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Imperfect Competition with Separating Exchange Markets

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Abstract

Obstfeld and Rogoff (1995) endeavour to investigate the international welfare spillovers with monopolistic competition and sticky output prices, yet in a unified exchange rate system. This paper applies their framework to the regime of dual exchange markets, generating plenty of results of policies. The particular contribution of this paper to the welfare effects of country sizes on policy lies in the cases of numerical simulations. The discussions of spillover effects, the current account dynamics, and imperfect competition to the separating exchange markets fill in the gaps on the literature. Then it takes a further step on open economy macroeconomics.

• **JEL Classifications:** F32, F33, F41

• **Key Words:** Imperfect Competition, Dual Exchange Markets, Welfare Effects, Population Weights.

I. Introduction

Imperfect competition has been important in macroeconomic models since the early 1980s, surveyed by Dixon and Rankin (1994). Nevertheless, there is as yet little literature on open economy macroeconomics under imperfect competition. Some of the major contribution has been made by: Aizenman (1989), Dixon (1990), Flood and Hodrick (1985) and Svensson and van Wijnbergen (1989).

Recently, Obstfeld and Rogoff (1995) have developed an important perspective on the international welfare spillovers through a global macroeconomic frame-

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work based on monopolistic competition and sticky nominal output prices. It is commonly recognized as the contribution that launched this new wave of research. In essence it offers a theory to explain both exchange rate dynamics and the intertemporal approach of the current account. The exchange rate adjustment process, as well as the need for and effects of macroeconomic policy. In the last five years a substantial literature has developed extending the Obstfeld and Rogoff model in a number of directions, surveyed by Lane (2001). As far as an unified fixed exchange rate system is concerned, one paper which extends their analysis to such a system is by Caselli (2001).

The central purpose of this paper is to consider analytically one specific exchange rate system which has been used by many countries in the last three decades. This is the dual exchange rate system. It has a mechanism by which some of the costs of fixed and flexible exchange rate systems are sought to be minimised. Alternatively, the gains from having one or other of the two polar alternatives can be increased by having a hybrid system. By fixing the exchange rate for the current account (called the commercial rate), the impact of volatility and uncertainty for the domestic real economy and the trade balance is sought to be reduced or eliminated. Having flexible exchange rates for the capital account (called the financial rate), some independence of monetary policy can be preserved with the domestic interest rate (and the inflation rate) having the ability to diverge from world rates. Hence, the monetary authorities can pursue a relatively independent monetary policy in response to shocks and attempt to stabilise the economy when there are business cycles. Furthermore, countries adopted such a regime are not limited to developing countries. According to the issues of International Monetary Funds Annual Report on Exchange Arrangements and Exchange Restriction, many developed countries, such as Belgo-Luxembourg Economic Union, have experienced separating exchange markets at different periods of time. In the international context, in May 1997, monetary crisis hit hard most South and East Asian countries. The crisis erupted because countries that suddenly opened up to foreign capital were not prepared to handle these new flows. A consequence of the greatly increased exchange rate volatility has been a parallel increase in policy discussions for exchange controls. Among Asia turmoil, Peoples Republic of China is the least affected one. Experts attributed it to the success of adopting two-tier exchange markets. Malaysia thus separated exchange markets to avoid transitory shocks in the financial exchange market affecting the current account, and hence the real economy. It allowed flexibility in setting domestic monetary targets.

Then, here we postulate a world of two imperfectly competitive economies, not just a small open economy, each populated by a continuum of agents who

consume all varieties of a single good produced in the world. In the case where all varieties of a given product are equally priced. It is through this method of analysis that comparative statics of the system, the rigidities of output prices and the expectation of future steady state will be characterised. Our particular contribution to the welfare effects of policy lies not only in the case of small policy changes by means of linearisation but also in the case of the large effects of large policy shifts studied through numerical simulations. Simulations suggest that country sizes certainly matter and significantly affect the welfare evaluations of policy shifts.

The discussions of spillover effect, the current account dynamics, and imperfect competition to the separating exchange markets will fill in the gaps on the research of such exchange rate management. It would also be compared from the older, Mundell- Fleming (1962) and Dornbusch (1976), tradition of open economy macroeconomics, which have explicitly modelled systems of dual exchange rates. The present context addresses the following policy issues: first, in the presence of monopoly power, the nature of the sticky-price fiscal multiplier compared to the corresponding long-run multiplier, and, second the responses to a once-and-for-all commercial devaluation. This paper is organised as follows. Section 2 provides the explanations for a two-country model of dual exchange rates. Section 3 and Section 4 examine the effects of fiscal policy and commercial devaluation respectively. The welfare effects of policy changes are illustrated in Section 5. Section 6 evaluates the international welfare transmission through numerical simulation. Section 7 concludes.

II. The Model

This section lays out the microeconomic underpinnings of the model; the problems of the agents are solved. Consider a two-country, one differentiated (non-storable) good, and monopolistic competition world. Dual exchange rates are modelled by assuming that the home residents are prohibited from transacting in world capital markets and domestic bond holdings are fixed in the aggregate. Under such a regime postulated here, domestic residents can neither buy nor sell foreign bonds (B) abroad, yet the volume of such bonds for each individual ($\bar{b}$) can be changed. Foreign interest income must be repatriated through current account then converted immediately into domestic money at the central bank. All current account transactions take place at a fixed commercial rate, $\bar{E}$, while capital account transactions are channelled through the freely floating financial rate, X. The exchange rates are defined as the price of foreign currency in terms of domestic currencies.

Briefly, there are two sets of agents in the world: households and the

government. Three assets exist: domestic and foreign currency, M and M^* as well as an internationally traded bond, say foreign bond, which is denominated in foreign currency and held by households. We now illustrate and solve the problems faced by each household and the government.

A. The Household

Households are indexed by $j \in [0,1]$, which have uniform distribution over [0, n] and (n,1] for domestic and foreign households respectively. The index presents not only the production share in the world goods market but also the measure of relative size of the home economy. The smaller the n, the smaller is the home economy. Household j supplies labour of variety j as well as derives utility from consumption, real money balances, and output whose only input is work effort. The household is infinitely-lived, and then in discrete time the utility function of domestic resident is

$$U_t = \Sigma_{k=1}^{\infty} \delta^{k-t} \left[\alpha ln C_k + (1-a) ln \frac{M_k}{P_k} - \frac{\mu}{2} y_k^2 \right] \tag{1}$$

Here, δ measures the rate of time preference or subjective rate of discount, which reflects the rate that future utility is discounted by the individual. The utility function of foreign household is defined analogously variables pertaining to the foreign country will be denoted by an asterisk throughout. The first term in utility is a consumption index C, which presents the effect of the consumption of goods on utility. That is

$$C = [\int_0^1 c(j)^{\sigma} dj]^{\frac{1}{\sigma}} \quad 0 < \sigma < 1 \tag{2}$$

$c(j)$ denotes the consumption of household j, and C is a CES (constant elasticity of substitution) function of $c(j)$s. Foreign households have the analogous consumption index. The parameter σ is the elasticity of substitution between goods in utility and the restriction, $0 < \sigma < 1$, on the demand elasticity makes it certain that there is one equilibrium. Furthermore, σ also presents a preference parameter and lies in the open interval (0,1). The greater the σ, the higher is the degree of substitutability between different variety goods. When σ is equal to one, the goods market becomes perfect competition.[1] Here we assume that all agents have the same tastes for varieties.

The second term in utility is the effect of real money balance on utility. Nominal

[1]From equation (1) of Obstfeld-Rogoff model, θ–1/θ indicated the same meanings in goods market indirectly (op. cit., pp. 627). When θ approaches infinity, the goods market becomes perfectly competitive.

money balance, M, is deflated by the nominal price index, P that is associated with C, consumption index. Being symmetrical among households, the price index of home country is given by

$$P = \left[\int_0^1 p(j)^{\frac{1}{\theta}} dj\right]^{\theta}$$

$$= \left[np_t^{\frac{1}{\theta}} + (1-n)(\bar{E}p^*)^{\frac{1}{\theta}}\right]^{\theta} \tag{3}$$

where θ is defined as $(\sigma-1)/\sigma$. Then the corresponding price index of foreign country is given by

$$P^* = \left[\int_0^1 p(j)^{\frac{1}{\theta}} dj\right]^{\theta}$$

$$= \left[n\left(\frac{p}{E}\right)^{\frac{1}{\theta}} + (1-n)p^{*\frac{1}{\theta}}\right]^{\theta} \tag{4}$$

where $p(j)$ denotes the nominal output price of firm j and $p^*(j)$ is the foreign nominal output price of the same good. Free movement of goods implies that the law of one price holds. That is,

$$p(j) = \bar{E}p\ (j) \tag{5}$$

For the same preference among consumers, equation (5) can also be expressed as

$$P = \bar{E}P^* \tag{6}$$

In order to investigate the budgeting procedure for the consumption of variety j and derive its demand function, we shall assume that all goods have unitary income elasticity. In addition to this assumption, the subutility function, equation (2), has an interesting symmetry that every pair of varieties is equally substitutable for each other. Thus it can be verified that the consumption index is definitely homothetic in its arguments, individual consumption. Therefore, the demand function for individual variety can be solved in two stages. In the first stage, each household chooses its spending on products as PC and such that it can allocate its spending across products. In the second stage, for each product j, the demand function is solved as

$$c_t(j) = C_t\left[\frac{P_t}{p_t(j)}\right]^{\frac{1}{1-\sigma}} \tag{7}$$

The demand functions of foreign households will be the same.

The third term in the utility function gives the disutility from effort used in producing product; μ is a productivity parameter. The household maximises profit under imperfect competition given the production function:

$$y(j) = f(l) = l^{\frac{1}{\mu}}, 0 < \frac{1}{\mu} < 1$$

We use a exponent form in that the marginal productivity of labour diminishes. Each household takes the price index as given, inputs labour to produce its own variety of product, and chooses $p(j)$ to maximise its output revenue. The maximisation problems however are subject to budget constraints, in each period, which are given by

$$M_t + X_t P_t^* b_t = p_t y_t + M_{t-1} + t_{t-1}^* \bar{E} b_{t-1} P_{t-1}^* + X_t P_{t-1}^* b_{t-1} - P_t C_t - P_t \tau_t \tag{8}$$

and

$$M_t^* + P_t^* b_t^* = p_t^* y_t^* + M_{t-1}^* + i_{t-1}^* P_{t-1}^* b_{t-1}^* + P_{t-1}^* b_{t-1}^* - P_t^* C_t^* - P_t^* \tau_t^* \tag{9}$$

where τ in equation (8) is the real tax paid to domestic government and the left-hand side of the above expression is the savings of period *t*. From equation (8), the payoff to domestic household holding foreign bonds for one period is the equivalent of

$$i_{t-1}^* \bar{E} P_{t-1}^* b_{t-1} + (X_t - X_{t-1}) P_{t-1}^* b_{t-1}$$

Domestic household can invest one unit of domestic money at period t–1 to get $1/X_{t-1}$ units of capital account foreign exchange. It earns i_{t-1}^*/X_{t-1} interest income at the end of period t-1 and is repatriated into domestic money through current account in amount $i_{t-1}^* E_t/X_{t-1}$ at period t. In addition, the principal may be repatriated at period t through capital account at the rate X_t. In domestic consumption units, the real payoff of holding such bonds can be rewritten as

$$\rho_{t-1} = \left[\frac{i_{t-1}^* \bar{E}}{X_{t-1}} + \frac{X_t - X_{t-1}}{X_{t-1}}\right]\frac{P_{t-1}}{P_t} \tag{10}$$

where ρ_{t-1} is regarded as domestic real interest rate. If we define the domestic inflation rate as $\pi_{t-1} = (P_t - P_{t-1})/P_{t-1}$ and the rate of depreciation of the

financial rate defined as $\phi_{t-1} = (X_t - X_{t-1})/X_{t-1}$ then the domestic real rate of interest becomes

$$1 + \rho_{t-1} = \frac{\frac{i^*_{t-1}\bar{E}}{X_{t-1}} + (1 + \phi_{t-1})}{1 + \pi_{t-1}} \tag{11}$$

The financial transactions taking place in the capital account market is governed by

$$1 + i_{t-1} = \frac{i^*_{t-1}\bar{E}}{X_{t-1}} + (1 + \phi_{t-1}) \tag{12}$$

The real payoff to foreigners from holding foreign-currency denominated bonds for one period is

$$1 + r^*_{t-1} = \frac{1 + i^*_{t-1}}{1 + p^*_{t-1}} \tag{13}$$

where r^* is the real interest rate of foreign economy. Comparing equation (11) with equation (13), the differences between the foreign return and the return received by home households come from the evolution of financial rate, ϕ_{t-1}, and from the financial premium, $X_{t-1}/\bar{E} = q_{t-1}$,[2] which is different from those derived by Obstfeld and Rogoff (op. cit., pp. 630), an unified flexible exchange rate regime.

A. The Government

The governments' preferences have been assumed to be identical to those of households, and hence their spending allocation processes are the same as previously mentioned. It is easy to show that domestic government's demand for the product of variety j is:

$$g_t(j) = G_t\left[\frac{p_t(j)}{P_t}\right]^{\frac{1}{\sigma-1}} \tag{14}$$

The foreign government has the same demand function. We assume that the finance of all government expenditures is by means of real taxation from domestic households as well as the interest from interest-bearing reserves. Then the budget constraints of governments are (in real terms):

[2]The derivative of domestic real rate of interest under dual exchange rate system is inspired by Marion (1991).

$$\tau_t = G_t + r^* m_{t-1} \tag{15}$$

and

$$\tau_t^* = G_t^* + r^* m_{t-1}^* \tag{16}$$

The domestic and foreign money supplies are given by

$$M_t = P_t f_t + D_0 \tag{17}$$

and

$$M_t^* = -P_t^* f_t + D_0^* \tag{18}$$

where D_0 and D_0^* denote the constant levels of domestic credit and f represents foreign reserves. We assume $D_0=D_0^*=0$ and so that real money supplies are given by $m_t=f_t$ and $m_t^* = -f_t$. The interest from real money supplies can be the equivalent of the interest from foreign reserves, as expressed on the right-hand sides of equations (15) and (16). Here the foreign country has been taken to be the reserve-currency country. In the absence of other world assets, it becomes $(1-n)f^*=-nf$. Then, it suggests that the world money supply is an exogenous variable, which in turn implies that the condition $(1-n)dm^*=-ndm$ holds.

However, the real money balances of both countries reflect the balances of current account in that the exchange rate applicable to commercial transactions in the home economy is fixed and the foreign economy has a unified fixed exchange rate system. It is quite different from those mentioned in Obstfeld and Rogoff (op. cit., pp. 629). In their model, both countries adopt flexible exchange rate systems – money balances in each country are exogenous variables.

Combining the budget constraints of the governments with those of the households yields per capita current account surplus as

$$(m_t - m_{t-1}) = \frac{p_t}{P_t} y_t(j) - G_t + \frac{i_{t-1}^* \bar{E} P_{t-1}^* b_{t-1}}{P_t} + r^* m_{t-1} - C_t \tag{19}$$

and

$$(m_t^* - m_{t-1}^*) = \frac{p_t^*}{P_t^*} y_t^*(j) - G_t^* + i_{t-1}^* b_{t-1}^* + r^* m_{t-1}^* - C_t^* \tag{20}$$

Adopting population weights and adding up private as well as government demands, the world demand curve for product j is

$$nc_t(j) + (1+n)c_t^*(j) + ng_t(j) + (1-n)g_t^*(j) = y_t^*(j) \tag{21}$$

Using equations (7) and (14), it becomes:

$$y_t^d(j) = \left(\frac{p_t}{P_t}\right)^{\frac{1}{\sigma-1}}(C_t^W + G_t^W) \tag{22}$$

Equation (22) makes use of the definitions of world private and government demand; that is

$$C_t^W = nC_t + (1-n)C_t^* \tag{23}$$

$$G_t^W = nG_t + (1-n)G_t^* \tag{24}$$

This completes our explanations of the agents' behavior. After solving relevant optimisation conditions and imposing the steady state condition, $\pi=\pi^*=0$, on equations (19) and (20), it implies that the steady state values of per capita consumption are:

$$\bar{C} = \frac{\bar{p}}{\bar{P}}\bar{y} - \bar{G} + \bar{i}^*\bar{b} + r^*\bar{m} \tag{25}$$

and

$$\bar{C}^* = \frac{\bar{p}^*}{\bar{P}^*}\bar{y}^* - \bar{G}^* - \bar{i}^* - \frac{n}{(1-n)}\bar{b} + r^*\bar{m}^* \tag{26}$$

The time subscripts of steady states have been dropped and overbars stand for the steady state values. As previous mentioned, the real quantity of external assets in the private sector of home country is fixed at $\bar{B}$ due to the operation of dual exchange markets. In the steady state, we assume that the holdings of foreign bonds in each household will be equalised, and hence such holdings in each individual of home economy is $\bar{b} = \bar{B}/n$. The holdings of such bonds in the private sector of foreign economy in the steady state are also fixed at and such that the share of each household is $\bar{b}^* = \bar{B}^*/(1-n)$. Equation (26) has made use of the identity of $\bar{B} + \bar{B}^* = 0$.

Given the assumption that services balance as well as real government expenditure in the initial steady state are equal to zero, we get the initial steady state values of domestic output as well as of foreign output as

$$\bar{y}_0 = \bar{y}_0^* = \left(\frac{\alpha\sigma}{\mu}\right)^{\frac{1}{2}}$$

where the subscript zero means initial steady state. Setting $r^* = \bar{\rho}_0 = \bar{i}_0^* = \bar{i}_0 = \frac{1-\delta}{\delta}$, we derive the initial steady state values of real money balance:

$$\bar{m}_0 = \frac{(1-\alpha)}{\alpha(1-\delta)}\bar{y}_0$$

and

$$\bar{m}_0 = \frac{(1-\alpha)}{\alpha(1-\delta)}\bar{y}_0^*$$

B. Log-linearized

To investigate the policy effects and welfare evaluations, following Obstfeld and Rogoff (1995), we denote percentage changes from initial steady state for any variable by hats, and then take the relevant log-linearisations as follows.

Because the commercial exchange rate is fixed, purchasing power parity becomes:

$$\hat{P}_t = \hat{P}_t^* \tag{27}$$

Then the general price indices for two countries are:

$$\hat{P}_t = \hat{P}_t^* = n\hat{p}_t + (1-n)\hat{p}_t^* \tag{28}$$

Taking into account population weights, the global goods market equilibrium condition will be

$$\hat{C}_t^W = n(\hat{p}_t + \hat{y}_t - \hat{P}_t) + (1-n)(\hat{p}_t^* + \hat{p}_t^* - \hat{P}_t^*) - \frac{dG^W}{\bar{C}_0^W} \tag{29}$$

Equation (29) has used the assumption that the government spending of the world is zero in the initial steady states. From the world demand for domestic output, equation (22), we get

$$\hat{y}_t = \frac{1}{\sigma-1}(\hat{p}_t - \hat{P}_t) + \hat{C}^W + \frac{dG^W}{\bar{C}_0^W} \tag{30}$$

Similar equation of the demand for foreign output is

$$\hat{y}_t^* = \frac{1}{\sigma-1}(\hat{p}_t^* - \hat{P}_t^*) + \hat{C}^W + \frac{dG^W}{\bar{C}_0^W} \tag{31}$$

From Equations (30) and (31), the higher substitution between goods, the more responsiveness of output demand to prices and more competitive of goods market.[3] Next, differentiating relevant first order optimisation conditions, the following log-linearised forms are obtained. They describe the relations between

real output producing world demand, equations (32) and (33), as well as households intertemporal marginal rates of substitution between future and current consumption, equations (34) and (35).

$$\hat{y}_t = \frac{-\hat{C}_t}{2-\sigma} + \frac{1-\sigma}{2-\sigma}\left(\hat{C}^W + \frac{dG^W}{\overline{C}_0^W}\right) \tag{32}$$

$$\hat{y}_t = \frac{-\hat{C}_t^*}{2-\sigma} + \frac{1-\sigma}{2-\sigma}\left(\hat{C}^W + \frac{dG^W}{\overline{C}_0^W}\right) \tag{33}$$

$$\hat{C}_{t+1} = \hat{C}_t + (1-\delta)\hat{\rho}_t \tag{34}$$

$$\hat{C}_{t+1}^* = \hat{C}_t^* + (1-\delta)\hat{r}_t \tag{35}$$

Combining the real rate of interest of domestic economy with that of foreign economy, the log-linear forms of money demand equation become

$$\hat{M}_t - \hat{P}_t = \hat{C}_t - \delta\left(\hat{\rho}_t + \frac{\hat{P}_{t+1} - \hat{P}_t}{1-\delta}\right) \tag{36}$$

and

$$\hat{M}_t^* - \hat{P}_t^* = \hat{C}_t^* - \delta\left[\hat{\rho}_t + \frac{\hat{P}_{t+1} - \hat{P}_t}{1-\delta} - \frac{\delta(\hat{X}_{t+1} - \hat{X}_t)}{1-\delta} + \hat{q}_t\right] \tag{37}$$

The above expressions have imposed the steady state values of interest rate and of financial premium. The spread between commercial and financial rates is assumed to be zero across steady states and such that $q_0 = q_1 = 1$, which indicates that financial premium can not persist due to arbitrage activities. We have completed a brief explanation of this model. The analysis of policy effects, welfare evaluations and simulations will be based on this descriptions.

III. Effects of Fiscal Policy

In this section we investigate the effects of fiscal policy under the situations of sticky output price as well as flexible price. Given that the initial steady state value of the government spending of the world is zero, consider the effects of unanticipated and permanent increases in domestic as well as in foreign government spending.

[3]Compared to equations (27) and (28) of Obstfeld-Rogoff model (op. cit. pp. 633), the same implications should be applied.

A. Impact Effects

With sticky output prices and fixed commercial exchange rate, the consumption price index of domestic economy remains unchanged in the short run. Thus, the rate of inflation is zero, and hence nominal and real rates of interest are equalised. It implies that both nominal and real rates of interest of foreign economy remain constant. Being only one traded bond in the world, the real payoff to domestic households should be the same as that to foreigners. Then, the evolution of financial rate does not exist and we find that $1 + \rho_t = 1 + i_t = 1 + r_t^* = 1 + i_t^* = 1/\delta, X_t = \bar{E} = X_{t+1}$ and $q_t = 1$.

To examine the short-run effects of fiscal policy, from equations (19) and (20), the approximations of short-run changes of per capita consumption are given by

$$\hat{C} = \hat{y} - \frac{dm}{\bar{C}_0^W} - \frac{dG}{\bar{C}_0^W} \tag{38}$$

and

$$\hat{C}^* = \hat{y}^* - \frac{dm^*}{\bar{C}_0^W} - \frac{dG^*}{\bar{C}_0^W} \tag{39}$$

where the time subscripts have been dropped for simplicity. Here we assume that individuals enter at period t and hence interest incomes of foreign reserves and of traded bond have been ignored in the short run. In addition, through direct solving techniques, we solve the changes of relevant variables as:

$$\hat{y} = \hat{y}^* = \frac{ndG + (1-n)dG^*}{\bar{C}_0^W} \tag{40}$$

$$\hat{C} = dm = \frac{(n-1)dG + (1-n)dG^*}{\bar{C}_0^W} \tag{41}$$

$$\hat{C}^* = dm^* = \frac{ndG - ndG^*}{1 + \bar{C}_0^W} \tag{42}$$

and

$$\hat{C}^W = 0 \tag{43}$$

The relations between the changes of output and those of per capita consumption are

$$\hat{y} = \frac{1 + \bar{C}_0^W}{\bar{C}_0^W}\hat{C} + \frac{dG}{\bar{C}_0^W} \tag{44}$$

and

$$\hat{y}^{*} = \frac{1 + \bar{C}_0^W}{\bar{C}_0^W}\hat{C}^{*} + \frac{dG^{*}}{\bar{C}_0^W} \tag{45}$$

There are four cases discussed as follows. First, we assume dG>0 and dG^{*}=0. On impact, an increase in domestic government spending causes excess demand for goods in the world. To satisfy such demand, both countries need to produce more and hence products are on the increase. Obviously, the increase in domestic output is less than that in domestic government spending which is composed of the varieties of one single good produced in the world. Home country thus runs current account deficit, as indicated in equation (41). From government budget constraint, equation (15), to finance its increased purchases, real taxation should be increased. The consumption of domestic households thus must fall. By contrast, the foreign economy runs current account surplus due to an increase in output. Foreigners consume more by the amount of per capita current account surplus. However, the whole consumption in the world remains unchanged. An increase in domestic government spending only results in the redistribution of world money supply but stimulates the outputs in both countries.

In the second case, dG=0 and dG^{*}>0, the impact effects of an increase in foreign government spending include stimulating outputs of both countries, reducing foreign consumption and raising domestic consumption. In the third case, dG=dG^{*}>0, the impact effects of the increases in both government spending should depend on the relative size of home country, n. From equations (40)-(42), when the numbers of household in both countries are equalised, the increased government spending should not affect anything. The larger the n, the more possibility of the effect of an increase in domestic government spending overweighs that in foreign government spending. When domestic economy is relatively large, $n > 1/2$, the impact effects are similar to those of case one. When domestic economy is relatively small, $n < 1/2$, the impact effects are similar to those of case two.

In the fourth case, d$G \neq dG^{*}$>0, the impact effects of the increases in both government spending depend not only on the relative size of both countries but also on the relative magnitude of spending. If ndG>(1n)dG^{*}, the adjustment process is the same as that of case one; if ndG<(1n)dG^{*}, the process is similar to that of case two.

The following proposition summarises the impact effects of fiscal policies:

Proposition 1: With imperfect competition of goods market and sticky output prices, dG>0 and dG*=0 (dG=0 and dG*>0), a permanent and unanticipated increase in domestic

(foreign) government spending will stimulate outputs of both countries, improve (deteriorate) the balance of payments of foreign economy. If $dG=dG^*>0$, then the larger the n, the likely the domestic government dominates the spending effects. However, the world consumption remains unchanged.

B. Long-run Effects

We specify the steady state changes as the percentage change in a steady-state value, for example, $\bar{y} = d\bar{y}/\bar{y}_0$ as defined by Obstfeld and Rogoff (1995). To examine the long-run effects of fiscal policy, an approximation of the steady state change for per capita domestic consumption is given by:

$$\hat{\bar{C}} = \hat{\bar{p}}(h) + \hat{\bar{y}} - \hat{\bar{P}} + \frac{r^* d\bar{m}}{\bar{C}_0^W} - \frac{d\bar{G}}{\bar{C}_0^W} + \frac{\bar{i}^* \bar{b}}{\bar{C}_0^W} \tag{46}$$

The corresponding equation for foreigner is:

$$\hat{\bar{C}} = \hat{\bar{p}}(f) + \hat{\bar{y}} - \hat{\bar{P}} + \frac{\bar{i}^* d\bar{m}^*}{\bar{C}_0^W} - \frac{d\bar{G}^*}{\bar{C}_0^W} - \frac{i^* n\bar{b}}{(1-n)\bar{C}_0^W} \tag{47}$$

Combining equations (46) and (47) with comparing steady states, it allows us to solve nine unknowns: $\hat{\bar{y}}, \hat{\bar{y}}^*, \hat{\bar{C}}, \hat{\bar{C}}^*, d\bar{m}, d\bar{m}^*, (\hat{\bar{p}} - \hat{\bar{P}}), (\hat{\bar{p}}^* - \hat{\bar{P}})$ and $\hat{\bar{C}^W}$. However, constant world resources and constant world money supply ensure that $nd\bar{m} + (1-n)^* d\bar{m}^* = 0$, which in turn implies that inflation rates in both countries are zero ($\pi = \pi^* = 0$). Then the steady state values of consumption prices will be unchanged. The relative price changes become the output price changes, because of a fixed commercial rate. The solutions for relevant changes are:

$$\hat{\bar{y}} = \frac{(1-n)(d\bar{G} - d\bar{G}^*)}{\Omega} + \frac{dG^W}{\bar{C}_0^W} \tag{48}$$

and

$$\hat{\bar{y}}^* = \frac{-n(d\bar{G} - d\bar{G}^*)}{\Omega} + \frac{dG^W}{\bar{C}_0^W} \tag{49}$$

$$\hat{\bar{C}} = d\bar{m} = \frac{(1-n)(2-\sigma)(d\bar{G} - d\bar{G}^*)}{\Omega} \tag{50}$$

$$\hat{\bar{C}^*} = d\bar{m}^* = \frac{-n(2-\sigma)(d\bar{G} - d\bar{G}^*)}{\Omega} \tag{51}$$

$$\hat{\bar{p}}(h) = \frac{(1-n)(1-\sigma)(d\bar{G} - d\bar{G}^*)}{\Omega} \tag{52}$$

$$\hat{\bar{p}}^{*}(f) = \frac{-n(1-\sigma)(d\bar{G} - d\bar{G}^{*})}{\Omega} \tag{53}$$

The relations between outputs and consumption in the comparing steady states are

$$\hat{\bar{y}} = \frac{1}{2-\sigma}\hat{\bar{C}} + \frac{nd\bar{G} + (1-n)d\bar{G}^{*}}{\bar{C}_0^{W}} \tag{54}$$

$$\hat{\bar{y}}^{*} = \frac{1}{2-\sigma}\hat{\bar{C}}^{*} + \frac{nd\bar{G} + (1-n)d\bar{G}^{*}}{\bar{C}_0^{W}} \tag{55}$$

where $\Omega = r^{*}(\sigma - 2) + 2\bar{C}_0^{W} > 0$. The above solutions reveal four consequences. First, in the long run, an increase in domestic government spending above, $d\bar{G}^{*} > 0$ and $d\bar{G}^{*} = 0$, will stimulate outputs of both countries but the stimulation effect in home country is bigger than that in foreign country, as indicated in equations (48) and (49). The expansion in domestic output and work effort associated with a rise in domestic government spending leads to a long-run improvement in the home terms-of-trade because household can adjust output price according to marginal condition, as described by equations (52) and (53). The home country runs current account surplus in that the real output increases much more than consumption does. By contrast, the foreign economy suffers current account deficit and per capita consumption falls.

Second, $d\bar{G} = 0$ and $d\bar{G}^{*} > 0$, an increase in foreign government spending above stimulates outputs of both countries, improves foreign terms of trade and current account, raises foreign consumption but deteriorates domestic consumption and current account.

Third, $d\bar{G} = d\bar{G}^{*} = 0$, the increases in government spending of both countries by the same magnitude should not affect anything regardless of the size of home country, *n*. Fourth, if $d\bar{G} > d\bar{G}^{*} > 0$, the process is similar to those of case two.

The following proposition summarises the long-run effects of fiscal policies:

Proposition 2: With imperfect competition of goods market and flexible output prices, $d\bar{G} > 0$ and $d\bar{G}^{*} = 0$ ($d\bar{G}^{*} > 0$ and $d\bar{G} > 0$), a permanent and unanticipated increase in domestic (foreign) government spending will stimulate the outputs of both countries, improve (deteriorate) the terms of trade of home economy but decrease (increase) the consumption of foreign economy. If $d\bar{G} = d\bar{G}^{*} > 0$, regardless of the size of n, the increases in government spending of both countries should not affect any other variable except outputs increasing by the same amount as such purchase.

IV. Effects of a Once-and-for-all Devaluation

Consider now the effects of a once-and-for-all devaluation of commercial rate by specifying the devaluation rate, γ, as $\gamma = dE/E_0$ To focus on the analysis of devaluation policy, we assume that the government purchases are zero.

A. Impact Effects

With sticky output prices, following a commercial devaluation, from equation (3), the change of consumption price index of domestic economy is

$$\hat{P} = (1-n)\gamma \tag{56}$$

On the other hand, the change of this index of foreign economy is

$$\hat{P}^* = -n\gamma \tag{57}$$

From equations (56) and (57), the smaller the domestic economy, the larger is the devaluation effect on P but the smaller is this effect (absolute effect) on P^*. It has indicated that on impact, domestic consumption price index adjusts upwards but this index of foreign economy adjusts downwards.

As noted by Obstfeld and Rogoff (op. cit., pp. 639), we lead the time by one period to be the steady states. Then periods $t-1$, t and $t+1$ are initial steady state, short-run and long-run times respectively. Under dual exchange markets, following an unanticipated and permanent commercial devaluation, on impact, financial rate can not adjust simultaneously[4] and hence the financial premium, q, falls. The domestic real interest rate, ρ, rises and the foreign real interest rate remains unchanged.

Given nominal rate of foreign interest, the impact changes of financial rate, of financial premium and of domestic real interest rate are:

$$\hat{\bar{X}} - \hat{X} = \gamma \tag{58}$$

$$\hat{\rho} = \frac{\gamma}{1-\delta} \tag{59}$$

and

$$\hat{q} = -\gamma \tag{60}$$

[4]There will be a one-period lag between the time when government conducts commercial devaluation and when the financial market responses. Thus, on impact, financial rate remains constant and over time, households attempt to buy bonds. The financial exchange rate rises and the spread vanishes.

Substituting equation (56) into equation (19) and equation (57) into equation (20), the approximations of short run change for per capita consumption are given by

$$\hat{C} = \hat{y} - \frac{dm}{\overline{C}_0^W} - (1-n) - \gamma \tag{61}$$

and

$$\hat{C}^* = \hat{y}^* - \frac{dm^*}{\overline{C}_0^*} + n\gamma \tag{62}$$

The changes of the world demand for domestic and foreign outputs become

$$\hat{y} = \frac{(1-n)\gamma}{1-\sigma} + \hat{C}^W \tag{63}$$

and

$$\hat{y}^* = \frac{-n\gamma}{1-\sigma} + \hat{C}^W \tag{64}$$

Using the sticky-price analysis structure to sole seven unknowns: $\hat{y}, \hat{y}^*$, $\hat{C}^W, \hat{C}, \hat{C}^*, dm$, and dm^*. The changes of relevant variables are solved as

$$\hat{y} = \frac{(1-n)\gamma}{1-\sigma} + \frac{\delta\gamma}{(1-\delta)} \tag{65}$$

$$\hat{y}^* = \frac{-n\gamma}{1-\sigma} + \frac{\delta\gamma}{(1-\delta)} \tag{66}$$

$$\hat{C}^W = \frac{\delta\gamma}{(1-\delta)} \tag{67}$$

$$\hat{C} = (1-n)\Omega_1\gamma + \frac{\delta\gamma}{1-\delta} \tag{68}$$

$$\hat{C}^* = -n\Omega_1\gamma + \frac{\delta\gamma}{(1-\delta)} \tag{69}$$

$$dm = (1-n)\Omega_1\gamma \tag{70}$$

and

$$dm^* = -n\Omega_1\gamma \tag{71}$$

where $\Omega_1 = \overline{C}_0^W(\sigma-\delta)/(1+\overline{C}_0^W)(1-\sigma)(1-\delta)$. Obviously, the sign of Ω_1 depends on the value of σ, the elasticity of substitution between two variety goods. In the limiting case, σ=1, all products in the group are perfect substitutes, i.e., goods market is perfect competition. If σ is sufficiently big and the value of the

rate of time preference, δ, is smaller than that of σ, then the sign of Ω_1 is positive. Here the centre of our analysis on the sign of Ω_1 should be positive.

From equation (65), a once-and-for-all commercial devaluation has a positive impact on domestic output. With sticky output prices, such devaluation results in a short-run deterioration of the home terms of trade generating home current account surplus, as showed by equation (70). With higher real balance, domestic residents consume more. From equation (66), the impact effect of commercial devaluation on foreign output can be violated. The larger the domestic economy, the less the positive impact of such devaluation on foreign output. If n is not less than time preference rate, $n \geq \delta$, then foreign output decreases on impact. On the other hand, if n is sufficiently smaller than δ, then foreign output increases on impact. The impact effect on foreign consumption is thus uncertain. However, on impact, a once-and-for-all commercial devaluation causes foreign economy to run current account deficit because of a constant world money supply. Furthermore, such devaluation has positive impact on world consumption. The following proposition summarises the impact effects of a once-and-for-all commercial devaluation:

Proposition 3: With imperfect competition, on impact, a once-and-for-all commercial devaluation has positive effects on domestic output, consumption and current account, yet it has negative effect on foreign current account. The impact effects on foreign output and consumption depend on the size of domestic economy (n). The smaller the domestic economy, the less the harmful impact effects on them.

B. Long-run Effects

In the long run, period t+1, the spread between commercial and financial rates ceases to exist, thus q returns to its original level. The domestic real interest rate ρ decreases over time. With flexible output price, P adjusts upwards and P^* adjusts downwards by the devaluation rate timing population-weight over time. The domestic economy runs current account deficit during the adjustment and the opposite holds for the foreign economy. In a word, in the long-run, this devaluation only affects financial exchange rate, increasing by the rate of commercial devaluation. The long-run effects are summarised as follows.

Proposition 4: With imperfect competition and flexible output prices, the neutrality of a once-and-for-all commercial devaluation holds for domestic and foreign economies.

V. Welfare Evaluation

From the utility function described in equation (1), the change of welfare,

resulting from exogenous shocks, is divided into real and monetary parts. That is, $dU = dU^R + dU^m$. Then a long-run change in the real terms of utility function is

$$dU^R = \alpha(\hat{\bar{C}} - \alpha\hat{\bar{y}}) \tag{72}$$

On the other hand, a long-run change in the monetary term of utility function is

$$dU^m = (1-\alpha)d\bar{m} \tag{73}$$

The total effect of domestic fiscal spending on domestic (foreign) welfare is the sum of permanent and temporary effects in real terms as well as those in monetary terms. The similar procedure is applied to the discussion of foreign fiscal policy. When the government spending of both countries increase simultaneously, the welfare effects on both economies are uncertain. Through solving techniques, it is now possible to present the welfare effects of fiscal policy in Table 1.

The following proposition summarises the welfare effects of fiscal policies:

Table 1. Welfare effects of domestic fiscal policy on domestic and foreign economies

	Temporary	Permanent
On domestic economy $dG>0$ ($dG^*=0$)	$\frac{dU^R}{dG} = \alpha\left[\frac{n\bar{C}_0^W(1-\alpha)-n\alpha-\bar{C}_0^W}{\bar{C}_0^W\left(1+\bar{C}_0^W\right)}\right] < 0$ $\frac{dU^m}{dG} = \frac{(1-\alpha)(n-1)}{1+\bar{C}_0^W} < 0$	$\frac{dU^R}{d\bar{G}} = \alpha\left[\frac{2(1-\sigma)(1-n)}{\Omega} - \frac{n\sigma}{\bar{C}_0^W}\right] > 0$ $\frac{dU^m}{d\bar{G}} = \frac{(1-\alpha)(1-n)(2-\sigma)}{\Omega} > 0$
On foreign economy $dG>0$ ($dG^*=0$)	$\frac{dU^{*R}}{dG} = \frac{\alpha\left[n\bar{C}_0^W - n\alpha\left(1+\bar{C}_0^W\right) - \left(1+\bar{C}_0^W\right)\right]}{\bar{C}_0^W\left(1+\bar{C}_0^W\right)} < 0$ $\frac{dU^{*m}}{dG} = \frac{n(1-\alpha)}{1+\bar{C}_0^W} < 0$	$\frac{dU^{*R}}{d\bar{G}} = \alpha\left[\frac{2(1-\sigma)(1-n)}{\Omega} - \frac{n\sigma}{\bar{C}_0^W}\right] > 0$ $\frac{dU^m}{d\bar{G}} = \frac{-n(1-\alpha)(2-\sigma)}{\Omega} < 0$
On domestic economy $dG^*>0$ ($dG=0$)	$\frac{dU^R}{dG^*} = \alpha\left[\frac{-n\bar{C}_0^W - (1-n)\sigma\left(1+\bar{C}_0^W\right)}{\bar{C}_0^W\left(1+\bar{C}_0^W\right)}\right] < 0$ $\frac{dU^m}{dG^*} = \frac{(1-\alpha)(1-n)}{1+\bar{C}_0^W} > 0$	$\frac{dU^R}{d\bar{G}^*} = \alpha\left[\frac{(1-2\sigma)(1-n)}{\bar{C}_0^W} - \frac{(2-2\sigma)(1-n)}{\Omega}\right] > 0$ $\frac{dU^m}{d\bar{G}^*} = \frac{-n(1-\alpha)(1-n)(2-\sigma)}{\Omega} < 0$
On foreign economy $dG^*>0$ ($dG=0$)	$\frac{dU^{*R}}{dG^*} = -\alpha\left[\frac{-n\bar{C}_0^W + (1-n)\sigma\left(1+\bar{C}_0^W\right)+1}{\bar{C}_0^W\left(1+\bar{C}_0^W\right)}\right] < 0$ $\frac{dU^m}{dG^*} = \frac{-n(1-\alpha)}{1+\bar{C}_0^W} < 0$	$\frac{dU^{*R}}{d\bar{G}} = \alpha\left[\frac{2(1-\sigma)n}{\Omega} - \frac{\sigma(1-n)}{\bar{C}_0^W}\right] < 0$ $\frac{dU^{*m}}{d\bar{G}} = \frac{-n(1-\alpha)(2-\sigma)}{\Omega} > 0$

Proposition 5: With imperfect competition of goods market and flexible output prices, if $dG>0$ and $dG^{*}=0$, then $U_{ss}>0$; if $dG^{*}>0$ and $dG=0$, then $U^{*}_{ss}>0$. It is not necessarily the case that an increase in government spending of one economy deteriorates (improves) the welfare of the other economy.

Now it allows us to discuss the welfare effects of devaluation. A once-and-for-all commercial devaluation can generate the increases in world utilities attributable to raise world consumption in the short run. From equation (1), the impact welfare effect of this devaluation on the real terms of domestic utility function is

$$\frac{dU^{R}}{\gamma} = \alpha\left(\frac{\hat{C}}{\gamma} - \sigma\frac{\hat{y}}{\gamma}\right) \tag{74}$$

Using equations (65) and (68), it becomes:

$$\frac{dU^{m}}{\gamma} = \alpha\left[(1-n)(1+\Omega_1) + \frac{(1-\sigma)\delta}{(1-\delta)} - \frac{\sigma(1-n)}{1-\sigma}\right] \tag{75}$$

On the other hand, this effect on the monetary term of domestic utility function is

$$\frac{dU^{m}}{\gamma} = (1-n)(1-\alpha)\Omega_1 \tag{76}$$

which is positive. These effects on the real and monetary terms of foreign utility function are

$$\frac{dU^{*R}}{\gamma} = \alpha\left[-n(1+\Omega_1) + \frac{(1-\sigma)\delta}{(1-\delta)} + \frac{n}{1-\sigma}\right] \tag{77}$$

and

$$\frac{dU^{*m}}{\gamma} = -n(1-\alpha)\Omega_1 \tag{78}$$

Both are negative. Using population weights, the global welfare effect of a once-and-for-all commercial devaluation is positive. That is

$$\frac{ndU^{R}}{\gamma} + \frac{(1-n)dU^{*R}}{\gamma} = \frac{\alpha(1-\sigma)\delta}{1-\delta} \tag{79}$$

However, there is no monetary impact of such devaluation on the global welfare.

VI. Simulation

To understand the general equilibrium effects of a domestic government

spending increase as well as the commercial devaluation and to analyse the welfare responses of policy shifts, simulations have been undertaken. In the first, the utility changes of fiscal policies are studied by assuming a small domestic open economy, n=0.1, and sticky output prices. In the following simulation, we investigate the effects of the significant increases in domestic as well as foreign government spending on both economies. Finally, the assumption of flexible output price adjustment is added. The same procedure is applied to the policy of a once-and-for-all commercial devaluation.

A. Welfare Evaluation of Fiscal Policy

The baseline steady-state conditions for the simulations are given in Table 2. In all cases, we assume that the productivity parameter for outputs is given by μ=1.6. The simulation structure is composed of equations (19), (20), (22), (23) and their relevant optimising conditions as well as its corresponding descriptions of foreign economy.

The impact effects of world government spending rises are shown in Table 3. We assume period $t-1$, t and $t+1$ are the initial steady state, the short-run and the long-term, respectively.

From Table 3, with sticky output prices, an increase in domestic (foreign) government spending will raise per capita outputs of both countries, foreign (domestic) consumption, foreign (domestic) real balance in comparison with those

Table 2. Key parameter values at initial steady-state equilibrium

Consumption share in utility α	0.5
Productivity factor μ	1.6
Time preference rate δ	0.8
Substitute elasticity of demand σ	0.8
Foreign real interest rate γ=(1−δ)/δ	0.25
θ=(σ–1)/σ	0.25
Domestic output $y_0 = \left(\frac{\alpha\sigma}{\mu}\right)^{1/2}$	0.5
Foreign output $y_0^* = \left(\frac{\alpha\sigma}{\mu}\right)^{1/2}$	0.5
Domestic real balances $m_0 = \frac{(1-\alpha)}{\alpha(1-\delta)} y_0$	2.5
Foreign real balances $m_0^* = \frac{(1-\alpha)}{\alpha(1-\delta)} y_0^*$	2.5

Table 3. Impact effects of a domestic government-spending rise

Period	G	G^*	m	m^*	C^W	y	y^*	C	C^*
t-1	0	0	2.5	2.5	0.5	0.5	0.5	0.5	0.5
t	1	0	1.75	2.5833	0.5	0.6	0.6	0.35	0.5167
t	0	1	3.25	2.4167	0.5	1.4	1.4	0.65	0.4833
t	1	1	2.5	2.5	0.5	1.5	1.5	0.5	0.5
t	2	1	1.75	2.5833	0.5	1.6	1.6	0.35	0.5167
t	2	2	2.5	2.5	0.5	2.5	2.5	0.5	0.5

Table 4 . Dependence of impact effects on n in fiscal policy

Period	G	G^*	n	m	m^{**}	C^W	y	y^*	C	C^*
t–1	0	0	0.1~0.9	2.5	2.5	0.5	0.5	0.5	0.5	0.5
t	1	0	0.1	1.75	2.5833	0.5	0.6	0.6	0.35	0.5167
t	1	0	0.5	2.0833	2.9167	0.5	1.0	1.0	0.4167	0.5833
t	1	0	0.9	2.4167	3.25	0.5	1.4	1.4	0.4833	0.65

of initial steady states. The larger the domestic economy (bigger n), the less negative effect of increased domestic government purchase on domestic real balance and consumption but more positive effect on outputs of both countries, as shown in Table 4. However, what we are interested in is the numerical welfare effects of fiscal policy. In reality, we assume domestic economy is small compared with the rest of the world and specify n as 0.1; furthermore, we focus on the case of effects of domestic government purchase.

Substituting the relevant numerical values into the real terms of domestic (foreign) utility function, equation (1), given G=1 and G^*=0, we find that with sticky output prices, an increase in domestic government spending will decrease per capita domestic and foreign utility by 0.266 and 0.072 respectively. In monetary terms, it decreases per capita domestic utility by 0.178 but increases per capita foreign utility by 0.016 and hence, adding population weights, it decreases the global real terms of welfare by 0.0914 and monetary terms of welfare by 0.0034.

In the long run, adding population weights, it decreases global real terms of welfare by 0.095 and monetary terms of welfare by 0.194; the new steady state values of variables are presented in Table 5.

In fact, an increase in domestic government spending, given foreign government purchase being zero, will increase the monetary term of foreign utility with sticky output prices as well as the monetary term of domestic utility with flexible output prices. In the long run, the larger the domestic economy, the more positive global

Table 5. Long run effect of a domestic government-spending rise

$G^*=0$ Period	G	M	m^*	C^w	Y	y^*	C	C^*	p/P	p^*/P^*
$t-1$	0	2.5	2.5	0.5	0.5	0.5	0.5	0.5	1	1
t	1	1.75	2.5833	0.5	0.6	0.6	0.35	0.5167	1	1
$t+1$	1	3.0752	2.3627	0.5	0.6379	0.5455	0.6150	0.4725	1.1812	0.9738

welfare effect of fiscal policy because the more positive welfare effect on domestic monetary terms outweigh the negative effect on foreign monetary and global real terms. We thus in turn imply that in the long run, without domestic government spending, the smaller the domestic economy, the more positive of global welfare effect of an increase in foreign government purchase. When both government purchases increase by the same amount, it will decrease global welfare in that it only increase outputs, which requires providing more effort and hence brings disutility.

We summarise the simulation results of welfare effects of fiscal policies as follows.

Proposition 7: With imperfect competition, the larger (smaller) the domestic economy, the more positive is the effect of an increase in domestic (foreign) government spending on global welfare.

B. Welfare Evaluation of a Once-and-for-all Devaluation

Given the same values of parameters, without government spending, the impact effects of a once-and-for-all commercial devaluation are reported in Tables 6 and 7.

As previous mentioned, the devaluation effect would depend on the value of σ significantly. When goods market is in imperfect competition, $\sigma=0$, devaluation can not affect any real variables. When competition increases, it has more positive effect on domestic economy as shown by Table 6. From Table 7, we also note that, on impact, the larger the domestic economy, the less positive devaluation effect on domestic economy but the more negative effect on foreign economy. This in turn implies that, a once-and-for-all commercial devaluation improves domestic current account, output and consumption, only when the domestic economy is "small" and there is imperfect competition in the world goods market. Otherwise, devaluation does not improve output but reduces global welfare.

Following similar specification as for fiscal policy, we set n at 0.1 and discuss the welfare effect of devaluation when monopoly power is smaller, $\sigma=0.95$. Substituting numerical values into equation (1) and adding population weights,

Table 6. Dependence of impact effects on σ in a once-and-for-all devaluation (given n=0.1)

Period	σ	γ	m	m^*	C^W	y	y^*	C	C^*
$t-1$	0.8	0	2.5	2.5	0.5	0.5	0.5	0.5	0.5
T	0	0.25	2.5	2.5	0.5	0.5	0.5	0.5	0.5
T	0.1	0.25	2.3711	2.5143	0.5177	0.5619	0.5128	0.6510	0.5029
T	0.8	0.25	2.5	2.5	0.55	1.1125	0.4875	1.0	0.5
T	0.95	0.25	4.0324	2.3297	0.5545	3.0064	0.2821	1.3513	0.4659

Table 7. Dependence of impact effects on n in a once-and-for-all devaluation (given σ=0.95)

Period	N	γ	μ	m^*	C^W	y	y^*	C	C^*
$t-1$	0.1	0	2.5	2.5	0.5	0.5	0.5	0.5	0.5
T	0.1	0.25	4.0324	2.3297	0.5545	3.0064	0.2821	1.3513	0.4659
T	0.5	0.25	3.3513	1.6487	0.7724	2.1346	0	1.2151	0.3297
T	0.9	0.25	2.6703	0.9676	0.9904	1.2628	0	1.0789	0.1935

with sticky output prices, a once-and-for-all commercial devaluation will decrease global utilities in real terms by 0.563 and in monetary terms by 0.008. In the long run, the neutrality of devaluation holds and such this devaluation can not affect global welfare. The following proposition thus summarises our discussion.

Proposition 8: A once-and-for-all commercial devaluation improves domestic current account, output and consumption, only when the domestic economy is "small" and there is imperfect competition in the world goods market. Otherwise, devaluation does not improve output but reduces global welfare.

VII. Conclusion

In a two-country model of dual exchange rates with imperfect competition in the goods market, government policy effects can be summarised in Table 8.

Obstfeld and Rogoff endeavour to investigate the international welfare spillovers with monopolistic competition and sticky output prices. Their model provides a rigorous assessment of policy effects and a significant advance in open economy macroeconomics. Yet it pertains only to the unified exchange rate system. We apply their framework to the regime of dual exchange markets, generating various policy results. In particular, we provide numerical simulations for evaluating large welfare effects of fiscal and devaluation policies to assess the dual exchange rate system. Simulations suggest that both country sizes and imperfect competition certainly matter. It significantly affect the welfare evaluations of policy shifts.

This paper enables us to consider the exchange rate dynamics of the various

Table 8. The summary of policy effects on the regime of separating exchange markets with imperfect competition

Variables	$G\uparrow$		$\gamma > 0$	
	Permanent	Temporary	Permanent	Temporary
y	+*	+	0**	+
y^*	+	+	0	***
C	+	−	0	+
C^*	−	+	0	−
p/P	+	0	0	−
p^*/P^*	−	0	0	+
m	+	−	0	+
$\hat{m}^*$	−	+	0	−
$X - X$	0	0	0	$_{\gamma}$
C^W	0	0	0	0
U (home)	−	−(+)	0	−
U (foreign)	−(+)	−	0	−
U (global)	−(+)		−	

*: positive policy effects
**: without policy effects
***: negative policy effects

policies under separating exchange markets. We derive the result that with imperfect competition as the case for monetary shocks, financial exchange rate may be less volatile under flexible prices than under sticky prices. However, under an unified flexible exchange rate system, this situation may be reversed (Obstfeld and Rogoff op. cit., pp. 653), a result of possibly some interest. In addition, the devaluation policy always reduces home, foreign, and world (temporary) welfare, so that a devaluation policy can never be a first- best policy. From the summarised table, both temporary and permanent fiscal shocks have no exchange rate effects. We also have the result that fiscal policies increase both domestic and foreign outputs, whereas their effects on global welfare could go in either direction, depending on the size of the domestic economy. The larger the domestic economy, the bigger positive global welfare effects of fiscal policy.

In the older, Mundell-Fleming modelled systems of dual exchange rates[5] with fixed goods prices, a monetary policy with dual exchange rates would not affect income. This result is the same as that under a fixed exchange rate system. The system of separating exchange markets *per se* is more nearly neutral than a system with flexible exchange rate in that, under the former system, the financial exchange rate plays an important role of adjusting monetary disturbances. On the other hand, an increase in government expenditure has some positive effect on income, negative effect on financial exchange rate and adverse effect on the

current account. In the Dornbusch modelled systems of dual exchange rates, with sticky goods prices, the monetary expansion exerts only transitory effect on output but the proportional depreciation in the financial exchange rate. On the discussions of the net effect of the increase in government spending, the country experiences a financial depreciations, the current account deficit, and a real commercial devaluation. This result is only not like the outcomes of Caselli (2001) in consumption behaviour but has the same experiences on outputs. The latter presents the fixed exchange rate version of the Obstfeld and Rogoff model on fiscal consolidations.

From the proceeding analyses, we thus believe that we have generated a number of results of interest and shed further light on macroeconomic arguments for and against adopting dual exchange markets. A dual exchange rate system is an intermediate exchange rate regime. Clearly, such a regime is not expected to be permanent but is to be used as an intermediate step for an economy abandoning its commitment to maintaining international parity in its exchange rates but unable to withstand the shocks and volatility emanating from a floating exchange rate which has adverse implications for the domestic macroeconomy.

Fixed exchange rates allow the current account to be protected from the uncertainty caused by fluctuating exchange rates. Where export promotion is a policy strategy under export promoting industrialisation, export volatility due to exchange fluctuations can have serious impact on a countrys long-term growth rates. In addition, the existence of exchange rate uncertainty *per se* reduces the volume of international trade and discourages inward investment. These features are common to developing countries, hence, the impetus towards keeping exchange rates fixed for the determinants (exports and imports) of the current account.

However, the exchange rate is different to peg in the face of large and increasing financial capital mobility. In recent years, developing countries have witnessed large capital flows, particularly for emerging stock markets. Often, the reserves of the domestic Central Bank is not large enough to withstand speculative pressures unless there are stringent capital controls. It is becoming increasingly different, within a framework of integrating capital markets and factor mobility, to maintain artificially pegged exchange rates and prevent black markets from operating and swamping the ability of the authorities to stop illegal transactions in the foreign exchange markets. The share of capital flows in GDP is high for many developing countries and shows an increasing trend for most developing countries.

The most important problem and difficulty for fixed exchange rate are the impotence of domestic monetary policy. Stabilisation policy via monetary means

[5]See Wang (1996) for traditional analyses of two-tier exchange markets.

becomes difficult and even impossible. Clearly, a system which attempts to combine the better features of both exchange rates is the most optimum exchange rate regime the developing countries would like to have. The separating exchange rate system contains these attractive features. The commercial rate is fixed so that the current account is insulated and protected. The financial rate is allowed to be flexible to act as a shock absorber to capital flows and to allow limited autonomy in monetary policy. The capital account transactions then obey the laws of demand and supply with flexible prices which rigid prices for the current account gives insulation and protection to vital components of the GDP. Concerning the real world of imperfect competition as well as international capital flows and their instability, separating exchange markets are often set up during a period of turbulence. It was and will be fitted better those countries with underdeveloped financial systems and great reliance on exports and imports.

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