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Abstract

We numerically examine the impact of the global economic crisis on the Cambodian garment exports as well as its economy by using the conventional CGE model. A seminal aspect of the paper is that we have successfully estimated the curvature of the CET and CES production functions for the Cambodian economy, by using the time series regression method. One of our most striking results indicates that the welfare cost of the impact of the crisis at least reaches 281 million US dollars, thus resulting in a 0.3 percent decrease in GDP with 20.8 thousand direct job losses in the garment industry. Our simulation results also show that the currently ongoing policy in Cambodia only reduces the negative impact of the crisis by 32 million US dollars, and we propose an expansion of the government budget of 304 million US dollars, in order to neutralize the negative impact of the global economic crisis on the Cambodian economy.

Keywords: Cambodia, Computable General Equilibrium (CGE) Model, Global Economic Crisis, Garment Industry, Welfare, Simulation

JEL Classification: C32, C68, D57, D58, D60, E17, F14, and F17

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1 Introduction

We numerically examine the impact of the current global economic crisis on the Cambodian garment exports as well as its economy by using the conventional static CGE model[1].

The Cambodian economy has heavily been relying on the exports of its garment products, since the garment industry emerged in year 1995. It was estimated that the garment industry contributed to 16% and 15% of the GDP of Cambodia in year 2007 and 2008, respectively[2]. Its share in the total exports has been more than 90% since 2003[3]. It was also estimated that the garment industry created 706 job opportunities in year 2008[4].

Due to the very high dependence of the Cambodian economy on the exports of its garment industry, the Cambodian economy seems vulnerable to external shocks. In fact, the Cambodian garment industry has experienced four negative external shocks; the expiration of Multi-Fiber Agreements (MFA) in year 2005, Vietnam's participation to WTO in year 2007, the abolition of restrictions on Chinese exports to the US in year 2008, and the global economic crisis triggered by the sub-prime mortgage problem in the US in late 2008. In particular, the fourth negative shock, the global economic crisis, has substantially damaged the Cambodian economy, while it unexpectedly survived from other three shocks in the past. The total amount of exports to the US drastically decreased by 20.8% in volume in a year between October 2008 and October 2009. The drastic decrease in the exports to the US consequently resulted in a 13.6% decrease in the total amount of products of the garment industry in volume in the same period, and it also induced about 49 thousand job losses in association with closing down of 42 garment factories.

We numerically explore such a considerable impact of the global economic crisis on the Cambodian economy within a general equilibrium framework. We employ the conven-

[1]See Ballard, C. L., D. Fullerton, J. B. Shoven, and J.Whalley, J. (1985), and Shoven, J B and J Whalley (1992) for the detailed explanation of the conventional static CGE model, for instance.

[2]See Economics Today (2010).

[3]See Economics Today (2009).

[4]A half of the job opportunities is estimated to be indrect job opportunities.

tional static CGE model, where the latest input-output table is used. The input-output table we use is one of the only available tables of Cambodia produced by Oum (2007)[5]. We have successfully constructed a Cambodia specific computable general equilibrium model by using one of the first ever input-output tables of Cambodia by Oum (2007). Another seminal aspect of our paper is that we have also estimated the curvature of the CET and CES production functions for the Cambodian economy, by using the time series regression method. As pointed out by Devarajan et al (1999) and Miller (2008), we have recognized that CET and CES functions are more suitable for the welfare analysis, while Sak and Kato (2009) discussed the effect of Vietnam's participation to WTO as well as the abolition of restrictions on Chinese exports to the US, only by using the Cobb-Douglas productions functions. Our main concern is with the impact of the current global economic crisis.

By using the estimated parameter values of the curvature as well as the actual input-output table, we have successfully re-produced the actual Cambodian economy within our CGE model. In comparison with our successful benchmark model, we simulated the impact of the current global economic crisis on the Cambodian economy, and we have obtained the following results: We estimate that a welfare loss by the crisis is 281 million US dollars, and that the global economic crisis also induced 20.8 thousand job losses in the garment industry. Unskilled labor in the garment industry was heavily damaged, and its income decreased by 7.11%. Furthermore, the currently ongoing two year tax policies, which have already been implemented in order to offset the negative impact of the crisis since 2010, only helps the Cambodian economy by 32 million US dollars per year, and a welfare loss under the currently ongoing policy is still 249 million US dollars. We also estimate that the government needs 304 million US dollars to neutralize the negative impact of the crisis on the Cambodian economy. Since we estimate the amount of the tax reduction under the current policy to be 41.37 million US dollars per year, the amount

[5] Only two input-output tables of Cambodia have become available recently. The input-output table by Oum (2007) consists of 35 different production sectors, and the one by Kobayashi et al (2006) consists of 43 different production sectors. The table by Oum (2007) overcomes the drawbacks of Kobayashi (2006), and we thus use the table by Oum (2007) in our paper. In general the available data on Cambodia is very limited, so that there is few research on Cambodia.

of a tax cut under the currently ongoing policy is too small to offset the negative impact of the global economic crisis on the Cambodian economy.

We organize our paper as follows. We briefly review the literature in the next section, and then we explain our numerical model, where we also present our social accounting matrix (SAM) and our calibration method. In section 4, we explore the impact of the global economic crisis by using our CGE model. In section 4, we also simulate the effect of the currently ongoing tax polices, and then propose our tax policy in order to offset the negative impact of the global economic crisis. We conclude our paper in section 5.

2 Literature Review

In terms of the effect of the expiration of Multi-Fiber Agreements (MFA) in year 2005, several studies have investigated the negative impact of the expiration on the Cambodian economy. Nordas (2004) used the GTAP model to conclude that only China and India would be better off by the expiration, while other countries including Cambodia would be worse off. Smith (2004) also predicted that the real GDP would decrease by 1.5% with 100 thousand job losses by the expiration. On the other hand, Sok and Oum (2004), and Bargawi (2005) concluded that the expiration would have a very small effect in the short-run, while Sok and Oum (2004) also warned a negative impact in the long-run. While many studies predicted a considerably negative impact of the expiration on the Cambodian economy in the long-run, the real Cambodian economy had survived. Yamagata (2006) attributed its reviving to high profitability of the garment industry, and also pointed out that the garment industry contributed to the reduction of poverty in Cambodia.

Regarding the impact of Vietnam's participation to WTO in year 2007, and the abolition of restrictions on Chinese exports to the US in year 2008, several studies also predicted the negative effect. The Economic Institute of Cambodia (2007) pointed out the vulnerability of the Cambodian economy attributed to its high dependence on exports of the garment products, and Asian Development Bank (2007) warned Cambodia by referring to the fact that both Vietnam and China export garment products to the US, which are similar to Cambodia. Sak and Kato (2009) estimated that the negative impact would be 905 million US dollars.

While the existing literature pointed out the negative impact of the past three external shocks, the garment industry had been more less active until the global economic crisis occurred in late 2008. Just after the global economic crisis started, the total amount of exports to the US drastically decreased by 20.8% in volume in a year between October 2008 and October 2009, as shown in Figure 1. The drastic decrease in the exports to the US consequently resulted in a 13.6% decrease in the total amount of products of the garment industry in volume in the same period, and it also induced about 49 thousand job losses caused by closing down of 42 garment factories. To our best knowledge, Chandararot et al (2009) only investigated the effect of the global economic crisis on the Cambodian economy based on their interview results within a multiplier framework. Thus, we propose a computable general equilibrium model, in which we can numerically investigate all possible channels of the impact of the global economic crisis. We also employ CET and CES production functions in order to make our welfare analysis more reliable. We numerically estimate a welfare loss of the impact of the global economic crisis on Cambodia, and also propose a government policy to neutralize the negative impact.

3 Numerical Analysis

We use the conventional static CGE model in which there are following agents; a representative consumer, four different production sectors, and the government. The four production sectors consist of "agriculture", "garment industry", "other industries", and "service sector", all of which have been obtained by re-categorizing 35 different production sectors in the input-output table of year 2004 by Oum (2007). Labor is divided into skilled and unskilled labor. The four production sectors have the conventional tree structure in their production processes, where we use the CET function for the decomposition of domestic goods into exported and final consumption goods, and also where we use the CES function for the substitution between imported and domestic goods used in production. The detailed explanation about the model is given in Appendix 1.

3.1 Social Accounting Matrix (SAM)

We have used the input-output table by Oum (2007) in order to construct our social accounting matrix (SAM). We have re-categorized the 35 different production sectors in Oum (2007) into 4 different production sectors as follows; the sectors from 1st to 5th in Oum (2007) into "agriculture" in our model, 6th to 8th and 12th to 25th into "other industries", 26th to 35th into "service sector, and 9th to 11th into "garment industry" in our model. We have also obtained the data on the aggregated private investments in year 2004 from the Economic Institute of Cambodia (2007) to complete our SAM, which is given in Table 1.

3.2 Calibration

Apart from the parameter values of CET and CES production functions, we have been able to calculate all values from our SAM. According to Devarajan et al (1999), we have obtained the parameter values of CET and CES production functions by estimating the regression models (see Appendix 2 for detailed estimation). Neither the serious serial correlation nor cointegration problems could be found. We have also followed Wang et al (1995) in order to calibrate our benchmark model, where we used the root mean square error ($RMSE$) to measure the discrepancy level between the actual values and the calculated ones in our benchmark model. The formula is given by:

$$RMSE = \sqrt{\frac{1}{k}\sum_{i=1}^{k}(A_i - B_i)^2},$$

where A_i and B_i denote the actual value and the benchmark value, respectively. The calculated $RMSE$ is given by Table 2. As Table 2 shows, our benchmark model has successfully been able to re-produce the actual Cambodian economy within the model. The parameter values in the benchmark model are given in Table 3-1. The estimated values of parameters in the CET and CES production functions are also given in Table 3-2.

We can now use our benchmark model to simulate the impact of the global economic crisis on the Cambodian economy.

4 The Impact of the Global Economic Crisis

4.1 Simulation

As Figure 1 shows, the total amount of garment products drastically dropped by 13.6% in volume in a year between October 2008 and October 2009, which we recognize as the impact of the global economic crisis on the Cambodian garment industry. Thus, we simulate the impact of a 13.6% decrease in garment products in volume on the Cambodian economy. Table 4-1, 4-2, and 4-3 show simulation results of the impact. Our simulation results indicate that the global economic crisis has induced a welfare loss of 281 million US dollars, and its impact on the garment industry is estimated to be a 6.8% decrease in the income of the garment industry. Table 4-3 shows the detailed impact of the crisis on the income of the garment industry. We estimate the unskilled labor to be heavily damaged with a 7.11% decrease in its income. The estimated total labor force of the garment industry was 294 thousand workers[6], and the average decrease of labor income by 7.1% corresponds to about 20.8 thousand direct job losses. Based on their interview result, Chandararot et al (2009) estimated that the global economic crisis caused 19 thousand job losses. Our slightly larger figure of job losses could attribute to our general equilibrium framework which takes into account all possible channels of the impact.

Note that about 52% of the total revenue of the garment industry has been spent on imports of raw materials used in its production[7]. Thus, we also expect the drastic decrease in garment products to have reduced imports of raw materials. Table 4-2 shows that net exports increased by 87.23%, which can be explained by a large decrease in imports caused by the global economic crisis. The increase in net exports contributed

[6]See Economic Institute of Cambodia (2007).
[7]See Economic Institute of Cambodia (2007).

to a slightly small decrease in GDP by 0.3%, while the amount of private consumption decreased by 6.6%.

While several studies estimated a negative impact of the other three shocks in the past[8], the garment industry had actually been expanding until the global economic crisis occurred, as shown in Figure 1. However, in fact, it was eventually damaged by the global economic crisis. The actual figure of the damage can be observed by a 13.6% decrease in the total amount of its products in volume. We simulated the effect of the actual 13.6% decrease, and we estimate the negative impact to be 281 million US dollars with 20.8 thousand job losses.

4.2 Neutralization Policy

A welfare loss of 281 million US dollars and 20.8 thousand job losses are obviously not negligible. The Cambodian government would be expected to offset the negative impact, and also to implement several government policies for sustainable economic growth. We now simulate the effect of a fiscal policy to neutralize the negative impact on the Cambodian economy.

Economics Today (2009, 2010) reports that the garment industry has been contributing to more than 90% of the total exports since 2003, and also that the agriculture sector employs more than 67% of the total labor force in 2008. Thus, we specifically target these two sectors, and we change the production tax rates of these two sectors to be zero, in order to neutralize the negative impact of the global economic crisis. In addition, since private consumption is likely to have been damaged by the crisis, we also decrease the individual income tax rate in order to offset the negative impact. Furthermore, if such a policy can still not neutralize the negative impact, then we also decrease the production tax rates of other remaining sectors, 'other industries' and 'service sector'[9]. Note that the Cambodian government has not been fiscally strong enough to issue government bonds yet, and it is not realistic to consider a deficit policy in our simulation. Thus, for sim-

[8]The three shocks include the expiration of Multi-Fiber Agreements (MFA) in year 2005, Vietnam's participation to WTO in year 2007, and the abolition of restrictions on Chinese exports to the US in year 2008.

[9]We keep the tariff rates of all industries unchanged.

plicity, we assume in our simulation that the government decreases the same amount of its consumption as the total amount of reduced taxes. This simplification might be unrealistic, but the government has to satisfy its budget constraint in a general equilibrium framework, and this assumption is more realistic than the case where the Cambodian government can rely on a deficit policy.

Table 5-1 and 5-2 show the simulation results of the neutralization policy. As Table 5-2 shows, the negative impact is neutralized by this policy (a welfare loss is now zero). By this neutralization policy, the government can also keep private consumption unchanged. However, as Table 5-1 shows, the garment industry still suffers, while the negative impact is slightly reduced. The agriculture sector most gains from this fiscal policy. Table 5-2 shows that the international trade becomes better, thus resulting in a 0.2% increase in GDP. Table 5-4 also shows the tax rates of this neutralization policy. As the table shows, decreasing the production tax rates of the garment industry and the agriculture sector to be zero is not enough to offset the negative impact of the global economic crisis. The government drastically has to decrease the income tax rate as well as the production tax rates of the other remaining sectors, otherwise the negative impact cannot be neutralized. The amount of reduced taxes reaches 304 million US dollars[10] in order to offset the negative impact. In reality, it seems difficult that the Cambodian government can reduce either its consumption by 274 million US dollars or the amount of taxes by 304 million US dollars. It is also difficult for the government to issue government bonds to finance the budget due to its fiscally low reliability. Thus, we should rather interpret this result as the case where the Cambodian government has to rely on outside resources such as international institutions and/or donor countries to finance 304 million US dollars in order to offset the negative impact of the global economic crisis.

[10]By the neutralization policy, government consumption is reduced by 274 million US dollars, and government savings are also reduced by 30 million US dollars. Thus, we simulate the total amount of reduced taxes to be 304 million US dollars for the neutralization policy.

4.3 Evaluation of the Currently Ongoing Policies

Recognizing that the garment industry was damaged by the global economic crisis, the Cambodian government has implemented two government policies to offset the negative impact. We now simulate the effect of the currently ongoing government policies. The ongoing actual polices consist of two tax policies for the garment industry; no tax on profits, and the postponement of a 1% monthly turnover tax for two years from 2010 to 2011 for the garment industry. The turnover tax is imposed on expenditures, so that the garment industry neither pays profit tax nor expenditure tax for two years.

We investigate the effect of the actually ongoing policies by simulating both production and import tax rates of the garment industry to be zero. Since the garment industry mainly imports its inputs such as raw materials, we assume that no tax on expenditure corresponds to the zero import tariff rate. As Table 1 of our SAM shows, the total amount of taxes collected by both the production and import taxes from the garment industry is 41.37 million US dollars. Thus we simulate the effect of the currently ongoing policies by reducing the total amount of tax revenue by the same amount, and it implies that the government needs finance 41.37 million US dollars per year from the outside sources in order to implement the ongoing policy. Note that the currently ongoing policies are in effect for two years until year 2011, and the overall effect of the currently ongoing policies should roughly be a double size. As our simulation result shows that the Cambodian government has to finance 304 million US dollars to neutralize the negative impact of the crisis, we expect that the effect of the currently ongoing policies with the tax reduction by 41.37 million US dollars would be too small. Table 6-1 to 6-3 show our simulation result. As Table 6-2 shows, a welfare loss would still be 249 million US dollars per year even after the ongoing policy is implemented. However, in comparison with our neutralization policy, the garment industry would not suffer as much as it does when our proposed neutralization policy is implemented. Under the ongoing policy, the income of the garment industry decreases by 4.30%, while it does by 6.37% under our neutralization policy. Since we estimate the welfare loss caused by the global economic crisis to be 281 million US dollars, the ongoing policy only reduces a welfare loss by 32 million US dollars, which is also interpreted as the effect of the currently ongoing policy.

5 Concluding Remarks

We numerically examine the impact of the current global economic crisis on the Cambodian garment exports as well as its economy by using the conventional static CGE model. We have successfully reproduced the real Cambodian economy within our CGE framework, by using one of the first ever input-output table of Cambodia as well as estimating the curvature of the CET and CES production functions.

We have estimated that a welfare loss by the crisis is 281 million US dollars, and also that the global economic crisis induced 20.8 thousand job losses in the garment industry. Unskilled labor in the garment industry was heavily damaged, and its income decreased by 7.11%. Furthermore, the currently ongoing two year tax policies only helps the Cambodian economy by 32 million US dollars per year, and a welfare loss under the currently ongoing policy is still 249 million US dollars. We have also estimated that the government needs 304 million US dollars to neutralize the negative impact of the crisis on the Cambodian economy. Since we have estimated the amount of the tax reduction under the current policy to be 41.37 million US dollars per year, the amount of a tax cut under the currently ongoing policy is too small to offset the negative impact of the global economic crisis on the Cambodian economy.

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Appendix 1: Model

In our CGE model, there are following agents; a representative consumer, four different production sectors, and the government. The four production sectors consist of "agriculture", "garment industry", "other industries", and "service sector", all of which have been obtained by re-categorizing 35 different production sectors in the input-output table of year 2004 by Oum (2007). Labor is divided into skilled and unskilled labor. The four production sectors have the conventional tree structure in their production processes.

We assume a representative consumer maximizes her utility, which is given by:

$$U\left(X_1, X_2, \cdots, X_4\right) = \prod_{i=1}^{4} X_i^{\alpha_i}, \tag{1}$$

where X_i denotes consumption of good i. $\sum_{i=1}^{4} \alpha_i = 1$ is assumed. $i$denotes each sector. The parameter value of each α_i is determined by using the SAM We assume that a representative consumer maximizes (1) with respect to her consumption goods subject to her budget constraint such that:

$$\sum_{i=1}^{4} p_i X_i = I\left(1 - \tau^I\right) - S^I,$$

where p_i and I denote the price of good $i$and income, respectively. τ^I is the proportional income tax rate, and it is calculated by using the SAM. S^Idenotes the amount of savings, and we assume that a representative consumer saves the constant amount relative to her disposal income. The amount of savings is assumed to be given by

$$S^I = s^I \left(1 - \tau^I\right) I,$$

where the constant ratio, s^I, is given exogenously[11]. The value of s^I has been calculated by using the SAM. Then income is given by

$$I = \sum_{i=1}^{4} r_i \overline{K_i} + \sum_{i=1}^{4} \left(w_{us} \overline{L^{us}}_i + w_s \overline{L^s}_i\right),$$

[11] The assumption that the ratio is exogenously given is made only for the model to be consistent to the actual social accounting matrix, and this assumption is very common in the literature.

where $\overline{K}$,$\overline{L^{us}}$,and $\overline{L^{s}}$ denote the initial endowments of capital, unskilled labour, and skilled labor, respectively. r,w_{us},and w_s are the prices of capital, unskilled labour, and skilled labor, respectively.

We assume that all production processes by four different production sectors are described by the tree structure. Following the conventional tree structure assumption, we describe all production processes by the following 4 step procedure.

Step 1: The production of composite goods

We assume that each firm produces its composite goods by using capital, unskilled labor, and skilled labor. We assume that each firm maximizes its profit given by:

$$\pi_i = p_i^Y Y_i\left(K_i, L_i^{us}, L_i^s\right) - rK_i - w_{us}L_i^{us} - w_s L_i^s,$$

where Y_i and p_i^Y denote the composite goods produced by firm $i$and its price, respectively. K_i,L_i^{us},and L_i^s denote capital, unskilled labor, and skilled labor used by firm $i$in order to produce its composite goods, respectively. The production technology is given by:

$$Y_i\left(K_i, L_i^{us}, L_i^s\right) = \xi_i K_i^{\beta_{K,i}}\left(L_i^{us}\right)^{\beta_{L^{us},i}}\left(L_i^s\right)^{\beta_{L^s,i}},\ i = 1, 2, \cdots, 4, \tag{2}$$

where we assume that $\beta_{K,i} + \beta_{L^{us},i} + \beta_{L^s,i} = 1$ for all $i = 1, 2, \cdots, 4$. Note that $\beta_{K,i}$,$\beta_{L^{us},i}$,and $\beta_{L^s,i}$ can be calculated by SAM. ξ_i is the scale parameter.

Step 2: The production of domestic goods

We assume that each firm produces domestic goods, Z_i, by using intermediate goods and its own composite goods, which production has been described at step 1. The optimal behavior in terms of the production of domestic goods can be described such that:

$$\begin{aligned}
&\underset{Y_i, X_{i,j}}{Max}\ \pi_i = p_i^Z Z_i - \left(p_i^Y Y_i - \sum_j^4 p_j^X X_{i,j}\right), \\
&st \quad Z_i = \min\left(\frac{X_{i,j}}{ax_{i,j}}, \frac{Y_i}{ay_i}\right),\ i, j = 1, 2, \cdots, 4,
\end{aligned} \tag{3}$$

where $X_{i,j}$ and p_j^X denote intermediate good j used by firm $i$and its price, respectively.

p_i^Z is the price of Z_i. $ax_{i,j}$ denotes the amount of intermediate good $j$used for producing one unit of a domestic good of firm i, and ay_i denotes the amount of its own composite good for producing one unit of its domestic good. Note that $ax_{i,j}$ and ay_i are calculated by using the SAM.

Step 3: Decomposition of Domestic Goods into Exported Goods and Final Domestic Goods

We assume that each firm decomposes Z_i $(i = 1, 2, \cdots, 4)$ into exported goods, E_i, and final domestic goods, D_i. We assume that each firm maximizes its profit such that:

$$\pi_i = p_i^e E_i + p_i^d D_i - (1 + \tau_i^p)\, p_i^Z Z_i, \tag{4}$$

where p_i^e and p_i^d denote the price when the domestic goods are sold abroad, and the price when the domestic goods are sold domestically, respectively. τ_i^p is the tax rate of a production tax imposed on the production of Z_i, and it is calculated from the SAM. We assume that the decomposition follows the CET technology such that:

$$Z_i = \chi_i \left(\kappa_i^e E_i^{\delta_i} + \kappa_i^d D_i^{\delta_i} \right)^{\frac{1}{\delta_i}}, \; i = 1, 2, \cdots, 4 \tag{5}$$

where we assume that $\kappa_i^d + \kappa_i^e = 1$ $(i = 1, 2, \cdots, 4)$. χ_i, κ_i^d,and κ_i^e are all calculated from the SAM χ_i is the scale parameter. Regarding δ_i, we have:

$$\delta_i \equiv \frac{\psi_i - 1}{\psi_i},$$

and ψ_i determines the curvature of the transformation technology at the given level of Z_i, which is given by:

$$\psi_i = \frac{d \ln \left(\frac{E_i}{D_i} \right)}{d \ln \left(\frac{p_i^e}{p_i^d} \right)}$$

The estimation of δ_i is given in Appendix 2.

Step 4: The Production of the final goods

Denote the final consumption goods by $Q_i (i = 1, 2, \cdots, 4)$. We assume that the final consumption goods are produced by using the final domestic goods, D_i, and the imported goods, M_i. The production technology at this final step is given by the following CES function:

$$Q_i = \mu_i \left(\gamma_i^m M_i^{\lambda_i} + \gamma_i^d D_i^{\lambda_i}\right)^{\frac{1}{\lambda_i}}, \; i = 1, 2, \cdots, 4, \tag{6}$$

where γ_i^j $(j = m, d; i = 1, 2, \cdots, 4)$ is the ratio between imported goods and final domestic goods, and we assume that that $\gamma_i^m + \gamma_i^d = 1$ $(i = 1, 2, \cdots, 4)$. μ_i is the scale parameter. We assume that each firm maximizes its profit with respect to M_i and D_i such that:

$$\pi_i = p_i^Q Q_i - (1 + \tau_i^m) p_i^m M_i - p_i^d D_i, \; i = 1, 2, \cdots, 4, \tag{7}$$

where p_i^Q and τ_i^m denote the price of its final consumption goods, Q_i, and the import tariff rate, respectively. $\mu_i, \gamma_i^m, \gamma_i^d$ and τ_i^m are all calculated from the SAM Regarding λ_i, we have:

$$\lambda_i \equiv \frac{\sigma_i - 1}{\sigma_i},$$

and $\sigma_i$determines the curvature of the substitution between M_i and D_i at the given level of Q_i, which is given by:

$$\sigma_i = \frac{d \ln \left(\frac{M_i}{D_i}\right)}{d \ln \left(\frac{p_i^m}{p_i^d}\right)}$$

The estimation of λ_i is given in Appendix 2.

We assume that the government imposes several taxes to satisfy its budget constraint. Its budget constraint is given by:

$$\sum_{i=1}^{4} p_i^Q X_i^g + S^g = T^I + T^p + T^m,$$

where the left hand side is the total government expenditure, and the right hand side is the total government revenue. X_i^g and S^g denote government consumption of final consumption good i,and the government savings, respectively. The total government revenue, or the total tax revenue is given by:

$$
\begin{aligned}
T^I &= \tau^I I, \\
T^p &= \sum_{i=1}^{4} \tau_i^p \left(p_i^Z Z_i \right), \\
T^m &= \sum_{i=1}^{4} \tau_i^m \left(p_i^m M_i \right),
\end{aligned}
$$

where T^I, T^p, and T^m denote the total income tax revenue, the total production tax revenue, and the total import tariff revenue, respectively.

Appendix 2: The Estimation of δ_i and λ_i

When we use the CET and CES production functions, we have to calibrate the parameter values of both functions, $\delta_i$and λ_i, in order to make the benchmark model close to the actual economy[12]. Note that we assume that each production sector maximizes (4) with respect to $E_i$and $D_i$subject to (5). Then the FOCs yield

$$E_i = E_i\left(p_i^e, p_i^d, p_i^Z; \tau_i^p, \kappa_i^e, \varkappa_i, \delta_i\right) = \left(\frac{\varkappa_i \kappa_i^e \left(1+\tau_i^p\right) p_i^Z}{p_i^e}\right)^{\frac{1}{1-\delta_i}} Z_i, \tag{8a}$$

$$D_i = D_i\left(p_i^e, p_i^d, p_i^Z; \tau_i^p, \kappa_i^d, \varkappa_i, \delta_i\right) = \left(\frac{\varkappa_i \kappa_i^d \left(1+\tau_i^p\right) p_i Z}{p_i^d}\right)^{\frac{1}{1-\delta_i}} Z_i,\ i = 1, 2, \cdots, 4. \tag{8b}$$

By using (8a) and (8b), we have:

$$\frac{E_i}{D_i} = \left(\frac{p_i^d}{p_i^e}\frac{\kappa_i^e}{\kappa_i^d}\right)^{\psi_i}, \tag{9}$$

where

$$\psi_i = \frac{1}{1-\delta_i}.$$

Taking logarithm over both sides of (9), we have:

$$\ln\left(\frac{E_i}{D_i}\right) = \psi_i\left(\ln\frac{p_i^d}{p_i^e} + \ln\frac{\kappa_i^e}{\kappa_i^e}\right) \tag{10}$$

We also assume that each production sector maximizes (7) with respect to $M_i$and $D_i$subject to (6). Then the FOCs yield

$$M_i = M_i\left(p_i^Q, p^m; \tau_i^m, \gamma_i^m, \mu_i, \lambda_i\right) = \left(\frac{\mu_i \gamma_i^m p_i^Q}{\left(1+\tau_i^m\right) p_i^m}\right)^{\frac{1}{1-\lambda_i}} Q_i, \tag{11a}$$

$$D_i = D_i\left(p_i^Q, p^d; \gamma_i^d, \mu_i, \lambda_i\right) = \left(\frac{\mu_i \gamma_i^d p_i^Q}{p_i^d}\right)^{\frac{1}{1-\lambda_i}} Q_i,\ i = 1, 2, \cdots, 4. \tag{11b}$$

By using (11a) and (11b), we have:

[12]When we only use the Cobb-Douglas functions, we can specify all parameter values by the SAM, and we do not have such a problem. See Sak and Kato (2009), where all production functions are assumed to be Cobb-Douglas ones.

$$\frac{M_i}{D_i} = \left(\frac{p_i^d}{p_i^m} \frac{\gamma_i^m}{\gamma_i^d \left(1 + \tau_i^m\right)} \right)^{\sigma_i}, \tag{12}$$

where

$$\sigma_i = \frac{1}{1 - \lambda_i}.$$

Taking logarithm over both sides of (12), we have:

$$\ln \left(\frac{M_i}{D_i} \right) = \sigma_i \left(\ln \frac{p_i^d}{p_i^m} + \ln \frac{\gamma_i^m}{\gamma_i^d \left(1 + \tau_i^m\right)} \right) \tag{13}$$

For simplicity, we now assume that $\sigma_i$and $\psi_i$are the same among different industries, so that we have $\sigma_i = \sigma$,and $\psi_i = \psi$. Then, by using (10), we have estimated the following econometric model:

$$\ln \left(\frac{E_i}{D_i} \right)_t = \beta_1 + \psi X_{it} + \beta_2 WTO_t + \beta_3 ASEAN_t + e_t, \tag{14}$$

where e_t is the error term, and $X_{it} = \left(\ln \frac{p_i^d}{p_i^e} + \ln \frac{\kappa_i^e}{\kappa_i^e} \right)_t$.$ASEAN_t$ and WTO_t are both dummy variables for controlling the fact that Cambodia has joined ASEAN in 1999 and that it has joined WTO in 2004, respectively such that:

$$ASEAN_t = \left\{ \begin{array}{c} 1 : if \ t > 1999 \\ 0 : if \ t \leq 1999 \end{array} \right\},$$

$$WTO_t = \left\{ \begin{array}{c} 1 : if \ t > 2004 \\ 0 : if \ t \leq 2004 \end{array} \right\}.$$

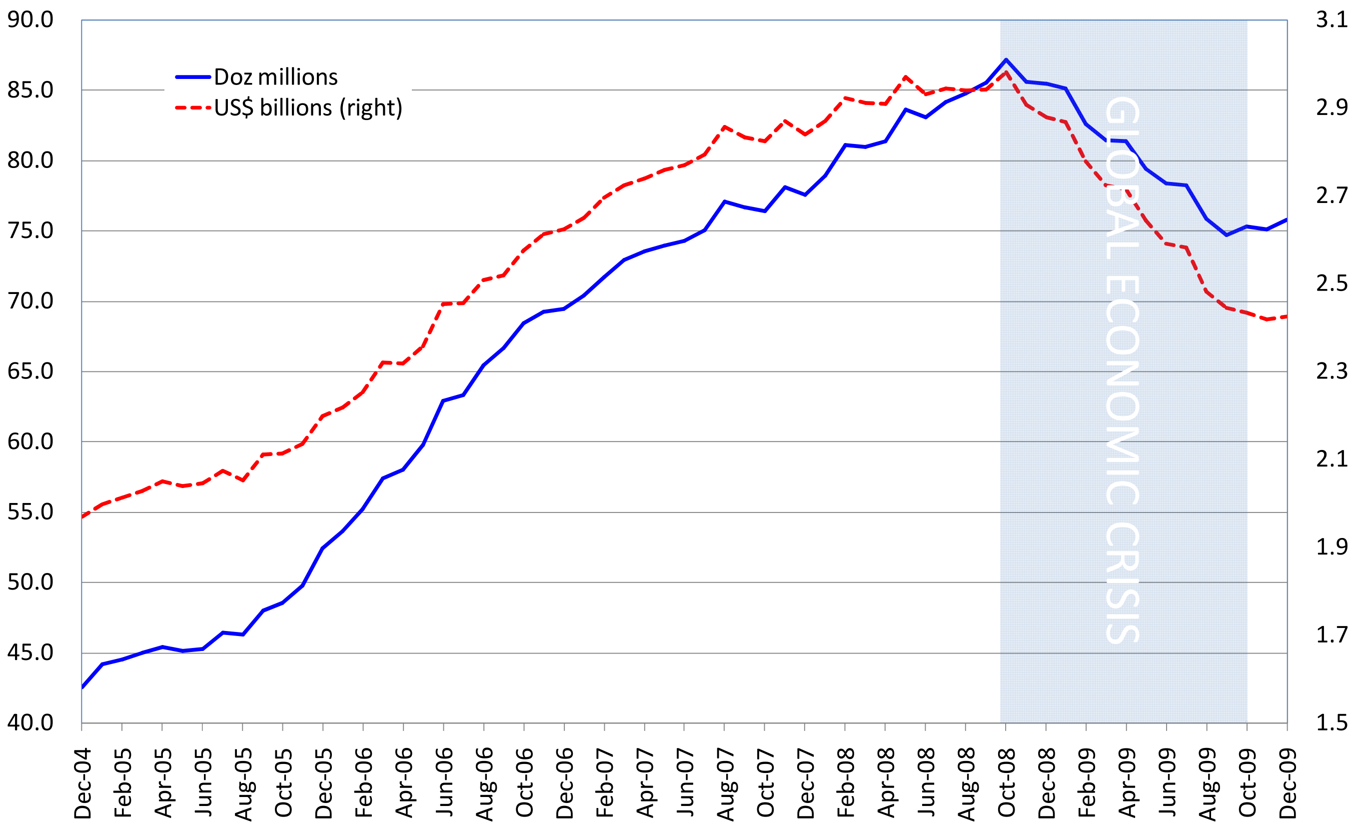
By using (13), we have also estimated the following econometric model:

$$\ln \left(\frac{M_i}{D_i} \right)_t = \varphi_1 + \sigma Z_{it} + \varphi_2 WTO_t + \varphi_3 ASEAN_t + v_t, \tag{15}$$

where v_t is the error term, and $Z_{it} = \left(\ln \frac{p_i^d}{p_i^m} + \ln \frac{\gamma_i^m}{\gamma_i^d \left(1+\tau_i^m\right)} \right)_t$. We also conducted the Breuch-Godfrey serial correlation LM test and the cointegration test, and we could not find any evidence of serial correlation and cointegration in the estimation of (14) and (15). The annual data between 1993 and 2007 from National Institute of Statistics of Cambodia was used for estimation.

The estimation of σ and ψ is given in Table 3-2. The calculated values of all other parameters by using the SAM are also given in Table 3-1.

Figure 1: Cambodia's Clothing Exports



Source: Author, compiled from E-data, Gov't sources

Table 1: Social Accounting Matrix of Cambodia of year 2004 (in US$ millions)

	agri	gar	othindu	serv	unsklab	sklab	capital	prdtax	imptax	hous	gov	inv	fore	TOTAL
agri	85.415	7.715	690.338	62.286						1006.287	0.004	0.148	216.864	2069.056
gar	1.584	1345.814	44.261	72.762						119.792	2.787	205.210	2049.517	3841.725
othindu	331.182	244.891	1239.906	834.953						1501.737	0.016	830.359	337.158	5320.202
serv	122.588	264.991	279.583	520.346						1306.182	517.723	21.279	677.290	3709.983
unsklab	1142.591	262.430	229.572	515.353										2149.946
sklab	3.544	38.682	43.126	301.445										386.797
capital	329.575	365.324	347.679	1149.610										2192.189
prdtax	5.345	22.700	35.171	43.449										106.665
imptax	2.224	18.669	273.704	4.926										299.523
hous					2149.946	386.797	2192.189							4728.932
gov								106.665	299.523	207.934				614.122
inv										587.000	93.592		376.404	1056.996
fore	45.008	1270.508	2136.862	204.854										3657.232
TOTAL	2069.056	3841.725	5320.202	3709.983	2149.946	386.797	2192.189	106.665	299.523	4728.932	614.122	1056.996	3657.232	

Source: Author, compiled from Oum (2007)

Table 2: Error Levels of the Benchmark Model (*RMSE*)

NOTATION	VARIABLE	ACTUAL (A_n)	BENCHMARK (B_n)	$(A_n-B_n)^2$
F	factor	4,728.931	4,728.931	0.000000
X	intermediate consumption	6,148.615	6,148.615	0.000000
Y	composite factor	4,728.932	4,728.931	0.000001
Z	domestic output	10,877.546	10,877.546	0.000000
D	final domestic goods	7,703.382	7,703.383	0.000001
Q	final goods	11,660.137	11,660.138	0.000001
Xp	private consumption	3,933.998	3,933.998	0.000000
Xg	government consumption	520.530	520.530	0.000000
Xv	investment demand	1,056.996	1,056.996	0.000000
E	exports	3,280.829	3,280.829	0.000000
M	imports	3,657.232	3,657.232	0.000000
Sp	private savings	587.000	587.000	0.000000
Sg	government savings	93.592	93.592	0.000000
Td	direct tax	207.934	207.934	0.000000
Tz	production tax	106.665	106.665	0.000000
Tm	import tax	299.523	299.523	0.000000
			RMSE	*0.000433*

See Appendix 1 for the definition of variables

Table 3-1: Parameter Values of the Benchmark Model

	utility in (1)	scale parameters			Parameters in (2)		
	α	ξ	μ	χ	$\beta_{L^{us}}$	$\beta_{L^{s}}$	β_{K}
garment industry	0.03	2.367	1.866	1.721	0.394	0.058	0.548
agriculture	0.256	1.729	1.183	1.524	0.774	0.003	0.223
other industries	0.382	2.405	2.121	1.533	0.37	0.07	0.56
service sector	0.332	2.592	1.364	1.708	0.262	0.153	0.585

	Parameters in (3)					Parameters in (5)		Parameters in (6)	
	$ax_{i,garm}$	$ax_{i,agri}$	$ax_{i,other}$	$ax_{i,service}$	ay	κ^{e}	κ^{d}	γ^{m}	γ^{d}
garment industry	0.003	0.042	0.24	0.018	0.263	0.721	0.279	0.677	0.323
agriculture	0.532	0.001	0.015	0.021	0.732	0.193	0.807	0.055	0.945
other industries	0.097	0.164	0.431	0.242	0.216	0.202	0.798	0.494	0.506
service sector	0.105	0.061	0.097	0.151	0.569	0.276	0.724	0.117	0.883

Table 3-2: The Estimation of δ and λ in the CET and CES Production Functions

($\delta = \frac{\psi - 1}{\psi}$ and $\lambda = \frac{\sigma - 1}{\sigma}$)

	equation (14)	equation (15)
constant term	-1.431***	-1.044***
X	-1.476*** $(=\psi)$	
Z		1.282*** $(=\sigma)$
WTO	0.18*	0.161**
ASEAN	0.581***	0.392***
$\bar{R}^2$	0.988	0.993
DW	2.6	2.728
Sample size	15	15

Data Source: National Institute of Statistics of Cambodia

***:1% significant, **: 5% significant, and *: 10% significant

Table 4-1: The Impact of the Global Economic Crisis on Output and Income

Unit: A million US dollars

	Output				Income			
	garment industry	agriculture	other industries	service sector	garment industry	agriculture	other industries	service sector
Benchmark	1792.209	1852.193	4983.043	3032.693	666.436	1475.71	620.377	1966.408
Result of Global Economic Crisis	1677.187	1805.834	4822.393	2910.224	621.073	1497.127	620.249	1990.465
% change	-6.4%	-2.5%	-3.2%	-4.0%	-6.8%	1.5%	0.0%	1.2%

Table 4-2: The Impact of the Global Economic Crisis on the Cambodian Aggregated Economy

Unit: A million US dollars

	Private Consumption	Net Exports	GDP	Welfare Loss
Benchmark	3934	-376	5135	
Result of Global Economic Crisis	3673	-48	5120	281
% change	-6.6%	87.2%	-0.3%	

Table 4-3: The Impact of the Global Economic Crisis on the Income of the Garment Industry

Unit: A million US dollars

	Income of the Garment Industry		
	Capital	Unskilled labor	Skilled labor
Benchmark	365.324	262.430	38.682
Result of Global Economic Crisis	341.359	243.763	35.954
% change	-6.56%	-7.11%	-7.05%

Table 5-1: The Effect of the Neutralization Policy on Output and Income

Unit: A million US dollars

	Output				Income			
	garment industry	agriculture	other industries	service sector	garment industry	agriculture	other industries	service sector
Benchmark	1792.209	1852.193	4983.043	3032.693	666.436	1475.71	620.377	1966.408
Neutralization Policy	1684.126	1903.402	4958.382	2702.025	623.978	1520.161	634.379	1950.223
% change	-6.0307%	2.7648%	-0.4949%	-10.9034%	-6.3709%	3.0122%	2.2570%	-0.8231%

Table 5-2: The Effect of the Neutralization Policy on the Cambodian Aggregated Economy

Unit: A million US dollars

	Private Consumption	Net Exports	GDP	Welfare Loss
Benchmark	3934	-376	5135	
Neutralization Policy	3935	-18	5145	0
% change	0.0%	95.2%	0.2%	

Table 5-3: The Effect of the Neutralization Policy on the Income of the Garment Industry

Unit: A million US dollars

	Income of the Garment Industry		
	Capital	Unskilled labor	Skilled labor
Benchmark	365.324	262.430	38.682
Neutralization Policy	344.563	242.775	36.669
% change	-5.68%	-7.49%	-5.20%

Table 5-4: Tax Rates of the Neutralization Policy

		production tax			
	income tax	garment industry	agriculture	other industries	service sector
Benchmark	4.400%	0.900%	0.300%	1.200%	1.300%
Neutralization policy	0.100%	0.000%	0.000%	0.061%	0.063%
% change	-97.7%	-100.0%	-100.0%	-94.9%	-95.2%

Note: Tax rates of the benchmark model have been calculated from the SAM.

Table 6-1: The Effect of the Ongoing Policy on Output and Income

Unit: A million US dollars

	Output				Income			
	garment industry	agriculture	other industries	service sector	garment industry	agriculture	other industries	service sector
Benchmark	1792.209	1852.193	4983.043	3032.693	666.436	1475.71	620.377	1966.408
Ongoing Policy	1717.896	1806.200	4831.451	2857.206	637.759	1494.568	618.722	1977.864
% change	-4.1464%	-2.4832%	-3.0422%	-5.7865%	-4.3030%	1.2779%	-0.2668%	0.5826%

Table 6-2: The Effect of the Ongoing Policy on the Cambodian Aggregated Economy

Unit: A million US dollars

	Private Consumption	Net Exports	GDP	Welfare Loss
Benchmark	3934	-376	5135	
Ongoing Policy	3685	-5	5130	249
% change	-6.3%	98.6%	-0.1%	

Table 6-3: The Effect of the Ongoing Policy on the Income of the Garment Industry

Unit: A million US dollars

	Income of the Garment Industry		
	Capital	Unskilled labor	Skilled labor
Benchmark	365.324	262.430	38.682
Ongoing Policy	350.522	250.207	37.033
% change	-4.05%	-4.66%	-4.26%