The gains from trade for a monetary economy once again

THEODORE PALIVOS Tilburg University and Louisiana State University
CHONG K. YIP Chinese University of Hong Kong

Abstract. We examine the effects of free trade on a small open economy within a dynamic generalized cash-in-advance model. We provide a complete characterization for the possibility of harmful trade and suggest alternative economic policies that can convert the loss associated with free trade into a gain. We also find, contrary to standard results, that there exists an optimal tariff for a small open economy, and we use calibration methods to assess its value.

Les gains du commerce international pour une économie monétaire: un autre coup d'oeil. Les auteurs examinent les effets du libre échange sur une petite économie ouverte dans un modèle généralisé où il y a paiement monétaire d'avance. On montre ce qui pourrait produire des flux de commerce nocifs et on suggère diverses politiques permettant de transformer la perte associée à ce commerce en gain. Contrairement à ce qui a été suggéré dans certains résultats antérieurs, on montre qu'il existe un tarif douanier optimal pour une petite économie ouverte et on utilise des méthodes de calibration pour en déterminer le niveau.

I. INTRODUCTION

A dictum of classical trade theory is that for a small open economy an improvement in the terms of trade is beneficial. Consequently, free trade is better than no trade. Although this proposition has been confirmed within various contexts of a barter economy (see, e.g., Kemp 1962; Samuelson 1962; Wong 1991), it has been mostly taken for granted in the case of a monetary economy. It is well established, however,

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that the introduction of money can alter results obtained within a non-monetary environment.[1]

There has been some related work in the literature on the effects of a tariff within general equilibrium models of money (notably Anderson and Takayama 1978, 1981; and Batra and Ramachandran 1980). Most of these papers, however, examine nominal issues, such as the effects of a tariff on domestic prices, the exchange rate, and the balance of payments, rather than the real effects of trade.[2] Kemp (1990), on the other hand, utilizes a static, money-in-the-utility-function (MIUF) model to examine the welfare effects of free trade for small monetary economies. He finds that an increase in the terms of trade may be harmful; the production and consumption gains may be swamped by a loss of satisfaction from holding cash when relative prices change.[3] Owing to the generic nature of the MIUF approach, however, it is difficult to uncover the economic forces that drive this conclusion. Finally, and perhaps more important, it is left as an open question whether the government can cancel or reverse the loss associated with free trade.

This paper attempts to clarify further the issue of gains from trade for a small monetary economy and to answer the aforementioned question, as to whether and how the government can reverse the loss associated with free trade, by laying the monetary foundations of the economy more carefully. More specifically, we emphasize the transactions role of money by constructing a dynamic generalized cash-in-advance model in which money is not equally efficacious in all markets. Stated differently, the share of purchases that must be made using cash varies across goods (markets).[4]

Our framework highlights the importance of different effects behind the possibility of harmful trade for a monetary economy.[5] Having established this possibility, we suggest alternative economic policies that can convert the loss associated with free trade into a gain. In fact, we find that government intervention can always improve the society's welfare, regardless of whether free trade is gainful or harmful compared with autarky. Three policy instruments are considered: the optimal quantity of money rule, also known as the Friedman rule (Friedman 1969), a tariff,

1 For instance, Drabicki and Takayama (1983) show that the theory of comparative advantage breaks down in a monetary world under fixed exchange rates when the balance of payments is not in equilibrium. Similarly, in a real trade model with a transactions-based demand for money, Stockman (1985) shows that changes in inflation can cause changes in the pattern of trade even in the absence of real changes in comparative advantage.

2 Furthermore, for analytical convenience, it is often assumed that commodities and money enter separably the utility function, which makes these monetary models behave very similarly to standard barter trade models (see the discussion in Anderson and Takayama 1977).

3 See also Kemp and Wong (1995), who extend various propositions of the welfare economics of free trade in the case of a monetary economy with incomplete markets. Money becomes valuable in their model via a cash-in-advance economy à la Stockman (1981); that is, all sectors are uniformly monetized. Thus, '[i]t remains to provide a more general multi-period analysis of an explicitly cash-in-advance kind but with non-uniformity of monetization allowed for' (18).

4 Hence, our cash-in-advance constraint can be viewed as a generalization of that used in Kemp and Wong (1995; see fn3).

5 This framework has also been used in Palivos and Yip (1995, 1997) to re-examine the effects of trade policies in a monetary setting.

and a consumption tax. Contrary to standard results, we show that there exists an optimal tariff for our small open economy.[6]

The organization of the paper is as follows. In section II the model is described, and its equilibrium allocation is studied in section III. In section IV a complete characterization for the possibility of harmful trade is provided and in section V three alternative economic policies that can improve social welfare are proposed. Finally, in section VI we give some quantitative estimates of the optimal policy instruments and in section VII we conclude.

II. THE MODEL

Consider a small open economy under a flexible exchange rate regime, where free trade of assets fixes the real rate of interest at the world level. The economy is inhabited by a large number of homogeneous agents who are infinitely lived and have perfect foresight. Each individual derives utility from consuming exportables (c_{1t}) and importables (c_{2t}), facing the standard period-by-period budget constraint:[7]

$$p_{1t}c_{1t} + (1+\tau)p_{2t}c_{2t} + M_{t+1} + B_{t+1} = p_{1t}x_{1t} + (1+\tau)p_{2t}x_{2t} + M_t + (1+i_t)B_t + S_t + T_t, \tag{1}$$

where p_{jt} = world price of good $j (j = 1, 2)$
τ = a tariff imposed on importables
M_t = nominal money holdings at the beginning of period t
B_t = nominal bond holdings at the beginning of period t
x_{jt} = domestic production of good $j (j = 1, 2)$
i_t = nominal interest rate
S_t = transfers of money received at the beginning of period t
T_t = lump-sum rebate of tariff revenues.

Since our focus is on issues concerning the gains from trade, we simplify the analysis by normalizing the nominal exchange rate to unity. The introduction of the second asset (besides money), B_t, on the other hand, is necessary for the existence of a steady-state equilibrium.

In addition to the budget constraint, (1), the representative agent faces the following cash-in-advance (CIA) or liquidity constraint:

$$\phi_1 p_{1t}c_{1t} + \phi_2(1+\tau)p_{2t}c_{2t} \leqq M_t + S_t, \tag{2}$$

6 A similar result is found in Gros (1987), in the context of barter exchange, under conditions of product differentiation and monopolistic competition.

7 Our results can easily be generalized to the case of n goods, where $n \in \mathbb{N}$. Moreover, the tariff, τ, here serves as a parameter to cover both the free trade case ($\tau = 0$) and the general restricted trade case ($\tau > 0$). Also, following standard practice, we assume that the government rebates the tariff revenues in a lump-sum fashion.

where $\phi_j \in [0, 1]$, $j = 1, 2$, denotes a constant share of purchases of good j. This constraint requires the individual to enter period t with money balances sufficient to finance at least a certain part of her consumption purchases. In general, consumption of one good requires larger cash balances, per unit of value, than consumption of the other good, and hence $\phi_1 \neq \phi_2$.[8] This may be justified in a number of different ways. First, it can be considered as the outcome of existing regulations regarding the terms of payments of imports and the obtaining and use of credit (foreign and domestic) to finance imports (see Laird and Yeates 1990), or as the outcome of existing export credits. Second, one can actually view c_1 and c_2 as composite goods consisting of different proportions of both non-durable goods and flow services of durables. Since the non-durable goods are subject to a different degree of credit rationing than the durables, one can expect $\phi_1 \neq \phi_2$.[9] Third, empirical evidence found in Cramer and Reekers (1976) indicates different money demands and liquidity/sales ratios across sectors. Finally, notice that $\phi_1 = \phi_2 = \kappa (\kappa \in [0, 1])$ implies that the velocity of circulation, defined as $V_t \equiv [p_{1t}c_{1t} + (1+\tau)p_{2t}c_{2t}]/[\phi_1 p_{1t}c_{1t} + \phi_2(1+\tau)p_{2t}c_{2t}] = 1/\kappa$, is constant and, in particular, independent of all other economic variables, such as the inflation rate, the rate of monetary expansions, the rate of interest, and the level of income. This, however, contradicts empirical evidence found in a series of papers (see, e.g., Mayor and Pearl 1984; Palivos, Wang, and Zhang 1993).

Letting β denote the subjective discount factor, the representative agent seeks to maximize the present value of her lifetime utility,

$$U = \sum_{t=0}^{\infty} \beta^t u(c_{1t}, c_{2t}), \tag{3}$$

subject to (1) and (2), taking M_0 and $B_0(M_0 > 0, B_0 > 0)$ as given, where $u(\cdot)$ denotes the instantaneous utility function. For convenience, we specify the optimization problem in terms of the functional equation:

$$V(M_t, B_t, p_{1t}, p_{2t}) \equiv \max \{u(c_{1t}, c_{2t}) + \beta V(M_{t+1}, B_{t+1}, p_{1t+1}, p_{2t+1})\}, \tag{4}$$

where the agent chooses c_{1t}, c_{2t}, M_{t+1}, and B_{t+1}, subject to (1) and (2). If we let λ_t and γ_t denote the Lagrangian multipliers for (1) and (2), respectively, then the necessary conditions for an optimum are

$$u_1(\cdot_t) = (\lambda_t + \phi_1\gamma_t)p_{1t} \tag{5}$$

$$u_2(\cdot_t) = (\lambda_t + \phi_2\gamma_t)(1+\tau)p_{2t} \tag{6}$$

$$\beta V_1(\cdot_{t+1}) = \lambda_t \tag{7}$$

$$\beta V_2(\cdot_{t+1}) = \lambda_t \tag{8}$$

$$\gamma_t[M_t + S_t - \phi_1 p_{1t}c_{1t} - \phi_2(1+\tau)p_{2t}c_{2t}] = 0, \quad \gamma_1 \geqq 0, \quad [\cdot] \geqq 0, \tag{9}$$

8 This formulation of the CIA constraint is slightly more general than the one considered in Stockman (1981), where $\phi_j = 1, j = 1, 2$, as well as the one adopted in Lucas and Stokey (1987), where there are two types of goods, pure cash goods with $\phi = 1$ and pure credit goods with $\phi = 0$.

9 A similar argument can be made with regard to necessary and luxury goods.

and the budget constraint, (1), where u_j and $V_j, j = 1, 2$, represent partial derivatives with respect to the jth argument and $\cdot_t$ means the arguments of the function evaluated at their values in period t. The interpretation of these conditions is as follows. Equations (5) and (6) characterize the optimal consumption choices by equating the marginal benefit of an additional dollar spent on each good to its marginal cost (marginal utility of wealth, λ, and of liquidity, $\phi_j\gamma$). Likewise, (7) and (8) equate the discounted marginal benefit of holding an additional unit of each asset to its marginal cost, while equation (9) is a restatement of the CIA constraint. Moreover, applying the envelope theorem, we get

$$V_1(\cdot_t) = \lambda_t + \gamma_t \tag{10}$$

$$V_2(\cdot_t) = \lambda_t(1 + i_t), \tag{11}$$

which equate the value of an additional unit of each asset (money and bonds) to its future return. Updating (10) and (11) and substituting them into (7) and (8), respectively, we obtain the following Euler equations:

$$\beta(\lambda_{t+1} + \gamma_{t+1}) = \lambda_t \tag{12}$$

$$\beta\lambda_{t+1}(1 + i_{t+1}) = \lambda_t. \tag{13}$$

To close the model, we specify the money supply process, $M_{t+1} = (1 + \mu)M_t$, where μ denotes the (constant) money growth rate. This and the money market equilibrium condition, $M_{t+1} = M_t + S_t$, yield $\mu M_t = S_t$. Moreover, the government budget constraint can be written as

$$(M_{t+1} - M_t) + [B_{t+1} - (1 + i_t)B_t] + R_t = T_t + S_t, \tag{14}$$

where $R_t \equiv \tau p_{2t}(c_{2t} - x_{2t})$ denotes the tariff revenue. Next, combining equation (14) with the private budge constraint, equation (1), yields

$$p_{1t}c_{1t} + p_{2t}c_{2t} = p_{1t}x_{1t} + p_{2t}x_{2t}, \tag{15}$$

which is simply the goods market equilibrium condition. Given M_0 and B_0, equations (5), (6), (9), (12)–(15), and the money supply process constitue a dynamic system that completely characterizes the equilibrium path of this economy. One can show that this economy does not exhibit any transitional dynamics and the new steady state is attained instantaneously.[10] Thus, henceforth we focus solely on the steady-state equilibrium of the model.

10 The proof is provided in an appendix, available from the authors upon request.

III. STEADY-STATE ANALYSIS

Let $p_t \equiv p_{2t}/p_{1t}$ denote the relative price of importables in terms of exportables. Equation (15) then becomes $c_{1t} + p_t c_{2t} = x_{1t}(p_t) + p_t x_{2t}(p_t)$, which yields, since consumption of each good is constant in steady state, a constant steady-state value for p_t, that is, $p_t = p \forall t$. This, in turn, implies that the nominal price of each good grows at a common rate π_t (the inflation rate); that is,

$$p_{jt+1}/p_{jt} = 1 + \pi_t, \qquad j = 1, 2. \tag{16}$$

If the CIA constraint is strictly binding, then $\gamma_t > 0$ and (9) yields

$$M_t + S_t = [\phi_1 c_{1t} + \phi_2(1+\tau)p_t c_{2t}]p_{1t}. \tag{17}$$

In steady state, p_t, c_{1t}, and c_{2t} are constant, and so (17) together with $\mu M_t = S_t$ imply $M_{t+1}/M_t = p_{1t+1}/p_{1t}$, or

$$\mu = \pi_t = \pi \forall t \tag{18}$$

that is, the inflation rate is constant. Furthermore, equations (12) and (13), imply

$$i_t = \frac{\gamma_t}{\lambda_t}. \tag{19}$$

Using next (5) and (6) one can show that γ_t/λ_t is also constant. Thus, the nominal interest rate assumes a constant steady-state value, $i_t = i\forall t$. Substituting $\gamma_t = i\lambda_t$ into either (5) or (6) and utilizing (16) and (18), we obtain

$$\lambda_t/\lambda_{t+1} = 1 + \mu, \tag{20}$$

that is, the marginal utility of wealth decreases at the rate of inflation or of monetary expansion. Finally, substitution of (20) into (13) yields the steady-state version of the Fisher equation:[11]

$$i = \rho + \mu, \tag{21}$$

where ρ denotes the rate of time preference; that is, $\beta \equiv 1/(1+\rho)$.

IV. THE NON-OPTIMALITY OF FREE TRADE

In this section we investigate the welfare effects of international trade.[12] It follows from equation (3) that the steady-state lifetime utility, U, is simply a monotone

11 We have also used the fact that log $(1+\mu) \approx \mu$. Since $M_t > 0 \forall t$, $\mu > -1$ and log $(1+\mu)$ is well defined.

12 Henceforth, we drop the subscript t from any variable that takes a constant value over time, such as p, c_1, c_2, etc.

transformation of the flow utility function; more specifically, $U = u/(1-\beta)$. To examine, the effects of trade on agent's lifetime utility, therefore, it suffices to examine its effects on $u(\cdot)$.

Substituting (19) and (21) into (5) and (6), we obtain

$$\frac{u_2}{u_1} = (1+\delta)(1+\tau)p, \tag{22}$$

where $\delta \equiv (\phi_2 - \phi_1)(\rho+\mu)/[1+\phi_1(\rho+\mu)]$. Equation (22) is a standard condition equating the marginal rate of substitution (MRS) between the two goods with their relative purchasing cost. Notice that δ gives the proportional increase or decrease in the market price, depending on whether ϕ_2 is greater or smaller than ϕ_1, owing to the monetary distortion (the CIA constraint). If $\phi_1 = \phi_2 = 0$, as is the case in a barter economy, one obtains $\delta = 0$ and the familiar condition MRS $= (1+\tau)p$. The same result also holds in the more general case, where $\phi_1 = \phi_2 > 0$.[13] Next, since $u = u(c_1, c_2)$, direct differentiation, in conjunction with (22), yields

$$dy = dc_1 + (1+\delta)(1+\tau)pdc_2, \tag{23}$$

where $dy \equiv du/u_1$ denotes the change in the economy's level of real income. Totally differentiating (15) and substituting away dc_1 in (23), we get[14]

$$dy = -(c_2 - x_2)dp + \tau pd(c_2 - x_2) + \delta(1+\tau)pdc_2. \tag{24}$$

The first term in the decomposition (24) refers to the terms-of-trade effect on real income, while the second term represents the standard distortionary effect of the tariff. The third term, which gives the effect of the monetary distortion in the presence of the CIA constraint, is the novel one. We are now in a position to analyse the welfare consequences of free trade in this monetary economy.

A necessary condition for the optimality of free trade is $dy = 0$ at $\tau = 0$. For a small economy, the terms of trade are given exogenously, and so $dp = 0$. Furthermore, under free trade, $\tau = 0$, and so the first two terms of (24) vanish within our framework. Consider next the special case of a barter economy, where $\phi_1 = \phi_2 = 0$. Then $\delta = 0$, and the whole right-hand side of (24) equals zero. This yields $dy = 0$ and free trade maximizes welfare. In general, however, $\phi_1 \neq \phi_2 \neq 0$, and so the third term in (24) will not disappear. Free trade, therefore, is no longer the first-best policy in our small monetary economy. The intuition of the non-optimality of free trade follows from the asymmetric effects that free trade has on nominal prices, which generate, in turn, countervailing forces on the CIA constraint. In particular, a decrease in p_{1t} releases the constraint, while an increase in p_{2t} tightens it. The net impact, therefore, depends on the relative weights of these two conflicting effects. Phrased differently, it depends on the magnitude of ϕ_1 relative

13 In the case of a standard CIA constraint, as, for example, in Stockman (1981), $\phi_1 = \phi_2 = 1$. This special case is also the one considered in Kemp and Wong (1995).

14 Note that $dx_1 + (1+\tau)pdx_2 = 0$, by the assumptions of profit maximization and perfect competition.

to ϕ_2 and hence on the sign of δ. The CIA framework introduced here highlights, therefore, the importance of the degree of liquidity restrictions (or of monetization) that applies to each good (market). In the case where $\phi_1 = \phi_2$, these two opposing forces cancel each other and the optimality of free trade is restored. Nevertheless, as mentioned above, this is a very strong assumption, since it rules out the possibility that consumption of one good requires larger cash balances, per unit of value, than consumption of the other good.

A geometrical demonstration of these results is given in figures 1a and 1b. Point 1 represents the equilibrium in production and consumption under autarky, whereas point 2 represents the production point under free trade in this monetary economy. Since the existence of the CIA constraint introduces only a demand-side distortion, point 2 is the production point under free trade in a barter economy as well. Point 3, on the other hand, is the free-trade consumption point in a barter economy, where MRS $= p$, while point $3'$ is the free-trade consumption point in a monetary economy, where (22) holds.

Under free trade ($\tau = 0$), depending on whether $\phi_1 < \phi_2$ or $\phi_1 > \phi_2$, the domestic relative purchasing cost of the two goods, $(1+\delta)p$, is smaller or greater than the world relative price, p. Figure 1a illustrates the case where $\phi_1 > \phi_2$, and the improvement in the terms of trade, consequent upon the unrestricted exchange of goods, magnifies the monetary distortion generated by the CIA constraint; the economy is worse off after trade. The case where $\phi_2 > \phi_1$ is depicted in figure 1b. Although free trade is preferred to autarky, policy intervention can further improve the concomitant level of welfare. In view of these results, the analysis of economic policies that can promote the society's welfare is in order.

V. OPTIMAL TRADE POLICIES

To realize the approach that one should follow in designing these policies, notice, from (22), that the non-optimality of free trade in a monetary economy arises from the divergence between the world-price ratio, p, and the domestic marginal rate of substitution, u_2/u_1, where, under competitive conditions, the latter is reflected by the free-trade domestic purchasing cost, $(1+\delta)p$. Thus, any policy that equalizes the domestic purchasing cost to the world-price ratio will also maximize society's welfare.

1. The optimal quantity of money rule

Consider first the case where $\tau = 0$ and the nominal money growth rate is set according to the optimal quantity of money rule. That is, $\mu = -\rho$, so that the nominal rate of return on bonds ($i = \mu + \rho$) equals the rate of return on money (zero). It follows, then, that $\delta = 0$. The intuition is as follows. The Friedman rule releases the CIA constraint, so that it is no longer strictly binding,[15] and hence it

15 Notice from (19) that if $i = 0$, then $\gamma_t = 0$, and hence the CIA constraint, (2), is not strictly binding.

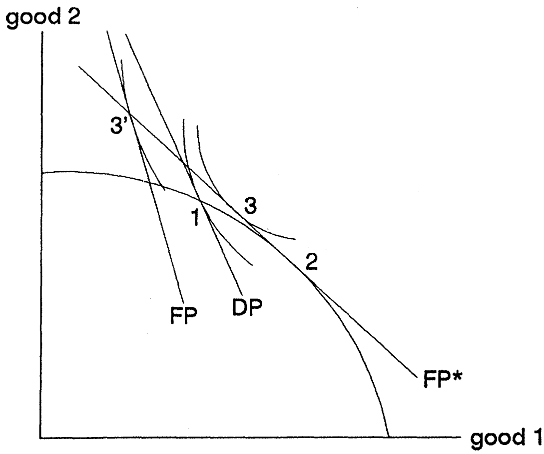

FIGURE 1a ($\phi_2 < \phi_1$) Autarky is preferred to free trade

NOTES

1 = consumption and production under autarky in a monetary economy.
2 = production under free trade in both monetary and barter economies.
3 = consumption under free trade in a barter economy.
3′ = consumption under free trade in a monetary economy.
DP (FP) = relative price under autarky (free trade) in a monetary economy.
FP* = relative price under free trade in a barter economy.

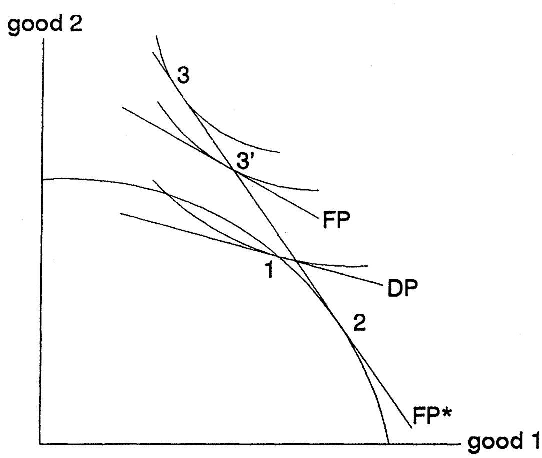

FIGURE 1b ($\phi_2 > \phi_1$) Free trade is preferred to autarky

NOTES

1 = consumption and production under autarky in a monetary economy.
2 = production under free trade in both monetary and barter economies.
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3′ = consumption under free trade in a monetary economy.
DP (FP) = relative price under autarky (free trade) in a monetary economy.
FP* = relative price under free trade in a barter economy.

removes the monetary distortion that gives rise to harmful trade.[16] Under the optimal quantity of money rule, agents no longer need to economize on their cash holdings and free trade is the optimal trade policy, even within a monetary environment. Nevertheless, the optimal quantity of money rule does not seem to be very popular among policy makers. That is why we next examine alternative trade policies that are more pragmatic.

2. A tariff

Alternatively, the government can impose a tariff rate on imports. Let E denote imports of good 2 ($E = c_2 - x_2$), and let p_h denote the domestic relative price of good 2 ($p_h = (1+\tau)p$). Then, under the small-country assumption, (24) implies

$$\frac{dy}{dp_h} = \tau p \frac{dE}{dp_h} + \delta(1+\tau)p \frac{dc_2}{dp_h}. \tag{25}$$

Also, $E = c_2(p_h, y) - x_2(p_h)$, where y denotes real income. Hence, simple differentiation yields

$$\frac{p_h}{E}\frac{dc_2}{dp_h} = -\alpha e^d + \eta \frac{1}{E}\frac{dy}{dp_h} \tag{26}$$

and

$$\varepsilon^m = \alpha e^d - \eta \frac{1}{E}\frac{dy}{dp_h} + (\alpha - 1)e^s, \tag{27}$$

where α, e^d, e^s, ε^m, and η denote, respectively, the inverse of the import share in domestic consumption of importables, the substitution elasticity of demand, the substitution elasticity of supply, the price elasticity of demand for imports, and the marginal propensity to import. They are defined as follows: $\alpha \equiv c_2/E > 1$, $e^d \equiv -(\partial c_2/\partial p_h)(p_h/c_2) > 0$, $e^s \equiv (dx_2/dp_h)(p_h/x_2) > 0$, $\varepsilon^m \equiv -(dE/dp_h)(p_h/E) > 0$, and $\eta \equiv p_h(\partial c_2/\partial y)$. Note that, in the absence of inferior goods, $\eta \in (0,1)$. Substituting (26), (27), and $p_h = (1+\tau)p$ in (25), one finds

$$\frac{dy}{d\tau} = -\left(1 - \frac{\tau\eta}{1+\tau} - \delta\eta\right)^{-1} \frac{pE}{1+\tau}\{[\tau + \delta(1+\tau)]\alpha e^d + \tau(\alpha - 1)e^s\}. \tag{28}$$

The optimal tariff is then found by setting $(dy/d\tau) = 0$ or, equivalently, $[\tau + \delta(1+\tau)]\alpha e^d + \tau(\alpha - 1)e^s = 0$, which yields

$$\tau^* = -\frac{\delta\alpha e^d}{(1+\delta)\alpha e^d + (\alpha - 1)e^s}. \tag{29}$$

16 Thus, contrary to Kemp's conjecture, to convert the loss associated with trade into a gain, it is *not* necessary 'to destroy the motive for holding cash' (1990, 30). It suffices instead to eliminate the opportunity cost of holding money. This will then destroy the motivation for economizing on money holding.

Once again, in the special case where $\phi_1 = \phi_2$, and hence $\delta = 0$ (which also characterizes a barter economy with both ϕs equal to zero), τ^* is zero and hence free trade is optimal. This is because, in this case, the tariff generates the standard consumption and production distortions that are well documented in the trade literature and hence free trade is the optimal policy. In a monetary economy where $\phi_1 \neq \phi_2$, there is an existing distortion, owing to the presence of the CIA constraint, which can be offset by manipulating the tariff rate. Thus, the optimal tariff is non-zero. Furthermore, notice from (29) that, depending on the direction of the monetary distortion – that is, depending on whether ϕ_1 is greater or smaller than ϕ_2 – the optimal tariff can be either positive or negative. More specifically, if $\phi_2 > \phi_1(<)$ – that is, if $\delta > 0(<)$ – then $\tau^* < 0(>)$.

A question arises then as to whether or not the optimal tariff is prohibitive.[17] Consider first the case depicted in figure 1b, where $\phi_2 > \phi_1$ and free trade is preferred to autarky. In this case, the optimal tariff cannot be prohibitive. In fact, it follows from (29) that the optimal tariff is negative (an export subsidy; see figure 2a, where τ_p denotes the prohibitive tariff). In the case where $\phi_2 < \phi_1$, however, as in figure 1a, free trade is inferior to autarky and thus the optimal tariff may be prohibitive (see figures 2b and 2c for the case where $\tau^* < \tau_p$ and $\tau^* = \tau_p$, respectively). To be more specific on this issue, one needs additional information on the structure of preferences and technology.

3. A consumption tax

The last instrument that we consider is a consumption tax on importables at the rate τ_c, so that the domestic relative price, p_c, can be written as $p_c = (1+\tau_c)p$. Following the same procedure used in the previous subsection, one can show that

$$\frac{dy}{dp_c} = [\tau_c + \delta(1+\tau_c)]p\,\frac{dc_2}{dp_c} \tag{30}$$

or

$$\frac{dy}{d\tau_c} = -\left(1 - \frac{\tau_c \eta}{1+\tau_c} - \delta\eta\right)^{-1} \frac{pE}{1+\tau_c}[\tau_c + \delta(1+\tau_c)]\alpha e^d. \tag{31}$$

The optimal consumption tax is then given by

$$\tau_c^* = -\frac{\delta}{1+\delta}. \tag{32}$$

Notice that $(1+\delta)(1+\tau_c^*) = 1$, so that the optimality condition MRS $= p$ is restored. Furthermore, comparing (29) and (32), one can conclude that the absolute value of

17 We thank an anonymous referee for bringing this point to our attention. Note that in the standard neoclassical trade framework, the optimal tariff cannot be prohibitive because free trade is preferred to autarky.

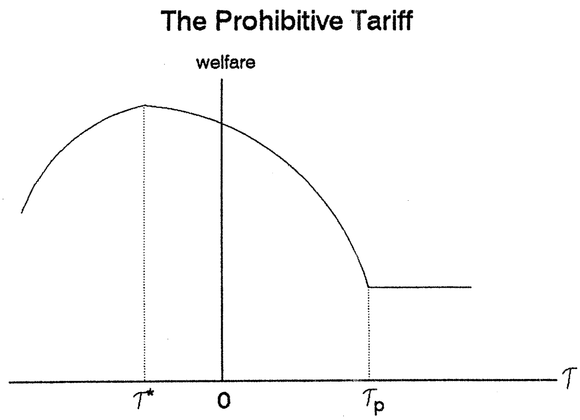

FIGURE 2a ($\phi_2 > \phi_1$, $\tau_p > 0 > \tau^*$)

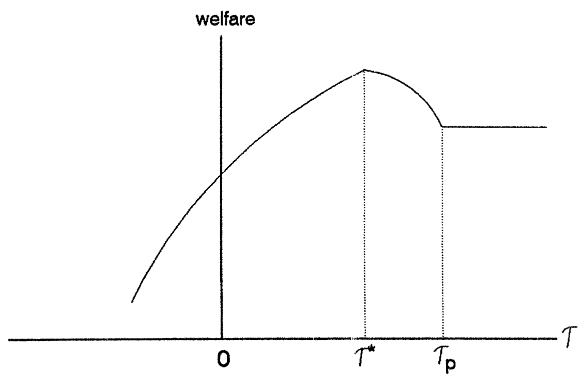

FIGURE 2b ($\phi_2 < \phi_1$, $\tau_p > \tau^* > 0$)

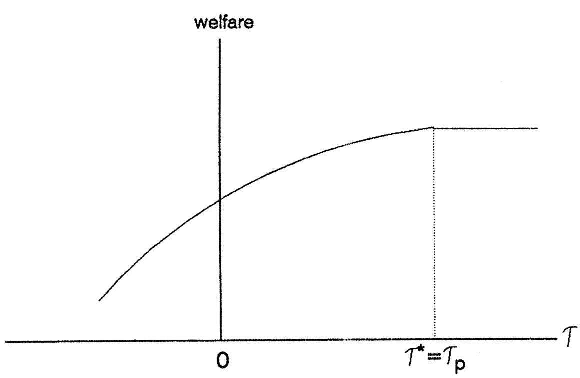

FIGURE 2c ($\phi_2 < \phi_1$, $\tau_p = \tau^* > 0$)

the optimal consumption tax serves as a supremum for the optimal tariff (τ_u^*); that is,

$$|\tau^*| = \left|\frac{\delta\alpha e^d}{(1+\delta)\alpha e^d + (\alpha - 1)e^s}\right| < \left|\frac{\delta}{(1+\delta)}\right| \equiv |\tau_u^*| = |\tau_c^*|. \tag{29'}$$

In particular, if the substitution elasticity of supply (e^s) is zero, then there is no production distortion loss and a tariff acts as a consumption tax.

Finally, we compare the welfare effect of a tariff with that of a consumption tax. Note, in particular, that a consumption tax is Pareto superior to a tariff, since the CIA constraint introduces a demand-side distortion making the consumption tax unavoidable. A tariff affects the consumption as well as the production side of the economy, however, thus creating unnecessary divergence between the given world-price ratio and the domestic marginal rate of transformation. Indeed, if $\tau_c = \tau$, then

$$\frac{dy}{d\tau_c} - \frac{dy}{d\tau} = \frac{1}{u_1}\left(\frac{du}{d\tau_c} - \frac{du}{d\tau}\right) = \left(1 - \frac{\tau\eta}{1+\tau} - \delta\eta\right)^{-1}\frac{\tau p E}{1+\tau}(\alpha - 1)e^s$$

$$= \tau p\,\frac{dx_2}{d\tau} > 0,$$

where the second equality follows after (25) and (30) are used.

VI. CALIBRATION

To assess the magnitude of the optimal policies, we next perform a simple calibration exercise. We begin with the optimal consumption tax, (τ_c^*), given by equation (32). For this, we set the value of the rate of time preference (ρ) equal to 0.03, a value commonly used in many simulation exercises (e.g., Davies and Whalley 1991). For the nominal money growth rate (μ), we use to alternative values, 0.0711 and 0.114. The first value is the average money growth rate for the Canadian economy in the period 1950–94 (International Financial Statistics, CD ROM), while the second value is the median money growth rate for eighty-three countries in the post World War II period (see Barro 1984, table 7.1). Finally, we assume $\phi_1 = 0.5$ and let ϕ_2 range from 0 to 1. Table 1 summarizes the calibration estimates for τ_c^*. Not only are these results interesting in their own right, but they also provide a range for the optimal tariff (see equation (29′)). According to table 1, τ_c^* ranges between −4.59 per cent to 5.06 per cent when $\mu = 7.11$ per cent and from −6.29 per cent to 7.20 per cent when $\mu = 11.4$ per cent. These estimates suggest that the optimal value for a consumption tax (or for a tariff) is in general small.[18] Furthermore, an increase in μ or in $|\phi_2 - \phi_1|$ raises the (absolute) value of δ (the mark-up that

18 When $\rho = 0.03$ and $\mu = 7.11$ per cent (11.4 per cent), the maximum value of the optimal consumption tax is 10.11 per cent (14.4 per cent). This, of course, occurs in this extreme case where $\phi_1 = 1$ and $\phi_2 = 0$.

TABLE 1
The optimal consumption tax (per cent)

ϕ_2	$\mu = 7.11$ per cent	$\mu = 11.4$ per cent
1.00	−4.59	−6.29
0.75	−2.35	−3.25
0.50	0.00	0.00
0.25	2.47	3.48
0.00	5.06	7.20

NOTE: $\phi_1 = 0.5$; $\rho = 0.03$.

is added to the producer's price, owing to the existence of the CIA constraint). Hence, a higher consumption tax/subsidy is needed to offset this increase in δ.

To further assess the magnitude of the optimal tariff, given by equation (29), we need to specify the value of the inverse of the import share in domestic consumption of c_2 (α), as well as the values of the substitution elasticities of demand and supply (e^d and e^s). We set the value of α equal to 3 and, based on Philips (1983, tables 4.4 and 7.2), let e^d range from 0.2 to 2.[19] For the value of e^s, however, we follow an indirect approach, since, to our knowledge, no econometric study is available. More specifically, combining equations (25) (in elasticity form) and (29) yields the following equation for e^s:

$$e^s = \frac{e^d(\varepsilon^m - \alpha\varepsilon^d)}{(\alpha - 1)\varepsilon^d},$$

where ε^d denotes the uncompensated elasticity of demand. Phlips (1983, tables 4.5 and 7.2) provides estimates of ε^d, for various commodity groups, which range from 0.4 to 1.7. Stern, Francis, and Schumacher (1976, table 2.1), on the other hand, suggest, from a basis of numerous econometric studies, values for the Canadian elasticities of import demands that fall within the interval 0.52–2.06. Using these estimates, we set the value 2.15 as an upper bound for e^s. Tables 2a and 2b summarize the calibration results for different values of μ, e^d, e^s, and ϕ_2. Changes in μ or in $|\phi_2 - \phi_1|$ affect the optimal tariff through the same channel as they use to affect the optimal consumption tax, namely, the mark-up δ. Moreover, an increase in e^s raises the production distortion loss and hence lowers the optimal tariff. Finally, notice that the optimal tariff/export subsidy responds positively to an increase in e^d. This result is in constrast to the one found in the traditional optimal tariff literature, where increases in e^d raise the consumption distortion loss of a

19 We have calculated the value of α in 1989 for various agricultural and mineral products (the data were obtained from UNCTAD 1991). Accordingly, α ranges from 1.35 to 6.07 in the world economy and from 1 to 3.63 in the Canadian economy. Armington (1970) adopts the value $\alpha = 2$. Melo and Tarr (1992), on the other hand, consider three alternative values for the import share (in value) of total supply, a variable that approximates the term $1/(\alpha - 1)$, 0.9, 0.5, and 0.1. Nevertheless, we have found that our estimates are rather insensitive to significant changes in α.

TABLE 2a
The optimal tariff (per cent)

ϕ_2	e^d	$\mu = 7.11$ per cent	$\mu = 11.4$ per cent
1.00	2.0	−3.48	−4.80
1.00	1.0	−2.81	−3.87
1.00	0.2	−1.10	−1.53
0.00	2.0	3.74	5.31
0.00	1.0	2.97	4.20
0.00	0.2	1.12	1.57

NOTE: $\phi_1 = 0.5$; $\rho = 0.03$; and $e^s = 1$.

TABLE 2b
The optimal tariff (per cent)

ϕ_2	e^s	$\mu = 7.11$ per cent	$\mu = 11.4$ per cent
1.00	2.15	−1.50	−2.69
1.00	1.00	−2.81	−3.87
1.00	0.01	−4.56	−6.26
0.00	2.15	1.54	2.84
0.00	1.00	2.97	4.20
0.00	0.01	5.02	7.15

NOTE: $\phi_1 = 0.5$; $\rho = 0.03$; and $e^d = 1$.

tariff and hence lower its optimal value. In the present framework, a higher value of e^d raises the consumption loss, but it also results in an increase of the beneficial effect of a tariff. Since the loss consists of two parts (consumption and production), the increase in the benefit is proportionately higher and hence the (absolute) value of the optimal tariff increases.

VII. CONCLUDING REMARKS

We have developed a tractable integrated framework for the simultaneous consideration of trade and monetary issues. Within such a framework we have examined the effects of free trade for a small monetary economy and have shown that if the consumption of exportables requires larger (smaller) cash balances than the consumption of importables, then free trade is harmful (gainful) compared with a no-trade situation. In either case, policy intervention can improve the country's social welfare. Examples of such intervention include the optimal quantity of money rule, a tariff, and a consumption tax. Finally, we have performed a simple calibration exercise, which suggests that the optimal values of these instruments are, in general, small.

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