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Uniform Trade Taxes, Devaluation, and the Real Exchange Rate

A Theoretical Analysis

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Theoretically, uniform trade taxes (uniform tariff-cum-subsidies) are equivalent in effect to devaluations of the commercial rate in a dual exchange rate system — if one disregards smuggling and customs fraud. When either form of illegal trade is factored in, this equivalence is broken, and the real exchange rate may actually appreciate in response to an increase in the uniform trade tax rate. When illegal trade takes the form of customs fraud, the rate for exportables will depreciate, but the rate for importables will appreciate.

The author of this paper analyzes the macroeconomics of uniform trade taxes — uniform tariff-cum-subsidies, or UTCSs — by comparing UTCS policies as an alternative to devaluation of the exchange rate.

The model he sets up establishes a basic equivalence between UTCS schemes and devaluation of the commercial rate in a dual exchange rate system. This equivalence disappears when smuggling and customs fraud are incorporated into the model.

In the flexible price, full employment world of the model, a UTCS scheme can change the real exchange rate if either smuggling or customs fraud is going on. What is striking, however, is that when smuggling is factored in, using a UTCS to raise the relative domestic price of traded goods may backfire and actually appreciate the real exchange rate. If customs fraud is factored in, the real exchange rate will appreciate for importables but will depreciate for exportables.

The author suggests further extensions to his model for a reasonably full understanding of the macroeconomics of UTCS schemes. First, he would incorporate distortionary means of

government finance into the analysis of illegal trade. One of the primary results of a UTCS scheme, when there is illegal trade, is to transfer income from the public to the private sector. This revenue shock is likely to add to the welfare burden of the UTCS scheme, when the government cannot levy lump-sum taxes.

Second, he would add investment to the model and investigate the relationship between investment response, the real exchange rate, and fiscal revenues under a UTCS when the government does not have lump-sum taxes. The tariff component of a UTCS satisfies the government's relative price and revenue objectives simultaneously, but the export subsidy component brings out a conflict between the two objectives. The government may therefore have an incentive to renege on the export subsidy component of the package.

Finally, a parity change (devaluation) or a UTCS scheme could be used to alleviate transitional unemployment due to sticky nominal wages in the short run. The author suggests examining the tradeoffs between the direct contractionary effects of the two policies and their expansionary effect through the tradeables product wage.

This paper is a product of the Macroeconomic Adjustment and Growth Division, Country Economics Department. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Aludia Oropesa, room N11-055, extension 61758 (47 pages with charts).

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Introduction

The purpose of this paper is to analyze the macroeconomics of uniform trade taxes under capital mobility and currency convertibility. Since uniform tariff-cum-subsidy (UTCS) policies are often proposed as alternatives to devaluation of the exchange rate, we emphasize the comparison between these alternatives, as well as the intermediate case of a dual exchange rate system. We do the analysis in a two-period, representative consumer framework, in order to bring out the importance of the time path of the alternative policies. The model is idealized in most respects, but should serve as a useful benchmark for further analysis in more realistic settings.¹

The paper is organized as follows. In Section 1, we set up a model based on Adams and Greenwood (1985), with exogenous output, lump-sum taxes, no government spending, and perfect capital mobility. The model is aimed at

¹ This paper was motivated by the UTCS scheme recently instituted in Cote d'Ivoire. Cote d'Ivoire is a member of the West African Monetary Union, a group of countries whose common currency (the CFA franc) is freely convertible into French francs by agreement with the French Treasury, which guarantees convertibility by extending overdraft privileges to the Union's Central Bank (see Krumm (1985)). Increases in domestic inflation starting in the mid 1970s, together with the recent nominal appreciation of the French franc and significant nominal depreciations in neighboring Ghana and Nigeria, have produced real appreciations in Cote d'Ivoire and a number of other CFA countries. This has led a number of authors (e.g., Krumm (1987), Devarajan and de Melo (1987)) to suggest that an optimal macroeconomic policy package would include a devaluation of the nominal exchange rate, if it were not for Cote d'Ivoire's responsibilities to the CFA Zone. The argument, and the rationale for the UTCS scheme that is currently in place in lieu of a parity change, is that sluggishness of domestic price adjustments is making adjustment to terms of trade shocks and international borrowing shocks excessively contractionary. Initial experience with the UTCS has not been encouraging, however; there is anecdotal evidence of widespread overinvoicing of imports, and there has been late payment by the government of the export subsidy. The purpose of this paper is to provide a theoretical framework in which these and other macroeconomic aspects of UTCS schemes can be analyzed. We assume perfect capital mobility because the CFA countries have minimal capital controls regarding transfers with France, and therefore "import" the relatively free French regime regarding capital account transactions.

distinguishing the real balance and real interest rate effects of the alternative policies, and forms the basis for later sections. We show that in this model, a UTCS is identical in all real respects to a devaluation of the commercial exchange rate in a dual exchange rate system. Both policies impose capital losses on all existing financial wealth, both change the real interest rate only if they are anticipated to be temporary, and neither affects the domestic nominal interest rate.

Section 2 adds a nontraded good to the model in order to study real exchange rate effects. When prices are flexible, permanent changes in exchange rates or uniform trade taxes feed directly through to the price of nontradeables, leaving the domestic price of traded goods relative to nontradeds unaffected. Temporary policies, in contrast, affect the current real exchange rate by altering the real interest rate.

The results of Sections 1 and 2 establish a basic equivalence between UTCS schemes and devaluations of the commercial rate in a dual exchange rate system. Sections 3 and 4 demonstrate that this equivalence is broken in the presence of illegal trade. We deemphasize monetary and intertemporal considerations here and analyze a simple three-sector model augmented to incorporate illegal trade.

In Section 3, we model traditional smuggling as an activity using up domestic resources. We show that an increase in trade taxes drives down real income by drawing resources into smuggling, thereby producing negative supply and demand shocks in both the tradeables and the nontradeables sectors. The effect of this on the real exchange rate is ambiguous; if the nontradeables sector has a relatively low income elasticity of demand or a relatively high cross-elasticity of supply with respect to the UTCS rate, a rise in the UTCS

rate will actually appreciate the real exchange rate, rather than achieving the desired depreciation. Equivalence with exchange rate changes is broken as long as prices are flexible, since a depreciation of the commercial rate does not alter the wedge (if any) between international and domestic prices of traded goods and thus does not increase incentives for illegal trade.

Section 4 deals with customs fraud, which does not use real resources but affects the real exchange rate through its effect on the relative price of traded goods. We show that a rise in the UTCS rate raises the tax/subsidy-inclusive terms of trade, leading to a reallocation of resources toward/s exportables and a rise in the price of nontradeables relative to importables.

Section 5 gives a brief discussion of the role that devaluations and UTCS schemes can play in alleviating transitional unemployment after a contractionary economic shock. Section 6 concludes the paper.

1. A Two-Period Model

As in Adams and Greenwood (1985), the representative consumer maximizes

$$(1) \quad U(\cdot) = U(c_1) + \beta U(c_2),$$

where c_t is consumption of an imported good, subject to the intertemporal budget constraint. Financial wealth can be held in the form of domestic money or interest-bearing foreign nominal bonds. Domestic money is held to economize on transactions costs; if real income and money balances in terms of imports are y_t and m_t , then transactions costs are $v(m_t/y_t)y_t$, where $v' \leq 0$, $v'' > 0$, and $v \in [0,1]$. A proportion $v(\cdot)$ of output is therefore lost due to

transactions costs.²

The government has four instruments in period t : (1) the commercial exchange rate, E_t ; (2) the financial exchange rate, e_t ; (3) a uniform ad-valorem tariff/subsidy rate s_t applying to imports and exports; and (4) lump-sum taxes, T_t . The private sector's budget constraint in period $t-1,2$ reads

$$(2) \quad P_t c_t - [1 - v(\frac{M_t}{P_{xt} X_t})] P_{xt} X_t - T_t - (M_t - M_{t-1}) + e_t i_t^* B_{t-1} - e_t (B_t - B_{t-1}),$$

where $P_t = (1+s_t)E_t P_t^*$ and $P_{xt} = (1+s_t)E_t P_{xt}^*$ are the domestic prices of the importable and exportable, M_t is the nominal money stock, X_t is the economy's endowment of the exportable good, i_t^* is the foreign nominal interest rate, and B_t is the private sector's holding of foreign nominal bonds.³

Deflating by the before-tariff price of importables, $E_t P_t^*$, and defining $g_t = (E_t - e_t)/e_t$ as the percentage gap between the commercial and financial exchange rates, the budget constraints in real terms for periods 1 and 2 are

$$(3a) \quad (1+s_1)c_1 - [1 - v(\frac{m_1}{(1+s_1)y_1})](1+s_1)y_1 - r_1 - m_1 - \frac{b_1}{(1+g_1)} + a_0$$

$$(3b) \quad (1+s_2)c_2 - [1 - v(\frac{m_2}{(1+s_2)y_2})](1+s_2)y_2 - r_2 - m_2 + \frac{m_1}{(1+g_2)(1+r_2^*)} + \frac{(1+r_2^*)b_1}{(1+g_2)},$$

² m_t is end-of-period real money balances.

³ We assume in (2) that there are no illegal transactions. See Sections 3 and 4 below.

where $y_t = P_{xt}X_t/E_tP_t^* - (1+s_t)(P_{xt}^*/P_t^*)X_t$ is the real value of output, r_t and b_t are the real values of lump-sum taxes and foreign bondholdings, $\pi_t^* = (P_t^* - P_{t-1}^*)/P_{t-1}^*$ is the foreign inflation rate, $g_t = (E_t - E_{t-1})/E_{t-1}$ is the rate of depreciation of the commercial exchange rate, and a_0 is the real value of initial financial wealth:

$$(4) \quad a_0 = \frac{M_0}{E_1P_1^*} + \frac{e_1(1+i_1^*)B_0}{E_1P_1^*} = \frac{m_0}{(1+g_1)(1+\pi_1^*)} + \frac{(1+r_1^*)b_0}{(1+g_1)}$$

Notice that we have imposed the terminal condition $B_2 = 0$ in writing (3b).

However, $m_2 > 0$; money is still held at the end of period 2 since transactions services during the period depend on end-of-period money balances.

Equation (2) implies that a unit of consumption invested in foreign bonds in period $t-1$ yields $(P_{t-1}/e_{t-1})(1+i_t^*)(e_t/P_t)$ units of consumption in period t . Substituting for the domestic price of the importable using $P_t = E_t(1+s_t)P_t^*$, the real consumption rate of interest is therefore given by

$$(5) \quad 1+r_t = \frac{(1+i_t^*)(1+s_{t-1})(1+g_{t-1})}{(1+\pi_t^*)(1+s_t)(1+g_t)} = \frac{(1+r_t^*)}{(1+\delta_t)(1+\gamma_t)}$$

as one can confirm by eliminating b_1 from equations (3a) and (3b). To get the second equality in (5), we defined growth rates δ and γ in the trade tax factor $(1+s)$ and the relative exchange rate factor $(1+g)$:

$$(1+\delta_t) = (1+s_t)/(1+s_{t-1}), \quad (1+\gamma_t) = (1+g_t)/(1+g_{t-1}).^4$$

Consumption and money demands are characterized by equality in the budget constraints and the following three first-order conditions:

$$(6a) \quad U'(c_1) = \beta(1+r_2)U'(c_2)$$

$$(6b) \quad -v' \left(\frac{m_1}{(1+s_1)y_1} \right) = \frac{i_2}{1+i_2}, \quad (1+i_2) = (1+i_2^*)(1+\hat{s}_2)$$

$$(6c) \quad -v' \left(\frac{m_2}{(1+s_2)y_2} \right) = 1.$$

Equations (6b) and (6c) yield money demand functions $m_1 = h(i_2)(1+s_1)y_1$ and $m_2 = k \cdot (1+s_2)y_2$, where $h' < 0$ and $k > 0$. Velocity is constant in period 2 because there is no financial opportunity cost to holding money in that period; real balances are increased until the marginal saving in transactions cost is equal to one unit of foregone consumption.

Although the domestic real interest rate is sufficient to determine the "tilt" of private consumption path by (6a), the private sector must know the time path of taxes (r_1, r_2) in order to determine its overall wealth and therefore the "level" of the consumption path. This leads us to an examination of the government budget.

Government

The government faces two constraints in each period: the central bank

⁴ Notice that $(1+\gamma_t) = (1+\hat{E}_t)/(1+\hat{\delta}_t)$, where \hat{E}_t and $\hat{\delta}_t$ are the rates of depreciation of the commercial and financial exchange rate, respectively.

balance sheet and the public finance constraint. The central bank balance sheet states that money creation is the result of foreign exchange intervention or domestic credit expansion. In nominal terms,

$$(7) \quad \Delta M_t = \Delta DC_t + E_t \Delta F_t,$$

where ΔF_t is the amount of international reserves (foreign bonds) acquired through exchange market intervention and ΔDC is the change in domestic credit to the government.⁵

In real terms, the central bank balance sheet is given by

$$(8) \quad m_t - m_{t-1}/(1+E_t)(1+\pi_t^*) = \mu_t + f_t - f_{t-1}/(1+\pi_t^*).$$

The government finance constraint states that the difference between expenditure and revenue must be made up by domestic credit creation and foreign borrowing. In nominal terms,

$$(9) \quad \Delta DC_t = G_t - T_t - \Phi_t - \Gamma_t - e_t i_t^* (B_{t-1}^G + F_{t-1}) + E_t (B_t^G - B_{t-1}^G),$$

where G_t and T_t are government consumption and lump-sum taxes, respectively, Φ_t is the value of central bank profits from exchange intervention, $\Gamma_t = E_t s_t P_t^* [c_t - (1-v(t))y_t]$ is the value of trade taxes, and B_t^G is foreign lending by the government.

⁵ We assume that capital gains and losses due to exchange rate changes are not monetized. Thus, if F_{t-1} is the initial value of foreign exchange holdings, the change in the domestic currency value of reserves is $E_t F_t - E_{t-1} F_{t-1} = \Delta E_t F_{t-1} + E_t \Delta F_t = EEA_t + \Delta F_t$, where $EEA_t = \Delta E_t F_{t-1}$ is the exchange equalization account, entered as a liability to offset $\Delta E_t F_{t-1}$ on the central bank's balance sheet.

The term ϕ_t requires some explanation. When the central bank makes transactions at more than one exchange rate, there will generally be a difference between the central bank's valuation of foreign exchange acquired through intervention and the amount of domestic currency actually used in the intervention. We denote by ϕ the excess of the former over the latter. In period 1, for example, ϕ is given by

$$(10) \quad \phi_1 = (E_1 - e_1)[i_0^* B_0 - (B_1 - B_0)]$$

We assume in equation (9) that both ϕ and interest on the central bank's foreign exchange holdings are transferred directly to the government account and therefore reduce domestic credit requirements one-for-one.

In real terms, and using the shorthand $v(t) = v(m_t/(1+s_t)y_t)$, the finance constraint reads

$$(11) \quad \mu_t = g_t - r_t - \phi_t - s_t[c_t - (1-v(t))y_t] + r_t^*(b_{t-1}^G - f_{t-1}) + b_t^G - b_{t-1}^G.$$

The terminal constraints facing the government are $b_2^G, f_2 \geq 0$. Imposing these with equality, and eliminating μ_t from (8) and (11), we have the following consolidated government budget constraints for periods 1 and 2:

$$(12a) \quad r_1 = g_1 - \phi_1 - s_1[c_1 - (1-v(1))y_1] - \left[m_1 - \frac{m_0}{(1+E_1)(1+\pi_1^*)} \right] \\ + (f_1 + b_1^G) - (1+r_1^*)(f_0 + b_0^G).$$

$$(12b) \quad r_2 = \xi_2 - \phi_2 - s_2 [c_2 \cdot (1-v(1))] y_2 - \left[m_2 - \frac{m_1}{(1+\xi_2)(1+\pi_2^*)} \right] \\ - (1+r_2^*)(f_1 + b_1^G) .$$

The interpretation of these equations is straightforward: lump-sum taxes pay for government expenditure and accumulation of external assets by the government in each period, but consumers receive a rebate of central bank profits, trade taxes, seigniorage revenues, and interest on the net external assets of the government.⁶

The government's intertemporal constraint can be derived by eliminating net official net foreign assets ($b_1^G + f_1$) from (12a) and (12b). Notice that the government always trades off consumption in the two periods at the world real interest rate r_2^* . This means that when there is a variable dual exchange rate system or temporary UTCS in place, the government and private sector face different real interest rates. Ricardian equivalence therefore fails in this situation. As we will see, this provides a channel for real effects of the various policies even in the absence of other frictions like sticky prices.

Policy alternatives

We can now use equations (3) - (6) and (12) to study the differences between the various alternative policies. We consider permanent and temporary policies in turn, under the assumption that the policies are unanticipated but

⁶ One can substitute (11) into (3) to verify that the balance of payments identity holds period-by-period; for period 1, for example, we get $([1-v(1)]y_1 - c_1 - g_1 + (1+r_1^*)(b_0 + f_0)) + (b_0 - b_1) = f_1 - f_0$, which states that the current account (the term in ()) plus the capital account ($b_0 - b_1$) equals the change in reserves.

that perfect foresight holds once the policies are in place.

Permanent policies

Consider first an unanticipated UTCS or change in exchange rates that occurs in period 1 and is understood to be permanent. Since no future trade tax or exchange rate changes are implied, both δ_2 and γ_2 are zero in equation (5). Permanent policies therefore have no effect on the real interest rate. From (6a), this means that any effect on current consumption levels must operate through changes in the consumer's initial wealth.

To see how the wealth effects of the alternatives differ, rewrite the real value of initial financial wealth as follows:

$$(13) \quad \frac{a_0}{(1+s_1)} = \frac{1}{(1+\delta_1)} \left\{ \frac{m_0/(1+s_0)}{(1+\hat{E}_1)(1+\pi_1^*)} + \frac{(1+r_1^*)b_0/(1+s_0)}{(1+\gamma_1)} \right\}.$$

where b_0 and m_0 are real values of initial money and foreign bond holdings. An across-the board devaluation ($\delta_1 - \gamma_1 = 0$, $\hat{E} > 0$) has the familiar effect of imposing a capital loss on domestic currency holdings. Installation of a dual exchange rate, with the financial rate appreciated relative to the unchanged commercial rate ($\delta_1 - \hat{E} = 0$, $\gamma_1 > 0$) produces a capital loss for holders of foreign assets but does not affect the real value of wealth denominated in domestic currency. A UTCS ($\hat{E}_1 - \gamma_1 = 0$, $\delta_1 > 0$) or devaluation of the commercial rate in a dual system ($\delta_1 = 0$, $\hat{E}_1 - \gamma_1 > 0$) imposes an equal percentage capital loss on all financial wealth.

Since the capital losses above do not represent changes in the economy's trading opportunities with the rest of the world, and in the current model do not affect output (which is exogenous), they do not represent changes in

consumption possibilities for the economy as a whole. They will therefore have no effect on consumption levels as long as the private sector correctly foresees the accompanying taxes and faces the same real interest rate as the public sector. Both of these conditions hold here, the first from perfect foresight, and the second from the fact that the policies are permanent.

Effects on money demand, and therefore (given the path of domestic credit) on the balance of payments, will depend on what happens to the nominal interest rate. Since interest parity holds, i_2 moves one-for-one with anticipated depreciation of the financial exchange rate. This means that permanent policies have no effect on real money demand, since they do not affect anticipations regarding changes in the financial exchange rate. These policies lower the real money supply on impact, however, thereby producing an excess demand for money and a corresponding balance of payments surplus.

The rebuilding of money balances by the private sector happens instantly, however, and has no real effects given the frictionless environment and perfect capital mobility. To restore the initial level of real money balances, the private sector simply sells foreign bonds to the central bank in return for domestic currency. These foreign exchange market interventions by the central bank change the distribution of domestic holdings of foreign bonds, but not the overall amount held. Since the private sector internalizes the government budget constraint, the desired increase in liquidity is achieved with no loss in real wealth.⁷

⁷ The result that devaluations are neutral even in the short run under perfect capital mobility and Ricardian equivalence is due to Obstfeld (1981, 1986a). It is important for this neutrality result that central bank reserves earn interest, that prices are flexible, and that the private sector has the same planning horizon as the government.

Temporary policies

Equation (5) makes three things clear. First, as long as there is some prospect that tariff/subsidy levels will change over time (i.e., $\delta_2 \neq 0$), a UTCS alters the real interest rate facing the private sector. A UTCS that is announced today but believed to be temporary ($s_1 > 0$ and $s_2 = 0$, so $\delta_2 < 0$) makes consumption today expensive relative to consumption in the future; if substitution effects dominate wealth effects, this rise in the real interest rate will mean an improvement in the current account.

Second, a temporary UTCS is equivalent in its effects on the real interest rate to an anticipated change in the gap between the commercial and the financial exchange rates in a dual exchange rate system. This is apparent from the interchangeability of δ and γ in (5): any time pattern of wedges (g_1, g_2) between the commercial and financial rate can be reproduced by a combination (s_1, s_2) of uniform trade taxes. A temporary UTCS therefore works just like an expected depreciation of the financial rate (with the commercial rate fixed) or an expected appreciation of the commercial rate (with the financial rate held fixed).

Finally, a temporary UTCS and a variable dual exchange rate system are equivalent in their effect on the real interest rate to a subsidy to foreign lending. To see this, simply rewrite (5) as $(1+r_2) = (1+r_2^*)(1 - [\delta_2/(1+\delta_2)])(1 - [\gamma_2/(1+\gamma_2)])$; setting $\gamma_2 = 0$ (for example), a subsidy at rate s on principal and interest income from international lending has exactly the same effect on the real interest rate as a temporary UTCS satisfying -

$$\delta_2/(1+\delta_2) = s. \text{ }^8, \text{ }^9$$

⁸ The equivalence of a dual exchange rate system to a tax on principal and interest on foreign bonds is emphasized by Adams and Greenwood (1985).

A temporary UTCS will therefore tend to raise the real interest rate and produce a current account improvement (the opposite would occur if the tariff/subsidy level were expected to rise). What about effects on the balance of payments? Again, by interest parity, the domestic nominal interest rate is governed by anticipated movements in the exchange rate applied to financial transactions. A UTCS will therefore have portfolio implications only if it changes expectations regarding future changes in the financial exchange rate. In the absence of such effects, real money demand will be unchanged, and the balance of payments improvement (given the path of nominal domestic credit) will be identical to the improvement under a permanent UTCS.¹⁰

Potential importance of portfolio effects

The balance of payments effects of temporary and permanent UTCS policies depend crucially on how these policies affect expectations regarding the financial exchange rate. Although our model is too stylized to address this issue formally, it is worth noting here that important portfolio issues may arise if implementation of a UTCS serves as a signal of an underlying balance of payments problem. The mechanism is simple: to the degree that the tax policy raises subjective probabilities of devaluation of the financial rate (either alone or as part of an across-the-board devaluation), it will raise

⁹ Note that the effect of $\hat{\epsilon}$ on the real interest rate can be circumvented by increasing the lag between delivery and payment for imports and exports. A UTCS, on the other hand, can only be circumvented by smuggling or faked invoicing (see Sections 3 and 4 below).

¹⁰ The change in the private capital account, however, will depend on how large a current account improvement is produced by the higher real interest rate; if the current account improves sufficiently, the private capital account may even improve, in contrast to the permanent UTCS case.

the domestic interest rate and cause a portfolio shift away from domestic currency towards foreign bonds. If the interest elasticity of money demand is high enough (in the current model, this depends on the curvature of $v(\cdot)$), the overall balance of payments may well deteriorate. If there is a limit on international borrowing by the central bank, it may be impossible (without other policy action) for the authorities to rule out an equilibrium in which implementation of the UTCS leads to self-fulfilling expectations of a balance of payments crisis and devaluation of the financial rate.

2. Nontraded goods and the real exchange rate

Suppose now that the economy receives an endowment in each period of a second, nontraded consumption good. The real exchange rate is given by the price of the nontraded good relative to the price of the importable:

$$(14) \quad q_t = \frac{P_{nt}}{E_t(1+s_t)P_t^*}$$

Budget constraints are identical to before, except that current real consumption is now $c_t = c_t^T + q_t c_t^N$ and real income at international prices is $y_t = (P_{xt}^*/P_t^*)X_t + q_t N_t$, where N_t is the endowment of the nontraded good. First-order conditions are as given in (6), along with the conditions $U_{Nt} = q_t U_{Tt}$ characterizing the optimal within-period allocation of consumption (U_{jt} is the partial derivative of the within-period utility function $U(c_N, c_T)$ with respect to c_j).

Consider using the three alternative policies (across-the-board devaluation, devaluation of the commercial rate relative to the financial rate in a dual system, or UTCS) to achieve a given depreciation in the real

exchange rate on impact. As before, if these policies are regarded as permanent, there will be no effect on the real rate of interest expressed in terms of imports. A variable UTCS, however, or an anticipated change in the wedge between the commercial and financial rates, will change the real interest rate. As in the earlier case, an anticipated depreciation (appreciation) of the financial rate relative to the commercial rate or an anticipated decrease (increase) in the tariff/subsidy rate will raise the real interest rate expressed in terms of imports.

As emphasized by Dornbusch (1983), what happens to the current account as a result of these policies will depend on what happens to the price of nontraded goods. An increase in the rate of appreciation of the real exchange rate will tend to reduce the real consumption rate of interest and worsen the current account, while a fall in the rate of appreciation will tend to increase the real interest rate and improve the current account.

3. Illegal Trade and UTCS Schemes, I: Smuggling

Any tax scheme sets up incentives for evasion. The possibility of evasion matters for at least three reasons: (1) evasion may use up real resources, both in the attempt to evade and in enforcement; (2) successful evasion may alter the income distribution between the private and public sector; (3) successful evasion may affect the relative prices facing agents at the margin, and thus undermine the resource allocation objectives of the original policy.¹¹

There are many possible forms that illegal transactions might take, given the government interventions that we are studying. In the dual exchange rate

¹¹ Note that (2) and (3) do not necessarily represent social costs.

system, for example, although the budget constraints (2) are written under the assumption that foreign bonds can only be accumulated by first acquiring foreign exchange at the financial rate from the central bank, it may be possible for importers or exporters to borrow and lend internationally at a different real interest rate simply by increasing the lag between shipment and payment.¹² Moreover, the coexistence of two separate exchange rates in a dual system may even set up opportunities for pure arbitrage.¹³

With respect to trade taxes, the key assumption in equation (2) is that smuggling and customs fraud are ruled out. In this section and the next, we ask how the possibility of illegal transactions alters the conclusions of Sections 1 and 2. To focus on the impact of illegal trade, we do the analysis in flexible-price, full-employment models in which the various policies have no real effects in the absence of illegal trade. Our key result is that the possibility of illegal trade breaks the equivalence we have been emphasizing between UTCS schemes and changes in the commercial exchange rate. When wages and prices are flexible, exchange rate changes may well have no impact on smuggling incentives; in contrast, the level of illegal trade is a nondecreasing function of the uniform trade tax/subsidy rate, and is strictly increasing above some minimum UTCS rate.

This lack of equivalence survives when prices or wages are sticky, as

¹² Suppose, for example, that the financial rate were expected to appreciate relative to the commercial rate ($\gamma < 1$ in equation (5)). An exporter could avoid the implied lower real interest rate by retaining export earnings from period 1 abroad and repatriating them in period 2, with interest, at the commercial rate.

¹³ Suppose that unilateral transfers from abroad take place at the commercial rate, and that the financial rate is appreciated relative to the commercial rate. Individuals can then collect the difference between the two exchange rates by smuggling out exports and receiving payment in the form of an (apparently) unrelated unilateral transfer.

long as the costs of illegal activity are denominated in traded goods. When costs are denominated partially in nontraded goods, however (as they would be, for example, if smuggling used domestic labor), price and wage stickiness provides a channel through which a devaluation can affect the incentives for illegal trade. This restores a partial equivalence between exchange rate changes and UTCS schemes. We show that equivalence is not complete, however, since a devaluation that achieves a given real depreciation on impact will have a smaller effect on smuggling incentives than the corresponding UTCS scheme.

Since intertemporal issues are secondary here, we look at one-period models of illegal trade. We also deemphasize monetary issues, since the existence of illegal trade does not add important new monetary dimensions as long as completely free convertibility is maintained (as we will assume).¹⁴

The remainder of this section is devoted to a model of "pure" smuggling in which illegal trade is carried out without the cloak of legal trade. In Section 4, we study a model of customs fraud, in which legal and illegal trade are inextricably linked. The two sections together give a fairly complete view of the effects of UTCS schemes and exchange rate changes in the presence of illegal trade.¹⁵

¹⁴ Pitt (1984) and Macedo (1987) analyze models in which tariffs and export taxes give rise to a black market. This does not occur as long as convertibility is maintained with "no questions asked" about the source or destination of foreign exchange obtained by private individuals.

¹⁵ In the classic Bhagwati and Hansen (1973) analysis, the costs of illegal trade are independent of the magnitude of legal trade. Pitt (1981) pointed out that this assumption determines some key features of the resulting equilibrium. Our first model follows the classic Bhagwati and Hansen (1973) analysis in this respect. The customs fraud model of Section 4 follows Pitt (1981) in giving a central role to the linkages between illegal and legal activity.

A Model of Smuggling

In the model of this section, a competitive smuggling industry uses domestic resources to bring goods past the customs authorities. We follow Bhagwati and Hansen (1973) in assuming that illegal trade is a completely separate activity from legal trade. The key implication of this separation is that smuggling does not affect the domestic prices of traded goods unless the marginal costs of smuggling are so low that legal trade is driven out completely. This allows us to focus on the real resource costs of illegal activity and on the income redistribution from the public to the private sector.

The addition of smuggling means that there are potentially five activities or sectors: production of the exportable and importable, production of the nontraded good, and smuggling of the exportable and importable. Since the domestic relative price of tradeables is unaffected by smuggling, however, we can consolidate tradeables into a single composite good. This leaves us with three sectors: production of tradeables and nontradeables, and smuggling of tradeables. Each sector uses domestic labor along with a sector-specific factor whose supply is fixed in the short run. Labor is perfectly mobile between sectors, so there is a single economy-wide nominal wage.

Production and smuggling

Letting the subscripts T, N and s denote the traded, nontraded and smuggling sectors, respectively, we will assume that the production functions $Q_j(L_j)$ have the properties $Q(0) = 0$, $Q' > 0$ and $Q'' < 0$. Q_s is the number of units of traded goods smuggled into the economy. We are modeling smuggling as

simply another domestic activity operating under decreasing returns to scale.¹⁶ The "price" received for a unit of smuggled goods is the wedge between the domestic and the world price of the good; as long as smuggling occurs under increasing marginal costs and legal trade is not driven out in equilibrium, the marginal source of supply of tradeables will be legal trade, and the domestic price will simply be the UTCS-inclusive world price.¹⁷ Net revenue from a unit of smuggling is therefore $E(1+s)P_T^* - EP_T^* - EsP_T^*$.¹⁸

If all activities are purely competitive, labor will be allocated so as to maximize net domestic revenue from the three activities. Denoting the maximized value of net revenues by R , we have $R = \text{Max } E(1+s)P_T^*Q_T + P_NQ_N + EsP_T^*Q_S$ subject to $L_T + L_N + L_S \leq L$, where P_T^* and Q_T are the foreign price and domestic production of tradeables, Q_S is the quantity of tradeables smuggled into the country, and L_j is the quantity of labor used in sector j . Since R is homogeneous of degree one in all prices, we can deflate by the domestic price of tradeables, $E(1+s)P_T^*$, to get real net revenue, $r(1, q, s/(1+s); L)$, where $q = P_N/E(1+s)P_T^*$ is the real exchange rate. The revenue function r has the property that its partial derivatives are the

¹⁶ By assuming that the smuggling activity uses domestic resources, we are departing from the traditional approach in which the costs of smuggling are denominated in traded goods (Bhagwati and Hansen (1973), Pitt (1981), Martin and Panagariya (1984)). Our approach is equivalent to Sheikh's (1974) assumption that smuggling requires a domestically produced nontraded good as input.

¹⁷ Since world prices of tradeables are fixed, this justifies our consolidation of imports and exports into a single composite tradeable good (it is also essential for this that the UTCS scheme itself has no direct effect on the relative price of tradeables).

¹⁸ We are proceeding as if there were a domestic market for both tradeable goods. In this case, all the smuggler has to do is to get the good into the country. When exportables are not consumed domestically, there is a separate problem of collecting the subsidy, which requires re-exporting the good. This cost would be included in the form of $Q_S(L_S)$.

supply functions for the three sectors.

Consumption and taxes

Since illegal trade leaves the price of domestic tradeables unaffected, expenditure on consumption is simply $E(1+s)P_T^*c_T + P_Nc_N$. We denote the minimized value of expenditure for any utility level U by $Z(E(1+s)P_T^*, P_N; U)$.¹⁹ Since Z is homogeneous of degree one in all prices, we can write the expenditure function in terms of tradeables as $Z/E(1+s)P_T^* = \epsilon(1, q; U)$; the partial derivatives of ϵ are the compensated demand functions.

The representative consumer has disposable income $Y - R - T$, where T is lump-sum taxes. Although smuggling is privately profitable, it does not contribute to social disposable income. This is clear when we consider the government budget constraint. Assuming that the government's only role is to collect trade taxes and rebate them as lump-sum transfers to the consumer, we have $T = s[EP_X^*(Q_X + X_s - c_X) - EP^*(c_M - Q_M - M_S)]$, where X_s , Q_X , and c_X are production, consumption, and smuggling of exports, all measured in terms of the composite tradeable good (and similarly for the importable). This implies $T = sEP_T^*[Q_T + Q_s - c_T]$, which can be further simplified by noticing that the balance of trade is zero ($Q_T = c_T$). Deflating by the domestic price of tradeables, and noting that $Q_s = r_3$, we have $\tau = [s/(1+s)]r_3$: lump-sum taxes are exactly equal to net revenues from illegal trade.²⁰ From the social point

¹⁹ We are assuming the existence of a representative consumer, which requires that preferences be identical and homothetic or that there be a benevolent government controlling the income distribution through lump-sum taxes.

²⁰ Notice that by homogeneity of degree 1 of ϵ , the consumer's disposable income, y , is given by $y = r - \tau = r_1 + qr_q + [s/(1+s)]r_3 - [s/(1+s)]r_3 = r_1 + qr_q$. Only directly productive activities contribute to social disposable income.

of view, smuggling is nothing more than a costly way of generating a redistribution of income within the private sector.

Equilibrium

The following two equations completely characterize equilibrium:

$$(15) \quad c(1, q; U) = r(1, q, \frac{s}{1+s}; L) - \frac{s}{1+s} r_3$$

$$(16) \quad c_q(1, q; U) = r_q(1, q, \frac{s}{1+s}; L)$$

The first of these states that the labor market clears, the economy is on its overall budget constraint, and the government budget constraint is satisfied; the second is the market-clearing condition for nontraded goods.

Equations (15) and (16) jointly determine q and U as functions of L and s (the third equilibrium condition, that the trade balance be zero, is implied by these two). Notice that the nominal exchange rate, E , does not appear in the equations. This means that changes in E have no real effects in this economy: any devaluation is immediately eroded by an equiproportional rise in wages and the price of nontraded goods.²¹ Notice also that when $r_3 = 0$, i.e., when the smuggling activity is prohibitively costly, the model reduces to the standard dependent economy model; in particular, q and U are determined independently of s . In the absence of smuggling, therefore, a

²¹ This would be true under price flexibility and perfect capital mobility even if money and international lending were in the model (as in Section 1).

(permanent) UTCS has no real effects, as in our previous analysis.²²

When smuggling is present, however, changes in s (in contrast to changes in E) do have real effects. Totally differentiating (15) and (16), we get

$$(17) \quad \begin{bmatrix} dq \\ dU \end{bmatrix} = \frac{1}{\Delta} \cdot \begin{bmatrix} \epsilon_{qU} & -\epsilon_U \\ r_{qq} - \epsilon_{qq} & \frac{s}{(1+s)} r_{q3} \end{bmatrix} \begin{bmatrix} -s(1+s)^{-1} r_{33} \\ r_{q3} \end{bmatrix} \cdot d\frac{s}{(1+s)}$$

where the subscripts to ϵ and r denote partial derivatives, and where $\Delta = [s/(1+s)]r_{q3}\epsilon_{qU} + \epsilon_U(r_{qq} - \epsilon_{qq}) > 0$.²³ After some algebra, we get the following expression for the change in the real exchange rate as a result of changing the UTCS level:

$$(18) \quad \frac{dq}{ds} = \frac{1}{(1+s)^2} \frac{1}{\Delta} (\epsilon_{qU} r_{13} - \epsilon_{1U} r_{q3})$$

$$(19) \quad \frac{dU}{ds} = \frac{s}{(1+s)^3} \frac{1}{\Delta} ([r_{q3}^2 - r_{qq} r_{33}] + \epsilon_{qq} r_{33})$$

Consider first the change in overall welfare due to the UTCS scheme. By convexity of the revenue function, the term in square brackets in (19) is nonpositive; this implies that the entire expression is negative, except at $s = 0$, where it is zero.²⁴ UTCS schemes are unambiguously welfare-worsening in

²² All UTCS policies are permanent here since the economy lasts only a single period.

²³ One can show that $\Delta = r_{qq}\epsilon_{1U} - r_{q1}\epsilon_{qU} - \epsilon_U\epsilon_{qq}$, which is unambiguously positive.

²⁴ Under the assumption that the marginal product of labor in smuggling goes to infinity as Q_s goes to zero, one can show that $r_{j_s} = 0$ for $s = 0$. An infinitesimal change in s starting at $s = 0$ therefore has no effect on U (or

this model: any finite increase in the UTCS rate in the presence of smuggling draws resources out of productive activities and lowers welfare.²⁵

Consider next the effect of a change in the UTCS rate on the real exchange rate. By equation (18), q appreciates or depreciates according to whether $\epsilon_{qU}/\epsilon_{1U}$ is less than or greater than r_{q3}/r_{13} (recall that $r_{1j} < 0$). Defining the income elasticity of demand for good j as μ_j and the cross-elasticity of supply in sector j with respect to $[s/(1+s)]$ as ϵ_{j3} , the condition can be written in the form²⁶

$$(20) \quad \text{sgn} \frac{dq}{ds} = \text{sgn} \left(\frac{\epsilon_{N3}}{\epsilon_{T3}} - \frac{\mu_N}{\mu_T} \right).$$

The effect on q is illustrated in Figure 1, where the real exchange rate is determined by equating relative demand to relative supply of nontradeables and tradeables. A rise in s drives up the economy-wide wage and draws labor into the smuggling activity. The effect on relative supply of nontradeables and tradeables depends on the relative cross-elasticities of supply in these

on q). For $s > 0$, r_{j3} is strictly less than zero.

²⁵ A related question is whether the smuggling is itself welfare-worsening, i.e., whether for a given UTCS rate welfare is higher or lower in the presence of smuggling. In this model, smuggling is unambiguously welfare-worsening (as in Bhagwati and Hansen (1973) when legal trade is not fully displaced). The reason is that the UTCS scheme is itself not a distortion, so that the loss of productive resources due to smuggling occurs in an undistorted economy. Sheikh (1974) analyzed the tariff case in a model similar to ours and found that the elimination of smuggling might be immiserizing -- i.e., that welfare could be higher in the presence of smuggling. This possibility would clearly extend to any non-uniform (and therefore distorting) tariff-subsidy scheme.

²⁶ The elasticities are given by $\mu_j = \epsilon_{jU}/\epsilon_{1U}$ and $\epsilon_{j3} = r_{j3}[s/(1+s)]/r_j$, $j = N, T$. In deriving (20), we use the fact that in equilibrium, $\epsilon_q = r_q$ and $\epsilon_1 = r_1$.

sectors with respect to a rise $s/(1+s)$; at the original real exchange rate, this amounts to asking which sector has a larger elasticity of supply with respect to its own product wage. The RS curve shifts to the left if the supply response is higher in nontradeables, and to the right if the response is higher in tradeables. RS is unchanged if $\epsilon_{q3}/\epsilon_{13} = 1$.

On the demand side, the movement of labor into smuggling produces a fall in disposable income. The effect of this on the RD curve depends on relative income elasticities. RD shifts to the right if $\mu_q/\mu_1 < 1$; in this case, a fall in income produces a shift in demand towards nontradeables. RD shifts to the left if nontradeables have the higher income elasticity; if $\mu_q = \mu_1$ (the case of homothetic preferences), there is no effect on RD.

A rise in s therefore has effects on both the supply and demand sides. It is quite possible that the final result for the real exchange rate will be the opposite of what was intended. We tend to get a real appreciation if (a) the income elasticity of demand for nontradeables is relatively low or (b) the cross-elasticity of supply of nontradeables with respect to the UTCS rate is relatively high in nontradeables as compared to tradeables.

Two Remarks

Remark 1. We have assumed that the marginal product of labor in the smuggling activity is infinite at $L_s = 0$. With this assumption, any finite s , regardless of how small, will call forth a movement of labor into the smuggling activity.²⁷ There are a number of cases, however, in which a small

²⁷ It is not true, however, that an infinitesimal change in s will produce a first-order shift of labor into smuggling starting at $s = 0$. An infinitesimal rise in s starting at $s = 0$ will produce a first-order increase in smuggling services, Q_s , but it will do so without drawing more than an infinitesimal amount of labor from productive sectors (and therefore without

UTCS may not provide sufficient incentives for smuggling. This would be true in our model, for example, if the marginal product of labor were (positive but) finite at $L_s = 0$, or if there were fixed costs to initiating the smuggling activity. In either of these cases, we would have $r_3 - r_{3j} = 0$ for $s < \bar{s}$, i.e., s would have to reach some critical minimum level $\bar{s} > 0$ before there would be any smuggling response. One would also get no real effects from a UTCS scheme in the short run if labor were immobile.²⁸ Of course, even in the presence of fixed costs or a finite marginal product of labor at $v = 0$, a sufficiently large UTCS, or a rise in the level of s from a positive base level with smuggling, will produce a supply shift towards smuggling.

Remark 2. The results in (18) and (19) establish an important asymmetry between uniform trade taxes and exchange rate changes in the presence of smuggling: only trade taxes have real effects. This asymmetry becomes less clear when prices or wages are sticky, since then changes in the exchange rate are capable of altering the relative return to legal and illegal activities (provided that the costs of smuggling are not denominated completely in traded goods). For example, suppose that there is unemployment due to a sticky economy-wide nominal wage, but the nontradeables price is flexible, so that the nontraded market always clears (i.e., we are on the border of the Keynesian and Classical unemployment regions in a disequilibrium framework).

Total labor demand is $L_d < L$:

affecting overall income or utility to first order).

²⁸ With immobile labor, (18) and (19) no longer hold. One can see, however, what must happen in equilibrium; nominal wages in all sectors must adjust to maintain real product wages at their original levels, and the price of nontraded must rise in direct proportion to the increase in tradeables prices. There are no real effects.

$$(20) \quad L^d = L_T \left(\frac{W}{E(1+s)P_T^*} \right) + L_N \left(\frac{W}{P_N} \right) + L_S \left(\frac{W}{EsP_T^*} \right) < L.$$

Now consider a rise in s or E that achieves a given increase in the domestic price of tradeables, $P_T = E(1+s)P_T^*$ on impact. Since these policies lower the product wage in the tradeables sector by the same amount, they lead to the same increase in the demand for labor there. The UTCS, however, has a greater effect on overall labor demand since it lowers the product wages in the smuggling sector by a larger amount. Denoting the elasticity of labor demand in the smuggling sector by $\eta_T < 0$, we have the following expressions for the change in employment in smuggling:

$$(21) \quad \left. \frac{d \log(L_T)}{d \log P_T} \right|_{\hat{s}} = \eta_s \left(\frac{1+s}{s} \right) > \left. \frac{d \log(L_T)}{d \log P_T} \right|_{\hat{E}} = \eta_s > 0.$$

The employment response is therefore larger when the change in traded goods prices is achieved through a UTCS than when it is achieved through devaluation. Both policies produce an increase in employment and income, together with expenditure switching towards nontradeds, at the initial price of nontradeds. There will therefore be a rise in the price of nontradeds to clear that market, leading to a further increase in the demand for labor as the nontradeds product wage falls. The final increase in employment and rise in the price of nontradeds will be larger for the UTCS, however, given the

stronger impact on employment in smuggling.²⁹

Income distribution effects

The final topic worth discussing in this simple model is the effect of smuggling on income distribution. We have already noted that smuggling in this model is nothing more than a costly way of influencing the income distribution within the private sector. Since resources devoted to smuggling are simply being used to engineer a transfer of trade tax revenues from the public sector to smugglers -- a transfer that the private sector would have received in any case, through rebates of tax revenues -- there is no net social benefit to offset the loss of resources.^{30, 31}

The assumption of lump-sum taxes is important in interpreting smuggling as simply a costly way of influencing the income distribution within the private sector. In a world with lump-sum taxes, the net revenue impact $[s/(1+s)]r_3$ of the UTCS scheme is irrelevant, since it can always be unravelled at zero social cost by lump-sum taxes. In practice, however, the government may not have nondistortionary tax instruments available, so that the income distribution between the private and public sectors may matter. In

²⁹ The overall welfare comparison of the two alternatives is unclear: the UTCS creates more employment, but it has more smuggling and therefore a higher resource cost.

³⁰ We noted earlier that illegal trade cannot deliver benefits in terms of alleviating policy-induced distortions, since a UTCS does not affect the relative prices of traded goods.

³¹ The argument that smuggling is welfare-worsening relies on the action of a benevolent government with access to lump-sum taxes. If this assumption fails, then income redistributions within the private sector or between the private and public sectors may affect welfare, and it is no longer clear that the smuggling equilibrium is Pareto inferior to the equilibrium without smuggling.

this case, the adverse impact of smuggling on public sector revenues places an additional welfare burden on the economy.

There will also be additional effects on the real exchange rate and other variables in the absence of lump-sum taxes. Suppose, for example, that trade taxes are the only tax instrument available to the government. The government budget constraint would then imply that either current government expenditure or (in a dynamic setting) future trade tax rates or expenditure must become endogenous. Effects on the real exchange rate and other variables will depend on where in the budget the required adjustment takes place. If current government expenditure bears the burden of adjusting to changes in current trade tax receipts, for example, there will be an additional effect on the real exchange rate depending on the relative consumption patterns of the private and public sectors.³²

4. Illegal Trade and UTCS Schemes, II: Fraudulent Invoicing

A channel for tariff avoidance that is important in a number of developing countries is underinvoicing of imports. While the use of official reference prices or specific tariffs would seem an easy solution to this problem, implementation of realistic reference price systems may be very costly for nonhomogeneous imports.³³ In addition, solving the underinvoicing

³² In this case, if the government had a higher marginal propensity to spend on nontraded goods, an increase in smuggling would draw demand away from the nontraded goods sector and put downward pressure on the real exchange rate.

³³ Cote d'Ivoire is a recent case of fraudulent invoicing in response to trade taxes (see footnote 1). As an indication of the policy tradeoffs, it is worth noting that at the time of introduction of the UTCS scheme, Cote d'Ivoire was already getting rid of specific tariffs due to their inefficiencies.

problem will increase the incentive for smuggling. What are the implications of this form of illegal trade?

Although underinvoicing and smuggling are both responses tax-induced divergences between the international and domestic prices of traded goods, the analysis of the previous section does not carry over directly to the underinvoicing case. There are two key differences in the structure of costs. First, while it was reasonable to think of smuggling as using up real resources (e.g., in utilizing inefficient transport routes), underinvoicing simply involves producing a fraudulent record of a transaction. The private cost of this activity may include bribes to dishonest officials, or penalties (if the underinvoicing is discovered by an honest official), but it seems appropriate to a first approximation to assume that the activity absorbs no real resources.³⁴ The supply- and demand-side reallocations that we emphasized in the previous section will therefore not play a role here.

The second difference is that it seems less natural in the underinvoicing case to think of legal and illegal trade as separate activities. In the smuggling model, the amount of smuggling could be determined independently of the extent of legal trade, because smuggling costs were independent of the amount of legal trade. No such separation is possible in the customs fraud case, since individuals engaged in customs fraud must use (the appearance of) legal trade as a "cover" for their illegal activity. This means that in contrast to the earlier analysis, a competitive equilibrium with underinvoicing will be characterized by what Pitt (1981) called "price disparity": the domestic price of the imported (exported) good will fall

³⁴ We are ignoring, as in the previous section, the costs of enforcement. We also ignore bribes to foreigners; unlike domestic bribes, which are simply transfers, these amount to social costs.

below (above) the full tariff-inclusive (subsidy-inclusive) price. These relative price effects are in fact the key channel through which customs fraud affects the real equilibrium.

We formalize these points below in a version of the static model of the previous section. To keep things simple, we abstract from smuggling and focus only on fraudulent invoicing. Since the analysis for overinvoicing of exports is symmetric to that for underinvoicing of imports, we do the full analysis only for the latter case.

Importers

For importer j , let us denote the amount of imports by M_j and the degree of underinvoicing by λ_j , where $(1 - \lambda_j)$ is the ratio of the reported price to the true world price. By definition of λ_j , the importer choosing M_j and λ_j deprives the government of tariff revenue of $W_j = s\lambda_j EP^* M_j$.

In general, the (expected) cost of underinvoicing should be some function of the three variables λ , W and M . We choose the following simple form:
 $C(\lambda, W, M) = p(\lambda)(bM + aW)$, $b, a \geq 0$, $p' > 0$, $p'' \geq 0$. One possible interpretation, consistent with importers being risk-neutral, is that $p(\cdot)$ is the probability of being "caught" (we require $p(\cdot) \in [0, 1]$) and $bM + aW$ is the penalty conditional on being caught.³⁵ An importer who is caught therefore loses the illegally appropriated tariff revenues W plus an additional amount

³⁵ In a smuggling context, $(1 - \lambda_j)/\lambda_j$ can be interpreted as the ratio of illegal to legal imports brought in by importer j . The smuggler in this case is using legal trade as a "cloak" to avoid detection of smuggling. The analysis here is therefore closely related to that of Pitt (1981) and Martin and Panagariya (1984) and Macedo (1987), who specify the probability of detection of smuggling as a function of this ratio.

$bM + (a-1)W$ that is proportional to the volume of affected imports.³⁶

Total expected profit for importer j is given by

$$(22) \quad \Pi_j = P_m M_j - EP^* M_j - (1 - \lambda_j) s EP^* M_j - p(\lambda_j)(bM_j + aW_j),$$

where P_m is the domestic price of the imported good. We assume that individual importers are small relative to the domestic market and therefore take P_m as parametric.

Given M_j , the optimal choice of λ satisfies the first-order condition

$$(23) \quad 1 - ap(\lambda) \leq (a\lambda + \frac{b}{sEP^*})p'(\lambda),$$

with equality if $\lambda > 0$ (we can guarantee $\lambda < 1$ by assuming that $p(1) = 1$). For an interior choice of λ , (23) requires that the marginal expected benefit of an increase in λ (which is an increase in profits with probability $1 - p(\lambda)$) equal the marginal expected cost (due to the increase in p).

Figure 2 shows the determination of λ given a , b and s . The curve LL is the left hand side (lhs) of equation (22); RR is the rhs. R_0R_0 is the rhs when $bp'(0)/sEP^* = 0$. The diagram can be used to derive the following conclusions, which we will state and then discuss:

Proposition 1 (Optimal underinvoicing)

(i) λ is a continuous function of s .

³⁶ a , b , and the parameters of $p(\cdot)$ are presumably functions of the government enforcement effort.

- (ii) if $b = 0$ and $s > 0$, $\lambda = \bar{\lambda} > 0$, a constant (this implies $d\lambda/ds = 0$).
- (iii) if $bp'(0) > 0$, $\lambda = 0$ for $s \leq \bar{s}$, where $\bar{s} > 0$.
- (iv) if $bp'(0) > 0$, $d\lambda/ds > 0$ for $s \geq \bar{s}$.
- (v) $\lim_{s \rightarrow \infty} \lambda = \bar{\lambda}$.

We now discuss (ii)-(v) in turn. Property (ii) states that if b is zero, the optimal degree of underinvoicing is some positive level regardless of the level of s . A rise in s increases the return to underinvoicing, but it also increases the expected penalty by raising s . When $b = 0$, these effects cancel out exactly, and there is no net effect on incentives for underinvoicing.

Property (iii) states that whenever $bp'(0)$ exceeds zero, there will be some cutoff level of s (denoted \bar{s}) such that only a UTCS above \bar{s} will have an effect on underinvoicing incentives. A positive value for $bp'(0)$ therefore acts like a fixed cost in the underinvoicing activity: as long as $bp'(0) > 0$, a small UTCS will have no real effects.

Property (iv) states that once the UTCS rate reaches its critical level \bar{s} , any further increases in s will raise the degree of underinvoicing. The degree of underinvoicing is therefore a monotonically increasing function of s for $s \geq \bar{s}$. By property (i), this increase happens smoothly, starting (by (iii)) at $\lambda = 0$.

Property (v) states that the degree of underinvoicing reaches an upper limit that is strictly below 1 as s goes to infinity. This limit is equal to the degree of underinvoicing that would prevail (see (ii)) if b were zero.

Before turning to the determination of M_j , it is worth noticing the relationship between λ and the exchange rate. As Proposition 2 states, this

is simply a matter of what happens to b/E as E changes:

Proposition 2 (Underinvoicing and the Exchange Rate)

- (1) if $bp'(0) > 0$ and $s \geq \bar{s}$, $d\lambda/dE > (<) 0$ iff $d\log b/d\log E < (>) 1$.
(ii) if $bp'(0) = 0$, $s < \bar{s}$, or $d\log b/d\log E = 1$, $d\lambda/dE = 0$.

The proposition states that a depreciation will raise the optimal degree of underinvoicing only if (1) s is at least equal to its critical level, and (2) the elasticity of b with respect to E is less than one. The first of these conditions follows directly from Proposition 1. The second comes from the first-order condition (23): a change in E will raise λ only if it lowers b/sEP^* .

The elasticity condition here is similar to our result in the smuggling case that a depreciation had no effect on smuggling incentives if smuggling costs were a proportional loss of the smuggled shipment. The same result arises here when b is denominated in traded goods; rise in E would then lead to a proportional rise in b (elasticity = 1), with no change in the optimal degree of underinvoicing.

The Domestic Price of Importables

Given the optimal choice of λ , it remains to solve for the j^{th} importer's optimal scale, M_j , and the total supply of imports, $\sum_j M_j$. The first of these is solved by setting $\partial \Pi_j / \partial M_j$ equal to zero, and the second by imposing the "free entry" condition $\Pi_j = 0$.

Since profits are linear in M (cf. (22)), the importer will wish to expand or contract without bound unless the domestic price of the import

adjusts to bring marginal cost and marginal revenue exactly into balance. The first-order condition $\partial \Pi_j / \partial M_j = 0$ therefore determines the domestic price that must prevail if M_j is to be positive and finite in equilibrium. Once this condition is satisfied, however, the importer is indifferent to the scale of operations. Entry is therefore no longer an issue; the "free entry" condition $\Pi_j = 0$ is automatically satisfied when $\partial \Pi_j / \partial M_j = 0$, and imports are demand determined.³⁷

The domestic price level satisfying $\partial \Pi_j / \partial M_j = \Pi_j = 0$, which we call the "break even" price, P^b , is given by:

$$(24) \quad P^b = [1 + (1 - (1 - ap(\lambda))\lambda)s + p(\lambda)\frac{d}{EP^*}]EP^*$$

Since no underinvoicing is done if the break-even price is above the tariff-inclusive price $(1+s)EP_m^*$, the equilibrium domestic price will be the minimum of the two. This allows us to define the effective tariff rate, σ_m , as the wedge between the international and domestic price of the importable:

$$(25) \quad P_m = (1 + \sigma_m)EP^* = \text{Min}[(1 + s)EP^*, (1 + (1 - (1 - ap(\lambda))\lambda)s + p(\lambda)\frac{d}{EP^*})EP^*].$$

It is easy to show that $0 < \sigma_m \leq s$ and that $0 < d\sigma_m/ds \leq 1$.³⁸ The effective tariff is therefore between zero and s , and rises monotonically with s . It is everywhere a smooth, differentiable function of s .³⁹

37 This gets us around the difficult problem of modeling entry and exit.

38 $d\sigma_m/ds = 1 - (1 - ap(\lambda))$.

39 Differentiability is useful since it implies that the expenditure and revenue functions are differentiable functions of s .

Figure 3 shows the effective tariff σ_m as a function of s . When b is zero, the effective tariff starts at zero and rises linearly with s , with slope $[1 - (1 - ap(\lambda))]s \in (0,1)$. When $b > 0$, no underinvoicing occurs for $s \leq \bar{s}$, so $\sigma_m = s$ up to that point. At $s = \bar{s}$, $d\sigma_m/ds = 1$, but any further rise in s causes σ_m to fall below s . As s gets large, the cost parameter b becomes less and less important, and σ_m approaches the value it would have had if b were zero.⁴⁰

The Domestic Price of Exportables

A similar analysis applies on the export side, where the incentive is to overinvoice export goods in order to collect a higher subsidy per unit. The equilibrium price of the exportable satisfies

$$(26) \quad P_x = (1 + \sigma_x)EP_x^* = \text{Max}[(1 + s)EP_x^*, (1 + (1 + (1 - ap(\lambda))\lambda)s + p(\lambda)\frac{b}{EP_x^*})EP_x^*].$$

Without loss of generality, have assumed in (26) that a and b are the same as they were in the import case (this implies that $\lambda_x(s) = \lambda_m(s)$ and $\bar{s}_m = \bar{s}_x$). Figure 3 shows the effective export subsidy, which equals s for $s \leq \bar{s}$ and then rises monotonically towards an asymptote of $[1 + (1 - ap(\lambda))]s$.

Equilibrium

In the smuggling case, illegal trade did not affect the domestic relative prices of the traded goods as long as there was some legal trade in

⁴⁰ It is interesting to notice that $\partial\sigma_m/\partial\lambda = 0$ in equilibrium. Increases in λ do not get passed on to the domestic price because importers must be compensated for the increased expected costs associated with the higher degree of underinvoicing.

equilibrium. This made it possible for us to consolidate into a single traded good. This consolidation is impossible in the customs fraud case, since illegal invoicing in response to a UTCS leads to a rise in the domestic relative price of the exportable. To keep things simple, we return to the basic structure of Sections 1 and 2, with exports and nontraded goods produced and imports and nontradeds consumed. We will denote the "effective" terms of trade resulting from a UTCS at rate s by ρ_X^s : $\rho_X^s = [(1+\sigma_X)/(1+\sigma_M)]\rho_X \geq \rho_X$.

Since fraudulent invoicing does not use real resources, the production side of the model simply involves the allocation of labor between the two production sectors (exports and nontradeds). The value-added function R gives the maximized value of output at domestic prices: $R = \text{Max}(E(1+\sigma_X)P_X^*Q_X + P_NQ_N)$ s.t. $L_X + L_N \leq L$. Deflating by the domestic price of imports, we have $r(\rho_X^s, q; L)$. The demand side is equally simple: assuming that traders have identical preferences to all other consumers, the minimum real expenditure required to reach utility level U is just $e(l, q; U)$.

The economy-wide budget constraint is a bit more complicated than in the smuggling case, because we must keep track of net profits from fraudulent invoicing. To incorporate invoicing profits, denote by χ_M and χ_X the actual, realized penalties on traders engaged in importing and exporting, respectively, measured in terms of imports at the domestic price.⁴¹ Replacing the expected penalty by the actual penalty in (22), realized profits are given by $\pi_M^r = M - [(1+(1-\lambda)s)/(1+\sigma_M)]M - \chi_M$ and $\pi_X^r = [(1+(1+\lambda)s)/(1+\sigma_M)]\rho_X X - \rho_X^s X - \chi_X$. Rearranging, we have $\pi_M^r = (1+\sigma_M)^{-1}(\sigma_M - s)M + w_M - \chi_M$ and $\pi_X^r = (1+\sigma_M)^{-1}(s - \sigma_X)\rho_X X + w_X - \chi_X$, where w_M and w_X are the real amounts of under- and over-invoicing, respectively. It follows that total realized profits from

⁴¹ The expected value of $EP_M^* \chi_M$ is $p(\lambda)(bM + aZ_M)$.

customs fraud are $\pi^F = (1+\sigma_M)^{-1}(\sigma_M - \sigma_X) + w - \chi$, where $w = w_M + w_X$ and $\chi = \chi_M + \chi_X$ are the total amounts of fraudulent invoicing and penalties, respectively, and where we have used the fact that the balance of trade, $B = EP_X^*X - EP_M^*M$, is zero. Domestic expenditure therefore satisfies $Z = R - T^F + EP^*\pi^F$, where T^F is the realized value of net lump-sum taxes.

The government budget constraint states that net trade subsidies are paid for by lump-sum taxes and the realized value of penalties: $T^F = s(1+\lambda_X)EP_X^*X - s(1-\lambda_M)EP_M^*M - p(\lambda_X)(dX + W_X) - p(\lambda_M)(dM + W_M)$. In real terms, $\pi^F = w - \chi$, where we have again used the fact that $B = 0$. In terms of its effect on income, the amount $w - \chi$ can be thought of as a transfer to traders that is financed by lump-sum taxes on all consumers.

We can now characterize equilibrium completely using the following three equations:

$$(27) \quad \epsilon(1, q; U) = r(\rho_X^S, q; L) + \left(\frac{\sigma_X - \sigma_M}{1 + \sigma_M}\right) \rho_X r_1$$

$$(28) \quad \epsilon_q(1, q; U) = r_q(\rho_X^S, q; L)$$

$$(29) \quad \rho_X^S = \frac{1 + \sigma_X}{1 + \sigma_M} \rho_X$$

Equations (27)-(29) jointly determine q and U as functions of L , s , ρ_X , and the penalty parameters b and a .

What are the general equilibrium effects of changes in the UTCS level? Consider first the effect on welfare. The welfare results are in fact qualitatively identical to those of Section 3. Totally differentiating (27)-(29), it is easy to show that $dU/ds = 0$ if the initial UTCS level does not

exceed \bar{s} . If the UTCS rate is above the critical level \bar{s} , however, increases in the UTCS rate are unambiguously welfare-worsening. Moreover, the illegal trade is itself welfare-worsening in the sense that for a given UTCS level, welfare is lower in the presence of customs fraud.

The result that illegal trade is unambiguously welfare-worsening is in contrast to Pitt (1981), who showed that illegal trade of the type analyzed here could be welfare-improving in the presence of a combination of tariffs and export taxes. As in the Section 3, however, the explanation is that unlike any combination of tariffs and export taxes, or any non-uniform tax-cum-subsidy scheme, the UTCS by itself is not a distortion. Illegal trade therefore has no role to play in alleviating the distorting effects of policy. In the customs fraud case, in fact, illegal trade actually introduces a distortion in the form of an "inadvertent" commercial policy. This explains why customs fraud is welfare-worsening in the UTCS context even though the activity does not absorb domestic resources.

Now consider what happens to the real exchange rate. For simplicity, consider the case where $b = 0$, so that $\bar{s} = 0$ and even a very small UTCS scheme will provide incentives for illegal trade. Starting at $s = 0$, increases in s raise σ_x more than one-for-one and σ_m less than one-for-one (Figure 3). We therefore get a rise in the effective terms of trade. The demand effects of this inadvertent commercial policy wash out when there is initially no illegal trade, and the overall effect on q is determined on the supply side. Since the effective terms of trade improvement produces a reallocation of domestic resources towards exportables, the supply of nontradeables falls and there must be a real appreciation in terms of importables:

$$(30) \quad \left. \frac{dq}{ds} \right|_{a=0, b=0} = \left(\frac{1}{\epsilon_{qx} - \epsilon_{qq}} \right) p_x r_{q1} \left(\frac{d\sigma_x}{ds} - \frac{d\sigma_H}{ds} \right) > 0.$$

While the real exchange rate in terms of importables, q , must appreciate, one can show that the price of the nontradeable does not rise by enough to fully offset the terms of trade improvement. The real exchange rate in terms of exportables therefore depreciates.

These points are illustrated in Figure 4, where we compare the UTCS (which improves the effective terms of trade) with an exogenous improvement in the terms of trade. The initial equilibrium is at points 1 in the diagram, where in quadrant I, $\epsilon = r$ at the initial real exchange rate q_1 and utility level U_1 . Introduction of a UTCS scheme does not affect the external terms of trade, and therefore leaves the balanced trade locus (quadrant III), and the economy's consumption possibility locus (quadrant I), unchanged. The consumption point moves from 1 to 3, however, as the real exchange rate in terms of importables appreciates from q_1 to q_3 . The real exchange rate in terms of exportables depreciates, making possible the shift of resources out of nontradeables in quadrant II. Accounting for invoicing profits and lump-sum taxes, real expenditure at the domestic price of importables is $\epsilon_3 = r_3 + \pi_x - r_x$. Small changes in q cause no change in welfare, by the Envelope theorem.

It is instructive to compare the UTCS equilibrium with what happens when the same effective terms of trade improvement occurs as a result of an exogenous change in the external terms of trade. In this case, the balance trade locus rotates downward, and the consumption possibilities locus shifts out, reflecting the economy's increased command over imports. As long as both

goods are normal, the real exchange rate in terms of importables must appreciate; what happens to the real exchange rate in terms of exportables depends on income and substitution effects.⁴² Utility is higher at U_2 , even for a small change in the terms of trade.

5. Transitional Unemployment

Up to this point, we have done our analysis in flexible-price, full-employment models in which purely nominal changes like devaluations had no real effects. While models of this type help bring out the analytical issues, they are incomplete for some policy purposes. In particular, there is no sense in which the exchange rate (real or nominal) is ever "overvalued" in this kind of model. There is therefore no reason for policymakers to want to change the parity or alter the price of traded goods in any other way. In this section, we extend the comparison of devaluations and UTCS schemes to one important case in which the nominal exchange rate is overvalued in a well-defined sense before the policy change.

We focus on a world in which the price of nontradeables is flexible, but the nominal wage is fixed in period 1 as a result of explicit or implicit wage bargaining.⁴³ With a given world price of tradeables, fixity of the nominal

⁴² See Gavin (1988). If the income effect dominates, consumption of the nontraded rises, and the real exchange rate in terms of exportables must depreciate. If the substitution effect dominates, consumption and production of the nontradeable fall, and the real exchange rate in terms of exportables appreciates.

⁴³ This could be due to nominal contracts or to unwillingness of workers to accept the fall in their real wages relative to other workers implied by a nominal wage cut. Efficiency wages are another possible source of unemployment, but these constitute a real, rather than nominal wage stickiness, and it is not clear that efficiency wages would adjust under pressure of unemployment (as would seem likely in the first two cases).

wage means fixity of the product wage in tradeables. This has two important implications. First, for given settings of the nominal exchange rate and taxes, the tradeables sector will have a fixed demand for labor and will therefore be unable to absorb changes in labor demand in the nontradeables sector. The labor market therefore need not clear in the short run. In particular, a contractionary shock that drives down the price of nontradeables will lead to a rise in unemployment.

Second, with w and P_T^* fixed in the short run, the tradeables product wage becomes a policy variable: policymakers can choose the short-run demand for labor in tradeables by setting the level of the exchange rate and/or trade taxes. These policies may therefore play a role in maintaining full employment in the face of contractionary shocks.

Figure 5 illustrates this role for parity changes or UTCS schemes. The initial equilibrium is at point 1, with a current account deficit of $b > 0$ and real exchange rate q_0 . Now suppose that the country is cut off from foreign borrowing, so that it must reduce its current account to zero in the current period ($b = 0$). This borrowing limit acts like a rise in the international interest rate, depressing demand for current consumption. The price of nontraded goods must fall, leading to a fall in labor demand in nontradeables at the initial nominal wage. With flexible wages, the nominal wage would fall, and labor would be reabsorbed in the tradeables sector as the product wage there fell. Equilibrium would be at point 2, with a rise in the nontradeables product wage, a fall in the tradeables product wage, and a depreciation of the real exchange rate (to $q_1 < q_0$).

With fixed nominal wages, however, the short-run equilibrium is at a point like 3, with unemployment. Labor released from the nontradeables sector

cannot be reabsorbed in the tradeables sector, since the combination of a fixed world price and fixed nominal wages prevents the product wage from falling.⁴⁴ The role for a parity change or UTCS is clear: either policy can be used to reduce the tradeables product wage directly and (in the absence of illegal trade⁴⁵) achieve the optimal allocation at point 2.

Caveats

With flexible goods prices, perfect capital mobility and forward-looking consumers, a devaluation or UTCS is unambiguously expansionary from an initial position of unemployment. If any of these assumptions fail, however, a devaluation may have contractionary effects in the short run that offset the benefits from falling product wages in the tradeables sector. Figure 5 may therefore give an overly optimistic picture of the role of a permanent parity change or UTCS as a device for alleviating transitional unemployment.⁴⁶

⁴⁴ Assuming homotheticity of preferences, the equilibrium must fall somewhere between points 1 and 4. Notice that while one can say that the nominal exchange rate is overvalued at point 3 (given trade taxes), the real exchange rate, q , has adjusted fully to the fall in demand for nontradeables, and may not be "misaligned" at all relative to its full employment equilibrium level (i.e., the equilibrium may be at point 4). This shows that when there is unemployment due to sticky wages, the familiar price-index based real exchange rates may give a misleading indication of incentives for resource allocation.

⁴⁵ In the presence of smuggling or customs fraud, our analysis of Sections 3 and 4 indicates that the UTCS is second-best, since it will lead to some combination of a wastage of resources and an unintended commercial policy.

⁴⁶ There are other reasons why Figure 4 may be overly optimistic. As Buiter (1988) points out, the impact of a devaluation on resource allocation depends a great deal on the source of underlying wage (or price) rigidities. If real wages were sticky due to indexation, for example, then the ability of the authorities to reduce the product wage in tradeables would be limited by the implied reduction in the real wage index. If workers consumed only tradeables, for example, the authorities might find it impossible to raise the price of tradeables without causing an offsetting rise in the economy-wide

On the demand side, a major potentially contractionary influence of a devaluation is its effect on the real value of wealth denominated in domestic currency. As we emphasized in Section 2 below, UTCS schemes (or devaluations of the commercial rate in a dual rate system) have even larger potential real balance effects since they reduce the real value of all financial wealth on impact, regardless of currency of denomination. On the supply side, devaluations exert contractionary pressure by raising the price of imported intermediate goods.

Since these contractionary effects are particularly important in the short run (see, e.g., Obstfeld (1986)), they are serious potential liabilities for a policy designed to reduce transitional unemployment. At the least, the existence of these effects implies that the adjustment path under a devaluation or UTCS may not be monotonically superior over time to the adjustment path in the absence of such a policy.

6. Conclusions

This paper has examined the similarities and differences between uniform trade taxes and exchange rate changes in a representative consumer setting. We reached the following conclusions, in the absence of illegal trade and under perfect capital mobility:

- (1) A UTCS is equivalent in all real respects to a devaluation of the commercial exchange rate in a dual rate system.
- (2) In terms of their effect on the real value of initial wealth, both policies mentioned in (1) are more contractionary than an across-the-board

nominal wage.

devaluation or a revaluation of the financial rate in a dual rate system, since the latter alternatives only affect wealth denominated in domestic currency.

(3) In terms of effects on the real interest rate, a temporary UTCS is identical to a variable dual exchange rate regime, where only movements in the gap between the commercial and financial rates matter. Anticipated across-the-board exchange rate movements, in contrast, do not affect incentives for intertemporal trade.

(4) UTCS policies do not affect the opportunity cost of domestic currency, and therefore have no portfolio implications, unless they change expectations regarding the exchange rate applied to financial transactions.

It is not surprising that when the possibility of illegal trade is taken into account, the equivalence between uniform trade taxes and exchange rate changes is broken. We examined both smuggling and customs fraud in a one-period, three-sector model in which devaluations had no real effects when trade taxes were zero, and showed that with both types of illegal trade, introduction of a UTCS scheme was capable of changing the real exchange rate. It is striking, however, that in the smuggling case, using a UTCS to raise the domestic relative price of traded goods may backfire and end up actually appreciating the real exchange rate in terms of importables. In the customs fraud case, the we get an appreciation of the real exchange rate in terms of importables, but the real exchange rate in terms of exportables will depreciate.

Three extensions of this paper are important before we have a reasonably full understanding of the macroeconomics of UTCS schemes. The first is to

incorporate distortionary means of government finance into the illegal trade analysis. Sections 3 and 4 emphasize that one of the primary results of a UTCS scheme in the presence of illegal trade is a transfer of income from the public to the private sector. This revenue shock is likely to add to the welfare burden of the UTCS scheme in the absence of lump-sum taxes.

The second extension is to add investment to the model and investigate the relationship between investment response, the real exchange rate, and fiscal revenues under a UTCS when the government does not have lump-sum taxes. The key issue here is that while the tariff component of a UTCS satisfies both the relative price and the revenue objectives of the government simultaneously, the export subsidy component brings out a conflict between these two objectives. The government may therefore have an incentive to renege on the export subsidy component of the package.

Finally, our assumption of price and wage flexibility severely limits the real balance and relative price effects that are the traditional channels for real effects of devaluations and UTCS schemes. We indicated in Section 5 how a parity change or UTCS could be used to alleviate a "transitional unemployment" problem due to sticky nominal wages in the short run. It would be useful to work through this analysis in detail in a two-sector production version of the intertemporal model of Section 2. This would make it possible to examine the tradeoffs between the direct contractionary effects of the alternative policies and their expansionary effect through the tradeables product wage.

FIG 2
Determination of λ

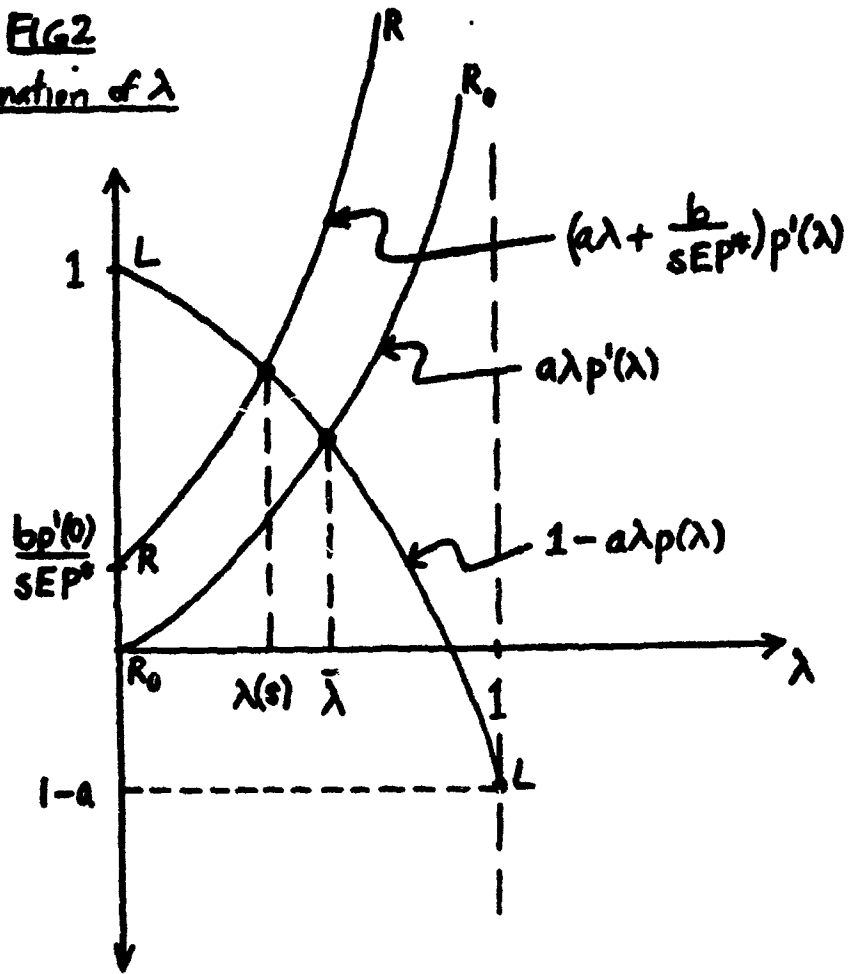


FIG 3
Effective Tariff and Subsidy

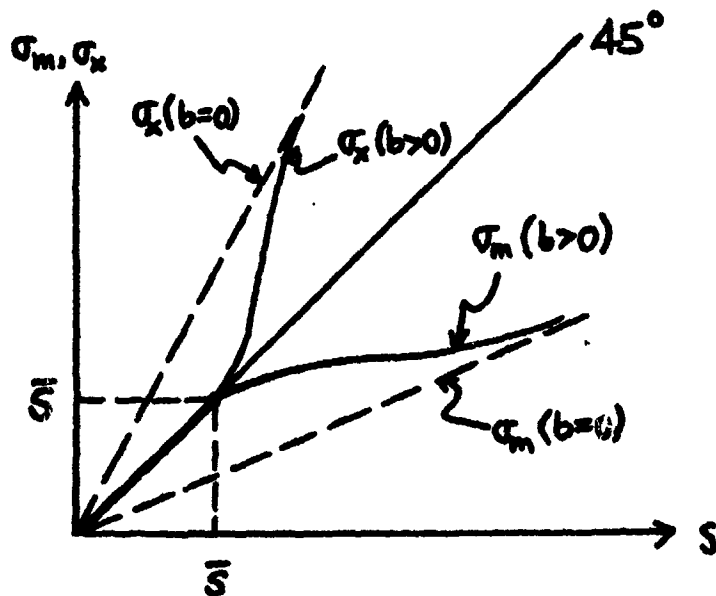
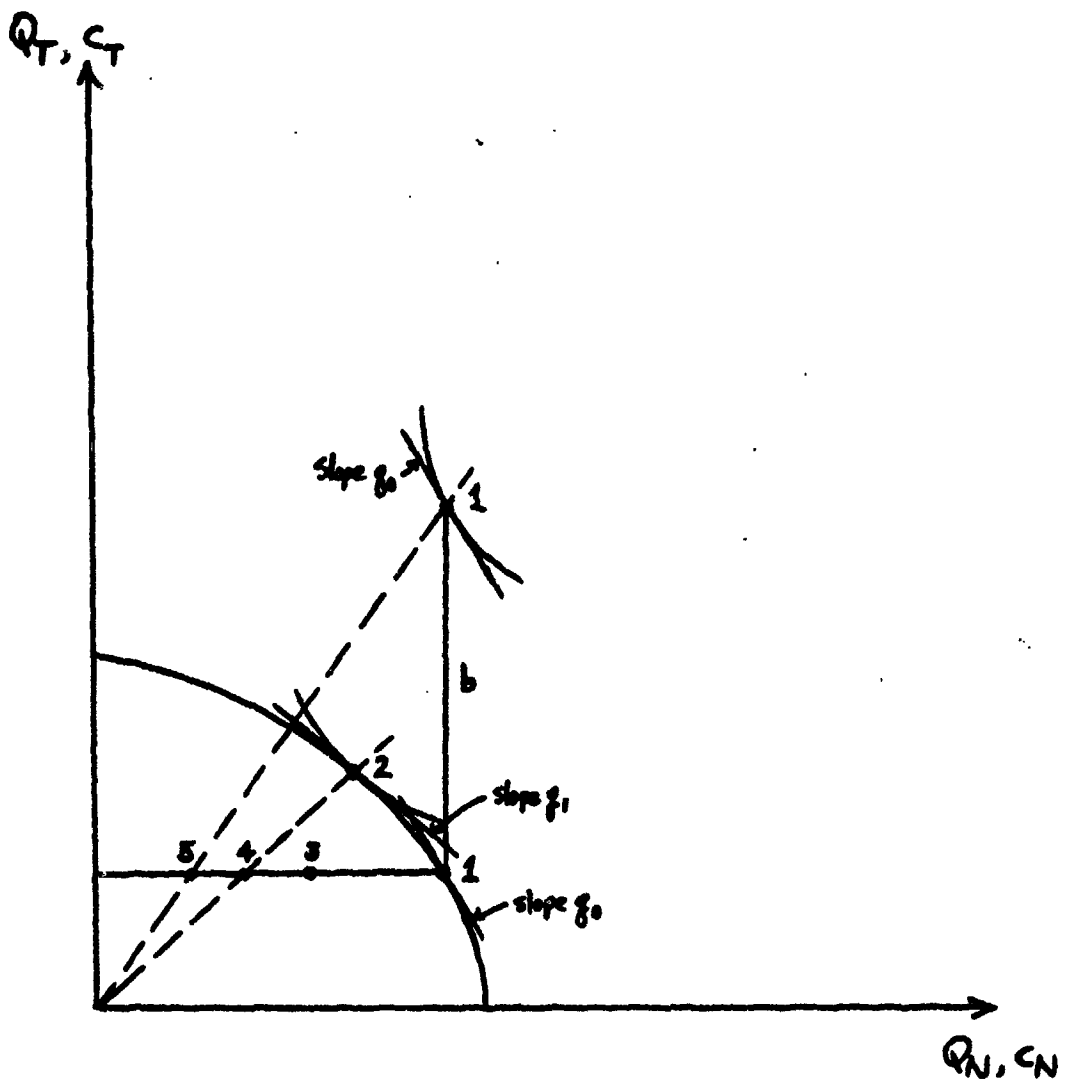


FIG 5
Adjustment With Unemployment



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