Discussion Papers In Economics And Business

The Dynamic Welfare Costs of the 1997 Asian Crisis

Tatsuyoshi Miyakoshi, Masakatsu Okubo and Junji Shimada

Discussion Paper 07-25

Graduate School of Economics and
Osaka School of International Public Policy (OSIPP)
Osaka University, Toyonaka, Osaka 560-0043, JAPAN

The Dynamic Welfare Costs of the 1997 Asian Crisis

Tatsuyoshi Miyakoshi, Masakatsu Okubo and Junji Shimada

Discussion Paper 07-25

June 2007

この研究は「大学院経済学研究科・経済学部記念事業」
基金より援助を受けた、記して感謝する。

Graduate School of Economics and
Osaka School of International Public Policy (OSIPP)
Osaka University, Toyonaka, Osaka 560-0043, JAPAN

The Dynamic Welfare Costs of the 1997 Asian Crisis *

by

Tatsuyoshi Miyakoshi [a] , Masakatsu Okubo[b] and Junji Shimada [c]

[a] Osaka School of International Public Policy, Osaka University

[b]Graduate School of Systems and Information Engineering,University of Tsukuba

[c] School of Management, Aoyama Gakuin University

Abstract

This paper has measured the welfare cost, investigated the effects of and the recovery process of the 1997 Asian crisis, and evaluated the IMF-supported programs. The paper finds: (i) the ratios of 'whole cost' to the consumption level of the hypothetical economy are large: 30% for Thailand, 50% for Indonesia, 36% for Korea, 18% for Malaysia and 39% for Hong Kong; (ii) the dynamic process of 'cost at period t' quickly converges to 40% right after the crisis, but the costs for Indonesia and Hong Kong gradually increase towards 100%; (iii) the IMF-supported programs for Thailand, Indonesia and Korea have been implemented right after the cost hits peaks; (iv) the cost of the IMF-supported program was not expensive compared with the corresponding welfare cost of crisis.

Keywords: dynamic welfare cost; time-varying model;1997 Asian crisis
JEL Classification Number:C32; C50; E32;E20

Correspondence: Tatsuyoshi Miyakoshi, Osaka School of International Public Policy
Osaka University,1-31, Machikaneyama-machi, Toyonaka,Osaka, 560-0043, Japan.
tel:+81-6-6850-5638; fax:+81-6-6850-5656. E-mail: miyakoshi@osipp.osaka-u.ac.jp

* Earlier versions of this paper were presented at Osaka University and Hitotsubashi University in 2003, City University of Hong Kong and Tokyo University in 2004, 2004 Western Regional Science Association Conference (in Hawaii), 2004 Western Economic Association Conference (in Vancouver), 2004 East Asian Economic Association Conference (in Hong Kong). We thank Kenneth S. Chan, Makoto Saito, Yum K. Kwan, Yong Wang, Eiji Ogawa, Yoshiro Tsutsui, Yuzo Honda, Shinsuke Ikeda, Soyoung Kim, and Joshua Aizenman for useful suggestions. The first author's research was supported by Grant-in-Aid 16530204 from the Ministry of Education, Culture, Sport, Science, and Technology of Japan.

1. Introduction

Some Asian currencies in the wake of flotation of the Thai baht in 2 July 1997 collapsed, and the crisis spread to other countries in the Asian region. The currency crisis triggered the financial crisis. Thus, the Asian crisis (currency and financial crises) covered most of the East-Asian countries by the early 1998. The Asian economies have experienced the drastic reduction of the economic growth. In particular, to Thailand, Indonesia and Korea (called as supported-countries by the IMF), the international organization (International Monetary Fund, World Bank, Asian Development Bank) and the G-7 countries provided the assistance together with the program of economic reform. Diagnoses of the seriousness of crisis and the appropriate recovery process are important because they enable a government to evaluate its policy effects (i.e., the IMF-supported program) and implement additional policy if required.

Few papers for diagnoses exist. Most of them diagnose it by independently using each measure of GDP, the exchange rates and the stock prices as well as previous researches. Ito (1999) and Yoo and Moon (1999) diagnosed no smooth recovery in the real economy and claimed that the IMF programs that do not address the crux of the matter were ineffective and costly. Berg (1999) stated that the issues of short-run stabilization receded as early as 1999. However, Cerra and Sweta (2005) found that while growth recovered fairly quickly after the crisis, there was evidence of permanent losses in the levels of output in all the countries. Lane et al. (1999) presented a preliminary assessment that the developments toward recovery had been much more favorable in Thailand and Korea that had been able to keep to the programs, but Indonesia had been still facing more difficult task in part because of the severity of the underlying political crisis. Kho and Stulz (2000) found the negative impact of IMF bailout announcements on the bank stock indices. In contrast, Lau and McInish (2003) found the positive impact on the individual bank stock returns and on the multiple event dates. No research diagnosed the Asian crisis by using the composite measure reflecting the change of fundamentals (GDP, exchange rates and stock prices). The people's welfare can reflect the changes of fundamentals through people's consumption and then will become one of composite measure.

A welfare measure was provided by Lucas (1987) and Obstfeld (1994). They measured compensations that would leave consumers indifferent to a decline in economic growth and an increase in economic instability. Miyakoshi, Okubo and Shimada (2006) refer to both types of compensation (for the decline in economic growth and the increase in instability) as the 'welfare cost of stagnation' and the model as the 'Lucas–Obstfeld model'. The welfare costs based on utility will equal the costs that people are willing to pay to prevent the stagnation. Then, we can evaluate whether the cost of the policy to prevent stagnation, which a government would finance from tax revenues, is higher than the welfare cost of stagnation. The practical use of measuring this cost has been explored by Miyakoshi, Okubo and Shimada (2006).[1] Their paper has proposed an alternative measure of costs to the Lucas–Obstfeld model, which can evaluate: (i) whether the policy was implemented in a timely fashion, (ii) whether the policy cost was expensive compared with the cost of stagnation, and (iii) whether the policy implemented was effective or whether an additional policy is required. Their model is widely applicable by replacing the costs of stagnation with the costs of crisis.

The purpose of this paper is to measure dynamically the welfare cost, investigate the

---

[1] However, Lucas and Obstfeld did not define the cost of stagnation. Rather, their concern was with the latter compensation (the cost of the economic instability) and they did not provide any analysis of the cost of stagnation: they only derived the formulation for the cost of stagnation. This also applies to work by Dolmars (1998), Krusell and Smith (1999), Storestetten et al. (2001), Beaudry and Pages (2001), and Pallage and Robe (2003).

effects of and the recovery process of the 1997 Asian crisis, and evaluate the IMF-supported programs We deploy Miyakoshi, Okubo and Shimada (2006)'s model to Thailand, Indonesia, Korea, Malaysia, and Hong Kong.

The paper finds: (i) the 'whole cost (ratios) per quarter' of crisis are evaluated large for all countries: 30% of the quarterly consumption in the starting period of crisis for Thailand, 50% for Indonesia, 36% for Korea, 18% for Malaysia and 39% for Hong Kong; (ii) the dynamic process of the 'cost (ratios) at period t' in Thailand, Korea and Malaysia quickly converges to 40% right after the crisis, reflecting the effectiveness of the policy; but the cost for Indonesia and Hong Kong remain still high at now, suggesting that the additional policy is required; (iii) the IMF-supported programs for Thailand, Indonesia and Korea have been implemented right after the cost hits peaks in each country, implying the quick program implementation; (iv) the policy cost of the IMF-supported program is not expensive compared with the corresponding welfare cost, suggesting the agreement of the program in each country.

This paper is organized as follows. In Section 2, we describe the Lucas-Obstfeld Model and the alternative model proposed by the Miyakoshi,Okubo and Shimad (2006). In Section 3, we describe the data set. In Section 4, we diagnose the 1997 Asian crisis. Section 5 concludes the paper.

2. Economic Model

Lucas-Obstfeld Model

Miyakoshi,Okubo and Shimad (2006) provide two models: the Lucas-Obstfeld Model and an alternative model. Detail derivations are given in their paper. First, we describe the former one. The representative agent lives infinitely and maximizes an expected utility function V by choosing real consumption C_t at time t. The agent has preferences specified by:

$$V = E\left[\sum_{t=0}^{\infty}\beta^{t}\frac{1}{1-\gamma}C_t^{1-\gamma}\right], \quad (1)$$

where $\beta \in (0,1)$ is a constant discount factor and $\gamma > 0$ is the constant coefficient of relative risk aversion. Here, consider a pure exchange economy with no production, no storable goods and no borrowing. Then, the optimal consumption C_t for an agent is subject to exogenous income I_t in each period and hence is equal to its income: $C_t = I_t$ for all t.

Assume a class of exogenous income and hence optimal consumption streams C_t with trend and cycle components, given by:

$$\begin{aligned} &C_t = \lambda(1+\mu)^t e^{-\frac{1}{2}\sigma^2} z_t, \\ &i.\ e.,\ \ln C_t = \ln\lambda - \frac{1}{2}\sigma^2 + \mathrm{t}\cdot\ln(1+\mu) + \ln z_t : \ln z_t \sim N(0,\sigma^2) \end{aligned} \quad (2)$$

where μ is the growth rate of consumption and $\ln z_t \sim N(0, \sigma^2)$. In addition, assume that an agent has rational expectations, which implies that an agent knows those moments, and then is maximizing an unconditional expectation of utility (1): the subscript of time t is not attached on V in (1). Owing to the property of the log-normal distribution, $E(z_t \bullet \exp(-\sigma^2/2)) = 1$, the mean consumption is:

$$E(C_t) = \lambda(1+\mu)^t, \quad (3)$$

where the mean consumption at t = 0 is λ.

Thus, Lucas and Obstfeld assumed that the stagnation process of exogenous income (consumption) can be expressed by constant moments over time of the distribution of consumption, λ, μ, and σ^2, and that an agent has rational expectations.

Under the above setup, we can calculate the indirect utility given the consumption process described by (2) and denote it by $V(\lambda, \mu, \sigma^2|\gamma,\beta)$.This is derived as follows:

$$V(\lambda,\mu,\sigma^2 \mid \gamma,\beta) = \frac{1}{(1-\gamma)(1-\phi)} \exp\left\{(1-\gamma)(\ln\lambda - \frac{\gamma}{2}\sigma^2)\right\} \quad if\ \phi < 1,$$

$$\phi = \exp\{\ln\beta + (1-\gamma)\ln(1+\mu)\}. \tag{4}$$

We define that the period of Asian crisis outburst is the next period to the peak period for consumption series after the third quarter of 1997 for all Asian countries, considering the Asian currency crisis on July 2 1997. We partition the whole sample (1990:Q1 to 2004:Q3) into two sub-samples by the outburst of the Asian crisis: the crisis periods including the crisis outburst and the pre-crisis periods excluding it.

We consider two economies. One is called *the crisis economy* in which consumption growth μ_C and its variance σ_C^2 are calculated based on the data in the crisis periods. We denote the resulting indirect utility as $V(\lambda_C, \mu_C, \sigma_C^2 \mid \overline{\gamma}, \overline{\beta})$. The other is called *the hypothetical economy (i.e., the economy without crisis),* which is based on expected consumption under the assumption that the growth rate and variance in the pre-crisis period are maintained during the crisis periods. The resulting indirect utility is $V(\lambda_H, \mu_H, \sigma_H^2 \mid \overline{\gamma}, \overline{\beta})$. The intuition behind this comparison is shown in Figure 1. Owing to (3), the λ_H is mean consumption at the beginning of the crisis period for the hypothetical economy. However, in actual, the consumption falls gradually during several periods after the crisis outburst, as denoted by dot line. We replace the dot line by a solid line for analytical convenience. Thus, we compare both economies depicted by the solid lines in the crisis periods. Although γ and β differ between both economies, we assume that they remain constant over time at $(\bar{\gamma}, \bar{\beta})$.

[INSERT Figure 1]

We define the 'whole cost' of crisis as follows.

Definition 1. The 'whole cost of crisis' is given by λ*, which satisfies the following equation:

$$V(\lambda_C + \lambda^*, \mu_C, \sigma_{\mathrm{C}}^2 \mid \bar{\gamma}, \bar{\beta}) = V(\lambda_H, \mu_H, \sigma_{\mathrm{H}}^2 \mid \bar{\gamma}, \bar{\beta}), \tag{5}$$

where the subscripts C and H denote the crisis and hypothetical economy, respectively. The key concept relating to the 'whole cost' of crisis is the following. The consumption parameters are different between the crisis (C-ECO) and the hypothetical economies (H-ECO). Consumer preferences, given by $(\bar{\gamma}, \bar{\beta})$, transform the difference in consumption parameters into a difference in utility levels. The 'whole cost' of crisis is measured by the compensation, uniform across all periods, required to leave consumers' utility indifferent between two economies. The 'whole cost' implies the cost from the beginning of the crisis to the future.

The calculation of the cost λ* is given by:

$$\lambda^* = \exp\{\Psi\} - \lambda_C,$$

$$\Psi = \frac{1}{1-\bar{\gamma}}\left\{\ln\left(\frac{1-\phi_C}{1-\phi_H}\right) + (1-\bar{\gamma})(\ln\lambda_H - \bar{\gamma}\sigma_H^2/2)\right\} + \bar{\gamma}\sigma_C^2/2 \qquad (6)$$

where

$$\phi_C = \exp\{\ln\bar{\beta} + (1-\bar{\gamma})\ln(1+\mu_C)\} \text{ and } \phi_H = \exp\{\ln\bar{\beta} + (1-\bar{\gamma})\ln(1+\mu_H)\}.$$

An Alternative Model: The Dynamic Welfare Cost

Assume that the crisis economy for consumption can be expressed by the time-varying intercept and slope as follows:

$$\ln C_t = a_t + b_t \cdot t + \ln z_t : \quad \ln z_t \sim N(0, \sigma^2)$$

$$a_t \equiv \ln\lambda_t - \frac{1}{2}\sigma^2; \quad b_t \equiv \ln(1+\mu_t) \qquad (7)$$

$$\begin{bmatrix} a_t \\ b_t \end{bmatrix} = \begin{bmatrix} \alpha_0 \\ \beta_0 \end{bmatrix} + \begin{bmatrix} \alpha_1 & 0 \\ 0 & \beta_1 \end{bmatrix} \begin{bmatrix} a_{t-1} \\ b_{t-1} \end{bmatrix} + \begin{bmatrix} \eta_{a,t} \\ \eta_{b,t} \end{bmatrix} : \quad \begin{bmatrix} \eta_{a,t} \\ \eta_{b,t} \end{bmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{bmatrix} q_a^2 & 0 \\ 0 & q_b^2 \end{bmatrix} \right) \text{t=0,1,2,…}$$

We assume that an agent has myopic rational expectations, which implies that an agent knows the moments of the distribution of only today t's consumption parameters, σ^2, a_t (λ_t) and b_t (μ_t). Moreover, an agent expects (or believes) these moments of today t to continue forever for future consumption. Thus, based on today t's information, an agent obtains the conditional moments for today t and for future consumption (i.e., for the crisis economy). The indirect utility function of (4) conditioned on today t's information includes the subscript of time t.

$$V_t(\lambda_t,\mu_t,\sigma^2 \mid \gamma,\beta)=\frac{1}{(1-\gamma)(1-\phi_t)}\exp\left\{(1-\gamma)(\ln\lambda_t-\frac{\gamma}{2}\sigma^2)\right\} \quad if\ \phi_t<1,$$

$$\phi_t=\exp\{\ln\beta+(1-\gamma)\ln(1+\mu_t)\}. \tag{8}$$

At period t, an agent gets these parameters and computes indirect utility from period t to the future, based on the coming information at period t. Here, we compare this 'indirect utility at period t' with the 'indirect utility at period t' for the hypothetical economy mentioned in the Lucas-Obstfeld model. The 'cost at period t' of crisis is given by λ_t*, which satisfies the following equation:

$$V_t(\lambda_{C,t}+\lambda_t^*,\mu_{C,t},\sigma_C^2 \mid \bar{\gamma},\bar{\beta})=V_t(\lambda_{H,t},\mu_H,\sigma_H^2 \mid \bar{\gamma},\bar{\beta}), \tag{9}$$

where the subscripts C and H denote the crisis and hypothetical economy, respectively. The parameters for the crisis economy are changed period by period, whereas the parameters for the hypothetical economy are the same and constant over each period, as in the Lucas-Obstfeld model. The $\lambda_{H,t}$ is the exception, because it is an intercept of consumption and it changes at period t.

Then, an agent re-computes the 'cost at period t' of crisis period by period, based on the updated information.

$$\lambda_t^* = \exp\{\Psi_t\} - \lambda_{C,\,t}\,,$$

$$\Psi_t = \frac{1}{1-\bar{\gamma}}\left\{\ln\left(\frac{1-\phi_{C,t}}{1-\phi_H}\right) + (1-\bar{\gamma})(\ln\lambda_{H,t} - \bar{\gamma}\sigma_H^2/2)\right\} + \bar{\gamma}\sigma_C^2/2\ , \qquad (10)$$

where

$$\phi_{C,\,t} = \exp\{\ln\bar{\beta} + (1-\bar{\gamma})\ln(1+\mu_{C,\,t})\} \text{ and } \phi_H = \exp\{\ln\bar{\beta} + (1-\bar{\gamma})\ln(1+\mu_H)\}$$

Keeping the variance constant in the crisis period but letting the consumption intercept and growth fluctuate, the agent recomputes the 'cost at period t' of crisis, relative to the hypothetical economy. The 'cost at period t' measures the cost from period to future and hence is different period by period.

Figure 2 is a schematic diagram that describes this idea, which summarizes our alternative model. An agent knows only the present period (T1)'s intercept $\lambda_{C,T1}$ and slope $\mu_{C,T1}$ in (7) from information at period T1, expects these parameters $\lambda_{C,T1}$ and $\mu_{C,T1}$ will continue forever. On this basis, the agent constructs the crisis economy from period t to the future. Thus, the crisis economies expected from period T1 to the future and from period T2 to the future will be different each other and the costs at T1 and T2 will be also different period by period. The 'cost at period t' calculated in this way may be literally called a dynamic cost of crisis, in contrast to a 'whole cost' computed from the beginning of crisis to the future by the Lucas-Obstfeld model. In general, the cost at period t will be higher at the start and lower at the end of the crisis period.

[INSERT Figure 2]

By using a 'cost at period t', we can evaluate: (i) whether the policy was implemented immediately in the period when the highest welfare cost arose, (ii) whether the cost of the implemented policies was expensive compared with the welfare costs of stagnation, and (iii) whether the cost of stagnation decreased gradually—that is, whether the policies were effective—or whether additional policies are required, which will be ascertained by determining the current welfare costs. These specific exercises cannot be undertaken under the existing frameworks, including under the Lucas–Obstfeld model.

Although an alternative model can compute the cost period by period, how can it derive the whole cost of crisis that occurred in an era? We may consider the 'cost at the period t' as the 'whole cost' of crisis. However, as an agent has myopic rational expectations about the crisis economy expressed by time-varying parameters, he or she cannot predict the future economy. Thus, the 'cost at the starting period' of the crisis cannot correctly capture the 'whole cost' from the starting period to the future. On the other hand, it is a very bold and implausible assumption that an agent has rational but not myopic rational expectations of the crisis economy expressed by time-varying parameters. Moreover, it is technically difficult to derive the 'whole cost' and the 'cost at period t' by applying the Lucas–Obstfeld model to an economy expressed by constant parameters. Thus, the two cost measures are derived based on the two different conceptions of the crisis economy. However, we propose a compromise. If we value a long-run viewpoint, it is natural to assume a stagnation economy with constant growth over time and instability. In contrast, if we value a short-run viewpoint, the assumption of a crisis economy with time-varying parameters is more natural. In this sense, when we value the long-run viewpoint and evaluate the 'whole cost' of crisis that has occurred in an era, the Lucas–Obstfeld measure may be appropriate.

To calculate the costs of crisis in Lucas- Obstfeld model, we proceed as follows. First, by using data for each sub-sample (the pre-crisis or the crisis period), we estimate the parameters (λ, μ, σ^2) for each economy and then use the preference parameters ($\bar{\gamma}$, $\bar{\beta}$) employed by Pallage and Robe(2003). These parameter estimates are reported in Table 1. Second, we measure the costs of crisis, which are reported in Table 2. Third, we calculate these costs for varying values of the parameters ($\bar{\gamma}$, $\bar{\beta}$) to do the robustness check. These results are reported in Table 3.

3. Data and the 1997 Asian Crisis

The data used in this paper are quarterly data mostly from the first quarter 1990 to the third quarter 2004 (i.e., 1990:Q1 to 2004:Q3), which gives 59 observations but changes depending on the data availability for each country: Thailand, Indonesia, Korea, Malaysia, and Hong Kong. To estimate the parameters (λ, μ, σ^2) for consumption in the model, we use total consumption expenditure for households (line 96f, measured in national currency) from the *International Financial Statistics* (IFS).[2] The per capita series is constructed by dividing consumption expenditure by the number of population (line 99z).[3] These data are converted to real values by using the consumer price index (line 64, for general prices in 2000): the money unit is a Baht for Thailand, a Rupiah for Indonesia, a Won for Korea, a Ringgit for Malaysia and a Hong Kong Dollar for Hong Kong. For the preference

[2] The consumption series is non-seasonally adjusted. It is seemingly important to delete the seasonal effects, while the sample size is small for all countries and then the seasonal adjustment reduce the sample size. In addition, for each country, we compare the non-seasonal adjusted data between both consumption paradigms. Then, the seasonal adjustment or non-adjustment is not so important.

[3] The data for population is on annual base, and then we assign the increase of the annual data to the quarterly data at a constant growth rate.

parameters ($\bar{\gamma}$, $\bar{\beta}$) employed by Pallage and Robe(2003), we calibrate the model.

Figure 3 plots consumption in logs for each country, which suggests a drop in the log of consumption (which reduces consumption growth) around 1997:Q3. The crisis outburst is 1997:Q3 for Thailand, 1998:Q1 for Indonesia, 1997:Q4 for Korea, 1998:Q1 for Malaysia and 1998:Q1 for Hong Kong. Our objective is to estimate the cost of the Asian crisis during the crisis period by comparing it with the hypothetical economy. This specification of the crisis outburst seems appropriate, and consistent with previous research, including Corsetti, Pesenti and Roubini (1999a,b). Therefore, we do not implement a formal test for structural change between two sub-periods.

[INSERT Figure 3]

4. Estimation Results and Discussion for Costs

Lucas-Obstfeld Model

The parameters for consumption in a pre-crisis period and a crisis period are estimated by applying a Maximum Likelihood methodology to the whole sample:

$$\begin{aligned} \ln C_t = {} & \ln(\lambda_H(1-DU_t)+\lambda_C DU_t) - \frac{1}{2}(\sigma_H^2(1-DU_t)+\sigma_C^2 DU_t) \\ & + \mathrm{t}\cdot\ln(1+\mu_H(1-DU_t)+\mu_C DU_t)+\ln z_t : \\ & \qquad \ln z_t \sim N(0,\sigma_H^2(1-DU_t)+\sigma_C^2 DU_t) \end{aligned} \tag{11}$$

where $DU_t=1$ if $t \geq T_B$ (that is, T_B=crisis outburst period) and 0 otherwise. In Table 1, the parameters in both the pre-crisis and the crisis periods are estimated and denoted as the estimated parameters for the hypothetical economy and the crisis economy. An agent perceives that the estimated parameters in both periods are the consumption parameters for both economies. All parameter estimates for consumption are obviously significant at the 1% level (not shown in Table 1). [4] All the null hypotheses of H1: $\lambda_H=\lambda_C$;H2: $\mu_H=\mu_C$;H3: $\sigma^2_H=\sigma_C{}^2$ are rejected except for Malaysia (μ) and Hong Kong (σ^2). That is, the difference in consumption growth and variance between both economies is statistically significant at the 5% level. In Thailand, the estimated quarterly consumption growth rate falls from 1.30% in the hypothetical economy to 1.06%. The variance of the error term in the log of consumption decreases from 0.0009 to 0.0002. The estimate of initial consumption at 1997:Q3 is 13,202 baht for the hypothetical economy and the one at 1997:Q3 for the crisis economy is 10,085 baht. The initial consumption of the crisis economy drastically dropped. These imply the drop of λ_H and λ_C in equations (5) and (6). See Figure 3. The instability of σ^2 reduces in the crisis periods except for Korea. This result will be due to the policy effects of each country.

[INSERT Table 1]

How much is the estimated 'whole cost' of crisis according to the model? As explained in Section 3, to measure these costs, we use the same preference parameters as Pallage and Robe (2003) does. For both economies, we use 0.98 as a base value for β of quarterly data**,** since they use 0.96 as a typical discount factor of annual data for developing countries. We also use the moderate risk-aversion level at γ =2.5.

As Table 2 shows, by using these parameters in equation (4), for Thailand, we obtain a utility level of –1.698E (–05) for the hypothetical economy (H-ECO) and one of –1.861E

[4] The data for dotted line in Figure 1 are omitted for estimation.

(–05) for the crisis economy (C-ECO). This implies that crisis reduces utility. Our cost measure λ* enables us to convert the reduction in the utility level into a level of compensation in national currency. The cost of crisis is 3,948 baht. In general, it is difficult to identify whether the cost is large or small. However, this amount is 30% of the initial level of consumption λ_H (13,202baht). This ratio 30% is easy to identify the large, which shows the relative amounts and hence an actual impact. These ratios are large for all countries: 30% for Thailand, 50% for Indonesia, 36% for Korea, 18% for Malaysia and 39% for Hong Kong.

[INSERT Table 2]

Which country paid the higher costs than other countries? Considering the ratios of the cost / λ_H, the supported-countries by the IMF (Thailand, Indonesia and Korea) burdened larger costs: in particular, the ratio for Indonesia is the highest,50%. However, the one of Malaysia is the lowest, 18% and about one-third of that of Indonesia. These findings are similar to those of the previous papers in a qualitative sense, while our paper is different in that we provide the money measures in a quantitative sense and a people's welfare point of view by using the welfare costs. Then, the advantage of our model can reveal how much people could pay the costs to prevent the crisis, which should be equal or less than this welfare cost, and can compare seriousness in people's mind of defects among countries. We will have to investigate the causes for the different costs between Indonesia and Malaysia in future.

To check the robustness of the results, we calibrate the preference parameters in (1). We use γ = 2.0, 2.5, 5.0 and β = 0.97, 0.98, 0.99, which encompass the range of parameter values used in previous research (see, e.g., Pallage and Robe, 2003). Note here that $\gamma>0$

implies risk aversion. In Table 3, for Thailand, the ratio of costs / λ_H ranges from 28% to 35% at β =0.99 as γ decreases and from 26% to 28% at γ=5, as the theoretical analysis with $\mu_H > \mu_C$ are shown in Miyakoshi, Okubo and Shimada (2006).[5] Varying the parameters, the maximum is 35% and the minimum is 26%. The minimum ratio is still large than 26%, compared with the ratio 30% at γ=2.5 and β =0.98 in Table 2. The ratios are robustly larger for the other countries. In particular, the ratios for the IMF-supported countries (i.e., Thailand, Indonesia and Korea) are larger than 35% at base values. In addition, the even minimum ratio 19% of Indonesia and 25% of Korea is larger than the maximum ratio 18.1% of Malaysia.

[INSERT Table 3]

An Alternative Model : Dynamics of Welfare Costs

The estimation results for α_0, α_1, β_0, β_1 and other parameters in model (7) by the Kalman filter algorithm for the time varying parameter model are obtained. The estimation results are shown in Table 4. [6] Moreover, the estimated a_t and b_t over time, actual values $\log C_t$ and the estimated $a_t + t \cdot b_t$ values over time are shown in Figure 4 and Figure 5. By using the estimated parameters for Thailand in Table 4, the estimated parameters over time are a_t =1.9342+0.7901 a_{t-1} and b_t=0.0026+0.7434 b_{t-1} , where all estimated parameters are significant at the 5% level. However, the dynamics of parameters converge to $\lim_{t\to\infty} a_t$ =1.9342/(1-0.7901)=9.21 and $\lim_{t\to\infty} b_t$ =0.0026/(1-0.7434)=0.01. Also, the dynamic

---

[5] Also, the theoretical analysis with $\mu_H < \mu_C$ in Miyakoshi, Okubo and Shimada (2006) shows $\partial\lambda^* / \partial\overline{\beta}$ <0 and $\partial\lambda^* / \partial\overline{\gamma}$ >0, which is confirmed in the findings for Malaysia.

[6] A formal test of $q_{a(b)} = 0$ involves nonstandard statistics, and hence the associated t-value are meaningless.

process of those parameters are shown in Figure 4, and thus the time-varying parameter estimates with the growth component and with the intercept component can capture the actual values of consumption, as seen in Figure 5. On period T1 seen in Figure 3, an agent can know the moments of distribution of the consumption process on period T1, that is, $a_{T1}(=\ln\lambda_{T1}-\sigma^2/2)$, $b_{T1}(=\ln(\mu_{T1}+1))$ and σ in (6), and expect these parameters to continue forever (i.e., constant forever), and computes the cost on this basis. But at period T1+1, the agent recomputes a different cost, based on the actual values of a_{T1+1}, b_{T1+1} and σ on period T1+1.

[INSERT Table 4, Figure 4 and Figure 5]

As seen in Figure 4, the estimated growth parameter $\mu_{CT}(=\exp(b_T)-1)$ and the intercept component of consumption λ_{CT} $(=\exp(a_T+\sigma^2/2))$ for the crisis economy are respectively less than those of the hypothetical economy in all periods, which induce the higher cost of crisis. On the other hand, the finding that the instability σ^2(=0.0153x0.0153 in Table 4) of the crisis economy for Thailand is smaller than that of the hypothetical economy σ^2 (=0.0009 at H-ECO in Table 1) induce the lower cost.

We should compute the 'cost at each period t ' by applying equation (10). As seen in Figure 6, the dynamic cost ratio for Thailand (IMF-supported country as well as Korea and Indonesia), i.e., the cost at period T / (λ_{HT} on period T for the hypothetical economy), hit uncountable-high cost in 1997Q3-1998Q1 (not shown in Figure 6 and due to ϕ_A>1) but immediately decreases to 53% in 1999Q3 and now converges to 50%. For Korea, the cost hits uncountable-high in 1997Q3 for only one period, but disappears at 1% in 1998Q3 one year after. However, after then, the cost increases gradually and stags at 40%. In this sense, the IMF-supported program to rescue these countries seems to have been effective. The cost for Indonesia did not hit the high level right after the crisis outbursts, while the cost did not show a sign of decreases and approaches to 100%, suggesting the IMF-supported program is not effective in this country. For Malaysia which is not a IMF-supported country (rather, refused a supported program), the cost is high right after the crisis outburst but rapidly drop down at 46% in 1999Q1 and decreasing more. The decrease suggests that its own policy, i.e., the capital control, was effective.[7] Finally, the cost of Hong Kong is not high right after the crisis outburst, but after then increases gradually and hits 60% in 2004Q3, showing no confirmed sigh of decreases. Now, in 2004Q3, the cost is still more than 40% for all countries, which needs more additional policy implementation.

[INSERT Figure 6]

Next, we investigate whether the policy (IMF-supported program) was implemented immediately at the period that the highest cost arose. The peak cost at more than 500% continues during 1997Q3-1998Q1 for Thailand and only in 1997Q4 for Korea, i.e., right after the crisis outburst. However, the costs for Indonesia increase in gradually creeping, requesting the additional programs. Table 5 shows that the IMF-supported program starts right after the crisis occurs in all three countries. In this sense, the IMF-supported program for each country was implemented right after the crisis outburst.

Whether was the cost of the IMF-supported program implemented expensive in

[7] Malaysia more strictly controlled the stock markets to prevent the speculative attacks during the crisis than the pre-crisis period. In fact, in 1998, Malaysia imposed a range of foreign exchange and capital controls that substantially insulated Malaysian financial markets from external influences and effectively closed down the offshore ringgit market. See IMF (1999, pp.180-185) in detail.

comparison with the size of the welfare costs? That is, if an SDR 2.9 billion Stand-By Arrangement for Thailand approved by the IMF (seen in Table 5) could rescue the Thai economy immediately (i.e., maintain its hypothetical economy), would people agree to pay this policy cost?. In 1998Q2 of Figure 6, the welfare cost is paid, 37,926 bath (276%) per quarter *forever*. If the policy cost of SDR 2.9 billion in Table 6 can maintain the hypothetical economy, how many quarters should people pay 37,926 bath per quarter to finance SDR 2.9billion ? That is, (Policy costs /people's number on 1998Q2) /How many months?=the welfare cost, and then, (SDR 2.9billion X 56.34 baht /0.05923 billion people) /37,926 baht per quarter =0.07 quarters[8]. It is very short period compared with *forever*, meaning the policy cost is cheap and people will agree to pay the policy cost. For Indonesia, in 1998Q1, the welfare cost is 111,138 rupiah (11%) and the policy cost is SDR 7.3 billion. (SDR 7.3billion X 11121 rupiah /0.20304 billion people) /111,138 baht per quarter =3.6 quarters. Similarly, for Korea, in 1998Q1, the period for people to pay is, (15.5billion SDR X 1847.54 won /0.04581 billion people) /1,223,880 won per quarter =0.51 quarters. The period for people to pay the policy cost is at most 3.6 quarters for three countries. It is a very short period, compared with the '*forever*', since the welfare cost is paid 'forever'. In this sense, the policy cost of the IMF-supported program seems to be cheap.

5. Concluding Remarks

This paper has measured dynamically the welfare cost, investigated the effects of and the recovery process of the 1997 Asian crisis, and evaluated the IMF-supported programs for Thailand, Indonesia, Korea, Malaysia, and Hong Kong, by deploying Miyakoshi, Okubo

---

[8] The data for exchange rate per SDR is complied from IFS(line aa.zf).

and Shimada (2006)'s model.

The paper finds: (i) the ratios of 'whole cost' to the consumption level of the hypothetical economy are large for all countries: 30% for Thailand, 50% for Indonesia, 36% for Korea, 17.7% for Malaysia and 39% for Hong Kong; (ii) the dynamic process of the 'costs at period t' in Thailand, Korea and Malaysia converge to around 40% right after the crisis, reflecting the effectiveness of the policy. However, the costs for Indonesia and Hong Kong increase gradually toward 100%, suggesting that the additional policy is required; (iii) the IMF-supported programs for Thailand, Indonesia and Korea have been implemented right after the cost hits peaks in each country, implying the quick implementation of the program; (iv) the policy cost of the IMF-program is not expensive compared with the corresponding welfare cost, suggesting that the program in each IMF-supported country will be agreed.

The findings of the paper support the previous qualitative analysis with the 1997 Asian crisis. However, the results of this paper are different in that we first provide the money measures in a quantitative sense, a people's welfare point of view by using the welfare costs, and the dynamics inspection.

References

Beaudry, P. and C. Pages (2001), “The cost of business cycles and the stabilization value of unemployment insurance”, European Economic Review 45:1545–1572.

Berg, A. (1999),” The Asia Crisis - Causes, Policy Responses and Outcomes ”, IMF Working Paper No. 99/138.

Cerra,V. and Saxena, S.C. (2005), “Did Output Recover from the Asian Crisis?” IMF Staff Papers 52:1-23

Corsetti,G., Pesenti,P. and Roubini,N.(1999a),”Paper tigers?: A model of the Asian crisis”, European Economic Review 43:1211–1236.

Corsetti,G., Pesenti,P. and Roubini,N.(1999b),” What caused the Asian currency and financial crisis?”, Japan and the World Economy11:305-373.

Dolmars, J.(1998), “Risk preferences and the welfare cost of business cycles”, Review of Economic Dynamics 1:646–676.

IMF(1999), The Annual Report 1999, International Monetary Fund.

Ito, T. (1999),”Asian Currency Crisis and the IMF”(in Japanese), The Economic Review (The Institute of Economic Research, Hitotsubashi University) 50:69-93.

Lane, T. etc.(1999),”IMF-Supported Programs in Indonesia, Korea, and Thailand: A Preliminary Assessment”, IMF Occasional Paper No.178.

Lau, S-T. and McInish, T. (2003),”IMF Bailouts, Contagion Effects, and Bank Security Reurns”**,** International Review of Financial Analysis 12:3-23.

Lucas, R.E. (1987), Models of Business Cycles, Blackwell, Oxford.

Lucas, R.E. (2003), “Macroeconomic priorities”, American Economic Review :1–14.

Kho, B-C. and Stulz, R. M. (2000),”Banks, the IMF, and the Asian crisis”, Pacific-Basin Finance Journal 8:135-275.

Miyakoshi,T. ,Okubo,M.and Shimada,J.(2006),” An Alternative Measure to Lucas-Obstfeld

Model:Dynamic Welfare Cost of Stagnation", mimeo, March 2006

Obstfeld,M.(1994),"Evaluating risky consumption paths: The role of intertemporal substitutability", European Economic Review 38:1471–1486.

Pallage, S. and Robe, M.A. (2003), "On the welfare cost of economic fluctuations in developing countries", International Economic Review 44: 677–698.

Saito, M.(1996), A New Macroeconomics (in Japanese), Yuhikaku, Tokyo.

Storestetten, K., Telmer, C.I. and Yaron, A. (2001), "The welfare cost of business cycles revisited: Finite lives and cyclical variation in idiosyncratic risk", European Economic Review 45:1311–1339.

Yoo, J-H. and Moon, C. W. (1999),"Korean financial crisis during 1997–1998 Causes and Challenges", Journal of Asian Economics 10:263-277.

Table 1. Estimated Parameters for Consumption

Country	Crisis	λ	μ	σ^2	H1:$\chi2(1)$ $\lambda_H=\lambda_C$	H2:$\chi2(1)$ $\mu_H=\mu_C$	H3: $\chi2(1)$ $\sigma^2_H=\sigma^2_C$
Thailand							
H-ECO	97Q3	13,202	0.0130	0.0009	331.47	6.30	5.56
C-ECO	97Q3	10,085	0.0106	0.0002			
Indonesia							
H-ECO	98Q1	965,616	0.0193	0.0052	6.13	406.29	12.42
C-ECO	98Q1	996,317	0.0033	0.0002			
Korea							
H-ECO	97Q4	1,665,633	0.0211	0.0003	512.34	234.44	10.19
C-ECO	97Q4	1,393,492	0.0129	0.0022			
Malaysia							
H-ECO	98Q1	1,698	0.0103	0.0028	67.39	*0.08*	4.36
C-ECO	98Q1	1,375	0.0107	0.0010			
Hong-Kong							
H-ECO	98Q1	31,353	0.0069	0.0013	59.28	38.99	*0.50*
C-ECO	98Q1	27,229	0.0009	0.0010			

Notes: H-ECO and C-ECO denote the hypothetical and the crisis economy. The value of lambda is measured in national currency. The critical value of $\chi^2(1)$ distribution is 3.84 at 5% level.

Table 2. Welfare Costs of the Crisis (γ =2.5, β =0.98)

Country	Indirect Utility		Welfare Costs	
	H-ECO	C-ECO	Level λ^*	Ratio (λ^*/λ_H) %
Thailand	-1.698E(-05)	-1.861E(-05)	3,948	30
Indonesia	-1.418E(-08)	-2.699E(-08)	487,229	50
Korea	-8.069E(-09)	-1.052E(-08)	594,993	36
Malaysia	-3.760E(-04)	-3.687E(-04)	301	18
Hong Kong	-4.946E(-06)	-6.969E(-06)	12,186	39

Notes: The cost is measured in national currency. E(-0X) denotes 10^{-X} . See notes of Table 1.

Table 3. Welfare Costs of the Crisis based on Various Preference Parameters

Country		β	
γ	0.97	0.98	0.99
Thailand			
2	29%	31%	35%
2.5	28%	30%	32%
5	26%	27%	28%
Indonesia			
2	42%	62%	113%
2.5	36%	50%	83%
5	19%	25%	33%
Korea			
2	35%	41%	35%
2.5	32%	36%	32%
5	25%	26%	25%
Malaysia			
2	17.9%	17.6%	17.0%
2.5	18.0%	17.7%	17.3%
5	18.1%	18.0%	17.9%
Hong Kong			
2	32%	41%	67%
2.5	31%	39%	60%
5	27%	32%	42%

Notes: The shaded number is the one at $\gamma=2.5$ and $\beta=0.98$ in Table 2. In particular, the number for Malaysia is denoted to one place of decimals.

Table 4. Estimated Parameters in (6)

		σ	α_0	α_1	q_a	β_0	β_1	q_b
Thailand	**Est.**	**0.0153**	**1.9342**	**0.7901**	**0.0000**	**0.0026**	**0.7434**	**0.0000**
	t-value	**[8.89]**	**[5.91]**	**[22.45]**	**[0.42]**	**[4.59]**	**[21.06]**	**[1.13]**
Indonesia	**Est.**	**0.0107**	**1.8605**	**0.8656**	**0.0000**	**0.0005**	**0.7363**	**0.0003**
	t-value	**[1.64]**	**[0.64]**	**[4.10]**	**[0.09]**	**[0.53]**	**[3.22]**	**[0.23]**
Korea	**Est.**	**0.0160**	**-0.1153**	**0.9994**	**0.0000**	**0.0332**	**0.7349**	**0.0011**
	t-value	**[3.12]**	**[-2.96]**	**[226.07]**	**[1.76]**	**[3.16]**	**[24.67]**	**[5.12]**
Malasia	**Est.**	**0.0231**	**4.9921**	**0.3105**	**0.0173**	**0.0034**	**0.6452**	**0.0000**
	t-value	**[2.87]**	**[4.18]**	**[1.89]**	**[2.00]**	**[6.35]**	**[14.66]**	**[0.14]**
HongKong	**Est.**	**0.0239**	**0.8780**	**0.9145**	**0.0000**	**-0.0006**	**0.4946**	**0.0008**
	t-value	**[4.02]**	**[4.42]**	**[46.55]**	**[0.67]**	**[-0.41]**	**[3.26]**	**[2.98]**

Table 5. IMF Supported Program Right After the Crisis: Date and Finance

Thailand

1997:_August 20_ The Board approves an SDR 2.9 billion Stand-By Arrangement for Thailand and releases a disbursement of SDR 1.2 billion.

October 17 The Board reviews the Stand-By Arrangement under the Emergency Financing Mechanism procedures.

November 25 Thailand issues a Letter of Intent detailing additional measures.

December 8 The Board completes the first review under the Stand-By Arrangement and disburses SDR 600 million.

1998:_February 24_ Thailand issues a Letter of Intent describing further measures.

Indonesia

1997:_November 5_ The Executive Board approves a Stand-By Arrangement for Indonesia authorizing drawings of up to SDR 7.3 billion, and disburses SDR 2.2 billion.

1998:_January 15_ Indonesia issues Memorandum of Economic and Financial Policies on additional measures.

April 10 Indonesia issues a Supplementary Memorandum of Economic and Financial Policies on additional measures.

May 4 The Board completes the first review under the Stand-By Arrangement and disburses SDR 734 million.

June 24 Indonesia issues a Second Supplementary Memorandum of Economic and Financial Policies on additional measures.

July 15 The Board completes the second review of the Stand-By Arrangement, disbursing SDR 734 million, and approves an increase in IMF financing under the Stand-By Arrangement by SDR 1 illion.

Korea

1997:_December 4_ The Board approves an SDR 15.5 billion Stand-By Arrangement for Korea and releases a disbursement of SDR 4.1billion.

December 18 The Board concludes the first biweekly review of the Stand-By Arrangement and releases a further SDR 2.6 billion, activating the IMF's new Supplemental Reserve Facility.

December 30 The Board approves a request by Korea for a modification of the schedule of drawings, bringing forward part of the amounts originally scheduled for February and May 1998, but without changing overall access to IMF resources, and disburses SDR 1.5 billion.

1998: _January 7_ Korea issues a Letter of Intent describing additional measures.

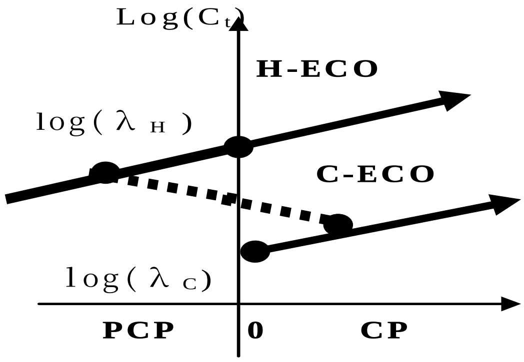
January 8 The Board concludes the second biweekly review of the Stand-By Arrangement and disburses SDR 1.5 billion.

February 7 Korea issues a Letter of Intent on additional measures.

February 17 The Board completes the first quarterly review of the Stand-By Arrangement and disburses a further SDR 1.5 billion.

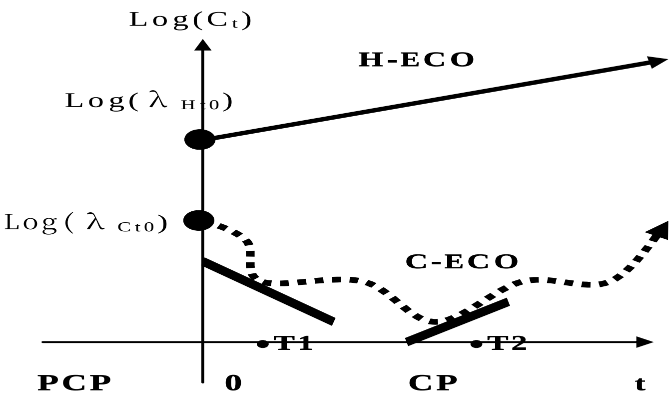
Note: This table is made from Annual Report 1998, p.23-32, *IMF*.

Figure 1. Hypothetical and Crisis economies



Note: PCP (H-ECO) and CP (C-ECO) denote the pre-crisis and the crisis periods (the hypothetical and the crisis economy), respectively. The t=0 denotes the crisis outburst period. Parts of intercept, $-(1/2)\sigma^2_H$ and $-(1/2)\sigma^2_C$, are neglected because they are negligible.

Figure 2. Hypothetical and Crisis economies using the Alternative Model



Note: see a note of Figure 1

Figure 3. Per Capita Consumption in Logarithm (in national currencies)

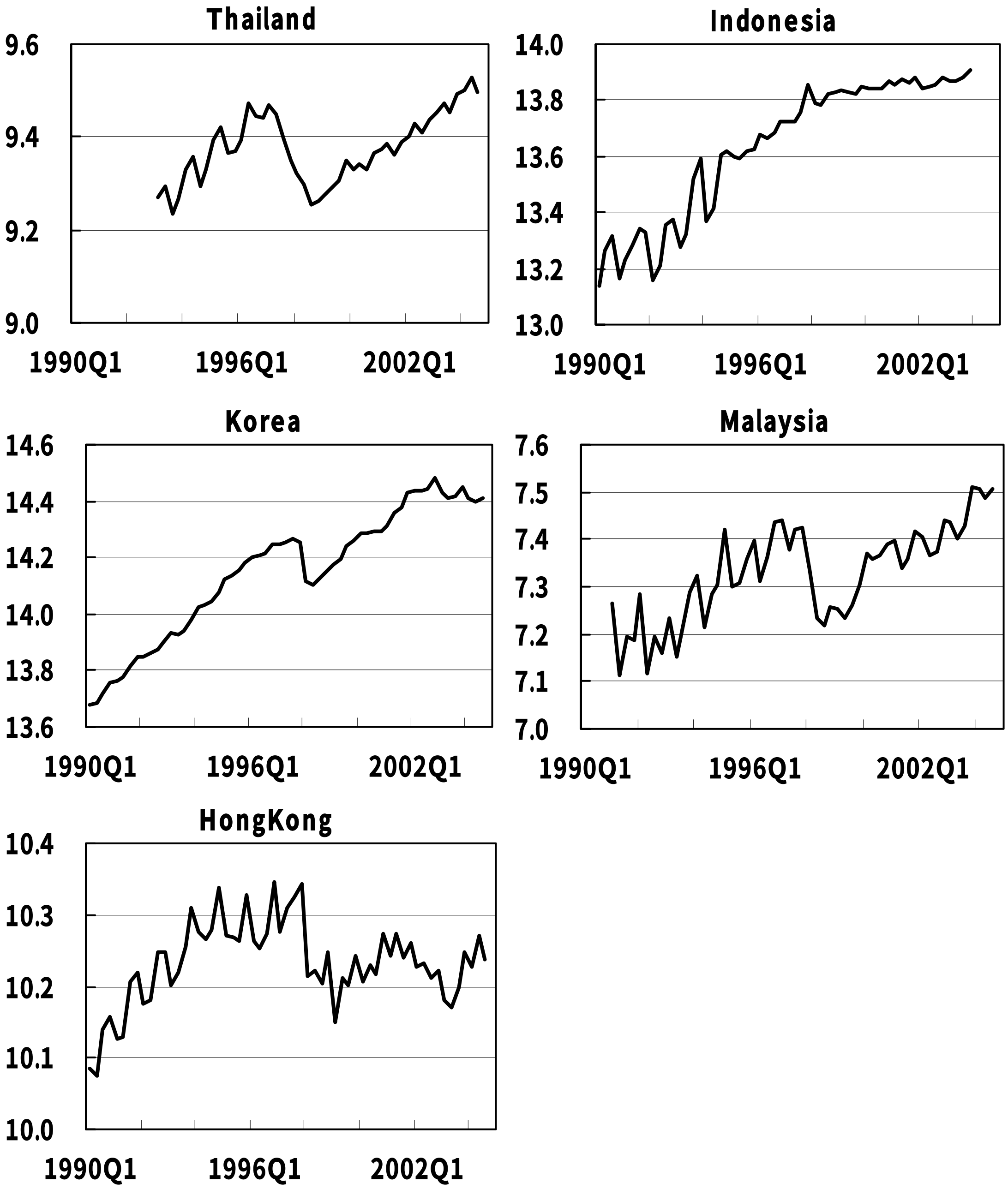
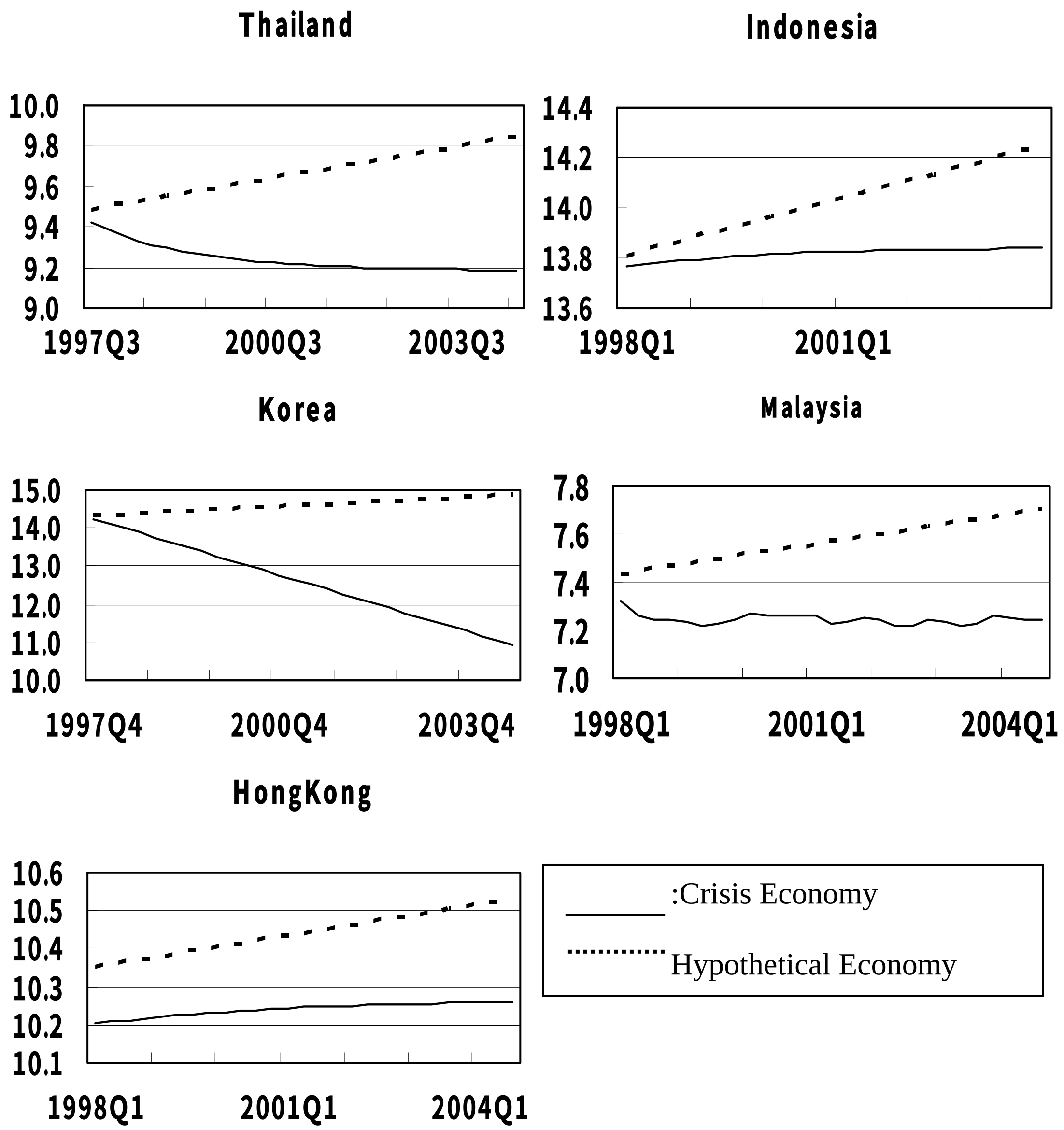


Figure 4.Estimated log(λ_t) and μ_t over Time: Hypothetical and Crisis Economies

(Estimated log(λ_t))



(Estimated μ_t)

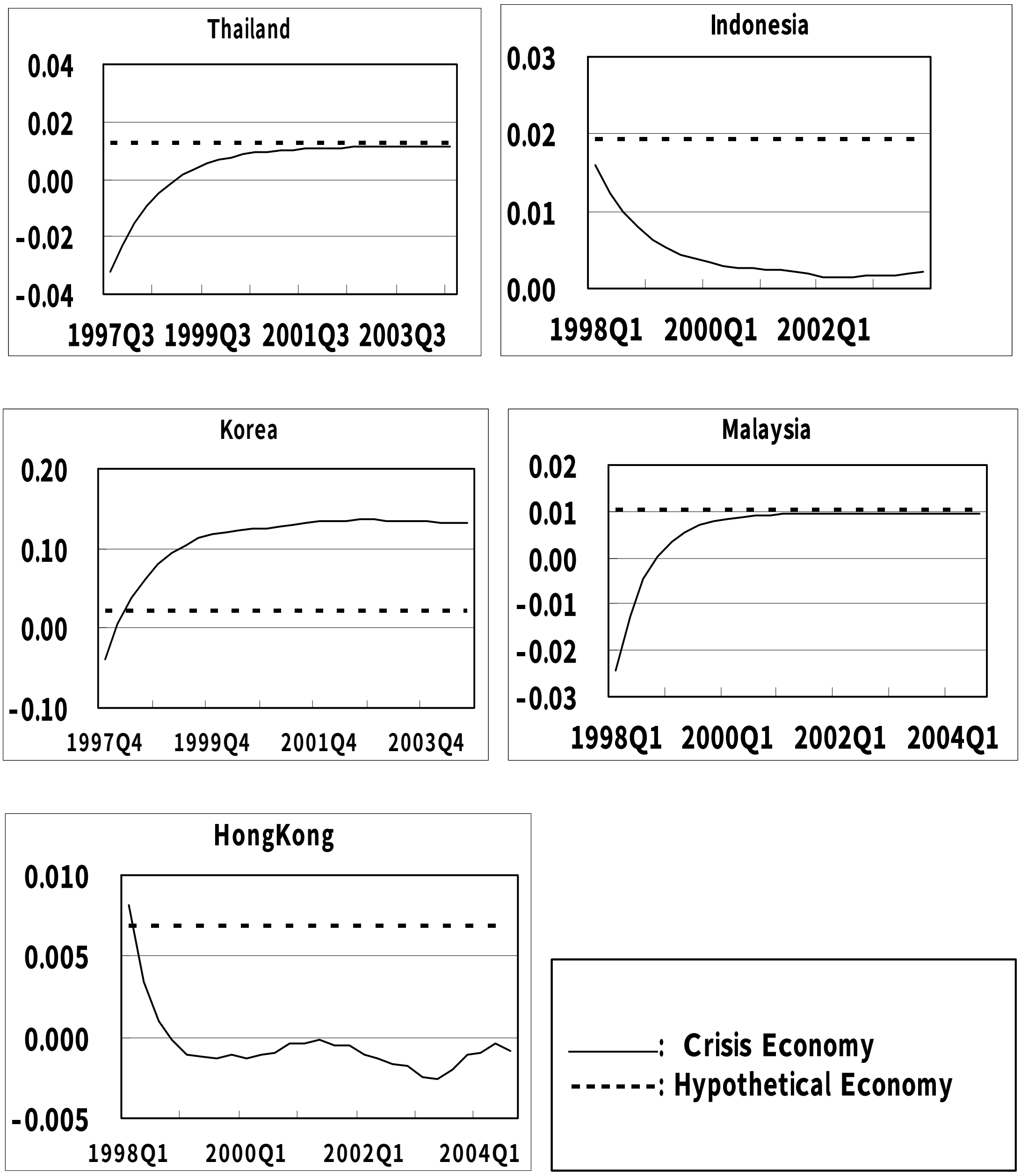


Figure 5. Estimation vs Actual Values of Consumption for the Crisis Economy

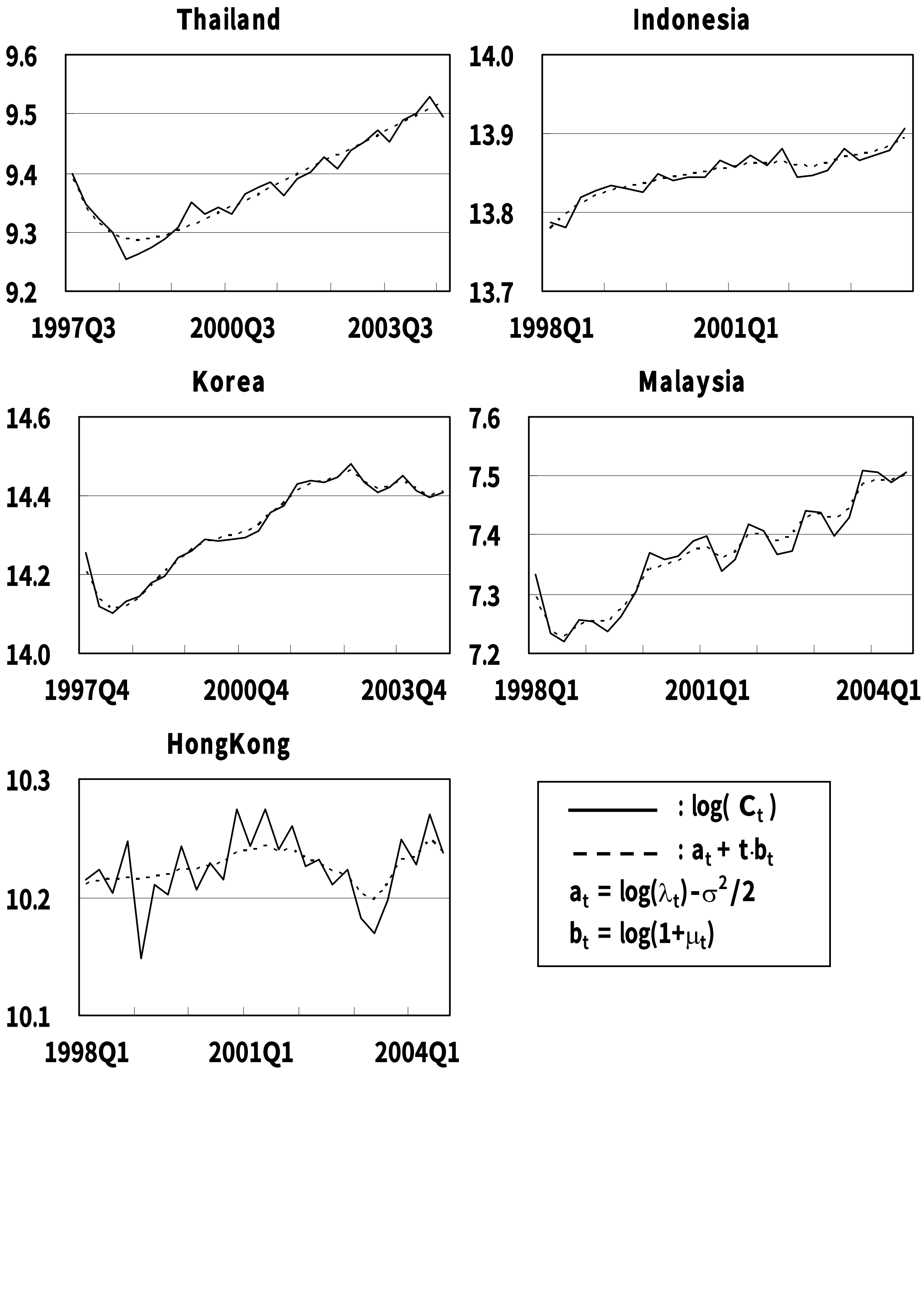


Figure 6. The Ratio of Costs at Each Period