfp_r \times ITFP_{ir}} \times \{\sum_{f \in F} \delta_{fir}^{\sigma v_i} \times PF_{fr}^{1-\sigma v_i}\}^{\frac{1}{1-\sigma v_i}} \tag{6}$$

$$PP_{ir} = \frac{1}{A_{ir}} \times \{\lambda_{ir}^{\sigma p_i} \times PN_{ir}^{1-\sigma p_i} + (1 - \lambda_{ir})^{\sigma p_i} \times PV_{ir}^{1-\sigma p_i}\}^{\frac{1}{1-\sigma p_i}} \tag{7}$$

$$P_{ir} = \frac{1}{\chi_{ir}} \times \{\kappa_{ir}^{\sigma e_{ir}} \times PD_{ir}^{1-\sigma e_i} + (1 - \kappa_{ir})^{\sigma e_i} \times PE_{ir}^{1-\sigma e_i}\}^{\frac{1}{1-\sigma e_i}} \tag{8}$$

$$PC_{ir} = (1 + tc_{ir}) \times PX_{ir} \tag{9}$$

$$CPI_r = \frac{\sum_{i \in I} PC_{ir} \times C_{ir}}{\sum_{i \in I} PCO_{ir} \times C_{ir}} \tag{10}$$

$$PID_r = \prod_{i \in I} PC_{ir}^{\beta_{ir}} \times CPI_r^{mps_r} \tag{11}$$

Factor Demand and Firms' Supply Equations

Equation 12 and 13 specify the demand functions for aggregate factor and intermediate inputs, while equation 14 gives demand functions of each primary factor. They equal unit demand function multiplied by the quantities of total output, and the unit demand functions are obtained by taking partial derivatives of the unit cost functions (equation 6 and 7) with respect to the relevant factor prices, according to Shephard's lemma.

$$NX_{ir} = (\frac{1}{A_{ir}})^{1-\sigma p_i} \times (\lambda_{ir} \times \frac{PP_{ir}}{PN_{ir}})^{\sigma p_i} \times Q_{ir} \tag{12}$$

$$VA_{ir} = (\frac{1}{A_{ir}})^{1-\sigma p_i} \times [(1-\lambda_{ir}) \times \frac{PP_{ir}}{PV_{ir}}]^{\sigma p_i} \times Q_{ir}$$

$$DF_{fir} = (\frac{1}{\Lambda_{ir} \times tfp_r \times ITFP_{ir}})^{1-\sigma v_i^{ir}} \times (\delta_{fir} \times \frac{PV_{ir}}{PF_{fr}})^{\sigma v_i} \times VA_{ir} \qquad \sum_{f \in F} \delta_{fir} = 1 \tag{13}$$

(14)

Equations 15-18 are the domestic and export supply functions corresponding to the constant elasticity of transformation (CET) function commonly used in today's CGE models. They are derived from revenue maximization, subject to the CET function, in a way similar to the derivation of factor demand functions. Equation 19 aggregates exports by the representative firm in each region, which implies that producers only differentiate output sold in domestic and foreign markets, but do not differentiate exports by destination (foreign markets are perfect substitutes). Equations 15-18 can be partially or entirely turn off in the model, in such case, $PD_{ir} = PE_{ir} = P_{ir}$ will be enforced and exports and domestic sales become perfect substitutes in the model.

$$DX_{ir} = (\frac{1}{\chi_{ir}})^{1-\sigma e_i} \times (\kappa_{ir} \times \frac{P_{ir}}{PD_{ir}})^{\sigma e_{sv}} \times Q_{ir}$$

for s ≠ sv (15)

$$DX_{sv,r} = (\frac{1}{\chi_{sv,r}})^{1-\sigma e_{sv}} \times (\kappa_{sv,r} \times \frac{P_{sv,r}}{PD_{sv,r}})^{\sigma e_{sv}} \times (Q_{sv,r} - TRQS_r)$$

(16)

$$EX_{ir} = (\frac{1}{\chi_{ir}})^{1-\sigma e_i} \times \{(1-\kappa_{ir}) \times \frac{P_{ir}}{PE_{ir}}\}^{\sigma e_i} \times Q_{ir}$$

for s ≠ sv (17)

$$EX_{sv,r} = (\frac{1}{\chi_{sv,r}})^{1-\sigma e_{sv}} \times \{(1-\kappa_{sv,r}) \times \frac{P_{sv,r}}{PE_{sv,r}})^{\sigma e_{sv}} \times (Q_{sv,r} - TRQS_r)$$

(18)

$$EX_{ir} = \frac{1}{PE_{ir}} \times \sum_{s \in R} \frac{ER_r}{(1+te_{irs})} \times PWE_{irs} \times X_{irs}$$

(19)

Trade and Final demand Equations

Trade and final demand equations are listed in equations 20-26. Equation 20 is the consumer demand function, which is the Extended Linear Expenditure System derived from maximizing a Stone-Geary utility function subject to household disposable income, which is specified in equation 31. Equation 21 defines household supernumerary income, which is disposal income less total expenditure on the subsistence minimum. Equations 22 and 23 give government and investment demands. Equations 24-26 are demand functions for domestic goods, for aggregate imported goods, and for imported goods by source, respectively. They describe the cost-minimizing choice of domestic and import purchases, as well as import sources. They are derived from corresponding cost functions according to Shephard's lemma in a way similar to the derivation of factor demand functions (taking partial derivatives of the cost function with respect to the relevant component prices). Because of the linear homogeneity of the CES function, the cost function that is dual to the commodity aggregator can be represented by its unit cost function (equations 3 and 4) multiplied by total quantity demanded.

$$C_{ir} = \gamma_{ir} + \frac{\beta_{ir}}{PC_{ir}} \times SY_r \tag{20}$$

$$SY_r = HDI_r - \sum_{j \in I} PC_{jr} \times \gamma_{jr} \tag{21}$$

$$GC_{ir} = \frac{\theta_{ir}}{PC_{ir}} \times GSP_r \tag{22}$$

$$ID_{ir} = \frac{kio_{ir}}{PC_{ir}} \times INV_r \tag{23}$$

$$DX_{ir} = \left(\frac{1}{\Gamma_{ir}}\right)^{1-\sigma m_i} \times \left(\alpha_{ir} \times \frac{PX_{ir}}{PD_{ir}}\right)^{\sigma m_i} \times TX_{ir} \tag{24}$$

$$MX_{ir} = \left(\frac{1}{\Gamma_{ir}}\right)^{1-\sigma m_i} \times \left\{(1-\alpha_{ir}) \times \frac{PX_{ir}}{PM_{ir}}\right\}^{\sigma m_i} \times TX_{ir} \tag{25}$$

$$X_{isr} = \left(\frac{1}{\mu_{ir}}\right)^{1-\sigma t_i} \times \left\{\xi_{isr} \times \left(\frac{PM_{ir}}{(1+tm_{isr}+tn_{irs}) \times ER_r \times PWM_{isr}}\right)^{\sigma t_i} \times MX_{ir}\right.$$

$$\sum_{s \in R} \xi_{isr} = 1$$

for $s \neq r$ (26)

International Shipping Equations

Equations 27-30 describe international shipping industry in the model. Equations 27 and 28 describe the supply side of the international shipping industry. Equation 27 states that at equilibrium, the returns from shipping activity must cover its cost. Like other industries in the model, it also earns zero profit. Equation 28 describes the demand for each region's service sector exports to the international shipping industry, which is generated by the assumed Cobb-Douglas technology in this industry. The next two equations (29 and 30), refer to the demand side of the international shipping industry. The demand for shipping services associated with commodity i in region r is generated by a fixed proportion input requirement (Leontif) coefficient trs_{isr}, which is routine/commodity specific (equation 29). In equilibrium, the total demand of shipping service must equal its total supply (equation 30).

$$TRQ = \frac{1}{PTR} \times \sum_{r \in R} \frac{P_{sv,r}}{ER_r} \times TRQS_r \tag{27}$$

$$TRQ = \sum_{r \in R} \sum_{i \in I} TRQD_{ir} \tag{28}$$

$$TRQS_r = \frac{\tau_r \times ER_r}{P_{sv,r}} \times PTR \times TRQ \tag{29}$$

$$TRQD_{ir} = \frac{1}{PRT} \times (\sum_{s \in R} trs_{isr} \times PWE_{isr} \times X_{isr}) \tag{30}$$

Income and Saving Equations

Equations 31-39 are income and saving equations in the model. Equations 31 and 32 define household disposal income and savings. Equations 33-37 determine government revenue from production taxes, consumption taxes, tariffs and export taxes (its negative equals a subsidy), respectively, while equations 38-39 define government transfer to household and the balance of trade (foreign savings) in each region.

$$HDI_r = \sum_{f \in F} PF_{fr} \times \overline{FS_{fr}} - dk_r \times \overline{FS_{KAr}} + GTRANS_r \tag{31}$$

$$GR_r = PTAX_r + CTAX_r + TARRIF_r + ETAX_r \tag{32}$$

$$SAV_r = \frac{HDI_r \times \sum_{i \in I} PC_{ir} \times C_{ir}}{CPI_r} \tag{33}$$

$$PTAX_r = \sum_{i \in I} tp_{ir} \times P_{ir}^r \times Q_{ir} \tag{34}$$

(35)

$$CTAX_r = \sum_{i \in I} tc_{ir} \times PX_{ir} (C_{ir} + GC_{ir} + ID_{ir})$$

$$TARRIF_r = \sum_{s \in R} \sum_{i \in I} (tm_{isr} + tn_{irs}) \times ER_r \times PWM_{isr} \times X_{isr} \tag{36}$$

$$ETAX_s = \sum_{r \in R} \sum_{i \in I} te_{isr} \times PE_{is} \times X_{isr} \tag{37}$$

$$GTRANS_r = GR_r - GSP_r - GSVA_r \tag{38}$$

$$BOT_r = \sum_{s \in R} \sum_{i \in I} PWE_{irs} X_{irs} + \frac{P_{sv,r}}{ER_r} \times TRQS_r - \sum_{s \in R} \sum_{i \in I} PWM_{isr} \times X_{isr} \tag{39}$$

General Equilibrium Conditions

Equations 40-43 define general equilibrium conditions of the model, which are system constraints that the model economy must satisfy. For every sector in each region, the supply of the composite goods must equal total demand (equation 40), which is the sum of household consumption (C_{ir}), government purchases (GC_{ir}), investment (ID_{ir}) and the firm's intermediate demand. Similarly, the demand for each factor in every region must equal the exogenously fixed supply (equation 41). In this dual formulation, output in each region is determined by demand. Sectoral equilibrium is determined in equation 42, unit output price equals average cost, which is also the zero profit condition. Equation 43 describes the macroeconomic equilibrium identity in each region, which is also the budget constraint for the investor. Since all agents in each region (households, government, investor, and firms) satisfy their respective budget constraints, it is well known that the sum of the excess demand for all goods is zero; that is, Walras's law holds for each region. Therefore, there is a functional dependence among the equations of the model. One equation is redundant in each region and thus can be dropped.

$$TX_{ir} = C_{ir} + GC_{ir} + ID_{ir} + \sum_{j \in I} io_{ijr} \times NX_{jr} \tag{40}$$

$$\sum_{i \in I} DF_{fir} = \overline{FS_{fr}} \tag{41}$$

$$P_{ir} = \frac{PN_{ir} \times NX_{ir} + PV_{ir} \times VA_{ir} + tp_{ir} \times P_{ir} \times Q_{ir}}{Q_{ir}} \tag{42}$$

$$INV_r = dr_r \times \overline{FS_{k,r}} + CPI_r \times SAV_r + GSAV_r - ER_r \times BOT_r \tag{43}$$

There are 19,960 equations and 20,113 variables in the inter-period block of the model. Since the 102 factor endowment variables (FS_r) are determined by initial stock and inter-period linkage equitions , three additional sets of variables have to be set exogenously as macro closures in order to make the model fully determinate. They are chosen from following variables for alternative closures: (1) gross investment or government transfer (INV_r or $GTRANS_r$), (2) balance of trade or exchange rate (BOT_r or ER_r), (3) government spending or surplus (deficit) (GSP_r or $GSAV_r$).

Inter-period and Trade-productivity Linkages

Equations 44-48 define the recursive structure of the five types of factor endowment (natural resource are sector specific and held constant , it can be modified if more reliable data become available) in the modeled economy. For instance, capital stock in each region at period t equals last period's capital stock plus the region's gross investment minus depreciation. While unskilled labor equals last period's employment multiply by population growth rate, plus rural-urban migration, $MIG_{rt,}$ minus the increase of skilled labor SK_{rt} (set exogenously).

$$FS_{RLr,t} = (1 + n_{rt}) \times FS_{RLr,t-1} + MIG_{rt} \tag{44}$$

$$FS_{KAr,t} = (1 - dk_r) \times FS_{KAr,t-1} + INV_{rt} \tag{45}$$

$$FS_{ULr,t} = (1 + n_{rt}) \times FS_{ULr,t-1} + MIG_{rt} - ds_r \times \overline{\nabla SK_{rt}} \tag{46}$$

$$FS_{SLr,t} = (1 + n_{rt}) \times FS_{SLr,t-1} + ds_r \times \overline{\nabla SK_{rt}} \tag{47}$$

$$FS_{LDr,t} = (1 - dl_t) \times FS_{LDr,t-1} \tag{48}$$

Equation 49 specifies the wage differential between agricultural labor and unskilled manufacturing labor, which drives the rural-urban migration endogenously and approach to one over time. Equation 50 links import embodied technology transfer (via imports of capital goods and intermediate inputs) and total factor productivity. Where $X0_{isr}$ is the base year real trade flows, IM is a subset of I, including those products embodied with advanced technology. It operates through share parameter and elasticities. An elasticity (ip_{ir}) of 0.1 implies that a 10 percent increase in real imports of capital and technology intensive goods would result a non more than 1 percent increase in total factor productivity in that sector depending the share of intermediate inputs in the sector's total imports. As pointed by Lewis, Robinson and Wang (1995), while there is fairly widespread agreement that linkage between imports of intermediate inputs and productivity gains do exist, there is less evidence of the size of the feedback. In our simulation exercises, the elasticities used for developed countries are at least less that half the values used for the developing countries.

$$\frac{PF_{ALr,t}}{PF_{ULr,t}} = wdf_r^{\exp^{-t\varphi_r}} \tag{49}$$

$$ITFP_{ir} = 1 + ims_{ir} \times \left\{ \frac{NX_{ir}}{NX_{ir} + VA_{ir}} \times \left[\frac{\sum_{j \in IM} \sum_{s \in R} x_{jsr}}{\sum_{j \in IM} \sum_{s \in R} xo_{jsr}} \right]^{\sigma ip_{ir}} + \frac{VX_{ir}}{NX_{ir} + VA_{ir}} - 1 \right\} \tag{50}$$

The model is implemented in GAMS (Brooke, et. al. 1988). Readers who are interested in the computer code and related data files may contact the author. Definitions of variables and parameters are list in tables A.1 and A.2. The correspondence between sectors in our model, GTAP database and ISIC are listed in Table-A3.

Table A.1--Definitions of variables

Variable	Definition	No. of variables
PWE_{isr}	World f.o.b. price for goods from region s to region r s r	I × R(R-1) (4,352)
PWM_{isr}	World c. i.f. price for goods from region s to region r s r	I × R(R-1) (4,352)
PM_{ir}	Price of aggregate imported goods in region r	I × R (272)
PX_{ir}	Price of composite goods in region r	I × R (272)
PD_{ir}	Price of domestic products sold at domestic market in region r	I × R (272)
PE_{ir}	Price of domestic goods for exports in region r	I × R (272)
PC_{ir}	Domestic consumer price in region r	I × R (272)
PP_{ir}	Average output price before production tax in region r	I × R (272)
P_{ir}	Average output price after production tax in region r	I × R (272)
PF_{fr}	Factor price in region r	F ×R (102)
PV_{ir}	Price of value added in region r	I × R (272)
PN_{ir}	Price of aggregate intermediate inputs in region r	I × R (272)
CPI_r	Price of savings in region r (consumer price index)	R(17)
ER_r	Exchange rate of region r	R (17)
PID_r	Price index in region r	R (17)
Q_{ir}	Sector output in region r	I × R (272)
VA_{ir}	Variable sector production cost in region r	I × R (272)
NX_{ir}	Aggregate sector intermediate input in region r	I × R (272)
DF_{fir}	Sector factor demand in region r	(F-3) × I × R +(IAG +RES) × R (850)
DX_{ir}	Sector domestic sales in region r	I × R (272)
EX_{ir}	Domestic goods for exports in region r	I × R (272)
C_{ir}	Household consumption in region r	I × R (272)
GC_{ir}	Government spending in region r	I × R (272)
ID_{ir}	Investment demand in region r	I × R (272)
TX_{ir}	Composite goods demand (supply) in region r	I × R (272)
MX_{ir}	Sector composite goods imports in region r	I × R (272)
X_{isr}	Trade flows from region s to region r s r	I × R(R-1) (4,352)
TRQ	Total international transportation supply	1
PTR	Price of international shipping service	1
$TRQD_{ir}$	International shipping demand by region r	I × R (272)
$TRQS_r$	International shipping service supply by region r	R (17)

HDI_r	Household disposable income in region r	R (17)
SY_r	Household supernumerary income in region r	R (17)
GR_r	Total government revenue in region r	R (17)
GSP_r	Total government spending in region r	R (17)
$TARRIF_r$	Total tariff revenue in region r	R (17)
$ETAX_r$	Total export tax revenue (subsidy expenditure) in region r	R (17)
$PTAX_r$	Total production tax revenue in region r	R (17)
$CTAX_r$	Total consumer sale tax in region r	R (17)
SAV_r	Household savings in region r	R (17)
$GSAV_r$	Government saving (deficit) in region r	R (17)
$GTRNS_r$	Government transfer in region r	R (17)
BOT_r	Balance of trade in region r (net capital inflow)	R (17)
INV_r	Gross investment by region r	R (17)
$ITFP_{ir}$	Import embodied TFP shifter by sector in region r	I × R (272)
FS_{fr}	Factor endowment by region r	F × R (102)
	Total number of variables:	
	$17\times R+(2\times F+IAG+RES)\times R+21\times I\times R+3\times I\times R(R-1)+(F-3)\times I\times R+2$ (20,113)	

Table A.2--Definitions of parameters

Parameter	Definition
te_{isr}	Sector export tax (subsidy) rate for goods to region r from region s
tm_{isr}	Sector tariff rate for goods from region s in region r
tn_{isr}	Sector NTB for goods from region s in region r
tp_{ir}	Sector indirect tax rate in region r
tc_{ir}	Consumer sale tax rate in region r
trc_{isr}	International transportation cost margin as percent value of f.o.b.
io_{ijr}	Input/output coefficients for region r
kio_{ir}	Sector share of total investment in region r
dk_r	Depreciation rate of capital stock in region r
$_r$	Regional share of international shipping service supply
$_{ir}$	Unit coefficients in first level Arminton aggregation function
μ_{ir}	Unit coefficients in second level Arminton aggregation function of region r
$_{ir}$	Share parameters in the first level Arminton aggregation function of region r
$_{ir}$	Share parameters in the second level Arminton aggregation function of region r
m_I	Substitution elasticities between domestic and import goods
t_I	Substitution elasticities among import goods from different regions
$_{ir}$	Unit coefficients in CET function of region r
$_{ir}$	Share parameters in CET function of region r
e_I	Elasticities of transformation between domestic sales and exports
A_{ir}	Unit parameter in aggregate cost function
$_{ir}$	Intermediate input share in aggregate cost function
p_{ir}	Elasticities of substitution between aggregate factor and intermediate input
$_{ir}$	Unit parameter in value added function
$_{fir}$	Factor share in value added function
v_{ir}	Elasticities of substitution among primary factors in value added
$_{ir}$	Sector minimum subsistence requirements for private households in region r
$ß_{ir}$	Marginal propensity to consume for private households in region r
mps_r	Marginal propensity to savings for private households in region r
$_{ir}$	Sector share of government spending in region r
tfp_r	General TFP shifter in region r
ims_{ir}	The share of of intermediate inputs in sector's total imports

ip_{ir}	Elasticity between intermediate goods import growth with TFP growth
dl_r	Land depletion rate in region r
ds_r	Share of additional tretiry education stock go to skilled labor force at each period
$_r$	Parameter that control the speed of wage convergence between agr. and unsliled labor
n_{rt}	population growth rate in region r at period t
wdf_r	Wage ratio of agricultural labor and unskilled-labor in region r at base year

Table A.13 Sector in the Global CGE Model and Their GTAP-ISIC Concordance

Sectors in the Model	GTAP[a] 4 Sector Number and Description	ISIC[b] Rev. 3 CODE
Agriculture	1. Paddy rice 2. Wheat 3. Cereal grains nec 4. Vegetables fruit nuts 5. Oil seeds 6. Sugar cane sugar beet 7. Plant-based fibers 8. Crops nec. 9. Bovine cattle , sheep and goats, horses 10. Animal products nec., 11. Row milk 12. Wool silk-worm cocoons	01111, 01301, 01401 01112, 01302, 01402 01113, 01303, 01403, 01121, 01204, 01404 01114, 01305, 01405 01115, 01306, 01406 01116, 01307, 01407 01117, 01122, 1132, 01308, 01408 01211, 01309, 01409 01220, 01212, 013010, 013011, 014010, 014011 01213, 013012, 014012
Forest & fishery	13. Forestry, 14. Fishing	0200, 0150, 0500
Mining	15. coal, 16. oil, 17. natural gas, 18. Minerals nec	1010, 1020,1030, 11101, 11102, 11201, 11202, 1200, 1310, 1320, 1410, 1421, 1422, 1429
Processed food	19. Bovine cattle sheep and goat horse meat p 20. Meat products nec, 21. Vegetable oils and fats, 22. Dairy products, 23. Processed rice 24. Sugar, 25. Food products nec	15111,15112, 15141,15142,1520,15311,1542 1512, 1513, 15312, 1532, 1533, 1541, 1543, 1544,1549
Beverage and tobacco	26. Beverages and tobacco products	1551, 1552, 1553, 1554, 1600
Textile	27. Textiles	1711-12,1721-23,1729-30, 2430
Apparel	28. Wearing apparel	1810,1820,2430
leather	29. Leather products, 42. Manufactures nec	1911, 1912, 1920, 3691, 3692, 3693, 3694, 3699
Wood & Paper	30. Wood products, 31. Paper products publishing	2010, 2021, 2022, 2023, 2029, 3610 2101, 2102, 2109, 2211, 2212, 2219,2221, 2222
Manufactured intermediates	32. Petroleum coal products 33. Chemical rubber plastic products 34. Mineral products nec 35. Ferrous metals 36. Metals nec 37. Metal products	2310, 2320 2330, 2411, 2412, 2413, 2421, 2422, 2423,2424, 2429, 2511, 2519, 2520 2610, 2691, 2692, 2693, 2694, 2695, 2696, 2699 2710, 2731, 2720,2732 2811, 2812, 2813, 2891, 2892, 2893, 2899
Motor	38. Motor vehicles and parts	3410,3420,3430
Other transport equipment	39. Transport equipment nec	3511, 3512, 3520,3530,3591,3592,3599
Eletronic	40. Electronic equipment	3000,3210,3220,3230
Machinery	41. Machinery and equipment nec	2213, 2230, 2911-15,2919,2921-27,2929-30, 3110, 3120, 3130,3140,3150,3190, 3311-13, 3320,3330
Traded Services	47. Trade, transport, 48. Financial, business, recreational services, 49. Public administration and defense, education, health services	3710,3720,4100,4510,50105020,5030,5040,5050,5110,5121-22,5131,5139, 5141-43,5149-50,5190,5220, 5231-34, 5239-40,5251-52,5259-60, 5510,5520, 6010,6021-23,6030,6110,6120,6210, 6220,6301--04,6309,6411-12,6420, 6511,6519,6591-92,6599,6601-03,6711-12,6719-20,7010,7020,7111-13,7121-23,7129,7130,7210,7220,7230, 7240, 250,7290,7310,7320,7411-14,7421-22, 7430,7491-95,7499,7511-14, 7521-23,7530,8010,8021-22,8030,8090, 8511-12,8519-20,8531-32,9000,9111-12,9120,9191-92,9199,9211,-14,9219-20,9231-33,9241,9249,9301-03,9309, 9500,9900
Utility, housing & construction	43. Electricity, 44. gas manufacture, distribution, 45. Water, 46. Construction, 50. Dwellings	4010,4020,4030,4510,4520,4530,4540,4550

a. Global Trade Analysis Project, version 4 (Hertel, 1997).

b. International Standard Industry Classification.

Table 1 Exchange rates in Asian countries

	Exchange Rate in 1997.6	Lowest Exchange Rate	Time for the lowest Exchange rate	Exchange Rate in 1999.9	I	II	III
Indonesia	2432	14750	1998.6	8360	-83.51%	-70.91%	76.44%
Malaysia	2.52	4.36	1998.1	3.8	-42.20%	-33.68%	14.74%
Philippines	26.4	44.8	1998.9	41	-41.07%	-35.61%	9.27%
Singapore	1.43	1.78	1998.8	1.71	-19.66%	-16.37%	4.09%
Korea	888	1680	1998.1	1218	-47.14%	-27.09%	37.93%
Taiwan	27.9	34.8	1998.8	31.8	-19.83%	-12.26%	9.43%
Thailand	25.3	53.7	1998.1	41.3	-52.89%	-38.74%	30.02%
Japan	114	145	1998.8	107	-21.38%	6.54%	35.51%

I: The ratio between the exchange rate before financial crisis and at the lowest point
II: The ratio between the exchange rate at September 1999 and before financial crisis
III: The ratio between the exchange rate at September 1999 and the lowest point.

Table 2 Economic Growth Rate in Asian Countries

	1996	1997	1998	1999*
Asia	8.2	6.6	1.8	3.9
Japan	3.9	0.8	-2.5	0.5
Hong Kong	4.9	5.3	-3.1	0.8
Taiwan	5.7	6.8	4.8	5.6
Korea	7.1	5.5	-6.2	1.4
Singapore	6.9	7.8	1.0	3.0
Malaysia	8.6	7.8	-2.0	0.5
Thailand	5.5	-0.4	-7.8	-0.7
Indonesia	8.0	5.0	-16.8	-2.7
Philippines	5.7	5.1	1.5	4.0

Data sources: IMF: "World Economic Outlook", December 1998 and the data in 1999 was forecasted by Statistical Information Center in Chinese Statistical Bureau.

Table 3 Export Structure of Asian Developing Countries

	China	Indonesia	Thailand	Philippines	Malaysia	Korea	Singapore	Taiwan
Agriculture	2.2	7.2	6.4	2.7	2.7	0.4	0.9	0.5
Processed food	3.2	6.3	14.2	7.1	7.1	1.6	2.1	2.6
Forest & fishery	0.2	0.6	0.3	0.3	1.6	0.1	0.1	0.2
Mineral products	2.3	4.8	3	2.5	1	0.7	0.5	1
Energy	2.4	20.7	0.6	0.9	6.1	1	5.2	0.1
Textiles	21	12.5	9.8	9.8	3.2	12.6	1.4	12.2
Other light manufacture	23.8	20.2	11.3	6	12.4	7.2	4.1	9.3
Intermediates	13.4	11.6	7.9	5	8.4	16.1	11.1	19
Motor vehicles	0.3	0.2	0.3	0.5	0.3	6.3	0.5	0.8
Othertransport	1.3	0.7	0.8	0.4	2.6	3.4	1.5	2.5
Electronics	8.6	3	11.6	10.7	20.7	9.9	28.5	18.4
Machinery	13.5	3.3	15	22.5	26.3	24.3	23	26.5
Housing & construction	0	0	0	1.5	0	0.6	0	0
Services	7.9	9	18.8	30.1	7.6	15.7	21.1	6.9
Total	100	100	100	100	100	100	100	100

Data sources: International Economic Statistical Yearbook. 1998.

Table 4 China's bilateral trade dependence with its major trade partners by sectors, 1995, (%)

	Taiwan	Hong Kong	Korea	Singapore	Indonesia	Thailand	Malaysia	Philippines	Japan	United States	Western Europe	Rest of the World	Total
Agriculture	4.0	12.7	5.3	4.9	5.0	1.5	1.9	0.7	22.8	4.8	17.3	19.1	100
Forest & Fishery	2.4	24.8	2.3	0.0	0.0	0.0	0.0	-	57.8	0.4	1.9	10.4	100
Energy & minerals	3.6	3.2	12.1	1.7	1.9	0.8	0.4	0.6	41.0	10.5	12.1	12.0	100
Processed food	1.0	14.0	5.3	1.7	0.8	0.5	1.1	0.7	44.6	7.9	9.2	13.2	100
Beverage & tobacco	0.2	37.9	0.2	11.1	0.5	0.1	0.8	18.6	2.7	1.0	1.7	25.0	100
Textile	1.5	13.1	10.7	3.1	1.1	2.1	1.0	1.9	14.8	7.7	12.1	31.0	100
Apparel	0.9	11.6	1.3	0.6	0.0	0.1	0.2	0.1	36.3	12.7	21.9	14.3	100
Other Light Manufacture	1.1	1.4	1.6	1.3	0.3	0.4	0.4	0.3	12.7	38.1	26.1	16.3	100
Wood & paper products	4.4	9.0	2.5	1.6	0.5	0.5	0.8	0.3	25.1	25.3	17.9	12.0	100
Manufactured intermediates	3.7	5.5	7.9	2.3	2.4	3.0	1.7	1.1	15.1	17.5	20.6	19.0	100
Motor vehicle	1.5	12.8	0.4	1.6	1.2	5.8	0.4	0.7	7.3	34.1	3.3	31.0	100
Other transport equipment	1.1	7.7	3.2	5.8	1.8	6.7	0.5	0.6	6.4	26.4	8.1	31.7	100
Electronics	1.5	2.5	1.4	4.5	0.4	1.3	1.5	0.4	10.1	29.9	30.3	16.4	100
Other machinery	4.2	3.9	2.8	4.1	1.2	1.4	1.5	0.6	14.0	25.0	23.8	17.5	100
Traded services	0.9	4.2	1.5	1.6	0.3	1.0	0.8	0.4	25.0	12.9	35.6	15.9	100
Total	2.1	6.3	3.6	2.4	0.9	1.2	0.9	0.7	19.7	21.9	22.8	17.5	100

Data Source: Auther calculated from version 4 GTAP database.

Table 5 Major Assumption for Baseline Calibration

	China	Taiwan	Hong Kong	Korea	Singapore	Indonesia	Thailand	Malaysia	Philippines	Japan	United States	Western Europe	Canada	Austrilia	South Asia	Rest of the World	World Average
								Average annual growth rate, %, 2000-2010									
Real GDP	7.2	4.5	4.2	4.9	3.4	5.9	5.5	6.2	4.2	2.4	2.5	2.4	2.8	3.2	7.1	3.0	3.0
Labor Force	0.8	0.8	0.2	1.1	0.3	2.0	0.8	2.7	2.4	-0.2	0.8	-0.1	0.6	1.0	2.2	2.2	1.5
Skill Labor	2.7	5.1	3.5	6.3	3.6	7.7	7.0	8.6	4.6	2.2	2.6	2.8	2.3	3.0	5.6	6.1	4.4
TFP	2.7	0.7	1.4	2.1	1.3	1.5	1.4	1.7	1.2	1.1	0.5	1.5	1.0	1.2	3.1	0.5	1.1
Capital Stock	9.9	7.3	4.2	4.3	4.5	6.7	4.9	7.2	3.8	2.9	4.6	2.7	4.2	4.0	5.8	2.6	3.6
Gross Investment	5.5	4.5	5.1	4.3	3.1	4.1	4.6	4.5	2.8	2.5	3.8	2.9	4.3	4.2	6.3	2.7	3.4
Exports	7.5	3.2	3.4	3.8	3.9	7.2	4.7	5.7	5.3	3.3	2.6	2.5	2.8	3.0	7.7	3.1	3.6
Imports	5.5	4.6	4.9	4.5	3.7	4.6	5.2	5.8	3.8	2.5	3.5	3.2	3.2	3.9	7.3	2.7	3.6
HH. Consumption	5.2	5.3	5.8	6.3	2.5	4.2	6.3	7.4	3.2	2.4	2.5	2.4	2.3	3.2	6.5	2.5	2.7
Public Consumption	9.4	4.2	6.1	4.4	3.5	7.0	5.6	6.7	4.5	1.7	1.1	2.3	2.4	2.7	7.5	4.0	2.6
Total Absorption	6.7	5.0	5.6	5.4	2.8	5.1	5.8	6.3	3.5	2.3	2.7	2.5	2.9	3.4	7.0	2.9	3.0
								Average annual agricultural labor force migration, 1000 persons, 2000-2010									
Rural labor migration	2505	16	0	26	0	765	328	39	200	12	31	104	-2	1	6719	7144	17887
								Labor composition, %, 2000									
Agricultural labor	72.0	9.6	0.9	13.5	0.3	53.8	58.7	22.4	41.0	5.4	2.6	5.0	2.4	4.6	57.0	38.6	46.3
Unskilled labor	20.6	74.7	78.4	74.0	70.8	41.7	34.6	61.9	51.2	77.2	63.9	65.6	61.7	64.6	38.0	49.3	42.1
Skilled labor	7.4	15.7	20.8	12.5	29.0	4.5	6.6	15.8	7.8	17.5	33.5	29.4	35.9	30.8	5.0	12.1	11.6
								Labor composition, %, 2010									
Agricultural labor	70.0	8.2	0.9	12.0	0.3	45.5	50.1	18.2	35.6	5.2	2.4	4.6	2.6	4.6	47.2	32.6	41.4
Unskilled labor	20.8	67.0	69.2	66.2	58.4	46.4	37.0	52.9	54.5	72.1	56.8	55.2	54.3	57.3	45.6	49.1	42.8
Skilled labor	9.2	24.8	29.9	21.8	41.3	8.1	12.9	28.9	9.8	22.7	40.8	40.2	43.1	38.1	7.2	18.2	15.8
								Gross investment as % of nominal GDP									
2000	39.5	25.1	35.8	26.9	37.4	30.9	35.0	42.8	24.5	27.8	20.9	21.0	20.1	23.5	20.7	19.0	
2010	38.3	25.3	37.7	27.2	37.4	30.9	35.0	42.8	24.5	29.0	24.0	22.1	23.3	26.3	21.4	19.0	
								Government spending as % of nominal GDP									
2000	12.4	19.5	8.7	18.3	9.4	6.9	10.2	11.0	12.9	18.5	16.6	15.6	21.4	21.9	17.1	15.2	
2010	13.1	18.7	10.1	17.4	9.4	6.9	10.2	11.0	12.9	17.6	14.4	15.2	20.4	19.9	16.3	15.2	
								Balance of trade as % of nominal GDP									
2000	-0.2	1.1	0.1	11.8	-4.5	4.2	12.3	16.1	-8.9	2.7	-4.4	1.3	3.0	-1.1	2.9	-0.5	
2010	-0.5	-3.6	-15.2	6.8	2.2	7.5	5.9	6.8	-9.8	3.2	-5.2	1.1	4.4	-0.6	1.2	1.9	

Note: Numbers in bold italy face are control variables and fixed exogenously in baseline calibration.

Table 6 -- Impact of private consumption growth in Japan recover to the level of 1985-1990: aggregated economic indicator by region

	China	Taiwan	Hong Kong	Korea	Singapore	Indonesia	Thailand	Malaysia	Philippines	Japan	United States	Western Europe	Canada	Austrilia	South Asia	Rest of World	World Average
Accumulated growth during 2000-2010, % change from baseline																	
Real GDP	64.1	43.8	52.6	46.3	40.2	53.4	50.8	53.9	41.8	32.9	33.0	32.2	33.0	38.5	57.8	37.2	35.5
Private consumption	50.7	47.7	88.8	69.7	18.6	66.9	67.3	60.7	49.5	32.3	33.5	31.7	27.7	40.5	69.3	38.3	35.5
Public consumption	79.7	40.4	65.3	40.9	37.1	50.0	49.0	54.1	39.6	29.8	28.0	32.0	31.5	36.8	50.5	38.9	33.5
Total real Absorption	58.1	45.8	75.4	53.4	25.0	57.9	56.7	51.5	45.4	31.8	33.6	32.0	31.6	40.4	62.6	37.8	35.5
Real export	72.6	38.7	37.1	33.0	44.5	32.4	41.7	52.9	34.1	39.1	33.5	34.6	38.6	31.5	38.9	32.4	37.9
Real import	49.6	43.9	58.8	44.3	36.8	46.9	51.2	50.1	42.6	28.7	37.6	33.2	34.9	41.6	64.4	35.4	37.9
TFP	31.1	24.5	33.3	29.2	27.6	25.2	23.9	26.5	24.9	25.2	23.0	26.0	23.5	26.8	30.8	23.0	25.2
Gross investment	46.9	43.8	56.0	42.7	33.4	42.0	44.8	41.4	35.2	32.9	37.2	33.4	38.7	42.4	51.1	34.4	36.1
Capital stock	30.5	19.6	13.3	10.9	10.8	16.6	13.6	19.0	10.4	8.3	12.0	8.0	11.4	11.2	14.9	8.1	9.9
Average annual growth rate during 2000-2010, % change from baseline																	
Real GDP	2.6	2.3	2.8	2.3	2.3	2.4	2.4	2.4	2.3	2.1	2.1	2.1	2.1	2.3	2.4	2.3	2.2
Private consumption	2.5	2.3	3.8	3.0	1.2	3.4	2.9	2.4	2.9	2.1	2.1	2.1	1.8	2.4	2.9	2.4	2.2
Public consumption	2.6	2.2	2.9	2.2	2.2	2.1	2.3	2.3	2.1	2.1	2.1	2.1	2.1	2.3	2.0	2.2	2.1
Total real Absorption	2.5	2.3	3.4	2.5	1.6	2.8	2.6	2.3	2.6	2.1	2.1	2.1	2.0	2.3	2.6	2.3	2.2
Real export	2.8	2.3	2.2	1.9	2.5	1.4	2.2	2.5	1.7	2.3	2.1	2.2	2.4	1.9	1.6	2.0	2.2
Real import	2.4	2.3	2.9	2.3	2.1	2.4	2.5	2.3	2.4	1.9	2.2	2.0	2.1	2.3	2.6	2.2	2.2
TFP	2.0	1.9	2.3	2.0	2.0	1.8	1.7	1.9	1.8	1.9	1.8	1.9	1.8	2.0	1.9	1.8	1.9
Gross investment	2.2	2.3	2.7	2.3	2.0	2.3	2.3	2.2	2.2	2.1	2.1	2.1	2.1	2.3	2.3	2.2	2.1
Capital stock	1.0	0.8	0.8	0.6	0.6	0.8	0.7	0.8	0.6	0.6	0.7	0.5	0.7	0.7	0.8	0.6	0.6
Agricultural labor force migration during 2000-2010, 1000 persons, change from baseline																	
Accumulated	602	72	2	175	1	1898	572	42	429	341	251	875	18	30	11262	21604	38187
Annual average	55	7	0	16	0	172	52	4	39	31	22	80	2	2	1024	1964	3472
Labor composition, 2010, % change from baseline																	
Agricultural labor	-0.1	-0.7	-0.1	-0.7	-0.0	-1.7	-1.5	-0.4	-1.2	-0.5	-0.2	-0.5	-0.1	-0.3	-1.8	-2.0	-1.2
Unskilled labor	0.1	0.7	0.1	0.7	0.0	1.7	1.5	0.4	1.2	0.5	0.2	0.5	0.1	0.3	1.8	2.0	1.2
Balance of trade as % of nominal GDP, change from baseline																	
2000	-0.1	0.0	0.0	-0.1	0.3	-0.2	-0.2	-0.2	-0.2	0.0	-0.0	0.0	0.1	-0.0	-0.1	-0.0	0.0
2010	0.4	0.1	-6.1	-1.3	4.1	-2.2	-1.9	0.4	-3.4	0.4	-0.2	0.2	1.4	-0.4	-1.5	0.0	0.0

Table 7--Impact of private consumption growth in Japan recover to the level of 1985-1990: trade performace

(Deviation from baseline, billion of 1995 US dollars)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
						Exports					
Japan	8.7	21.3	38.2	58.0	78.3	98.9	119.6	141.4	169.0	198.8	230.0
China	3.4	8.7	16.6	26.9	39.0	55.8	72.4	92.0	117.8	148.4	183.9
Taiwan	2.0	4.8	8.6	13.1	17.8	22.8	27.7	32.8	39.4	46.6	54.2
Hong Kong	1.4	3.5	6.4	9.7	13.0	17.3	20.7	24.3	28.8	33.7	38.8
Korea	2.4	6.0	11.0	17.0	23.4	30.7	37.7	45.4	55.2	66.1	77.9
Singapore	2.2	5.5	9.9	15.2	20.7	26.4	32.3	38.8	47.0	56.0	65.8
Indonisia	0.4	1.0	1.8	2.9	4.1	5.4	7.0	8.9	11.4	14.5	18.2
Thailand	1.0	2.4	4.4	6.9	9.6	13.0	16.3	20.1	25.0	30.7	37.2
Malaysia	1.3	3.3	6.0	9.5	13.4	18.0	22.8	28.3	35.5	44.0	53.7
Philipnes	0.3	0.8	1.5	2.3	3.2	4.5	5.5	6.6	8.1	9.7	11.4
United States	9.7	23.5	41.7	62.7	83.8	104.9	125.7	147.4	174.8	204.3	234.9
Western Europe	14.9	35.8	63.4	95.1	126.8	158.1	188.9	220.9	261.3	304.3	348.8
Canada	3.4	8.2	14.5	21.9	29.3	36.8	44.3	52.1	62.1	73.0	84.2
Austrilia	0.9	2.2	3.9	5.9	7.8	9.8	11.8	13.8	16.4	19.2	22.0
New Zealand	0.2	0.4	0.8	1.2	1.6	2.0	2.4	2.8	3.4	4.0	4.6
South Asia	0.7	1.7	3.2	5.0	7.1	12.9	16.5	20.7	26.1	32.5	39.8
Rest of World	8.8	21.3	38.0	57.5	77.5	95.5	115.3	136.6	163.7	193.5	225.4
World total	61.8	150.3	269.9	410.7	556.4	712.7	866.7	1032.8	1244.7	1479.1	1731.1
						Imports					
Japan	4.8	11.6	21.0	31.9	43.2	54.7	66.3	78.7	94.6	112.1	131.1
China	3.9	9.9	18.3	28.7	39.6	51.2	62.8	75.1	90.5	107.1	124.7
Taiwan	1.9	4.8	8.8	13.5	18.6	24.0	29.6	35.7	43.6	52.3	61.9
Hong Kong	1.3	3.4	6.4	10.2	14.4	18.7	23.9	29.8	37.8	47.3	58.5
Korea	2.1	5.1	9.3	14.3	19.5	25.1	30.8	37.1	45.1	54.2	64.0
Singapore	2.0	4.9	8.9	13.5	18.4	23.4	28.6	34.2	41.2	49.0	57.3
Indonisia	0.8	2.1	3.9	6.0	8.2	10.5	12.8	15.2	18.2	21.4	24.8
Thailand	1.1	2.6	4.9	7.9	10.9	14.1	17.4	20.8	25.1	29.8	34.8
Malaysia	1.3	3.3	6.0	9.4	13.0	16.9	21.1	25.7	31.3	37.5	44.2
Philipnes	0.6	1.5	2.8	4.3	5.9	7.4	8.9	10.6	12.6	14.9	17.4
United States	16.0	38.4	68.1	103.0	138.9	179.6	218.2	259.9	313.5	373.1	436.8
Western Europe	10.9	26.3	46.8	70.5	94.7	122.0	147.5	174.9	210.0	248.9	290.8
Canada	2.8	6.7	12.0	18.1	24.3	31.0	37.5	44.3	53.1	62.9	73.2
Austrilia	1.2	2.9	5.3	8.0	10.9	13.9	17.1	20.6	25.1	30.3	36.0
New Zealand	0.3	0.7	1.2	1.8	2.4	3.0	3.6	4.3	5.2	6.1	7.1
Western Europe	1.2	3.1	5.8	9.1	12.8	16.5	20.5	25.0	30.7	37.3	44.5
Rest of World	11.9	28.6	50.8	76.2	101.7	127.5	152.9	179.8	213.7	250.2	288.6
World total	64.1	156.0	280.0	426.1	577.2	739.5	899.3	1071.5	1291.3	1534.4	1795.7

Table 10 -- Impact of Chinese RMB devaluation: aggregate results

	China	Taiwan	Hong Kong	Korea	Singapore	Indonesia	Thailand	Malaysia	Philippines	Japan	United States	Western Europe
						Scenario 1: 10 percent devaluation						
Total exports Billion $	29.2	-3.2	-2.0	-2.3	-0.9	-0.9	-1.2	-1.2	-0.2	-6.0	-5.8	-8
Total exports %	13.9	-2.5	-2.7	-1.6	-0.8	-1.8	-1.9	-1.4	-0.8	-1.2	-0.8	-1
Total imports Billion $	-16.9	-0.4	0.7	-0.2	0.2	-0.0	0.5	0.3	-0.0	0.7	1.2	1
Total imports %	-10.1	-0.3	0.7	-0.1	0.2	-0.1	0.6	0.4	-0.1	0.2	0.1	0
Balance of Trade Billion $	46.1	-2.8	-2.8	-2.1	-1.2	-0.9	-1.7	-1.5	-0.2	-6.7	-7.1	-9
						Scenario 2: 20 percent devaluation						
Total exports Billion $	58.8	-6.0	-3.8	-4.4	-1.8	-1.8	-2.5	-2.4	-0.4	-11.4	-11.5	-15
Total exports %	28.0	-4.6	-5.0	-3.1	-1.5	-3.5	-3.7	-2.8	-1.6	-2.4	-1.6	-1
Total imports Billion $	-30.6	-0.7	1.3	-0.3	0.4	-0.1	0.9	0.6	-0.1	1.4	2.4	2
Total imports %	-18.3	-0.6	1.1	-0.2	0.3	-0.2	1.1	0.8	-0.2	0.3	0.3	0
Balance of Trade Billion $	89.4	-5.3	-5.0	-4.1	-2.3	-1.8	-3.4	-3.0	-0.3	-13.0	-14.1	-18
						Scenario 3: 30 percent devaluation						
Total exports Billion $	88.8	-8.4	-5.2	-6.3	-2.6	-2.7	-3.7	-3.5	-0.6	-16.5	-17.0	-23
Total exports %	42.2	-6.5	-7.0	-4.5	-2.2	-5.1	-5.5	-4.2	-2.4	-3.4	-2.4	-2
Total imports Billion $	-41.8	-0.9	1.7	-0.4	0.6	-0.1	1.4	1.0	-0.1	2.3	3.7	4
Total imports %	-25.0	-0.9	1.5	-0.3	0.4	-0.3	1.6	1.2	-0.4	0.5	0.4	0
Balance of Trade Billion $	130.7	-7.5	-6.9	-5.9	-3.3	-2.6	-5.1	-4.5	-0.5	-18.9	-20.9	-27

Table 11 -- Impact of 10 % Chinese RMB devaluation: changes in exports by sector, percent divation from base

	China	Taiwan	Hong Kong	Korea	Singapore	Indonesia	Thailand	Malaysia	Philippines	Japan	United States	Western Europe	Rest of World
Agriculture	30.6	-2.0	1.7	-2.7	-0.7	-1.9	-1.0	-1.4	-2.0	-2.6	-1.9	-2.0	-1.5
Forest & Fishery	73.9	-2.2	0.3	-3.1	-1.1	-3.0	-8.5	-3.4	-4.5	-4.1	-2.0	-3.1	-1.5
Energy & minerals	26.7	-0.7	-0.3	-1.9	-0.4	-0.8	-2.0	-1.3	-1.7	-1.0	-0.9	-0.6	-0.6
Processed food	29.0	-1.0	-4.0	-1.5	-1.4	-1.7	-1.9	-2.0	-0.9	-2.5	-1.2	-0.7	-1.1
Beverage & tobacco	35.1	-2.3	-9.2	-2.5	-4.6	-1.6	-1.7	-4.8	-6.0	0.0	-0.8	-0.8	-0.4
Textile	12.8	-4.4	-4.3	-2.8	-2.9	-1.9	-2.0	-2.6	-1.2	-4.3	-1.3	-2.0	-1.1
Apparel	7.6	-1.5	-2.3	-0.9	-0.9	-1.3	-2.9	-1.1	-0.3	-9.7	-3.6	-5.7	-0.3
Other Light Manufacture	32.2	-6.5	-5.9	-6.1	-3.6	-7.0	-7.1	-5.7	-6.2	-6.0	-5.9	-6.5	-7.1
Wood & paper products	27.2	-2.4	-4.5	-3.4	-1.1	-1.8	-1.3	-1.9	-0.7	-1.3	-0.6	-0.4	-0.6
Manufactured intermediates	21.1	-2.8	-4.5	-1.9	-0.9	-0.7	-1.1	-0.6	-0.7	-1.6	-0.8	-0.7	-0.8
Motor vehicle	52.5	-0.1	-3.3	-0.1	1.0	0.3	-0.4	0.1	1.0	0.0	0.2	-0.2	0.1
Other transport equipment	53.1	-2.4	-2.7	-1.2	-1.6	-1.4	-1.8	-1.8	-1.1	-1.6	-1.3	-1.5	-1.0
Electronics	21.8	-1.1	-3.4	-1.2	-0.5	-1.1	-1.3	-0.9	-0.4	-1.4	-1.1	-1.3	-0.9
Other machinery	25.7	-2.1	-2.6	-1.1	-0.5	-0.4	-1.1	-0.7	-0.3	-1.3	-0.8	-1.0	-0.7
Traded services	21.4	-0.1	-2.4	-0.2	-0.1	-0.2	-0.3	-0.5	-0.2	0.1	-0.0	-0.1	-0.1
Utility, housing & construction	25.8	-1.0	-1.0	-0.8	-0.3	0.0	-0.7	-0.9	-0.7	-0.6	-0.1	-0.3	-0.7
Total	22.9	-2.4	-2.8	-1.6	-0.7	-1.6	-1.9	-1.4	-0.7	-1.2	-0.8	-0.9	-0.8

Table 8 -- Impact of Chinese RMB devaluation: aggregate results with no MFA restriction in developed country markets

	China	Taiwan	Hong Kong	Korea	Singapore	Indonesia	Thailand	Malaysia	Philippines	Japan	United States	Western Europe	Rest of World	World total
Scenario 1: 10 percent devaluation														
Total exports Billion $	35.8	-3.1	-2.2	-2.5	-0.9	-1.1	-1.4	-1.3	-0.3	-5.9	-6.1	-8.5	-11.8	-9.3
Total exports %	17.0	-2.4	-3.0	-1.8	-0.7	-2.2	-2.2	-1.5	-1.0	-1.2	-0.8	-1.0	-1.1	-0.2
Total imports Billion $	-16.6	-0.3	0.8	-0.2	0.2	-0.1	0.5	0.4	-0.1	1.9	1.6	2.0	0.2	-9.7
Total imports %	-9.9	-0.3	0.7	-0.1	0.2	-0.1	0.6	0.5	-0.1	0.4	0.2	0.2	0.0	-0.2
Balance of Trade Billion $	52.3	-2.8	-3.0	-2.3	-1.1	-1.1	-2.0	-1.7	-0.2	-7.8	-7.7	-10.5	-6.2	0.0
Scenario 2: 20 percent devaluation														
Total exports Billion $	72.4	-5.8	-4.1	-4.8	-1.8	-2.3	-2.9	-2.5	-0.5	-11.2	-11.9	-16.5	-23.4	-15.2
Total exports %	34.4	-4.4	-5.5	-3.4	-1.5	-4.3	-4.3	-3.0	-2.0	-2.3	-1.7	-2.0	-2.2	-0.4
Total imports Billion $	-29.9	-0.6	1.3	-0.4	0.4	-0.1	1.0	0.7	-0.1	4.0	3.3	4.1	0.5	-15.8
Total imports %	-17.9	-0.6	1.2	-0.2	0.3	-0.3	1.2	0.9	-0.3	0.9	0.4	0.5	0.0	-0.4
Balance of Trade Billion $	102.3	-5.1	-5.5	-4.5	-2.2	-2.1	-3.9	-3.3	-0.4	-15.2	-15.3	-20.7	-12.2	0.0
Scenario 3: 30 percent devaluation														
Total exports Billion $	109.8	-8.1	-5.9	-7.0	-2.6	-3.3	-4.2	-3.8	-0.8	-16.1	-17.7	-24.1	-34.8	-18.6
Total exports %	52.2	-6.3	-7.9	-5.0	-2.2	-6.3	-6.4	-4.5	-3.1	-3.3	-2.5	-2.9	-3.3	-0.5
Total imports Billion $	-40.8	-0.9	1.8	-0.5	0.5	-0.2	1.5	1.1	-0.2	6.1	5.1	6.5	0.7	-19.4
Total imports %	-24.4	-0.8	1.6	-0.3	0.4	-0.4	1.8	1.3	-0.4	1.4	0.6	0.8	0.1	-0.5
Balance of Trade Billion $	150.6	-7.3	-7.7	-6.5	-3.1	-3.1	-5.7	-4.9	-0.6	-22.3	-22.9	-30.8	-18.2	0.0

Table 9 -- Impact of 10 % Chinese RMB devaluation: changes in exports by sector with no MFA restraction in developed country markets

	China	Taiwan	Hong Kong	Korea	Singapore	Indonesia	Thailand	Malaysia	Philippines	Japan	United States	Western Europe	Rest of World
Agriculture	32.1	-2.1	1.8	-2.9	-0.8	-2.1	-1.0	-1.4	-2.1	-2.8	-2.0	-2.1	-1.6
Forest & Fishery	78.1	-2.3	0.3	-3.3	-1.2	-3.2	-9.1	-3.5	-4.7	-4.3	-2.1	-3.2	-1.6
Energy & minerals	27.0	-0.8	-0.3	-1.9	-0.4	-0.8	-2.1	-1.3	-1.7	-1.0	-0.9	-0.6	-0.6
Processed food	29.7	-1.0	-4.3	-1.6	-1.5	-1.8	-2.0	-2.1	-0.9	-2.6	-1.2	-0.7	-1.2
Beverage & tobacco	35.5	-2.3	-9.8	-2.5	-4.6	-1.5	-1.6	-4.9	-6.0	0.0	-0.8	-0.8	-0.4
Textile	20.1	-2.2	-2.2	-2.2	-3.5	-2.9	-2.6	-3.1	-1.7	-2.8	-2.3	-2.7	-2.3
Apparel	34.9	-6.0	-3.3	-7.3	-0.4	-6.0	-6.8	-5.7	-1.9	-11.8	-6.9	-9.5	-5.3
Other Light Manufacture	32.0	-6.4	-5.8	-6.0	-3.6	-6.9	-7.0	-5.7	-6.1	-5.9	-5.8	-6.5	-7.1
Wood & paper products	27.1	-2.5	-4.7	-3.5	-1.1	-1.8	-1.3	-1.9	-0.8	-1.3	-0.6	-0.4	-0.6
Manufactured intermediates	20.9	-2.8	-4.6	-1.9	-0.9	-0.7	-1.1	-0.6	-0.7	-1.6	-0.8	-0.7	-0.8
Motor vehicle	51.7	-0.0	-3.3	-0.0	1.0	0.4	-0.4	0.1	1.0	0.0	0.2	-0.1	0.1
Other transport equipment	52.3	-2.3	-2.7	-1.1	-1.6	-1.3	-1.8	-1.8	-1.1	-1.6	-1.2	-1.5	-0.9
Electronics	21.5	-1.2	-3.7	-1.2	-0.5	-1.1	-1.3	-0.9	-0.3	-1.5	-1.1	-1.4	-0.9
Other machinery	25.3	-2.1	-2.7	-1.1	-0.5	-0.4	-1.1	-0.7	-0.3	-1.3	-0.8	-1.0	-0.7
Traded services	21.2	-0.1	-2.4	-0.2	-0.1	-0.2	-0.3	-0.5	-0.2	0.2	0.0	-0.0	-0.1
Utility, housing & construction	25.6	-0.9	-1.0	-0.8	-0.3	0.1	-0.7	-0.9	-0.7	-0.5	-0.0	-0.3	-0.6
Total	27.2	-2.3	-2.9	-1.7	-0.7	-2.0	-2.1	-1.5	-0.8	-1.2	-0.8	-1.0	-1.0

Table 12 -- Impact of Chinese RMB devaluation: Other countries exchange rate, percent deviation from base

	China	Taiwan	Hong Kong	Korea	Singapore	Indonesia	Thailand	Malaysia	Philippines	Japan	United States	Western Europe
Scenario 1: 10 percent devaluation												
exchange rate %	-10.0	-1.4	-1.8	-0.9	-0.8	-1.1	-1.1	-1.0	-0.6	0.0	0.0	0.0
Terms of trade %	-7.8	-0.2	0.1	0.1	0.3	-0.1	-0.2	-0.1	0.4	0.8	0.5	0.5
Scenario 2: 20 percent devaluation												
exchange rate %	-20.0	-2.7	-3.4	-1.8	-1.5	-2.1	-2.2	-2.0	-1.3	0.0	0.0	0.0
Terms of trade %	-14.3	-0.5	0.1	0.1	0.4	-0.3	-0.6	-0.2	0.8	1.4	0.9	0.9
Scenario 3: 30 percent devaluation												
exchange rate %	-30.0	-3.8	-4.9	-2.6	-2.2	-3.2	-3.2	-2.9	-1.9	0.0	0.0	0.0
Terms of trade %	-19.9	-0.7	0.1	0.1	0.5	-0.6	-0.9	-0.3	1.0	2.0	1.2	1.3

Table 13 -- Impact of Japanese Yen devaluation: aggregate results

	Japan	China	Taiwan	Hong Kong	Korea	Singapore	Indonesia	Thailand	Malaysia	Philippines	United States	Western Europe	Rest of World	World total
Scenario 1: 10 percent devaluation														
Total exports Billion $	79.5	-6.3	-4.1	-1.3	-6.0	-3.4	-1.0	-2.3	-2.0	-0.5	-25.0	-27.1	-19.3	-18.8
Total exports %	16.4	-3.0	-3.2	-1.7	-4.3	-2.8	-1.9	-3.5	-2.3	-2.1	-3.5	-3.2	-1.8	-0.5
Total imports Billion $	-49.4	0.4	-0.4	2.3	0.2	3.4	-0.1	0.9	0.4	-0.2	12.2	11.4	-0.6	-19.4
Total imports %	-11.4	0.2	-0.3	2.1	0.2	2.6	-0.1	1.1	0.5	-0.5	1.4	1.4	-0.1	-0.5
Balance of Trade Billion $	128.9	-6.7	-3.8	-3.6	-6.3	-6.9	-0.9	-3.3	-2.4	-0.4	-37.3	-38.6	-6.1	0.0
Scenario 2: 20 percent devaluation														
Total exports Billion $	161.5	-11.7	-7.8	-2.3	-11.4	-6.3	-1.8	-4.3	-3.7	-1.0	-47.1	-51.6	-35.9	-23.5
Total exports %	33.4	-5.6	-6.0	-3.1	-8.2	-5.2	-3.3	-6.5	-4.3	-3.7	-6.6	-6.1	-3.4	-0.6
Total imports Billion $	-87.9	0.9	-0.6	5.0	0.6	6.7	-0.1	1.8	0.8	-0.4	26.0	24.5	-1.3	-24.1
Total imports %	-20.2	0.5	-0.6	4.4	0.4	5.2	-0.3	2.1	1.0	-1.0	2.9	3.0	-0.1	-0.6
Balance of Trade Billion $	249.3	-12.6	-7.2	-7.3	-12.0	-13.1	-1.6	-6.1	-4.5	-0.6	-73.3	-76.2	-10.7	0.0
Scenario 3: 30 percent devaluation														
Total exports Billion $	245.3	-16.6	-11.2	-3.3	-16.3	-8.9	-2.4	-6.0	-5.1	-1.3	-67.1	-73.8	-49.9	-16.7
Total exports %	50.7	-7.9	-8.6	-4.4	-11.7	-7.3	-4.5	-9.1	-6.1	-5.1	-9.3	-8.8	-4.7	-0.4
Total imports Billion $	-118.4	1.5	-0.9	8.0	1.0	10.0	-0.3	2.5	1.1	-0.5	41.5	39.5	-1.8	-17.0
Total imports %	-27.2	0.9	-0.8	7.1	0.6	7.6	-0.5	3.0	1.4	-1.4	4.7	4.9	-0.2	-0.4
Balance of Trade Billion $	363.6	-18.1	-10.4	-11.3	-17.3	-18.9	-2.1	-8.5	-6.2	-0.8	-108.6	-113.4	-14.0	0.0

Table 14 -- Impact of Japanese Yen devaluation: changes in exports by sector

	China	Taiwan	Hong Kong	Korea	Singapore	Indonesia	Thailand	Malaysia	Philippines	Japan	United States	Western Europe	Rest of World
Agriculture	8.7	-3.9	-0.7	-3.6	-4.2	-0.7	-1.3	-0.6	-0.7	-1.5	0.0	-0.0	0.3
Forest & Fishery	30.8	-11.0	-7.9	-5.9	-8.5	-0.6	-3.5	-9.2	-7.0	-6.0	-7.4	-5.8	-1.4
Energy & minerals	23.6	0.4	1.6	-1.7	-0.2	0.8	-0.4	-2.1	-0.9	1.1	-0.3	-0.5	0.1
Processed food	21.8	-5.6	-6.1	-2.1	-6.5	-0.8	-3.3	-1.9	-0.3	-2.0	-2.3	-0.7	-1.0
Beverage & tobacco	37.6	1.6	1.9	-0.4	-4.9	0.4	0.4	1.3	5.3	2.9	-5.6	-1.2	0.6
Textile	26.9	-0.4	-0.9	-2.4	-0.8	-3.2	0.2	-0.3	0.4	-0.2	-1.4	-2.0	-0.5
Apparel	71.5	0.5	0.3	-0.4	0.2	0.5	0.5	0.8	0.6	0.2	-5.7	-7.2	0.2
Other Light Manufacture	44.9	-3.2	-3.1	-2.7	-4.8	1.4	-2.3	-3.1	5.4	-2.4	-4.5	-4.4	-2.4
Wood & paper products	32.6	-2.1	-1.7	-0.7	-0.8	-2.1	-3.0	-3.4	-1.6	-1.3	-1.5	-0.7	-0.5
Manufactured intermediates	20.3	-1.6	-0.8	-2.2	-2.2	-2.9	-2.2	-1.9	-1.3	-2.6	-1.9	-1.4	-1.6
Motor vehicle	45.4	-9.6	-9.9	-14.6	-7.3	-4.8	-12.7	-6.5	-8.6	-8.3	-8.7	-12.8	-7.9
Other transport equipment	61.5	-3.9	-4.1	-13.8	-3.5	-4.8	5.1	-7.6	-4.0	-2.0	-7.2	-6.7	-3.3
Electronics	26.7	-2.0	-3.4	-4.7	-3.2	-0.5	-3.3	-6.0	-2.3	-0.6	-4.5	-4.4	-3.7
Other machinery	23.9	-4.3	-2.6	-4.5	-4.1	-1.2	-0.7	-4.8	-2.1	0.8	-5.3	-4.7	-4.1
Traded services	21.5	-3.2	-4.1	-0.9	-6.1	-4.5	-4.1	-4.9	-5.1	-2.5	-1.4	-0.9	-3.2
Utility, housing & construction	31.0	2.8	0.9	0.5	1.0	1.9	2.3	1.7	2.3	1.5	0.5	0.1	1.1
Total	28.4	-2.2	-2.5	-1.6	-3.8	-1.9	-1.7	-3.2	-1.5	-1.1	-3.4	-3.2	-1.8

Table 15 -- Impact of Japanese Yen devaluation: Other countries exchange rate when balance of trade fixed at base

	Japan	China	Taiwan	Hong Kong	Korea	Singapore	Indonesia	Thailand	Malaysia	Philippines	United States	Western Europe
Scenario 1: 10 percent devaluation												
exchange rate %	-10.0	-1.4	-1.7	-1.5	-2.0	-1.7	-1.4	-1.9	-1.4	-1.0	0.0	0.0
Terms of trade %	-7.5	0.2	0.5	0.6	-0.3	0.3	0.2	0.0	0.3	0.5	1.1	1.2
Scenario 2: 20 percent devaluation												
exchange rate %	-20.0	-2.7	-3.3	-2.9	-3.9	-3.1	-2.6	-3.6	-2.5	-1.8	0.0	0.0
Terms of trade %	-14.0	0.3	0.7	1.1	-0.6	0.5	0.3	-0.0	0.5	1.0	2.1	2.3
Scenario 3: 30 percent devaluation												
exchange rate %	-30.0	-3.9	-4.7	-4.1	-5.6	-4.3	-3.6	-5.2	-3.5	-2.4	0.0	0.0
Terms of trade %	-19.5	0.3	0.9	1.7	-1.1	0.6	0.3	-0.1	0.7	1.4	2.9	3.3

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