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"Government Purchases and Relative Prices In a Two-Country World"

Prepared by Jonathan D. Ostry 1/

Authorized for Distribution by Donald J. Mathieson

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Abstract

The effects of government expenditures on interest rates, terms of trade, and real exchange rates are examined in a three-good (importables, exportables, nontradables), two-country, intertemporal, optimizing model. Temporary spending increases (on tradable or nontradable goods) may raise or lower the world return on internationally traded bonds and may improve or worsen the current account of the country undergoing the fiscal expansion. The results are shown to differ substantially from those obtained in models employing a higher degree of commodity aggregation. The determinants of the comovement between the terms of trade and the real exchange rate are also examined.

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410; 431

1/ This is a revised version of a previous working paper (Ostry (1987)) and also draws on Chapter 3 of my Ph.D. dissertation submitted to the Department of Economics, University of Chicago. I thank the members of my thesis committee, Jacob Frenkel, John Huizinga, and Assaf Razin for helpful discussions and comments and also Carlos Végh for his suggestions.

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Summary

This paper develops a fully optimizing, intertemporal model of a two-country world in which agents consume three goods (importables, exportables, and nontradables). The model analyzes the effects of government spending policies on relative prices (rates of interest, real exchange rates, and the terms of trade) and quantities in the world economy. Previous models have employed a higher degree of commodity aggregation and hence have been unable to analyze the determinants of comovements among the various relative prices (for example, the terms of trade and real exchange rates) induced by fiscal policies.

The main results suggest that the composition of government purchases, both within a period and across periods, is a crucial determinant of both the domestic effects and the international transmission of government purchases. In contrast to composite-tradable-commodity models, the paper finds that a temporary increase in government spending on either tradable or nontradable goods has an ambiguous effect on the world interest rate. "Perverse" cases--in which temporary spending shocks actually lower the world interest rate--tend to be associated with sharp fluctuations in other relative prices (terms of trade and real exchange rates) along the adjustment path. The paper argues that the behavior of these relative prices is potentially of some importance in determining the overall effect of fiscal policies on macroeconomic variables, such as consumption, investment, and employment.

The paper also considers the relationship between government purchases and the current account balance. While much theoretical work exists on the relationship between budget deficits and the current account (the "twin" deficits), the case considered in the paper involves the effects of balanced budget increases in spending. It is shown that because government spending policies have an ambiguous effect on the consumption rate of interest and terms of trade of the country undergoing fiscal expansion, temporary increases in government spending may actually be associated with improving current account positions. Moreover, and in contrast to previous findings, the paper demonstrates that this result may occur both in the case of government spending on home goods or in that of spending on tradable goods.

I. Introduction

Recent theoretical developments in open economy macroeconomics have provided a consistent framework in which to analyze the domestic effects, as well as the international transmission, of changes in government expenditures and tax policies. 1/ Much of this research has focussed on the effects of divergent fiscal policies in the major industrial countries on the paths of interest rates and real exchange rates in the world economy. The behavior of these relative prices is of course a key determinant of some other macroeconomic variables of interest, such as the composition, level and growth rate of consumption and output, the level of investment, and trade and current account balances. Focus on these particular relative prices may also be justified by the fact that their fluctuations have indeed been large by historical standards over the past decade, and also that this period has coincided with historically large divergences among the fiscal policies pursued by the major industrial countries.

Whereas the open economy literature has focused mainly on the real interest rate and real exchange rate effects of government policies, earlier real trade theorists emphasized the importance of another relative price, the terms of trade, in the determination of consumption, saving, investment, output, trade and current account balances. 2/ In the recent literature on the macroeconomic effects of fiscal policies, the role of terms of trade effects has not, however, received much prominence. 3/ In fact, many models were based on the assumption of a composite tradable commodity, and hence completely abstracted from any possible effects of fiscal policies on the terms of trade.

The focus on real interest rates and exchange rates, rather than perhaps on a more general setting in which these relative prices, in addition to the terms of trade, are jointly determined, is perhaps surprising in light of the following considerations. First, at a theoretical level, changes in government purchases and taxes will,

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1/ See, e.g., Buiter (1986), Masson and Knight (1986), and Frenkel and Razin (1987), as well as the extensive bibliography contained therein.

2/ The importance of terms of trade effects is not only found in the microeconomic trade literature but also in macroeconomic discussions of the Harberger-Laursen-Metzler effect (see Harberger (1950) and Laursen and Metzler (1950)) and also in discussions of the macroeconomics of protectionism (see, e.g., Mundell (1961)).

3/ Exceptions include the papers by Devereux (1987), Djajic (1987), and Ihori (1987). However, unlike the model developed here, these authors assume either that all goods are tradable or that, if some goods are nontradable, then there exists a composite tradable commodity. In this paper, I consider an explicit three good (two tradable, one nontradable) framework. In addition, Devereux (1987) and Djajic (1987) assume a specific parametrization of the utility function which is a special case of the class of utility functions considered in this paper.

depending on their commodity composition and intertemporal allocation, alter the time path of the terms of trade Further, the resulting changes in the terms of trade provide an additional channel (which is distinct from the real interest rate channel) through which fiscal policies in one country are transmitted to the rest of the world. As a consequence, even if interest rates are unaffected by changes in one country's fiscal policy (as might be the case if capital were not internationally mobile--see, e.g., Ihori (1987)), it would not be the case that macroeconomic variables in one country would be insulated from changing fiscal policies in another. In addition, as shown in Ostry (1988), changes in the terms of trade constitute a key determinant of a country's real exchange rate so that, in comparison to models that abstract from terms of trade effects, both the domestic effects and the international transmission of fiscal policies are likely to be different in models with or without endogenous terms of trade. Finally, the welfare consequences of alternative policies are likely to be directly affected by the terms of trade changes they induce. Policymakers may wish to take such considerations into account when considering alternative actions.

On the empirical side, the widely divergent fiscal policies pursued by the major industrial countries during the 1980s have been associated with sharp movements in the terms of trade (in addition of course to the movements in real interest rates and real exchange rates which have been the focus of previous work). 1/ Figure 1 illustrates, for the G-7 countries, the path of the terms of trade and real effective exchange rates over the 1980-86 period. The plots obviously reject the assumption of constant terms of trade (implicit in the theoretical literature) as being incompatible with the data. Indeed, as Table 1 shows, the terms of trade were more variable (as measured by the standard deviation of the series) for a majority of the G-7 countries over this period than were the real effective exchange rates. 2/ Finally, Table 1 also reveals the high degree of correlation between the two series (terms of trade and real exchange rates) for some countries (between 70 and 90 percent for the U.S., U.K., Germany, and Japan), the lower positive correlation for Italy and Canada (approximately 30 and 45 percent), and the negative correlation in the case of France. To take the U.S. as an example, Figure 1 shows clearly how, during the first half of the 1980s, the strong dollar was associated with consistently improving terms of trade whereas in 1985, when there was a sharp real depreciation of the dollar, the terms of trade deteriorated sharply also. A model with endogenous interest rates, real exchange rates and terms of trade may shed some light on factors

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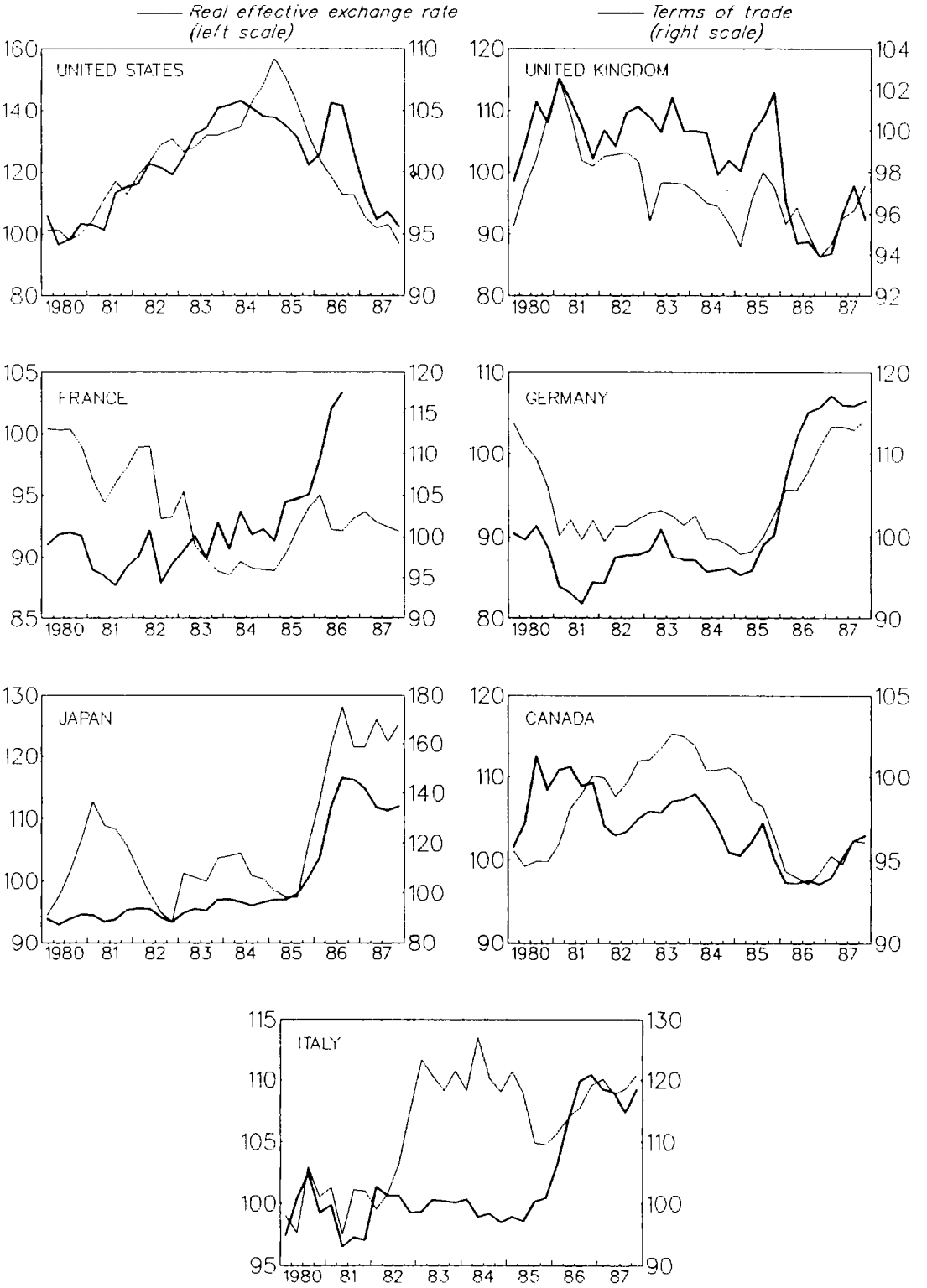
1/ For a full discussion of the stylized facts, see Frenkel and Razin (1987).

2/ This result hold irrespective of the measure of the real effective exchange rate, i.e., whether based on relative normalized unit labor costs or on relative value added deflators. All data are from IMF, World Economic Outlook.

FIGURE 1

INDICES OF REAL EFFECTIVE EXCHANGE RATES AND THE TERMS OF TRADE [1]



Source: International Monetary Fund, *World Economic outlook*.

[1] An upward movement in the real effective exchange rate indicates a real appreciation and an upward movement in the terms of trade indicates an improvement in the latter.

Table 1. The Terms of Trade and the Real Effective Exchange Rate: Statistical Summary

	Standard Deviation		
	Terms of Trade	Real Exchange Rate	Correlation
United States	0.0379	0.1665	0.7957
United Kingdom	0.0244	0.0646	0.7124
France	0.0567	0.0401	-0.1922
Germany, Federal Republic of	0.0807	0.0521	0.8115
Japan	0.1948	0.1032	0.8896
Canada	0.0214	0.0573	0.4182
Italy	0.0837	0.0462	0.3496

Note: Data are quarterly from Q1 1980 to Q4 1987 except for terms of trade for France, which are from Q1 1980 to Q3 1986.

Source: International Monetary Fund, World Economic Outlook.

underlying the movement of each series (in response to fiscal shocks) as well as the comovement among them which previous models employing a higher degree of commodity aggregation were unable to do.

The main results of the paper emphasize the separate roles of world interest rates and terms of trade in the international transmission of fiscal disturbances. The analysis highlights the key channels through which government spending influences the various relative prices, as well as the comovement among them. Specifically, it is shown that the effect of government spending changes on the world rate of interest depends on both the temporal/intertemporal allocation of that spending relative to the private sector (a transfer problem criterion) as well as on the relative magnitudes of the intratemporal and intertemporal elasticities of substitution in consumption. Whereas a temporary current rise in government spending on exportable goods always raises the world rate of interest, a temporary increase in government consumption of importables or nontradables will lower the return on internationally traded bonds if the intertemporal elasticity of substitution is sufficiently large.

Movements in domestic and foreign real exchange rates reflect both the intertemporal allocation of government nontradables consumption relative to the private sector, as well as policy-induced movements in world temporal and intertemporal terms of trade. In the case of a temporary rise in government purchases of nontradables originating in the home country, the domestic real exchange rate always appreciates. Moreover, its dynamic adjustment path is characterized by equilibrium overshooting. In contrast, the foreign real exchange rate appreciates (depreciates) if the intertemporal elasticity of substitution in consumption is larger (smaller) than the intratemporal elasticity of substitution. In the case of a temporary increase in government purchases of tradable goods, both the domestic and foreign real exchange rates depreciate and their dynamic adjustment path is characterized by equilibrium undershooting. In this case, the policy-induced comovements between the terms of trade and real exchange rates in each of the two countries depend on the intratemporal allocation of government spending across the two tradable goods.

The paper is organized as follows. Section II develops a two-period, two-country, real model with optimizing agents who consume three goods: importables, exportables, and nontradables. The equilibrium conditions are then used to determine the effects of government purchases on real interest rates, terms of trade, and domestic and foreign real exchange rates (Section III). A discussion of the implications of movements in these relative prices for the behavior of various quantities of interest (consumption, investment, and labor supply) is also presented. Section IV considers the relationship between government purchases and the current account. Section V presents the main conclusions and some suggestions for further research.

II. The Analytical Framework

1. The consumer's problem and the government

Consider a two-period, two-country, general equilibrium model of the world economy. In each country, there exists a representative consumer who maximizes an intertemporal utility function subject to a sequence of two budget constraints (one corresponding to each period of the agent's life). The resources available to this agent take the form of endowments of three commodities: importables, exportables and nontradables. Agents are assumed to have access to an integrated world capital market through which all borrowing and lending takes place at the world rate of interest.

In each country, there is a government that levies lump sum taxes and spends the proceeds on various goods. The government has access to the world capital market and can borrow and lend at the same interest rate as the private sector. The horizon of the government is identical to that of private individuals. The model is therefore completely Ricardian so that the real equilibrium is independent of the timing of taxes. 1/

We abstract from monetary considerations in the model and focus instead only on real quantities and prices. There is no uncertainty and individuals are assumed to have perfect foresight.

We assume that preferences may be represented by a weakly time separable utility function with homothetic subutilities. The agent's optimization problem may then be viewed as taking place in two stages. 2/ In the first stage, the agent allocates within-period spending across the three goods in order to minimize the total expenditure necessary to achieve a given level of subutility. The solution to this problem yields demands, c_{it}, i = x (exportable), m (importable), n (nontradable), and the consumption based price index, P_t, t = 0, 1. Demands are functions of the temporal relative prices, p_{mt} and p_{nt}, and within period spending, P_tC_t, where p_{it} is the relative price of good i, and C_t represents subutility or real spending in period t. Home country exportables serve as numeraire. All foreign economy variables will be denoted by an asterisk.

In the second stage, the agent maximizes an intertemporal utility function, $U(C_0, C_1)$, subject to the constraint that lifetime expenditure not exceed lifetime wealth, W_0, defined as the present value of the endowment stream net of historical debt commitment and lump sum taxes. The intertemporal budget constraint can therefore be written as:

1/ A simple extension of the model--the introduction of distortionary taxation--would permit a meaningful discussion of government budget deficits.

2/ We consider here the optimization problem faced by the domestic agent. The structure of the foreign agent's problem is identical.

$$P_0C_0 + \alpha_{x1}P_1C_1 = [\bar{Y}_{x0} + p_{m0}\bar{Y}_{m0} + p_{n0}\bar{Y}_{n0}]$$

$$+ \alpha_{x1}[\bar{Y}_{x1} + p_{m1}\bar{Y}_{m1} + p_{n1}\bar{Y}_{n1}] - [T_0 + \alpha_{x1}T_1] - (1+r_{x,-1})\ B^p_{-1} = W_0 \quad (1)$$

where α_{x1} represents the world discount factor equal to $(1 + r_{x0})^{-1}$ and r_{xt} is the rate of interest prevailing between periods t and t+1; $\bar{Y}_{it}$ is the endowment of good i; T_t represents lump sum taxes in period t = 0,1 and B^p_{-1} represents the private sector's initial debt commitment.

The government's consolidated budget constraint is given by:

$$[G_{x0} + p_{m0}G_{m0} + p_{n0}G_{n0}] + \alpha_{x1}[G_{x1} + p_{m1}G_{m1} + p_{n1}G_{n1}]$$

$$= [T_0 + \alpha_{x1}T_1] - (1+r_{x,-1})B^g_{-1} \quad (2)$$

where G_{it} denotes government consumption of good i in period t, i = x,m,n and t = 0,1 and B^g_{-1} is the government's initial debt commitment.

The representative consumer sees through equation (2) and incorporates the government budget constraint into his own. Accordingly, the equilibrium value of wealth for the consumer is given by:

$$W_0 = [(\bar{Y}_{x0} - G_{x0}) + p_{m0}(\bar{Y}_{m0} - G_{m0}) + p_{n0}(\bar{Y}_{n0} - G_{n0})] +$$

$$\alpha_{x1}[(\bar{Y}_{x1} - G_{x1}) + p_{m1}(\bar{Y}_{m1} - G_{m1}) + p_{n1}(\bar{Y}_{n1} - G_{n1})] - (1+r_{x,-1})B_{-1} \quad (3)$$

where $B_{-1} = B^p_{-1} + B^g_{-1}$, denotes the economy's external debt commitment. Note that, when the definition of equilibrium wealth is substituted into the consumer's budget constraint (equation (1)), the latter becomes equivalent to the condition that, over the lifetime of this economy, namely during periods 0 and 1, the present value of the sum of the trade account surpluses must equal the economy's initial debt commitment.

It will prove useful to rewrite equation (1) in real terms; that is, in terms of period 0 subutility. Dividing through by P_0, we obtain:

$$C_0 + \alpha_{c1}C_1 = W_{c0}, \quad (1')$$

where $\alpha_{c1} = \alpha_{x1}P_1/P_0$, $W_{c0_1} = W_0/P_0$ represent the consumption based discount factor (equal to $(1+r_{c0})^{-1}$ where r_{c0} is the consumption interest rate 1/ prevailing between periods 0 and 1) and consumption based lifetime wealth, respectively. The optimization problem and constraints faced by the foreign country are completely analogous to those presented here for the home country.

2. The general equilibrium

An equilibrium is defined as a set of prices, p_{m0}, p_{m1}, p_{n0}, p_{n1}, p^*_{n0}, p^*_{n1}, and α_{x1}, together with an allocation, which satisfy any seven of the following eight market clearing conditions, as well as the requirements that agents in each country maximize utility subject to constraint (1) and an analogous equation for the foreign economy:

$$c_{x0}(p_{m0}, p_{n0}, P_0C_0(\alpha_{c1}, W_{c0})) + c^*_{x0}(p_{m0}, p^*_{n0}, P^*_0C^*_0(\alpha^*_{c1}, W^*_{c0})) = (\bar{Y}_{x0} - G_{x0}) + (\bar{Y}^*_{x0} - G^*_{x0}) \quad (4)$$

$$c_{x1}(p_{m1}, p_{n1}, P_1C_1(\alpha_{c1}, W_{c0})) + c^*_{x1}(p_{m1}, p^*_{n1}, P^*_1C^*_1(\alpha^*_{c1}, W^*_{c0})) = (\bar{Y}_{x1} - G_{x1}) + (\bar{Y}^*_{x1} - G^*_{x1}) \quad (5)$$

$$c_{m0}(p_{m0}, p_{n0}, P_0C_0(\alpha_{c1}, W_{c0})) + c^*_{m0}(p_{m0}, p^*_{n0}, P^*_0C^*_0(\alpha^*_{c1}, W^*_{c0})) = (\bar{Y}_{m0} - G_{m0}) + (\bar{Y}^*_{m0} - G^*_{m0}) \quad (6)$$

$$c_{m1}(p_{m1}, p_{n1}, P_1C_1(\alpha_{c1}, W_{c0})) + c^*_{m1}(p_{m1}, p^*_{n1}, P^*_1C^*_1(\alpha^*_{c1}, W^*_{c0})) = (\bar{Y}_{m1} - G_{m1}) + (\bar{Y}^*_{m1} - G^*_{m1}) \quad (7)$$

$$c_{n0}(p_{m0}, p_{n0}, P_0C_0(\alpha_{c1}, W_{c0})) = (\bar{Y}_{n0} - G_{n0}) \quad (8)$$

$$c_{n1}(p_{m1}, p_{n1}, P_1C_1(\alpha_{c1}, W_{c0})) = (\bar{Y}_{n1} - G_{n1}) \quad (9)$$

$$c^*_{n0}(p_{m0}, p^*_{n0}, P^*_0C^*_0(\alpha^*_{c1}, W^*_{c0})) = (\bar{Y}^*_{n0} - G^*_{n0}) \quad (10)$$

1/ See Dornbusch (1983), Svensson and Razin (1983) or Frenkel and Razin (1987) on the consumption rate of interest.

$$c^*_{n1}(p_{m1}, p^*_{n1}, P^*_1 C^*_1(\alpha^*_{c1}, W^*_{c0})) = (\bar{Y}^*_{n1} - G^*_{n1}) \tag{11}$$

Equations (4) and (5) state that the world demand for the exportable good must equal the world supply, net of government purchases, in each of the two periods while equations (6) and (7) state the corresponding condition for the importable commodity. Equations (8) and (9) specify zero excess demand for the home country's nontradable good in each of the two periods while equations (10) and (11) express the corresponding condition for the foreign economy's nontradable commodity. The specific form of the demand functions given in equations (4) through (11) follows from the earlier assumptions made concerning preferences. The exogenous variables in equations (2) through (9) are the endowments and the levels of government consumption. The equilibrium conditions demonstrate clearly, in this Ricardian setting, the equivalence between supply shocks and changes in government spending.

Figure 2 illustrates the equilibrium configuration of relative prices around an initial equilibrium of zero government consumption, i.e., $G_{it} = 0$, $\forall$ i, t. Consider the left-hand panel (panel a) first. The NN (N^*N^*) schedule represents the locus of combinations of the domestic (foreign) real exchange rate ratio, 1/ p_{n0}/p_{n1} (p^*_{n0}/p^*_{n1}), and terms of trade ratio, p_{m0}/p_{m1}, along which there is zero excess demand for the domestic (foreign) nontradable good in periods 0 and 1. The Appendix shows that the slopes of these schedules are given by: 2/

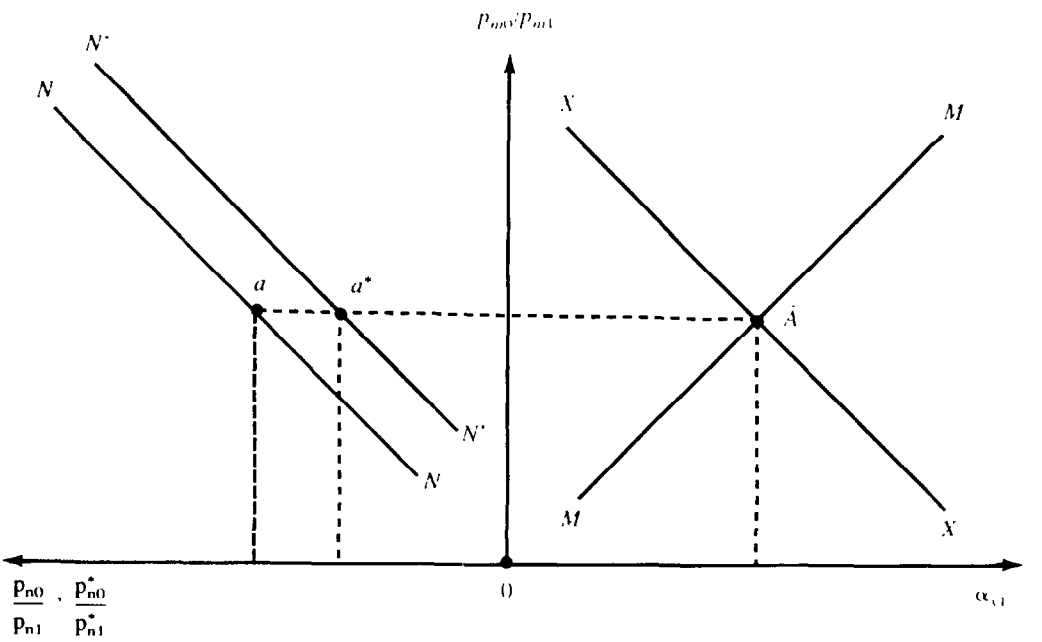
$$\left.\frac{d\log(p_{n0}/p_{n1})}{d\log(p_{m0}/p_{m1})}\right|_{NN} = \beta_m(\sigma_{nm} - \sigma)\Delta_1 \quad \left.\frac{d\log(p^*_{n0}/p^*_{n1})}{d\log(p_{m0}/p_{m1})}\right|_{N^*N^*} = \beta^*_m(\sigma^*_{nm} - \sigma^*)\Delta^*_1 \tag{12}$$

where β_i (β^*_i) is the domestic (foreign) expenditure share of good i, σ_{ij} (σ^*_{ij}) is the domestic (foreign) Allen elasticity of substitution between goods i and j, σ (σ^*) is the domestic (foreign) intertemporal elasticity of substitution, and Δ_1, Δ^*_1 are positive constants.

1/ In this paper, the real exchange rate (RER) is defined as the relative price of exportables in terms of nontradables, $1/p_{nt}$. The paper considers the response of this measure of the RER to various shocks. The response of alternative measures of the RER, such as the importables RER, p_{mt}/p_{nt}, or the consumption based measure of the RER (which is a weighted average of the importables and exportables measures), can easily be derived within the framework presented here.

2/ The schedules in Figure 1 are drawn under the assumption that the initial equilibrium is stationary as defined in the appendix. The main qualitative results of the paper do not depend on this assumption as shown in the appendix.

FIGURE 2
The general equilibrium configuration of relative prices: The world rate of interest, terms of trade and domestic and foreign real exchange rates.



Data: $\sigma_{ij} > \sigma$

The intuition of equation (12) is as follows: suppose there is a rise in the relative price of importables in period 0. This leads to substitution among importables, exportables and nontradables within period 0. If importables and nontradables are Hicksian substitutes (complements), there is excess demand (supply) for nontradables at the initial price and a real appreciation (depreciation) is necessary to restore equilibrium in the home goods sector. This is the intratemporal substitution effect. Now suppose that p_{m0} and p_{m1} both rise but that p_{m0} rises by more than p_{m1} so that the ratio, p_{m0}/p_{m1}, rises. In this case the magnitude of the intratemporal substitution effect in period 0 exceeds that in period 1 and the price ratio, p_{n0}/p_{n1}, rises in order to maintain market clearing if importables and home goods are Hicksian substitutes, and conversely if they are complements. The magnitude of this intratemporal substitution effect is governed by σ_{nm} (σ^*_{nm}), 1/ the domestic (foreign) elasticity of substitution between importables and nontradables, which enters with a positive sign in equation (12).

On the other hand, the rise in p_{m0}/p_{m1} raises the cost of current relative to future consumption, i.e., raises the consumption rate of interest. Agents substitute their expenditures from the current to the future period, part of which fall on nontradables. This intertemporal substitution effect therefore lowers the real exchange rate ratios, p_{n0}/p_{n1} and p^*_{n0}/p^*_{n1}. The magnitude of this effect is governed by σ (σ^*), the domestic (foreign) intertemporal elasticity of substitution, which enters with a negative sign in equation (12). 2/

Thus, equation (12) states that the terms of trade and real exchange rate ratios will be positively correlated if and only if the intratemporal elasticity of substitution between importables and nontradables exceeds the intertemporal elasticity of substitution. In Figure 1, the slopes of the two schedules reflect this assumption. When performing the comparative statics exercises, however, both the case of relatively large intertemporal elasticities of substitution and the case of relatively large intratemporal elasticities of substitution will be considered.

Consider now the right-hand panel (panel b) of Figure 2. The MM schedule represents the locus of combinations of the world discount factor, α_{x1}, and world terms of trade ratio, p_{m0}/p_{m1}, which equilibrates the world market for good m in periods 0 and 1 while the XX schedule represents the corresponding market clearing locus for good x. These schedules represent a reduced form relationship in the sense that they already incorporate the relationships embodied in equation (12). Their intersection at point A therefore represents the equilibrium value of the world discount factor and terms of trade ratio.

1/ In a three good model, σ_{ij} (σ^*_{ij}) may be positive or negative for some $i \neq j$.

2/ In a two period model, σ (σ^*) is necessarily positive.

Consider first the slope of the MM schedule. 1/ A rise in the world discount factor, α_{x1} (a fall in the world rate of interest), causes aggregate spending in both countries to be brought forward and therefore raises the world importables consumption ratio, c^w_{m0}/c^w_{m1}, holding other prices constant. In order to eliminate the resulting excess demand, the terms of trade ratio, p_{m0}/p_{m1}, must rise. This suggests that the MM schedule is positively sloped.

One complication arises, however, because the rise in α_{x1} raises the domestic and foreign real exchange rate ratios, p_{n0}/p_{n1} and p^*_{n0}/p^*_{n1}. The reason is that the fall in the world interest rate creates excess demand for current relative to future goods (including nontradables) which requires a rise in their current relative to their future price to maintain market clearing.

The new real exchange rate ratios alter the world importables consumption ratio through two channels. The intratemporal substitution effect raises the consumption ratio, c^w_{m0}/c^w_{m1}, if home goods and good m are Hicksian substitutes in both countries, and lowers c^w_{m0}/c^w_{m1} if the goods are complements. The intertemporal substitution effect always lowers c^w_{m0}/c^w_{m1}. This is because the rise in p_{n0}/p_{n1} and p^*_{n0}/p^*_{n1} raises the consumption rate of interest in both countries.

This suggests that if intratemporal elasticities of substitution exceed intertemporal elasticities (as in Figure 2), the endogenous response of the real exchange rate reinforces the direct effect of a rise in α_{x1} on c^w_{m0}/c^w_{m1} whereas if the intertemporal elasticities are sufficiently large, real exchange rate effects mitigate the direct effects. The following section considers a special case for the utility functions in which the real exchange rate effects cannot outweigh the direct effects so that the MM schedule is necessarily upward sloping. 2/

Consider now the slope of the XX schedule. A rise in α_{x1} creates excess demand for exportables in period 0 relative to period 1. How can this excess demand be eliminated? There are two effects. If importables and exportables are Hicksian substitutes, a fall in p_{m0}/p_{m1} reduces the demand for good x in period 0 relative to period 1, and conversely in the case of complements. This is the intratemporal substitution effect. In addition, however, the fall in p_{m0}/p_{m1} lowers the consumption rate of interest and thereby raises the demand for c_{x0} relative to c_{x1} in both countries. This is the intertemporal substitution effect. This argument suggests that--depending on the relative magnitudes of these two effects--

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1/ The algebraic expressions for the slopes of the MM and XX schedules are provided in the appendix.

2/ In this case, real exchange rate effects alter the magnitude but not the sign of the slope of the MM schedule.

the XX schedule may be either positively or negatively sloped. 1/ The appendix shows that provided the intratemporal elasticities of substitution exceed the corresponding intertemporal elasticities (as assumed in Figure 2), the XX schedule is negatively sloped. The opposite case of relatively large intertemporal elasticities is considered below.

Figure 2 provides a complete characterization of relative prices in the initial equilibrium. Point A gives the equilibrium value of the terms of trade ratio and world discount factor while points a and a^* give the values of the domestic and foreign real exchange rates along the NN and N^*N^* schedules. Note finally that these schedules are drawn for the equilibrium value of α_{x1} at point A in Figure 2.

III. Government Purchases and Relative Prices

This section considers the effects of changes in government purchases on the key macroeconomic relative price variables: the temporal and intertemporal terms of trade, and real exchange rates in each of the two countries. The behavior of these relative prices in response to fiscal policy changes is of course of primary importance in determining the overall effect of such policies on other macroeconomic variables of interest, such as consumption and the current account.

In order to simplify the exposition, we make the assumption that preferences are identical across countries 2/ and take the following form:

$$U = [C_0^{\rho} + \delta C_1^{\rho}]^{1/\rho}, \quad U^* = [C_0^{*\rho} + \delta C_1^{*\rho}]^{1/\rho}, \quad \rho < 1, \quad 0 < \delta < 1 \qquad (13)$$

$$C_t = [a_x c_{xt}^{\lambda} + a_m c_{mt}^{\lambda} + a_n c_{nt}^{\lambda}]^{1/\lambda}, \; C_t^* = [a_x c_{xt}^{*\lambda} + a_m c_{mt}^{*\lambda} + a_n c_{nt}^{*\lambda}]^{1/\lambda} \qquad (14)$$

$0 < a_i$, $i = x, m, n$, $\lambda < 1$. Both the intertemporal and intratemporal utility functions exhibit constant elasticities of substitution with $\sigma = \sigma^* = 1/(1-\rho)$, $\sigma_{ij} = \sigma_{ij}^* = 1/(1-\lambda)$, $\forall i \neq j$. Further, to assure complete symmetry between the two countries, we also assume that in the initial equilibrium, the relative price of nontradables is equated across

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1/ The XX schedule also incorporates real exchange rate effects which operate in essentially the same manner as in the case of the MM schedule (explained previously).

2/ This is of course a standard assumption in the classical trade literature. It is also fairly common in the modern intertemporal approach: see, e.g., Devereux (1987), Frenkel and Razin (1987), Appendix to chapter 7, and Gardner and Kimbrough (1987). The specification of preferences adopted here is, however, more general than many previous specifications found in the literature, as alluded to in the introduction.

countries. 1/ This additional assumption implies that real interest rates and expenditure shares are equated across countries in the initial equilibrium and, therefore, that transfer-problem criteria relating to cross-country differences in intra- or intertemporal spending propensities play no role in determining the effects of fiscal policy changes. 2/

With these additional assumptions, it is shown in the Appendix that the XX and MM schedules have the following slopes:

$$\left.\frac{d\log(p_{m0}/p_{m1})}{d\log\,\alpha_{x1}}\right|_{XX} = \frac{\sigma}{\beta_m(\sigma-\sigma_{ij})}, \qquad \left.\frac{d\log(p_{m0}/p_{m1})}{d\log\,\alpha_{x1}}\right|_{MM} = \frac{\sigma}{(1-\beta_x)\sigma + \beta_x\sigma_{ij}}. \quad (15)$$

As alluded to previously, the XX schedule is negatively sloped if the intratemporal elasticity of substitution exceeds the intertemporal elasticity (as in Figure 2) but is positively sloped if $\sigma > \sigma_{ij}$. In this case, it is easy to verify that the slope of the XX schedule is always larger than the slope of the MM schedule (which is always positive in the case of CES utilities).

1. Government spending on nontradables

Consider first the effect of government consumption of nontradable goods. Using the diagrammatic apparatus developed in Figure 2, the vertical shifts of the equilibrium schedules in response to a rise in the discounted sum of government spending, G, are given by:

$$\left.\frac{d\log(p_{m0}/p_{m1})}{dG}\right|_{MM} = k_1(\sigma_{ij}-\sigma)(\gamma-\gamma^g) \quad (16)$$

$$\left.\frac{d\log(p_{m0}/p_{m1})}{dG}\right|_{XX} = k_2(\gamma^g-\gamma) \quad (17)$$

where k_1, k_2 are positive constants 3/ and γ^g is the government's average saving propensity defined as the ratio of future government spending to the discounted sum of government spending.

Equations (16) and (17) reveal that the direction in which the equilibrium schedules shift in response to changes in government spending depends on two factors: first, a transfer-problem criterion involving

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1/ This can be done by appropriate choice of the nontradable good endowments and initial wealth levels.

2/ See Ostry (1988) and the appendix for an analysis of the general case of different (non-CES) utility functions in the two countries. Note also that the CES parametrization given here restricts all intratemporal elasticities of substitution (between any pair of commodities) to be equal.

3/ $k_1 = [(W_0+W_0^*)\sigma_{ij}[\beta_x\sigma_{ij}+(1-\beta_x)\sigma]]^{-1} > 0$, $k_2 = [(W_0+W_0^*)\sigma_{ij}\beta_m]^{-1} > 0$.

relative magnitudes of public and private sector spending propensities; second, the relative magnitudes of the intratemporal and intertemporal elasticities of substitution.

Consider first the transfer problem criterion. A rise in government spending on nontradables redistributes aggregate spending between the public and private sectors. Insofar as the (intertemporal 1/) spending propensities differ between these two groups, aggregate demand will change and, given supply, the time profile of the equilibrium real exchange rate will be altered.

Specifically, if the private sector saving propensity (γ) exceeds the saving propensity of the government (γ^g), then the rise in government spending redistributes aggregate spending on nontradables in favor of a unit with a relatively large spending propensity in period 0, and vice-versa. In the first case, the rise in G raises the equilibrium real exchange rate ratio, p_{n0}/p_{n1}, and conversely.

Consider the case in which $\gamma > \gamma^g$ (as when the government increases spending temporarily, in the current period) so that the direct impact of the rise in G is to raise the equilibrium value of p_{n0}/p_{n1}. The new time profile of the real exchange rate has two effects. First, the intra-temporal substitution effect implies that agents substitute away from nontradables in favor of tradables. The magnitude of this effect is governed by the intratemporal elasticity of substitution, $\sigma_{ij} > 0$, in the CES case. Second, the rise in p_{n0}/p_{n1} raises the cost of current in terms of future consumption, i.e., raises the consumption interest rate. This intertemporal substitution effect tends to lower consumption of tradables in the current relative to the future period. The magnitude of this effect is governed by $\sigma > 0$, the intertemporal elasticity of substitution in consumption.

The previous discussion suggests that if the intratemporal substitution effect is large relative to the intertemporal substitution effect, then a temporary rise in government spending on home goods creates excess demand for current relative to future period tradables, and conversely. How can this excess demand (supply) be eliminated? Consider first the case in which $\sigma_{ij} > \sigma$. In this case, the excess demand for importables (in period 0 relative to 1) requires a rise in the terms of trade ratio, p_{m0}/p_{m1}, to clear world markets so that, as indicated by equation (16),

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1/ In the general case in which the government consumes both tradable and nontradable goods, the relative price effects of changes in government spending involves a transfer problem criterion that includes the relative magnitudes of public and private spending propensities, both intratemporally and intertemporally. In the case under consideration, however, in which government spending is concentrated entirely on nontradable goods, the transfer problem criterion reduces to an expression involving differing spending propensities over time (i.e., saving propensities) only.

there is an upward displacement of the MM schedule. The excess demand for exportables requires a fall in p_{m0}/p_{m1} to maintain market clearing in the world market for good x so that, as indicated by equation (17), the XX schedule shifts down.

It is also easy to verify that if $\sigma > \sigma_{ij}$, the XX schedule also shifts down. This is because the excess supply for good x in period 0 relative to period 1 requires a fall in p_{m0}/p_{m1} to restore market clearing. The mechanism is straightforward: the fall in p_{m0}/p_{m1} lowers the consumption rate of interest, thereby stimulating current relative to future period demand for good x via an intertemporal substitution effect. The intratemporal substitution effect operates in the opposite direction but is weak because $\sigma > \sigma_{ij}$. The same argument reveals that the MM schedule also shifts down in this case.

The two cases are illustrated in Figures 3 and 4. In both figures, the original world equilibrium is given by point $\tilde{A}$. In Figure 3, which corresponds to the large intratemporal elasticity of substitution case, the shifts in the MM (M'M') and XX (to X'X') schedules result in a new equilibrium at point $\tilde{B}$ and the world rate of interest necessarily rises (i.e., the world discount factor, α_{x1}, falls). In Figure 4, which corresponds to the large intertemporal elasticity of substitution case, the equilibrium moves from point $\tilde{A}$ to point $\tilde{B}'$, and the world rate of interest falls. Further, it can be shown that in both cases, the terms of trade ratio is unaffected by the change in government spending on home goods. 1/

Consider now the behavior of real exchange rates. In the case in which $\sigma > \sigma_{ij}$ (Figure 4), the results are clear cut. Because the world rate of interest falls, agents in both countries substitute spending from the future to the current period, part of which falls on home goods. A rise in both real exchange rate ratios, p_{n0}/p_{n1} and p^*_{n0}/p^*_{n1}, is therefore required to maintain market clearing. This is reflected by the leftward displacement of the NN (N^*N^* 2/) schedules to N'N' ($N^{*\prime}N^{*\prime}$) respectively. Note that the magnitude of the shift in the NN schedule exceeds that of the N^*N^* schedule because the increase in government spending originates in the home country. This implies that the new home country equilibrium, given by point a'' lies to the left of the foreign economy's equilibrium, given by point $a^{*\prime\prime}$, and that both lie to the left of the original

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1/ If preferences are identical across countries, but not of the specific CES variety given in equation (14) which constrains intratemporal elasticities of substitution to be identical between any two goods, then it can be shown that a key determinant of the movement in the terms of trade is whether nontradables are better substitutes intratemporally for importables or exportables, that is whether $\sigma_{nm} \gtrless \sigma_{nx}$. Of course, if we relax the identical preferences assumption, the behavior of the terms of trade depends also on transfer problem criteria relating to differences in spending propensities across countries.

2/ In the initial equilibrium, these two schedules coincide.

FIGURE 3
The effect of a temporary increase in government spending on home goods: The case of large intratemporal substitutability.

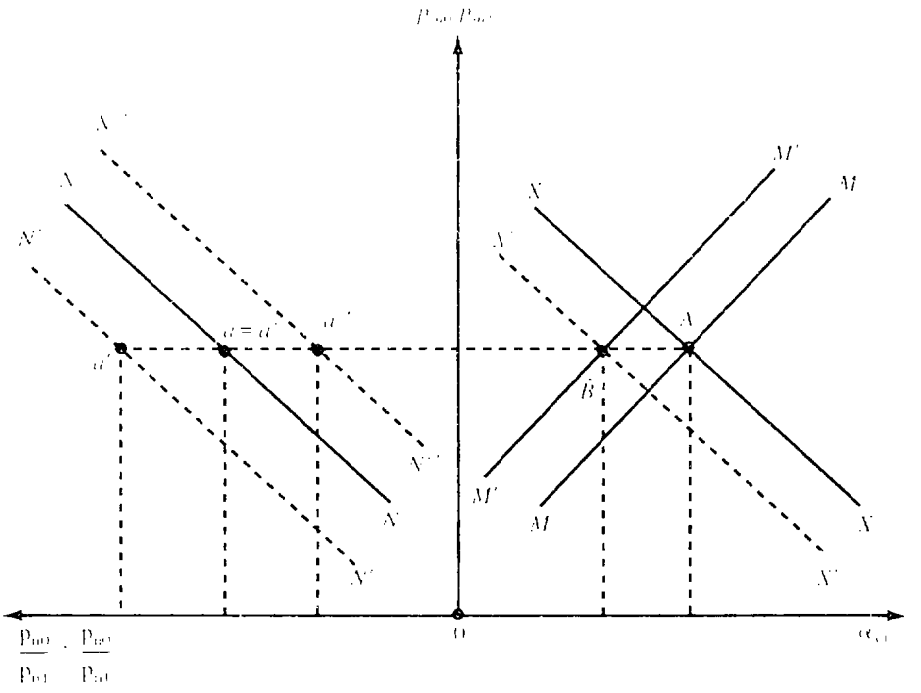
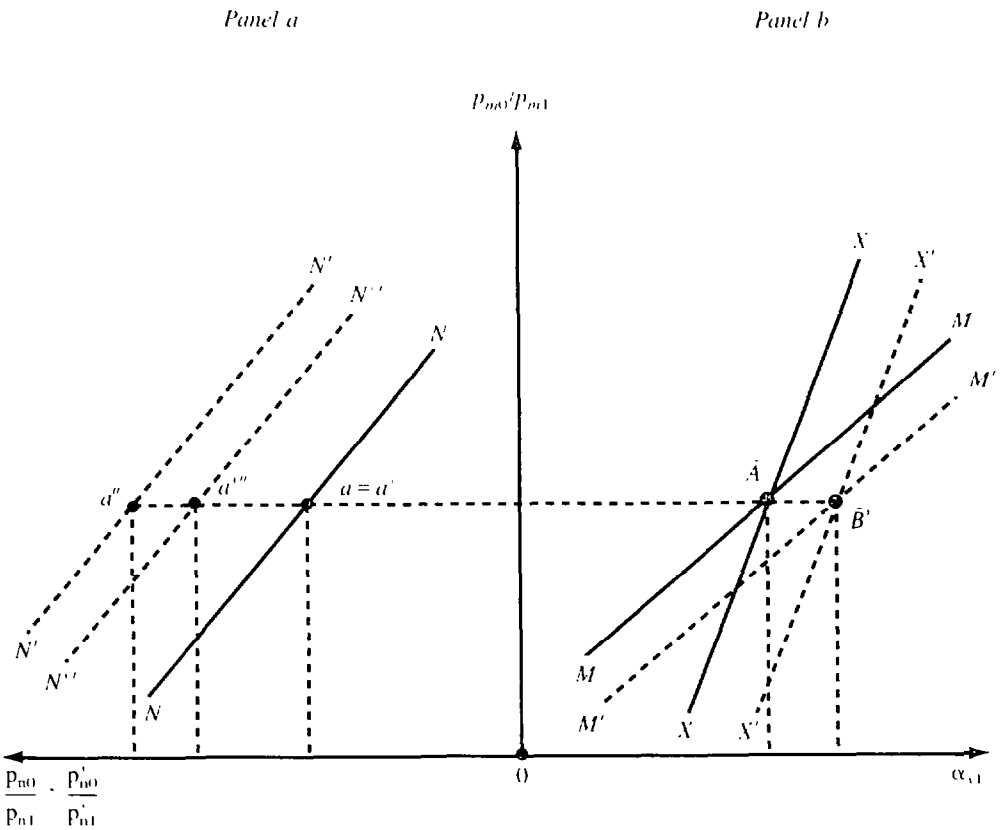


FIGURE 4
The effect of a temporary increase in government spending on home goods: The case of large intertemporal substitutability



equilibrium given by point a. Real exchange rates are positively correlated across countries in response to the increase in government spending. Furthermore, because the short run (period 0) response exceeds the long run (period 1) response, the temporary rise in government spending generates overshooting of the equilibrium real exchange rate.

Consider now the case of relatively large intratemporal elasticities of substitution (Figure 3). In this case, the behavior of the foreign real exchange rate is opposite to the previous case, i.e., there is a real depreciation in the current relative to the future period. The reason is of course that with $\sigma_{ij} > \sigma$, the rise in government spending results in an increase in the world rate of interest which in turn generates excess supply of nontradables in the current relative to the future period and a fall in p^*_{n0}/p^*_{n1}. This is reflected by a rightward displacement of the N^*N^* schedule and a new equilibrium of the foreign economy at point $a^{*\prime}$ in Figure 3. Note that at this point, the short run response of the real exchange rate falls short of the long run response, so that we may refer to this situation as one of equilibrium undershooting.

When $\sigma_{ij} > \sigma$, the domestic real exchange rate is influenced by two opposing forces: the increase in government spending requires a rise in p_{n0}/p_{n1} to clear the nontradables sector whereas the rise in the world interest rate requires a fall in the nontradables price ratio. It can be shown, however, that in the case of identical CES preferences, the former influence always dominates so that p_{n0}/p_{n1} rises, i.e., the behavior of the equilibrium real exchange rate is characterized by overshooting, and the new domestic economy equilibrium is given by a point such as a' in Figure 3. It is also noteworthy that in this case ($\sigma_{ij} > \sigma$), domestic and foreign real exchange rates are negatively correlated (in contrast to the previous case in which they are positively correlated).

Table 2 summarizes the main results of this section. It can be seen that, under the assumption of identical CES utilities across countries, the behavior of the interest rate and the domestic and foreign real exchange rates depend both on a transfer problem criterion relating government and private sector saving propensities and on the relative magnitudes of the intratemporal and intertemporal elasticities of substitution in consumption. Finally, note that, as alluded to previously, the absence of movement in the terms of trade resulting from an increase in government spending on home goods depends critically on the specification of preferences. As shown in the Appendix, if elasticities of substitution differ across goods within a period (as with the more general utility function of Section II), the terms of trade will not in general remain constant. Moreover, their response can be shown to depend on whether home goods are more closely substitutable for importables or exportables in consumption. In contrast, in the following section, it is shown that changes in government expenditures on tradable goods will in general lead to fluctuations in both the terms of trade and real exchange rates of both countries even with preferences as specified in

Table 2. The Effect of a Rise in the Discounted Sum of Government Spending on Nontradable Goods

Relation Between Intratemporal and Intertemporal Elasticities of Substitution	Intertemporal Allocation of Government Spending							
	$\gamma > \gamma^g$				$\gamma < \gamma^g$			
	r_{x0}	$\frac{p_{m0}}{p_{m1}}$	$\frac{p^*_{n0}}{p^*_{n1}}$	$\frac{p_{n0}}{p_{n1}}$	r_{x0}	$\frac{p_{m0}}{p_{m1}}$	$\frac{p^*_{n0}}{p^*_{n1}}$	$\frac{p_{n0}}{p_{n1}}$
$\sigma_{ij} > \sigma$	+	0	-	+	-	0	+	-
$\sigma_{ij} < \sigma$	-	0	+	+	+	0	-	-

equations (13) and (14). Thus, in this case, we can also examine the determinants of the comovement between the two temporal relative prices, namely the terms of trade and the real exchange rate.

2. Government spending on tradable goods

In subsections a and b, we consider the effects of increased government consumption of exportables and importables on world relative prices and domestic and foreign real exchange rates. Subsection c goes on to consider some possible implications of the analysis for the behavior of various macroeconomic aggregates of interest including consumption, investment, and employment. An attempt is also made to compare the various results concerning government expenditures on tradables versus nontradable goods.

a. Exportables

Consider now the effect of a rise in the discounted sum of government consumption of good x. The vertical displacement of the XX schedule is given by: 1/

$$\frac{d\log(p_{m0}/p_{m1})}{dG}\Big|_{XX} = k_3(\gamma - \gamma^g)/(\sigma - \sigma_{ij}) \qquad (18)$$

1/ The MM schedule does not shift in the case of increased government consumption of good x.

where k_3 is a positive constant. 1/ As before, the direction in which the XX schedule shifts in response to an increase in government spending on the exportable good depends on a transfer problem criterion involving the relative magnitudes of the public and private sector saving propensities, γ and γ^g, and an additional condition involving the relative magnitudes of the intratemporal and intertemporal elasticities of substitution in private consumption. 2/ The logic is similar to what was described in the previous section. If $\gamma > \gamma^g$ (as with a temporary current increase in government spending), the transfer problem criterion dictates that the redistribution of aggregate spending between the public and private sectors creates excess demand in the current relative to the future period. In order to eliminate this excess demand, the consumption rate of interest must rise in both countries. In the case under consideration, the rise in the consumption rate of interest is accomplished by a combination of a rise in the world rate of interest (i.e., a decline in the world discount factor, α_{x1}) and an improvement in the terms of trade in the current relative to the future period (i.e., a decline in p_{m0}/p_{m1}). These results are illustrated in Figures 5 and 6 (for the case $\gamma > \gamma^g$) where it is seen that, qualitatively, the direction in which the world temporal and intertemporal terms of trade moves in response to the change in government expenditures does not depend on the relative magnitudes of the intra- and intertemporal elasticities of substitution. Note also that the improvement in the terms of trade implies that the rise in consumption rates of interest in both countries is smaller than the rise in the rate of return on real bonds, r_{x0}.

The behavior of domestic and foreign real exchange rates depends only on movements in world temporal and intertemporal terms of trade. This is because, with shocks originating in the tradables sector, there is no direct impact on the relative price of home goods. In Figures 5 and 6, it is shown that the nontradables equilibrium locus shifts rightward, reflecting the rise in interest rates in world markets. The interest rate effect therefore favors a real depreciation in the current relative to the future period in both countries. However, in addition to this effect, the fall in the terms of trade ratio, p_{m0}/p_{m1}, reinforces the interest rate effect in Figure 5 (in which intratemporal elasticities of substitution are relatively large) but mitigates the effect of rising world interest rates in the large intertemporal elasticity of substitution case (Figure 6). The reason for the latter, as already noted, is that if $\sigma > \sigma_{ij}$, the intertemporal substitution effect associated with the fall in p_{m0}/p_{m1} (which reduces the consumption rate of interest and thereby tends to raise current period nontradables consumption) outweighs the intratemporal substitution effect which favors consuming more (relatively cheaper) exportables (i.e., less nontradables) in period 0. However, it can be

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1/ $k_3 = [(1-\beta_n)\sigma_{ij}+\beta_n\sigma]/[\beta_x\beta_m\gamma(1-\gamma)(W_0+W_0^*)\sigma_{ij}] > 0$.

2/ As explained previously, the relative magnitudes of these elasticities of substitution determine the adjustment in relative prices (specifically in p_{m0}/p_{m1}) necessary to maintain market clearing in the world market for good x.

shown that the interest rate effect always dominates so that, qualitatively, a current increase in government consumption of exportables must generate a real depreciation of the (exportables 1/) real exchange rate (a fall in p_{n0}/p_{n1} and p^*_{n0}/p^*_{n1}), in the current relative to the future period, in both countries, irrespective of the relative magnitudes of the intra- and intertemporal elasticities of substitution (see appendix). The analysis therefore suggests comovements consisting of improving terms of trade and real depreciations resulting from a temporary increase in government consumption of good x. Moreover, along the adjustment path to the new long run equilibrium, the real exchange rate will exhibit equilibrium undershooting.

b. Importables

A rise in the discounted sum of government spending on good m shifts the MM locus by an amount equal to: 2/

$$\left.\frac{d\log(p_{m0}/p_{m1})}{dG}\right|_{MM} = k_4(\gamma - \gamma^g) \tag{19}$$

where k_4 is a positive constant. 3/ Thus, as in the previous cases, the direction in which the MM schedule shifts depends on a transfer problem criterion involving differences between public and private saving propensities. Accordingly, if $\gamma > \gamma^g$ ($\gamma < \gamma^g$), the rise in government spending raises aggregate demand for good m in the world economy in the current (future) relative to the future (current period), and a rise in the terms of trade ratio, p_{m0}/p_{m1}, is necessary to clear world markets. The upward displacement of the MM schedule is portrayed in Figures 7 and 8. There, it is seen that, irrespective of the relative magnitudes of the intratemporal and intertemporal elasticities of substitution, a temporary rise in government spending on good m causes a deterioration in the terms of trade in the current relative to the future period. In contrast to the case of government spending on good x, it is also apparent that the behavior of the world rate of interest is ambiguous: it rises if $\sigma_{ij} > \sigma$ but falls if $\sigma > \sigma_{ij}$.

To understand this result, recall that a temporary rise in current government spending on any tradable good creates excess demand for current relative to future tradables, the elimination of which requires a rise in the consumption rates of interest in both countries to restore market clearing. When the government biases its spending toward good x, the terms of trade improve in the current relative to the future period (which

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1/ It is easy to show that there is also a real depreciation of the consumption based measure of the real exchange rate (which is simply a weighted average of the importables and exportables measures).

2/ Changes in government spending on good m do not affect the position of the XX schedule.

3/ $k_4 = [(1-\beta_n)\sigma_{ij}+\beta_n\sigma]/\{(W_0+W^*_0)\sigma_{ij}\gamma(1-\gamma)\beta_m[\beta_x\sigma_{ij}+(1-\beta_x)\sigma]\} > 0$.

FIGURE 5
The effect of a temporary increase in government spending on exportables: The case of large intratemporal substitutability.

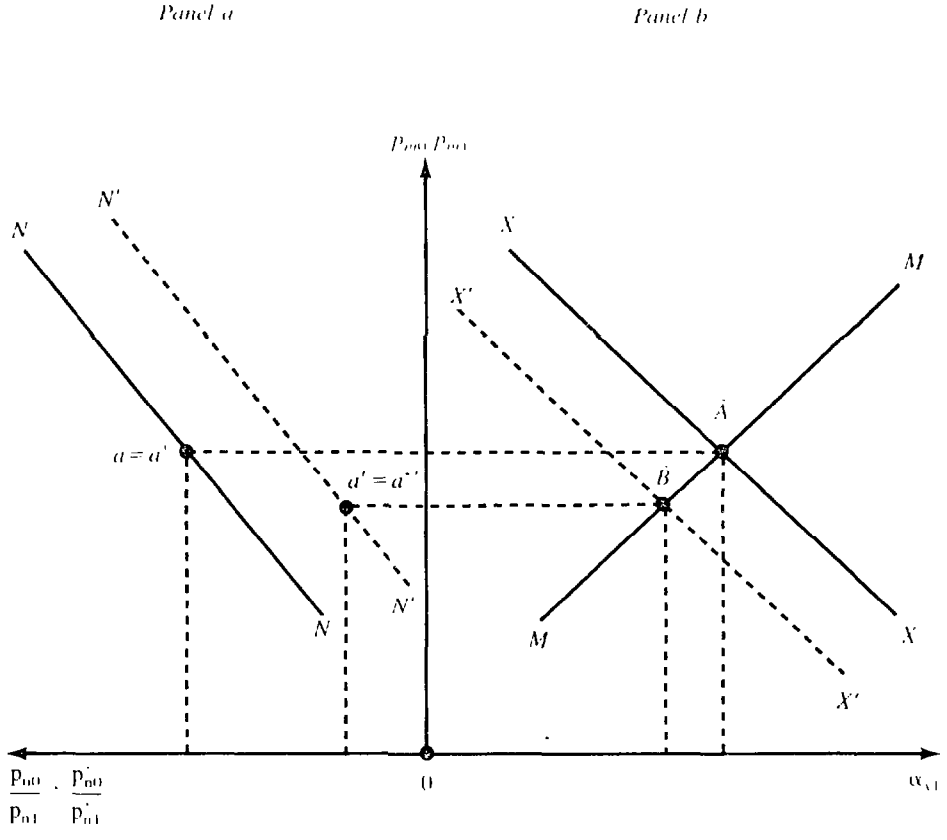


FIGURE 6
The effect of a temporary increase in government spending on exportables: The case of large intertemporal substitutability.

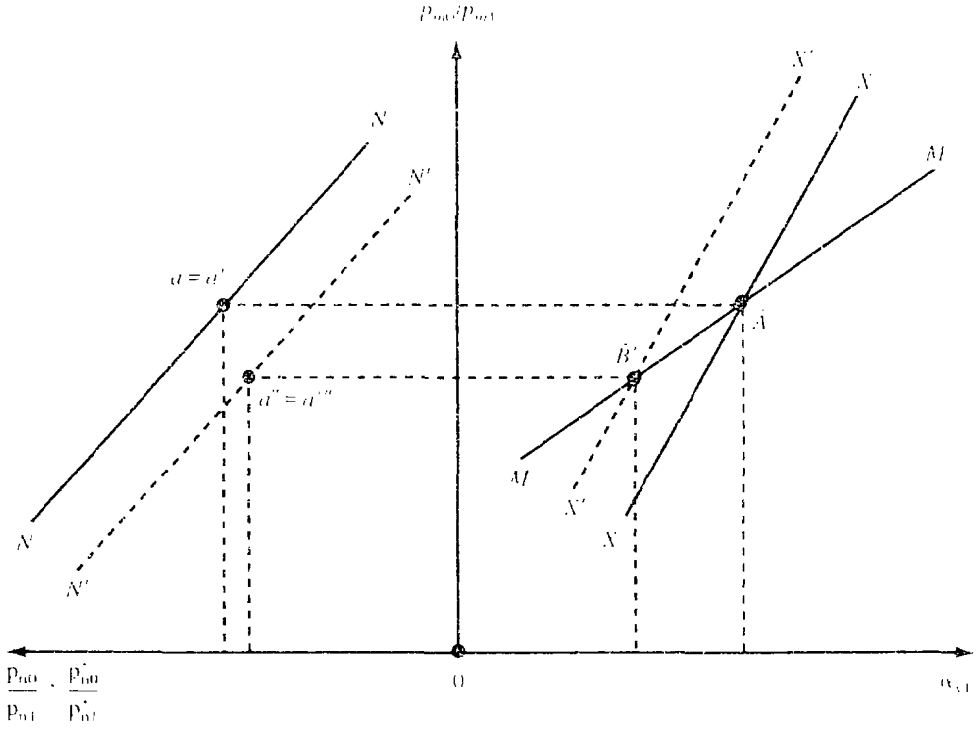


FIGURE 7
The effect of a temporary increase in government spending on importables: The case of large intratemporal substitutability.

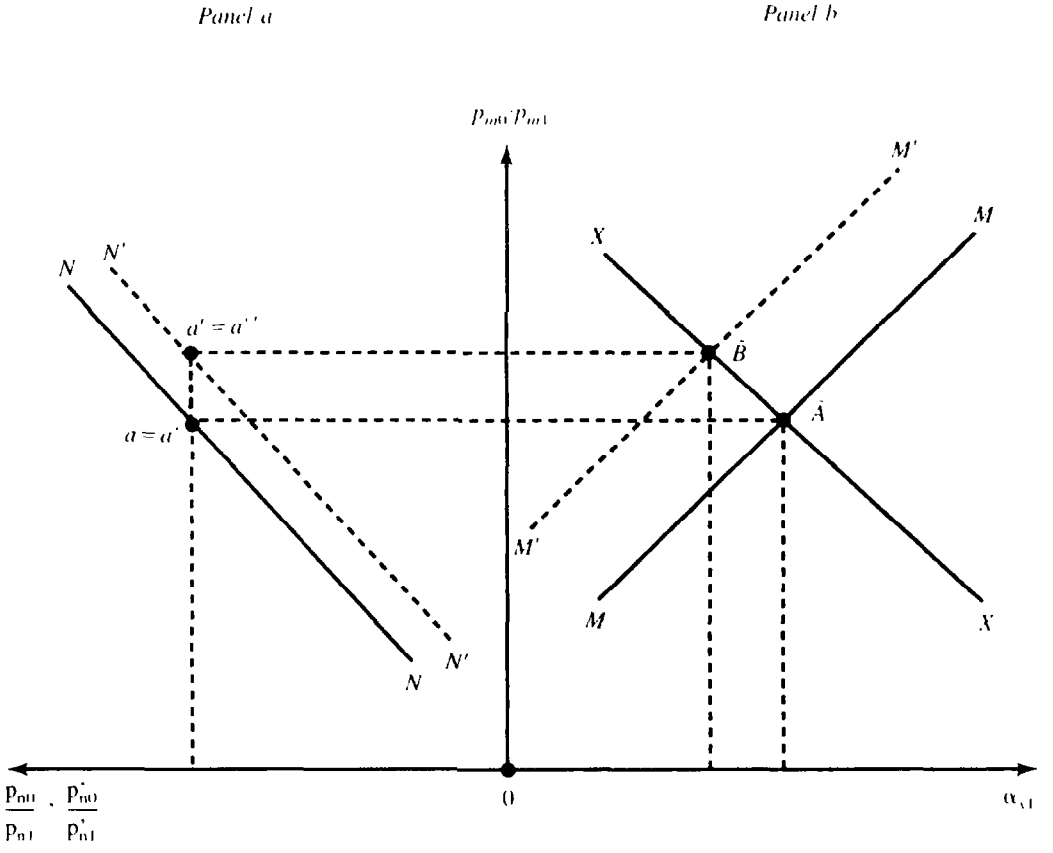
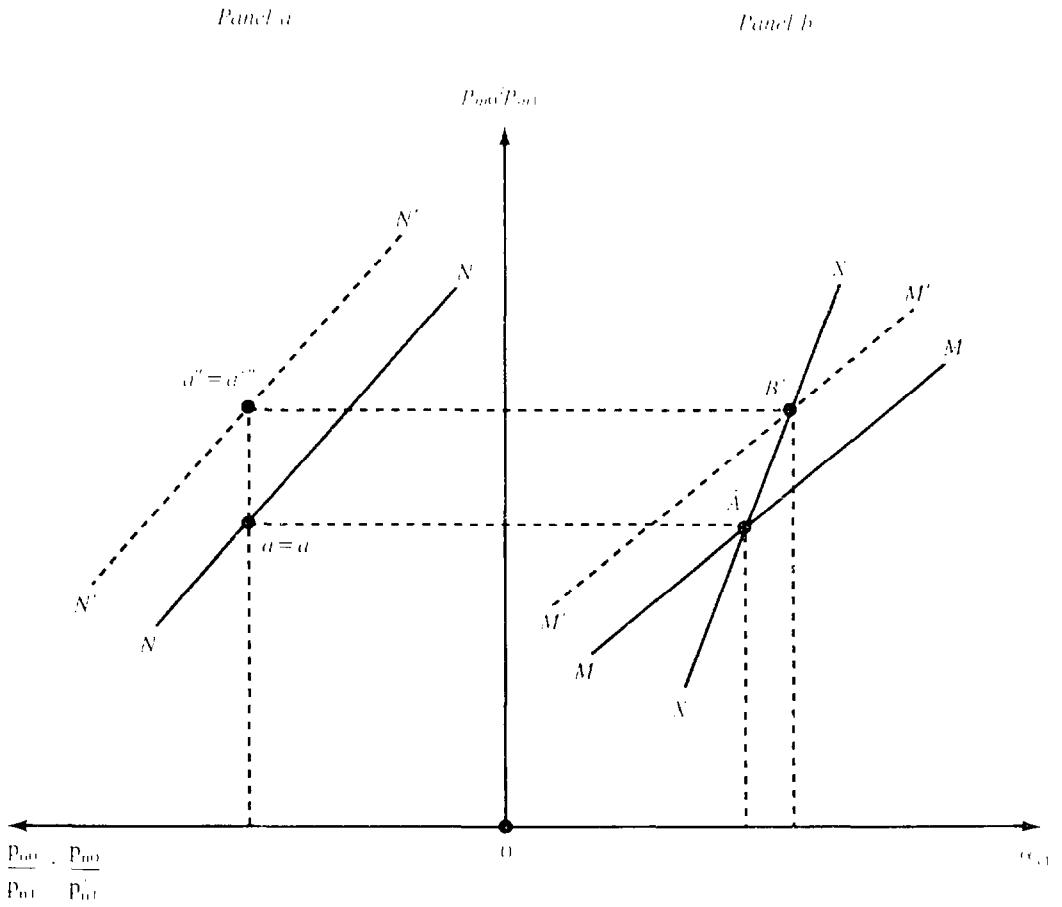


FIGURE 8
The effect of a temporary increase in government spending on importables: The case of large intratemporal substitutability.



tends to lower consumption interest rates) so that, in order for consumption rates of interest to increase, the world rate of interest must necessarily rise. In contrast, when the government biases its spending toward good m, the terms of trade ratio, p_{m0}/p_{m1}, necessarily rises, thereby contributing to the required increase in consumption rates of interest in both countries. The direction in which the rate of return on the internationally traded bond must move in order to eliminate world deceiving is therefore ambiguous. If $\sigma > \sigma_{ij}$, the intertemporal effect associated with the terms of trade deterioration is more than sufficient to suppress world borrowing at the initial interest rate. It follows that in this case, the world discount factor actually rises (the world interest rate falls) as shown in Figure 8. In contrast, when $\sigma_{ij} > \sigma$, the intertemporal substitution effect associated with movements in the terms of trade is rather weak and, therefore, in order to eliminate excess demand for current tradables (i.e., desired world borrowing), a rise in the world rate of interest becomes necessary (Figure 7). One conclusion of the above analysis is that independent of whether the government consumes tradable or nontradable goods, the world rate of return on internationally traded bonds may either rise or fall as a result of a temporary rise in government spending. Such a result, which contrasts with the usual prediction of neoclassical macro- models, demonstrates the importance of intertemporal movements in other macroeconomic relative prices (in this case, the terms of trade and the real exchange rate) for the determination of macroeconomic equilibrium. It also argues in favor of a modelling strategy that allows for the endogenous determination of these relative prices (i.e., a three sector model) in response to macro-disturbances, at least until empirical research demonstrates that movements in the time paths of the terms of trade and the real exchange rate are quantitatively unimportant for the determination of agents' intertemporal consumption decisions.

Having determined the behavior of world temporal and intertemporal terms of trade, we can now ask how real exchange rates react to a temporary increase in government spending on importables. In Figure 7, the rise in the world rate of interest shifts the nontradables equilibrium locus rightward, i.e., for given terms of trade, there is a real depreciation in the current relative to the future period. In contrast, in Figure 8, the fall in the world rate of interest shifts the NN and N^*N^* loci leftward, and there is a real appreciation in the current relative to the future period, at initial terms of trade. The movement in the latter always dampens the effect of changes in the world interest rate on the domestic and foreign real exchange rate. 1/ Specifically, if $\sigma_{ij} > \sigma$ (Figure 7), the deterioration in the terms of trade favors an appreciation in the current relative to the future period (corresponding to the northwest movement along the N'N' locus). In contrast, when $\sigma > \sigma_{ij}$, the

1/ The fact that movements in the temporal and intertemporal terms of trade exert conflicting influences on the foreign economy highlights the importance of relaxing the composite tradable commodity assumption when considering the effects of fiscal policy changes.

effect of the fall in the world interest rate on domestic and foreign real exchange rates is mitigated by the rise in p_{m0}/p_{m1} which favors a real depreciation in the current relative to the future period (corresponding to a north-east movement along the nontradables equilibrium locus in Figure 8).

In fact, it can be shown (see the Appendix) that the overall effect of movements in the temporal and intertemporal terms of trade is to leave both the domestic and foreign exportables real exchange rate ratios unchanged. Before concluding anything from this result, however, the following two points should be kept in mind. First, the result is essentially an artifact of the choice of numeraire. Specifically, because a temporary rise in government consumption of any tradable commodity must raise the consumption rate of interest, it follows that spending on all goods will be tilted toward the future so that a consumption based measure of the real exchange rate must depreciate in the current relative to the future period. 1/ Second, although the real exchange rate ratio is unaffected by the temporary change in fiscal policy, the level of the real exchange rate does in fact change, period by period. Specifically, it can be shown that there is a real depreciation both in periods 0 and 1, and that the magnitudes of these depreciations are equal to each other. Therefore, in this case, the (exportables) real exchange rate exhibits neither equilibrium under- nor overshooting (in contrast to the cases considered in the previous two subsections) along the adjustment path but instead adjusts instantaneously to its new long run equilibrium value.

Table 3 summarizes the main results concerning the relative price effects of government spending on tradable goods. First, it can be seen that a temporary increase in government spending on tradable goods need not increase the rate of return on internationally traded bonds if spending is relatively biased toward the importable commodity and elasticities of substitution are relatively large intertemporally. Second, in three of the four cases, movements in the temporal and intertemporal terms of trade exert conflicting influences on the foreign economy, so that it may be of some importance, in evaluating the size of comovements induced by changes in fiscal policy, to relax the assumption of a composite tradable commodity. Third, the analysis suggests that real depreciations of the (consumption based) measure of the real exchange rate and equilibrium undershooting are the likely outcomes resulting from temporary government expenditures on tradable goods, which are opposite to

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1/ It can be shown that although the exportables real exchange rate ratio is unaffected by the rise in government consumption of importables, the corresponding importables real exchange rate ratio does in fact decline reflecting the terms of trade deterioration in the current relative to the future period. Therefore, a consumption based measure of the real exchange rate (which is simply a weighted average of the exportables and importables measures) would clearly reveal a real depreciation in the current relative to the future period.

Table 3. The Effect of a Rise in the Discounted Sum of Government Spending on Tradable Goods

Relation Between Intratemporal and Intertemporal Elasticities of Substitution		Allocation of Government Expenditures: Intratemporally and Intertemporally							
		$\gamma > \gamma^g$				$\gamma < \gamma^g$			
		r_{x0}	$\frac{p_{m0}}{p_{m1}}$	$\frac{p^*_{n0}}{p^*_{n1}}$	$\frac{p_{n0}}{p_{n1}}$	r_{x0}	$\frac{p_{m0}}{p_{m1}}$	$\frac{p^*_{n0}}{p^*_{n1}}$	$\frac{p_{n0}}{p_{n1}}$
$\sigma_{ij} > \sigma$	importables	+	+	0	0	-	-	0	0
	exportables	+	-	-	-	-	+	+	+
$\sigma_{ij} < \sigma$	importables	-	+	0	0	+	-	0	0
	exportables	+	-	-	-	-	+	+	+

the predictions for nontradables. Fourth, the comovement between the terms of trade and the real exchange rate depends on the intratemporal allocation of government expenditures, being positive in the case of government spending on exportables and negative in the case of government spending on importables. Fifth, with shocks originating in the tradable rather than the nontradable sector, the main determinant of both domestic and foreign real exchange rates are movements in the world temporal and intertemporal terms of trade, which are of course common to both countries. Therefore, the expected correlation between domestic and foreign real exchange rates is positive when the government spends on tradables. This contrasts with the case of government spending on home goods in which the comovement of domestic and foreign real exchange rates would be negative for sufficiently small values of the intertemporal elasticity of substitution in consumption.

c. Implications for other macro-variables

In the description of the model (Section II), we deliberately abstracted from many relevant features of actual economies in order to concentrate on some important channels through which changes in government expenditures impact upon relative prices, and are thereby transmitted to the domestic and foreign economies. In a more general model, one might wish to incorporate investment behavior and perhaps endogenous employment either via the inclusion of leisure as an argument in the utility function or by imposing some exogenously determined wage setting process which causes (at least in the short run) unemployment. It is perhaps worth mentioning how the types of comovement suggested by the previous analysis might plausibly affect macro-variables such as employment and investment in an extended version of the model of Section II.

First, it has been noted that, in contrast to the predictions of models which assume the existence of a single composite tradable commodity, the nature of the international transmission of government spending shocks is affected by movements in the terms of trade. Of course, fluctuations in the terms of trade are also a key determinant of the behavior of real exchange rates in both countries (see Ostry (1988)). If we suppose that employment is demand determined, say because of the existence of some exogenously set minimum wage, it follows that changes in both the intersectoral allocation and the overall level of employment induced by fiscal policies will depend crucially on the behavior of both the terms of trade and the real exchange rate. Thus, an implication of the model is that it is in principle possible to observe either positive or negative comovements between changes in the level of employment in the country originating the fiscal shock, and the rest of the world. In a related paper, Edwards and Ostry (1989) show that the sign of these comovements will depend on the signs of the comovements in terms of trade and real exchange rates that are generated by the fiscal shock, as well as on the relative factor intensities among the three sectors.

A second possible extension which is easy to incorporate into the model of Section II would involve antagonizing investment behavior. In

this case also, the predictions of a model employing a composite tradable commodity may differ substantially from those of the present model. The reason is of course that investment decisions will not only be determined by movements in the world rate of interest, but also by fluctuations in terms of trade and real exchange rates over time. As shown by Devereux (1987), the rate of interest relevant for investment decisions depends on both the intersectoral allocation of investment, and on the behavior of the various relative prices. If the pattern of specialization differs across countries and fiscal policy shocks are associated with sharp movements in either the real exchange rate or the terms of trade, then investment levels may be negatively correlated across countries even in a world of perfect mobility of financial capital.

Finally, within the context of the present model, it is of course possible to determine the pattern of comovement in consumption between countries. If we consider the growth rate of consumption, it is obvious that with homothetic preferences, its only determinant is the change in the consumption interest rate induced by the fiscal disturbance. In our previous analysis, it was shown that in the case in which the government spends on nontradable goods and in which the intertemporal elasticity of substitution in consumption was sufficiently large, consumption rates of interest would comove negatively across countries in response to a temporary fiscal shock (see also Devereux (1988)). In this case, therefore, consumption (growth rates) would comove negatively across countries in a world of perfect capital mobility.

IV. The Current Account

The relationship between fiscal policies and the current account has received much attention both among researchers and policymakers over the past several years. Much of the debate seems to concern the relationship between budget deficits and the current account (the so-called "twin deficits") without much discussion of the relationship between balanced budget increases in government expenditures and the trade or current account balance. 1/ Of course, many countries (including the United States) have experienced in recent years significant changes in both components of the budget deficit (i.e., spending and taxes). Our previous analysis indicates that, in order to evaluate the overall impact of the deficit, one must first understand the separate effects of each of its components. Our model is particularly well suited to address this issue

1/ An exception is Devereux (1988). However, his model does not allow for endogenous terms of trade adjustment and hence ignores some potentially important interactions between government spending policies and the current account.

in a framework which allows for the endogenous response to government spending policies of the major macroeconomic relative price variables. 1/

In order to simplify the algebra, we consider the effect of a rise in government spending originating in the home country on the foreign economy's trade or current account balance. Of course, within our two-country framework, the response of the domestic economy's trade balance is equal and opposite in sign to that of the foreign country. Accordingly, the foreign country's period 0 trade balance evaluated in world prices, TA_0^*, is defined as the excess of its GDP over current period spending, viz.:

$$TA_0^* = [\bar{Y}_{x0}^* + p_{m0}\bar{Y}_{m0}^* + p_{n0}^*\bar{Y}_{n0}^*] - P_0^*C_0^*(\alpha_{c1}^*, W_{c0}^*) \tag{20}$$

Note that in the absence of historical debt commitment, initial trade and current account balances are equal. Consider now the effect of a temporary increase in government spending on TA_0^*. The first case to consider is one in which the government's expenditure is strongly biased towards nontradable goods. In this case, 2/

$$dTA_0^* = P_0^*C_0^*\gamma\sigma d\log\alpha_{c1}^* \tag{21}$$

As can be seen, the movement in the trade balance depends only on the response of the foreign consumption based discount factor. Now, as argued previously, a temporary increase in government spending on home goods will raise the foreign consumption based interest rate if the intratemporal elasticity of substitution exceeds the intertemporal elasticity of substitution but will lower it in the opposite case. Thus, it is clear that an increase in government spending need not worsen the current account of the country undergoing the fiscal expansion. In particular, for sufficiently large values of the intertemporal elasticity of substitution, the expanding country's current account will improve and the

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1/ The analysis of budget deficits can easily be incorporated into the framework of Section II via the introduction of distortionary taxation. The latter extension would also enable one to analyze issues concerning the domestic effects and international transmission of tax reforms.

2/ All the expressions in this section are evaluated around an initial equilibrium in which trade is balanced between the two countries. Allowing for initially unbalanced trade would introduce additional revaluation effects associated with real exchange rate changes and welfare effects associated with real interest rate changes. These additional effects would allow for additional channels through which the correlations between changes in government spending and the current account could be rendered ambiguous but would not alter any of the qualitative results presented here.

fiscal shock will be transmitted negatively to the foreign economy's current account. Note that the absence of any welfare effects from equation (21) is due to the result (of Section III) that government spending on home goods does not affect the terms of trade. This means that the only determinant of national saving are movements in the consumption rates of interest in each country. 1/ Because the foreign economy's interest rate may actually fall when the home country increases government consumption of nontradables, its saving may fall and hence its current account may deteriorate. This result will occur if and only if the intertemporal elasticity of substitution in consumption exceeds the intratemporal elasticity, i.e., sign (dTA_0^*) = sign $(\sigma_{ij} - \sigma)$.

Consider now the case of government spending on tradable goods. In this case, as shown in Section III, both the temporal and intertemporal terms of trade will be affected. Therefore, we should expect savings decisions to be determined not only by interest rate effects as in the previous case, but also by terms of trade induced changes in welfare. Consider first the case of government spending on importables. In this case, the foreign trade balance is affected as follows:

$$dTA_0^* = -P_0^*C_0^*[\gamma\sigma d\log\alpha_{c1}^* + \beta_m\gamma(1 - \mu_{m0}^*)d\log p_{m0}] \qquad (22)$$

where $\mu_{m0}^* > 1$ represents the ratio of the foreign endowment to consumption of good m. Equation (22) states that the response of the foreign trade balance consists of two parts. The first, $-P_0^*C_0^*\gamma\sigma d\log\alpha_{c1}^*$, is the interest rate effect. Recall from Section III that a temporary increase in government spending on tradable goods always raises consumption rates of interest in both countries. The rise in the consumption rate of interest (fall in the consumption discount factor) encourages saving and thereby improves the foreign trade balance. Accordingly, the first term in equation (22) is positive.

In addition, an increase in government spending on good m improves the foreign economy's terms of trade in period 0. 2/ This temporary welfare gain also encourages saving. The reason of course is that part of any temporary real income gain is always saved because of consumption-smoothing motives. Thus both the real interest rate effect and the terms of trade effect operate in the same direction in favoring an improvement (worsening) in the foreign (domestic) trade balance.

This contrasts sharply with the case of government spending on good x. Again, equation (22) gives the trade balance response, except that in this case, the behavior of the terms of trade is different. As before,

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1/ These reflect, of course, not only movements in world rates of interest, but also real exchange rate (and terms of trade) changes.

2/ It is simple to show that the future terms of trade are unaffected (see the Appendix).

real interest rates rise in both countries and this effect serves to improve the foreign trade balance. In contrast, a temporary rise in government consumption of good x worsens the terms of trade for the foreign country, i.e., dlog $p_{m0} < 0$. Part of this temporary real income loss will be smoothed by borrowing in the international capital market. The overall effect on the foreign country's trade balance depends on the interaction between the real interest rate and terms of trade effects. It can be shown that when government consumption is biased toward good x, the foreign trade balance may in fact deteriorate. A factor favoring such an outcome is a large volume of period 0 imports which yields a large temporary welfare loss for the foreign economy resulting from the fiscal expansion at home. A conclusion of this section is therefore that if terms of trade effects are important, a temporary increase in government spending on tradable goods (exportables) may actually improve the trade balance of the country undergoing the fiscal expansion. A second conclusion is that if intertemporal substitution possibilities in consumption are large, a temporary increase in government spending on nontradable goods will improve the trade balance of the country undergoing the fiscal expansion. Both results are in sharp contrast to the predictions of previous models in which government spending increases tend to be associated with worsened current account positions. The analysis shows the following considerations to be important in determining the sign (and magnitude) of the correlations between government spending and the current account: first, the intratemporal (and intertemporal) allocation of the government's expenditure relative to the private sector; second, the endogenous responses of relative prices; third, the magnitudes of intertemporal and intratemporal elasticities of substitution in consumption; and fourth, the volume of trade flows (imports) in the initial equilibrium.

V. Conclusions

The main determinants of the behavior of government spending shocks on macroeconomic relative price variables (interest rates, terms of trade and real exchange rates) were examined and shown to depend crucially on the intratemporal and intertemporal composition of government spending (transfer-problem criteria) and relative magnitudes of the private sector's elasticities of substitution within and across time periods. Results were shown to differ substantially from those obtained in models employing a higher degree of commodity aggregation. An additional advantage of the three good model is that it permits explicit consideration of some theoretical determinants of the comovement between the terms of trade and real exchange rate resulting from government spending (or other) disturbances. 1/ It was argued that policy-induced movements in the terms of trade and real exchange rates may constitute important factors determining the behavior of quantities such as

1/ For a an examination of the relationship between the terms of trade and the real exchange rate in a small-country setting, see Ostry (1988).

consumption, saving, investment, and employment resulting from government spending changes. Although movements in world interest rates are a common determinant of macroeconomic aggregates in a world of high financial capital mobility, movements in other relative prices are potentially a source of asymmetrical behavior across countries resulting from certain disturbances.

At the theoretical level, several extensions may be worthy of examination. The model might be generalized either to incorporate some distortions (taxes, minimum wages, and capital controls) and an explicit modelling of investment behavior might be attempted (see Devereux (1987)). Other disturbances (commercial policies, budget deficits, tax reforms) which have been prominent in recent policy discussions might also be examined within the present framework. In addition, it would certainly be of interest to attempt estimation and testing of a model similar to the one presented here (i.e., a stochastic version of it) in order to determine a range of plausible parameter values (intra- and intertemporal elasticities of substitution) on which the effects of policies were shown to depend.

The Two-Country Model

To solve the model, proceed as follows. First, logarithmically differentiate equations (8) and (9) around the equilibrium of no government spending and use the Slutsky decomposition to obtain:

$$\begin{bmatrix} -\beta_{m0}\sigma_{nm}-\beta_{x0}\sigma_{nx}-\beta_{n0}\gamma\sigma & \beta_{n1}\gamma\sigma \\ \beta_{n0}(1-\gamma)\sigma & -\beta_{m1}\sigma_{nm}-\beta_{x1}\sigma_{nx}-\beta_{n1}(1-\gamma)\sigma \end{bmatrix} \begin{bmatrix} \hat{p}_{n0} \\ \hat{p}_{n1} \end{bmatrix} =$$

$$\begin{bmatrix} -\beta_{m0}\{\sigma_{nm}-[(1-\gamma)(1-\mu_{m0})+\gamma\sigma]\} & -\beta_{m1}\gamma[\sigma-(1-\mu_{m1})] \\ -\beta_{m0}(1-\gamma)[\sigma-(1-\mu_{m0})] & -\beta_{m1}\{\sigma_{nm}-[\gamma(1-\mu_{m1})+(1-\gamma)\sigma]\} \end{bmatrix} \begin{bmatrix} \hat{p}_{m0} \\ \hat{p}_{m1} \end{bmatrix} +$$

$$\begin{bmatrix} -\gamma\sigma+\gamma(1-\mu_1) & a-\phi_{n0}\beta^g_{n0}(1-\gamma^g) \\ (1-\gamma)\sigma+\gamma(1-\mu_1) & a-\phi_{n1}\beta^g_{n1}\gamma^g \end{bmatrix} \begin{bmatrix} \hat{\alpha}_{x1} \\ dG \end{bmatrix}, \qquad \text{(A-1)}$$

where μ_1 is the ratio of period 1 GDP to period 1 spending; $a=1/W_0$; $\phi_{it}=1/p_{it}c_{it}$; β^g_{it} denotes the period t government propensity to consume good i and where the remaining notation is as defined in the text. Use equation (A-1) to solve for $\hat{p}_{n0}$ and $\hat{p}_{n1}$ in terms of the remaining variables:

$$\begin{bmatrix} \hat{p}_{n0} \\ \hat{p}_{n1} \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \end{bmatrix} \begin{bmatrix} \hat{p}_{m0} \\ \hat{p}_{m1} \\ \hat{\alpha}_{x1} \\ dG \end{bmatrix} \quad \text{where} \qquad \text{(A-2)}$$

$a_{11} = \Delta\{\beta_{m0}(\beta_{m1}\sigma_{nm}+\beta_{x1}\sigma_{nx})[\sigma_{nm}-(1-\gamma)(1-\mu_{m0})-\gamma\sigma]+\beta_{m0}\beta_{n1}(1-\gamma)\sigma(\sigma_{nm}+\mu_{m0}-1)\}$

$a_{12} = \Delta[\beta_{m1}\gamma(\beta_{m1}\sigma_{nm}+\beta_{x1}\sigma_{nx})(\sigma+\mu_{m1}-1)+\beta_{m1}\gamma\beta_{n1}\sigma(\sigma_{nm}+\mu_{m1}-1)]$

$a_{13} = \Delta[(\beta_{m1}\sigma_{nm}+\beta_{x1}\sigma_{nx})\gamma\sigma+(\beta_{m1}\sigma_{nm}+\beta_{x1}\sigma_{nx}+\beta_{n1}\sigma)\gamma(\mu_1-1)]$

$a_{14} = \Delta\{-[a-\phi_{n0}\beta^g_{n0}(1-\gamma^g)][\beta_{m1}\sigma_{nm}+\beta_{x1}\sigma_{nx}+\beta_{n1}(1-\gamma)\sigma]-[a-\phi_{n1}\beta^g_{n1}\gamma^g]\gamma\beta_{n1}\sigma\}$

$a_{21} = \Delta[\beta_{m0}(1-\gamma)(\beta_{m0}\sigma_{nm}+\beta_{x0}\sigma_{nx})(\sigma+\mu_{m0}-1)+\beta_{m0}(1-\gamma)\beta_{n0}\sigma(\sigma_{nm}+\mu_{m0}-1)]$

$a_{22} = \Delta\{\beta_{m1}(\beta_{m0}\sigma_{nm}+\beta_{x0}\sigma_{nx})[\sigma_{nm}-\gamma(1-\mu_{m1})-(1-\gamma)\sigma]+\beta_{m1}\beta_{n0}\gamma\sigma(\sigma_{nm}+\mu_{m1}-1)\}$

$a_{23} = \Delta[-(\beta_{m0}\sigma_{nm}+\beta_{x0}\sigma_{nx})(1-\gamma)\sigma+(\beta_{m0}\sigma_{nm}+\beta_{x0}\sigma_{nx}+\beta_{n0}\sigma)\gamma(1-\mu_1)]$

$a_{24} = \Delta\{-[a-\phi_{n1}\beta^g_{n1}\gamma^g][\beta_{m0}\sigma_{nm}+\beta_{x0}\sigma_{nx}+\beta_{n0}\gamma\sigma]-[a-\phi_{n0}\beta^g_{n0}(1-\gamma^g)]\beta_{n0}(1-\gamma)\sigma\}$

and $\Delta=\{(\beta_{m0}\sigma_{nm}+\beta_{x0}\sigma_{nx})[\beta_{m1}\sigma_{nm}+\beta_{x1}\sigma_{nx}+\beta_{n1}(1-\gamma)\sigma]+\beta_{n0}\gamma\sigma(\beta_{m1}\sigma_{nm}+\beta_{x1}\sigma_{nx})\}$.

Second, logarithmically differentiate equations (4)-(6) (any three of equations (4)-(7) will give the same result) and substitute out the domestic and foreign real exchange rates by using equations (A-2) and an analogous equation for the foreign economy (obtained by differentiating equations (10) and (11)):

$$\begin{bmatrix} \lambda_{x0}b_{11}+(1-\lambda_{x0})b^*_{11} & \lambda_{x0}b_{12}+(1-\lambda_{x0})b^*_{12} & \lambda_{x0}b_{13}+(1-\lambda_{x0})b^*_{13} \\ \lambda_{x1}b_{21}+(1-\lambda_{x1})b^*_{21} & \lambda_{x1}b_{22}+(1-\lambda_{x1})b^*_{22} & \lambda_{x1}b_{23}+(1-\lambda_{x1})b^*_{23} \\ \lambda_{m0}b_{31}+(1-\lambda_{m0})b^*_{31} & \lambda_{m0}b_{32}+(1-\lambda_{m0})b^*_{32} & \lambda_{m0}b_{33}+(1-\lambda_{m0})b^*_{33} \end{bmatrix} \begin{bmatrix} \hat{p}_{m0} \\ \hat{p}_{m1} \\ \hat{\alpha}_{x1} \end{bmatrix} - \begin{bmatrix} c_1 \\ c_2 \\ c_3 \end{bmatrix} dG$$

where λ_{it} is the share of the home country's consumption in world consumption (or endowment) of good i in period t, i.e., $\lambda_{it}=c_{it}/(\bar{Y}_{it}+\bar{Y}^*_{it})$,

$b_{11} = \beta_{m0}[\sigma_{mx}-(1-\gamma)(1-\mu_{m0})-\gamma\sigma]+\beta_{n0}(\sigma_{nx}-\gamma\sigma)a_{11}+\beta_{n1}\gamma\sigma a_{21}$,

$b_{12} = \beta_{m1}\gamma[\sigma-(1-\mu_{m1})]+\beta_{n0}(\sigma_{nx}-\gamma\sigma)a_{12}+\beta_{n1}\gamma\sigma a_{22}$,

$b_{13} = \gamma\sigma+\gamma(\mu_1-1)+\beta_{n0}(\sigma_{nx}-\gamma\sigma)a_{13}+\beta_{n1}\gamma\sigma a_{23}$,

$b_{21} = \beta_{m0}(1-\gamma)[\sigma-(1-\mu_{m0})]+\beta_{n0}(1-\gamma)\sigma a_{11}+\beta_{n1}[\sigma_{nx}-(1-\gamma)\sigma]a_{21}$,

$b_{22} = \beta_{m1}[\sigma_{mx}-(1-\gamma)\sigma-\gamma(1-\mu_{m1})]+\beta_{n0}(1-\gamma)\sigma a_{12}+\beta_{n1}[\sigma_{nx}-(1-\gamma)\sigma]a_{22}$,

$b_{23} = -(1-\gamma)\sigma+\gamma(\mu_1-1)+\beta_{n0}(1-\gamma)\sigma a_{13}+\beta_{n1}[\sigma_{nx}-(1-\gamma)\sigma]a_{23}$,

$b_{31} = -\beta_{n0}\sigma_{nm}-\beta_{x0}\sigma_{mx}-\beta_{m0}(1-\gamma)(1-\mu_{m0})-\beta_{m0}\gamma\sigma+\beta_{n0}(\sigma_{nm}-\gamma\sigma)a_{11}+\beta_{n1}\gamma\sigma a_{21}$,

$b_{32} = \beta_{m1}\gamma[\sigma-(1-\mu_{m1})]+\beta_{n0}(\sigma_{nm}-\gamma\sigma)a_{12}+\beta_{n1}\gamma\sigma a_{22}$,

$b_{33} = \gamma\sigma+\gamma(\mu_1-1)+\beta_{n0}(\sigma_{nm}-\gamma\sigma)a_{13}+\beta_{n1}\gamma\sigma a_{23}$,

$c_1 = \lambda_{x0}[a-\beta_{n0}(\sigma_{nx}-\gamma\sigma)a_{14}-\beta_{n1}\gamma\sigma a_{24}]-\phi_{x0}\beta^g_{x0}(1-\gamma^g)$,

$c_2 = \lambda_{x1}[a-\beta_{n0}(1-\gamma)\sigma a_{14}-\beta_{n1}(\sigma_{nx}-(1-\gamma)\sigma)a_{24}]-\phi_{x1}\beta^g_{x1}\gamma^g$,

$c_3 = \lambda_{m0}[a-\beta_{n0}(\sigma_{nm}-\gamma\sigma)a_{14}-\beta_{n1}\gamma\sigma a_{24}]-\phi_{m0}\beta^g_{m0}(1-\gamma^g)$.

The coefficients with an asterisk are defined in an analogous manner. The above system can be solved for the effects of government spending changes on world relative prices. To determine the effects on real exchange rates, the solutions for world prices are substituted back into equation (A-2) and the analogous equation for the foreign country. If preferences are identical in the two countries and the initial level of the real exchange rate is also equated between countries (by suitable choice of the nontradable endowments and initial wealth levels), then the system simplifies considerably and the results given in the text emerge.

Finally, the results for relative prices can then be used to compute the effects of government spending policies on consumption and the current account.

To derive the slopes of the NN and N^*N^* schedules, subtract the solution for $\hat{p}_{n1}$ from the solution for $\hat{p}_{n0}$, set $\hat{\alpha}_{x1} = dG = 0$, and assume that the expenditure shares (the β_{it}'s) are constant over time. This yields the expression for the slope of the NN schedule given in equation (10), and analogously for the foreign country.

To derive the slope of the XX schedule, differentiate logarithmically equations (4) and (5) and substitute out for $\hat{p}_{n0}$, $\hat{p}_{n1}$, $\hat{p}^*_{n0}$, $\hat{p}^*_{n1}$, by using equation (A-2). Solve for $\hat{p}_{m0}$, $\hat{p}_{m1}$ in terms of $\hat{\alpha}_{x1}$, setting dG=0. Subtract the solution for $\hat{p}_{m1}$ from the solution for $\hat{p}_{m0}$, and assume that β_{it}, λ_{xt}, and μ_{mt} are all constant over time. This gives the following expression:

$$\left.\frac{d\log(p_{m0}/p_{m1})}{d\log\,\alpha_{x1}}\right|_{XX} = \tag{A-3}$$

$$\frac{-\{\lambda_x[\sigma+\beta_n\sigma(\sigma_{nx}-\sigma)\Delta_1]+(1-\lambda_x)[\sigma^*+\beta^*_n\sigma^*(\sigma^*_{nx}-\sigma^*)\Delta^*_1]\}}{\lambda_x\beta_m[(\sigma_{mx}-\sigma)+\beta_n(\sigma_{nx}-\sigma)(\sigma_{nm}-\sigma)\Delta_1]+(1-\lambda_x)\beta^*_m[(\sigma^*_{mx}-\sigma^*)+\beta^*_n(\sigma^*_{nx}-\sigma^*)(\sigma^*_{nm}-\sigma^*)\Delta^*_1]},$$

where $\Delta_1 = [\beta_m\sigma_{nm} + \beta_x\sigma_{nx} + \beta_n\sigma]^{-1}$, and correspondingly for Δ^*_1. Following the same steps for the world importables market clearing conditions (equations (4) and (5)), and assuming that β_{it}, λ_{mt}, and μ_{mt} are all constant over time, gives the following expression for the slope of the MM schedule:

$$\left.\frac{d\log\,(p_{m0}/p_{m1})}{d\log\,\alpha_{x1}}\right|_{MM} = \tag{A-4}$$

$$\frac{-\{\lambda_m\sigma[1+\beta_n(\sigma_{nm}-\sigma)\Delta_1]+(1-\lambda_m)\sigma^*[1+\beta^*_n(\sigma^*_{nm}-\sigma^*)\Delta^*_1]\}}{\lambda_m[-\Delta_2+\beta_m\beta_n(\sigma_{nm}-\sigma)^2\Delta_1]+(1-\lambda_m)[-\Delta^*_2+\beta^*_m\beta^*_n(\sigma^*_{nm}-\sigma^*)^2\Delta^*_1]},$$

where $\Delta_2 = [\beta_n\sigma_{nm} + \beta_x\sigma_{mx} + \beta_m\sigma]$, and correspondingly for Δ^*_2. With identical CES preferences, equation (A-3) and (A-4) become equation (15) of the text. To compute the vertical shifts of the MM and XX schedules in response to the temporary tariff, follow the same steps as to derive the slopes of these schedules except set $\hat{\alpha}_{x1} = 0$.

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