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Tariff Risk and International Borrowing with Incomplete Asset Markets

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Abstract

When residents of two countries have access to complete contingent claims markets, the welfare effects of changes in tariffs are opposite to those found in static trade theory. This paper demonstrates that a much simpler asset market structure can be sufficient to generate such a result. In the context of a two period model with asset trade restricted to simple bonds, I decompose wealth and substitution effects that underlying the impact of tariff changes on consumption and the current account. Use of this relatively simple model helps to provide intuitive insight and facilitates the use of an illustrative diagrammatic framework.

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Tariff Risk and International Borrowing with Incomplete Asset Markets

In models of international exchange, explicit consideration of asset trade can lead to equilibrium outcomes which are significantly different than those found in the comparative statics of traditional trade theory.[1] One remarkable example of this was described by Stockman and Dellas (1986): When residents of two countries have access to complete markets in contingent claims, the welfare effects of a small change in an import tariff are opposite to those familiar from basic trade theory. The imposition of a small tariff by the one country can result in an *ex post* allocation in which that country's consumption falls -- a reversal from the pattern described in the standard optimum tariff analysis.[2]

This paper demonstrates that a much simpler asset market structure is generally sufficient to generate the welfare reversal described by Stockman and Dellas. In the context of a two period model with asset trade restricted to simple bonds, I derive the wealth and substitution effects that underlie the impact of tariff changes on consumption and the current account. Use of this relatively simple model helps to provide intuitive insight and facilitates the use of an illustrative diagrammatic framework.

The analysis focuses on three effects engendered by temporary tariff rate changes:[3] an income effect associated with the deadweight loss from price distortions, an inter-temporal substitution effect related to a tariff's influence on the price of current consumption versus future consumption, and a relative income effect related to changes in the world terms of trade.[4] It is the inter-temporal substitution effect which is fundamental to explaining the Stockman/Dellas reversal phenomenon.

Section 1 of the paper describes a small open-economy version of the model, illustrating effects of tariff changes on real income and the current account when asset trade is introduced. Section 2 presents a two-country version of the model, evaluating the various wealth and substitution effects that contribute to the welfare reversal phenomenon. Concluding remarks are contained in Section 3.

1. A Small Open-Economy Model

As a point of departure, consider the effects tariff of changes on the consumption and saving decisions of the residents of a small open economy. This analysis illustrates the effect described by Razin and Svensson (1983) and Edwards (1988); namely, that the temporary imposition of a tariff not only distorts the price of imports relative to domestically produced goods, but it also raises the price of current consumption relative to future consumption. As a result, desired saving rises, current consumption falls, and the country runs a current account surplus.

A representative resident of the country maximizes utility derived from consumption of domestic goods and imports over two periods:

$$\text{Max} \left\{ U(x_1,y_1) + \beta U(x_2,y_2) \right\},$$

$$\text{with} \quad U(x_t,y_t) = \left(\frac{1}{1-\gamma}\right) \left[\alpha\, x_t^{1-\delta} + (1-\alpha)\, y_t^{1-\delta} \right]^{\frac{1-\gamma}{1-\delta}},$$

where x_t and y_t represent consumption of domestic goods and foreign goods, respectively, during period t. The elasticity of substitution between the two goods is $1/\delta$, and γ is the coefficient of relative risk aversion. The inverse of γ also measures the inter-temporal substitution elasticity.[5]

The agent's maximization problem is constrained by:

$$x_1 + \pi_1(1+\tau_1)y_1 + B/(1+r) = X_1 + \overline{T}_1 \qquad (1)$$

$$x_2 + \pi_2(1+\tau_2)y_2 = B + X_2 + \overline{T}_2 \qquad (2)$$

where π_t is the world relative price of imported goods, τ_t represents the tariff, and B is the agent's purchases of bonds on the world market. $\overline{T}_t=\tau_t\pi_t y_t$ denotes a lump-sum transfer of tariff revenue to the representative agent (exogenous to the individual's maximization problem). The solution for the case where the agent has no access to international asset markets -- portfolio autarky -- is simply the special case in which B=0 is imposed on the budget constraints. For this small-country case, both π and the world interest rate $R=(1+r)$ are treated as constants.

Endowments are assumed constant, $X_1=X_2=\overline{X}$. Therefore, tariff rate changes are the only stochastic element of the model. Realizations of tariffs in the two periods are drawn from independent log-normal distributions, $\ln(1+\tau_t) \sim N(\overline{\tau},\sigma^2)$, where $\overline{\tau}$ is a permanent trade distortion that defines a baseline equilibrium. Before trading assets on world markets in period 1, realizations of actual tariff rates for both period are revealed.

The first-order conditions for the maximization problem can be expressed:

$$\frac{U_X(\cdot_1)}{\beta U_X(\cdot_2)} = (1+r) \tag{2a}$$

$$\frac{U_Y(\cdot_1)}{U_X(\cdot_1)} = \pi_1(1+\tau_1) \equiv P_1 \tag{2b}$$

$$\frac{U_Y(\cdot_2)}{U_X(\cdot_2)} = \pi_2(1+\tau_2) \equiv P_2 \tag{2c}$$

$$x_1 + \pi_1 y_1 + B/(1+r) = \overline{X}_1 \tag{2d}$$

$$x_2 + \pi_2 y_2 = B + \overline{X}_2 \tag{2e}$$

Equations (2b) and (2c) require that the marginal rate of substitution between x-goods and y-goods be equated to the tariff-distorted relative price faced by the representative agent within each period, while (2a) equates inter-temporal marginal substitution to the world interest rate. Equations (2d) and

(2e) are simply the budget constraints, with the lump-sum transfer of tariff revenue now netted into the import terms.

For the baseline equilibrium where $\tau_1=\tau_2=\bar{\tau}$, the world relative price of the importable good, π, is normalized to equal one, and it is assumed that the country begins with zero net indebtedness on world markets. Taking first-order approximations of conditions (2b)-(2e) and denoting proportional changes in the variables with a circumflex [e.g. $\hat{x}_1=d\ln(x_1)$], solutions for relative consumption demands can be found as functions of tariff-inclusive relative prices and the country's international net borrowing or lending:

$$\hat{x}_1 = \left(\frac{1-s}{\delta}\right)\hat{P}_1 - \beta\hat{B} \tag{3a}$$

$$\hat{y}_1 = -\left(\frac{s}{\delta}\right)\hat{P}_1 - \beta\hat{B} \tag{3b}$$

$$\hat{x}_2 = \left(\frac{1-s}{\delta}\right)\hat{P}_2 + \hat{B} \tag{3c}$$

$$\hat{y}_2 = -\left(\frac{s}{\delta}\right)\hat{P}_2 + \hat{B} \tag{3d}$$

where $\hat{B}=\partial\ln(B)$. $\hat{P}_t$ represents the change in the domestic relative price of imports, which is simply equal to the tariff-rate change in this small-country case. The parameter s denotes the agent's consumption share of domestic goods in the baseline equilibrium. Subsequent analysis assumes $s>\frac{1}{2}$; the representative agent's consumption bundle includes high domestic-content.[6]

Aggregate consumption is defined by the CES aggregator nested within the utility function:[7]

$$C_t = \left[\alpha\, x_t^{1-\delta} + (1-\alpha)\, y_t^{1-\delta}\right]^{\frac{1}{1-\delta}} .$$

Changes in aggregate consumption can be approximated as $\hat{C} = \theta\hat{x} + (1-\theta)\hat{y}$, where θ is the agent's expenditure share on domestic goods (the baseline trade distortion $\bar{\tau}$ implies that $\theta < s$).[8] Using the demand functions (3), aggregate consumption demands can be expressed as:

$$\hat{C}_1 = \left(\frac{\theta - s}{\delta}\right) \hat{P}_1 - \beta\hat{B} \qquad (4a)$$

$$\hat{C}_2 = \left(\frac{\theta - s}{\delta}\right) \hat{P}_2 + \hat{B} \qquad (4b)$$

The terms involving $(\theta\text{-}s)/\delta$ in expressions (4) represent income effects due to the deadweight loss of the tariff distortion.[9] The inter-temporal dimension of consumption demand is captured by the $\hat{B}$ terms in equations (3) and (4). In portfolio autarky, $\hat{B}$ reflects movements of desired savings, which give rise to movements in the real interest rate as the domestic bond market clears. When inter-temporal borrowing and lending opportunities are available, $\hat{B}$ represents changes in the current account.

Using an approximated version of (2a), substituting the commodity demand equations (3), and solving for $\hat{B}$, the savings function can be expressed in the form:

$$\hat{B}^d = \frac{1}{(1+\beta)} \left\{ \left[\left(\frac{\theta - s}{\delta}\right) + \left(\frac{1-\theta}{\gamma}\right) \right] (\hat{P}_1 - \hat{P}_2) + \frac{1}{\gamma}\hat{R} \right\} \qquad (5)$$

The divergence of current from future tariffs has two effects on desired savings: The first is a wealth effect due to the deadweight loss described above; for example, an increase in the period 1 tariff reduces income relative to period 2, lowering desired savings in order to smooth consumption. The second effect is due to direct inter-temporal substitution induced by differences in the domestic price of imports across time-periods. An increase in the period 1 tariff raises the overall cost of consumption in period 1, lowering consumption and raising desired savings in proportion to the expenditure share on imports (1-θ) and the inter-temporal substitution elasticity $1/\gamma$. As long as the deadweight loss terms are small, the positive substitution effect will dominate.

Substituting (5) into (4a), aggregate consumption demand becomes:

$$\hat{C}_1^d = \frac{1}{(1+\beta)} \left\{ \left[\frac{\theta-s}{\delta}\right] (\hat{P}_1 + \beta\hat{P}_2) - \beta\left[\frac{1-\theta}{\gamma}\right](\hat{P}_1 - \hat{P}_2) - \frac{\beta}{\gamma}\hat{R} \right\}. \tag{4a'}$$

In equation (4a′), an increase in the first period tariff lowers consumption demand due to both the wealth effect and inter-temporal substitution effect.

Figure 1 illustrates the effects of a temporary tariff imposed in period 1. Real income falls $[(\theta\text{-}s)/\delta<0]$, as can be seen by setting $\hat{B}=0$ in equation (4a). Consumption demand declines due to both effects shown in (4a′). In the absence of asset trade, consumption and income are necessarily equal and the decline in first-period consumption is equivalent to the deadweight loss of the tariff. The domestic real interest rate falls below the world interest rate in order to clear local bond markets. When the agent has access to borrowing/lending opportunities at world interest rate R_w, first period consumption is even lower, and the tariff-imposing country runs a current account surplus. The pivotal feature of this outcome is the inter-temporal substitution effect induced by $(\hat{P}_1 - \hat{P}_2)$.[10]

2. A Two-Country Model

In a two-country exchange setting, it becomes necessary to consider price changes and interactions between intra-temporal and inter-temporal markets as they clear simultaneously. The approach taken in this section follows three steps: First, evaluate the world market for the home country's importable good in the absence of asset trade. Second, use the resulting change in the terms of trade to consider the effects on desired savings and consumption demand in the two countries.

Finally, consider the interaction between the intra-temporal and inter-temporal markets.

2.1 Modifications to the Model

Features of the foreign economy are modeled so as to retain the general nature of the demand functions for the home country in Section 2. The representative agent in the foreign country maximizes utility over his domestic consumption (y^*) and imports (x^*), with a utility function symmetric to that of the home country's: $U(x,y) = U(y^*,x^*)$. Units of the two countries' endowments, $\bar{X}$ and $\bar{Y}$, are normalized so that the baseline world relative price, π, remains equal to one.

Approximating the first-order conditions from the foreign country's maximization problem, we can derive consumption demands and desired savings functions analogous to those found in Section 2. However, both the relative price of goods and the interest rate will now be solved endogenously as world intra-temporal and inter-temporal markets clear.

Commodity demand function for the first period will be:

$$\hat{x}_1 = \left(\frac{1-s}{\delta}\right)\hat{P}_1 - (1-s)\hat{\pi}_1 - \beta\hat{B} , \tag{6a}$$

$$\hat{x}_1^* = \left(\frac{s}{\delta}\right)\hat{P}_1^* + (1-s)\hat{\pi}_1 - \beta\hat{B}^* , \tag{6a*}$$

$$\hat{y}_1 = -\left(\frac{s}{\delta}\right)\hat{P}_1 - (1-s)\hat{\pi}_1 - \beta\hat{B} , \tag{6b}$$

$$\hat{y}_1^* = -\left(\frac{1-s}{\delta}\right)\hat{P}_1^* + (1-s)\hat{\pi}_1 - \beta\hat{B}^* , \tag{6b*}$$

where $P_1^* = \pi_1/(1+\tau^*)$ is the relative price of the y-good that prevails in the foreign country. The first terms in equations (6) capture intra-temporal substitution effects of relative price changes, and the third terms summarize the inter-temporal dimension of commodity demands. The second term reflects a relative wealth effect due to changes in the terms of trade. An increase in the world price of the y-good raises the real income of the foreign resident (the exporter of the y-good) and lowers that of the home-country resident.

2.2 Intra-temporal Equilibrium:

Equilibrium in the market for y-goods, which can be used to establish the world relative price of y, can be found by imposing the equilibrium condition $y_d^W \equiv y + y^* = \overline{Y}$, or:

$$(1-s)\,\hat{y}_1 + s\,\hat{y}_1^* = -(1-s)\left(\frac{A}{\delta}\right)\hat{\pi}_1 - \frac{s(1-s)}{\delta}(\hat{\tau}_1 - \hat{\tau}_1^*) + (2s-1)\beta\hat{B} = 0 \tag{7}$$

where $A = 2s + \delta(1-2s)$.[11] The condition $A>0$ is simply a statement of the Marshall-Lerner stability condition, and will be assumed to hold throughout the analysis.

Solving (7) for the world relative price of y-goods in terms of the tariff changes $\hat{\tau} = \partial\ln(1+\tau)$ and $\hat{\tau}^* = \partial\ln(1+\tau^*)$:

$$\hat{\pi}_1 = -\left(\frac{s}{A}\right)(\hat{\tau}_1 - \hat{\tau}_1^*) + \frac{\delta(2s-1)}{(1-s)A}\beta\hat{B}\,. \tag{8a}$$

The relative price in the second period will be:

$$\hat{\pi}_2 = -\left(\frac{s}{A}\right)(\hat{\tau}_2 - \hat{\tau}_2^*) - \frac{\delta(2s-1)}{(1-s)A}\hat{B}\,. \tag{8b}$$

In the absence of asset trade ($B=0$), the world price of the y-good falls when the home country places a tariff on y-imports, while the price rises if the foreign country places a tariff on its x-imports. As long as $(s/A)<1$, a tariff raises the domestic price of importables in the tariff-imposing country.[12]

Figure 2 illustrates the effect of a home-country tariff on equilibrium in the market for y-goods, ignoring for now the feedback from inter-temporal trade (i.e., holding $B=B^*=0$). As functions of the world price of the y-good, the slopes of the demand curves take into account the relative wealth effects of changes in π, as reflected in the second terms of equations (6). The slope of the home-country's demand curve is unambiguously negative due to reinforcing substitution and wealth effects. However, a lower π reduces foreign real income and consumption demand, offsetting the intra-good substitution effect for the foreign resident. A tariff imposed in the home country reduces the home-resident's demand and therefore the total world demand for the y-good. As a result, the world relative price of y falls.[13]

2.3 *Inter-temporal Equilibrium*

Using the solution for changes in intra-temporal prices found above for the case of portfolio autarky, we can examine the state of the market in inter-temporal claims when bond trade is introduced.

Incorporating the effects of changes in relative prices, the bond demand function (5) and its foreign analog can be expressed as:

$$\hat{B}^d = \frac{1}{(1+\beta)}\left\{ \left[\left(\frac{\theta-s}{\delta}\right) + \left(\frac{1-\theta}{\gamma}\right)\right](\hat{P}_1 - \hat{P}_2) - (1-s)(\hat{\pi}_1 - \hat{\pi}_2) + \frac{1}{\gamma}\hat{R} \right\} \tag{9}$$

and

$$\hat{B}^{*d} = \frac{1}{(1+\beta)}\left\{ \left[-\left(\frac{\theta-s}{\delta}\right) + \left(\frac{\theta}{\gamma}\right)\right](\hat{P}^*_1 - \hat{P}^*_2) + (1-s)(\hat{\pi}_1 - \hat{\pi}_2) + \frac{1}{\gamma}\hat{R} \right\} \tag{9*}$$

Changes in relative prices have three effects on desired savings: The first is related to the deadweight loss from distorted domestic prices. A home country tariff results in an increase in P_1 and decline in $P_1^*(=\pi_1)$, lowering both countries' real incomes and demand for bonds. The second effect is the inter-temporal substitution effect associated with changes in the price of current versus future consumption. This effect tends to raise desired savings in the home-country and lower it in the foreign country, with the magnitudes of these changes proportionate to each country's expenditure share on the y-good. Finally, the relative wealth effect induced by the decline of π_1 also raises bond demand in the home country and lowers it in the foreign country.

Figure 3 illustrates the bond market equilibrium. In response to a home-country tariff, the net effects of changes in relative prices is to increase bond demand in the home-country and lower it in the foreign country. In the absence of asset trade, these changes in desired saving imply that interest rates diverge in the two countries. Inter-temporal trade allows the two agents to exploit this differential and accommodate the shifts in desired saving.

The relative magnitudes of the two shifts is ambiguous, with the solution for the equilibrium world interest rate given by:

$$\hat{R} = \frac{1}{2}\left\{ (\hat{\pi}_2 - \hat{\pi}_1) + \gamma\left[\left(\frac{\theta - s}{\delta}\right) + \left(\frac{1-\theta}{\gamma}\right)\right](\hat{\tau}_2 - \hat{\tau}_1) - \gamma\left[\left(\frac{\theta - s}{\delta}\right) - \left(\frac{\theta}{\gamma}\right)\right](\hat{\tau}_2^* - \hat{\tau}_1^*) \right\}. \quad (10)$$

If the change in the terms of trade is large, then the shift in B^{*d} dominates, and the world interest rate rises. On the other hand, if the terms of trade changes little, the home country bears a larger share of the total tariff burden, so the shift in $\hat{B}^d$ dominates and the world interest rate declines.

Figure 3 illustrates the intermediate case where the home and foreign bond-demand schedules shift by equal magnitudes. Whether the world interest rate rises or falls, it is clear that the introduction of asset trade unambiguously implies a current account surplus for the tariff-imposing country.

Inter-temporal equilibrium can also be illustrated in reference to C_1 and C_1^*. Changes in real income due to tariff changes can be derived by solving consumption demands for the portfolio autarky case (B=B*=0). Letting I_1 and I_1^* denote these changes in real income,

$$\hat{I}_1 = \left(\frac{\theta - s}{\delta}\right)\hat{P}_1 - (1-s)\hat{\pi}_1 , \tag{11}$$

$$\hat{I}_1^* = -\left(\frac{\theta - s}{\delta}\right)\hat{P}_1^* + (1-s)\hat{\pi}_1 . \tag{11*}$$

The effects of price distortions summarized in the first terms of equations (11) have the effect of lowering real income in both countries. However, as long as (s-θ) is small ($\bar{\tau}$ small), these shifts will be dominated by the relative income effects from the change in the terms of trade. Hence I_1 rises and I_1^* falls in response to the decline in π. These shifts are illustrated in Figure 4.

Incorporating relative price changes into the expression (4a′) [and its foreign counterpart] and substituting the bond-demand equations (9), aggregate first period consumption demand schedules take the form:

$$\hat{C}_1^d = \frac{1}{(1+\beta)}\left\{\left(\frac{\theta - s}{\delta}\right)(\hat{P}_1 + \beta\hat{P}_2) - \beta\left(\frac{1-\theta}{\gamma}\right)(\hat{P}_1 - \hat{P}_2) - (1-s)(\hat{\pi}_1 + \beta\hat{\pi}_2) - \frac{\beta}{\gamma}\hat{R}\right\} \tag{12}$$

$$\hat{C}_1^{*d} = \frac{1}{(1+\beta)}\left\{-\left(\frac{\theta - s}{\delta}\right)(\hat{P}_1^* + \beta\hat{P}_2^*) - \beta\left(\frac{\theta}{\gamma}\right)(\hat{P}_1^* - \hat{P}_2^*) + (1-s)(\hat{\pi}_1 + \beta\hat{\pi}_2) - \frac{\beta}{\gamma}\hat{R}\right\} \tag{12*}$$

Taking $\hat{R}$=0, equations (10) define shifts in the consumption demand schedules in Figure 4. The income effects of price distortions [the first terms in (12)] reduce consumption demand in both countries. The inter-temporal substitution effects [the second terms in (12)] lower C_1^d and raise C_1^{*d}, while the relative wealth effects of the terms of trade change raise C_1^d and lower C_1^{*d}. The situation depicted in Figure 4 assumes that the inter-temporal substitution effect dominates. As discussed in the context of the bond market, the sign of $\hat{R}_W$ is ambiguous; Figure 4 is constructed for the intermediate case where $\hat{R}_W = 0$.

The changes in real income engendered by the tariff increase imply that home consumption rises and foreign consumption falls in the absence of asset trade. At these consumption levels, however, the foreign interest rate is higher than the home interest rate. The introduction of asset trade is therefore associated with increased savings and reduced current consumption in the home country. At the market clearing level of the world interest rate, home consumption falls and foreign consumption rises -- the Stockman-Dellas consumption reversal.

As is clear from the foregoing analysis, the relative consumption outcomes of a tariff change in the presence of asset trade depends crucially on the inter-temporal substitution effect captured in the second terms of (9) and (12). A home-induced tariff raises the price of current consumption for the home agent and lowers the price of current consumption for the foreign agent. Bond markets allow the two agents to adjust their consumption bundles inter-temporally to accommodate these price changes.

2.4 General Equilibrium

The analysis thus far has not taken account of feedback effects between the intra-temporal and inter-temporal markets. Consumption and current account movements were evaluated at the relative price that cleared the goods market in the absence of asset trade. However, current account movements also affect relative demands in the intra-temporal goods market.

Equations (9) and the bond-market equilibrium condition, $B+B^*=0$, can be taken as defining a relationship between inter-temporal and intra-temporal markets; that is, as defining a locus of combination of current account changes and intra-temporal prices such that the inter-temporal market is in equilibrium. Denote this locus as BB:

$$\textbf{BB:}\quad \hat{B} = \frac{1}{(1+\beta)}\left\{\left[\left(\frac{\theta-s}{\delta}\right) + \left(\frac{1-2\theta}{2\gamma}\right) - (1-s)\right](\hat{\pi}_1 - \hat{\pi}_2) + \frac{1}{2}\left[\left(\frac{\theta-s}{\delta}\right) + \left(\frac{1-\theta}{\gamma}\right)\right](\hat{\tau}_1 - \hat{\tau}_2) - \frac{1}{2}\left[\left(\frac{\theta-s}{\delta}\right) - \left(\frac{\theta}{\gamma}\right)\right](\hat{\tau}_1^* - \hat{\tau}_2^*)\right\} \qquad (13)$$

Similarly, equations (8) define a relationship between B and π_1/π_2 such that the intra-temporal goods market is in equilibrium in both periods. This locus (denoted as XY) takes the form:

$$\textbf{XY:}\quad \hat{B} = \frac{1}{1+\beta}\left(\frac{s(1-s)}{\delta(2s-1)}\right)\left\{\left(\frac{A}{s}\right)(\hat{\pi}_1-\hat{\pi}_2) + [(\hat{\tau}_1 - \hat{\tau}_1^*) - (\hat{\tau}_2 - \hat{\tau}_2^*)]\right\}. \qquad (14)$$

Figure 5 illustrates these relationships in B-(π_1/π_2) space. The XY locus is upward sloping, while the BB curve slopes downward. An increase in the home-country tariff in period 1 shifts both schedules to the right. The shift of the BB curve is due to the substitution effect of a higher cost of first-period consumption in the home country (this effect is partly offset by the real-income loss due to distorted intra-temporal substitution). The XY curve shifts down (vertically) by $(s/A)\hat{\tau}$, reflecting the change in π_1 evaluated at $\hat{B}=0$. Figure 5 depicts the case where the XY-curve shift is larger than the BB shift (as is likely for plausible parameter values).

Under these circumstances, it is clear that the general equilibrium analysis does not qualitatively alter the results described earlier: the world price of the y-good falls, and the home country runs a current account surplus. However, the previous partial equilibrium analysis -- which involved examining the effects of the BB-shift at $\hat{\pi} = -(s/A)\hat{\tau}_1$ -- overestimated both the decline in π_1 and the increase in B. The lending from the home country to the foreign country raises world demand for the y-good relative to portfolio autarky (because the foreign resident has a higher marginal propensity to consume that good). This partially offsets the decline in π that would take place in the absence of asset trade. As a result of this dampening of the terms-of-trade change, the magnitude of the current account adjustment is also smaller than the previous analysis suggested (reflected in movement along the BB curve).

The feedback effects between markets have a reinforcing effect on movements in aggregate consumption. Although the previous analysis overstated the rise in the home country's savings, the decline in home-country consumption is reinforced by the dampening effect of borrowing and lending on the terms of trade. That is, the rise in π relative to the portfolio autarky equilibrium induces a fall in real income [equation (11)], which is smoothed over the two periods through declines in both savings (13) and consumption (12). Hence, the smaller current account surplus shown in Figure 5 is associated with lower current consumption in the home country and higher current consumption in the foreign country.

Note that the possibility that the BB shift will dominate XY shifts cannot be completely ruled out. In this instance, the world price of the y-good would rise in response to a home tariff. This result can be thought of as an asset-market analog of the Lerner tariff paradox, even though such a paradoxical outcome is ruled out by the stability conditions for this model in in absence of asset trade. An increase in the world price of y is possible when the domestic-consumption shares are large, so that the income reallocation toward the foreign agent that takes place through bond-trade gives rise to a relatively large increase the the foreigner's demand for

y. The underlying mechanism is similar to that of the classic Lerner paradox: tariff revenue is being transferred to an individual who has a higher propensity to consume the taxed good than does the individual paying the tariff. In this case it is the bond market through which this income transfer takes place.

2.5 Implications for complete markets

The relative welfare reversal described by Stockman and Dellas relied on the existence of complete markets in state-contingent claims. The analysis presented in this paper demonstrates that the same phenomenon can occur when asset trade is limited to simple borrowing/lending opportunities.

When markets are complete, divergent movements in consumption will be even more pronounced than in the case examined here. With bond-trade, the ability to smooth fluctuations in real income is limited to trading-off consumption over time. With a contingent-claims market, these relative income changes can be pooled against unrealized states.

Specifically, the changes in relative income attributable to the terms-of-trade change -- represented in the third terms in equations (9) and (12), for example -- can be fully pooled with state-contingent trade. In the analysis of the bond-market equilibrium above, it was assumed that the inter-temporal substitution effects dominated in equations (12). In the absence of the relative wealth effects due to terms-of-trade changes, this outcome is assured (only the small dead-weight loss effect remains to counter). Hence, the additional pooling provided by contingent-claims trade has the effect of increasing the magnitudes of the shifts in the C_1^d and C_1^{*d} curves shown in Figure 5. As a result, the movements in aggregate consumption examined above for bond trade represent dampened versions of the fluctuations would take place within a complete-markets setting.

In fact, the equilibrium allocations obtained with the bond market equilibrium can be directly related to the two alternative extreme assumptions about asset market structure. For example, the response of consumption to a first-period tariff can be decomposed as,

$$\hat{C}_1^B = \left(\frac{1}{1+\beta}\right) \hat{C}_1^A + \left(\frac{\beta}{1+\beta}\right) \hat{C}_1^C \qquad (15)$$

where the superscripts B, A and C denote bonds, autarky and complete markets, respectively. That is, the bonds-only allocation is a weighted average of the allocations that obtain with no asset trade and with a complete contingent-claims regime. When only simple bonds are are available, agents use the limited menu of assets to partially insure against tariff risk.

3. Summary and Conclusions

In this paper, I have used the relatively simple analytics of a two-country, two-period model with world borrowing and lending opportunities to illustrate the interactions between asset markets and goods markets that occur when individuals face risk from tariff changes. The exposition illustrates the analysis of Razin and Svensson (1983) for the small open-economy case, and extends it to two-country setting in order to demonstrate that a very simple asset market structure can be sufficient to generate the relative welfare reversal described by Stockman and Dellas (1986).

Three mechanisms have figured prominently in the analysis:

First, relative price distortions of tariffs give rise to real deadweight losses as agents substitute between domestic goods and importables inefficiently. These losses cannot be eliminated by asset trade, but give rise to (small) real income effects and have implications for current account changes as agents attempt use borrowing and lending to smooth consumption.

The second, and most significant mechanism is the inter-temporal price effect of tariffs. A tariff increase in the home country raises the domestic price of imports relative to locally produced goods, *and* it raises the domestic price of current consumption relative to future consumption. This inter-temporal price change gives rise to substitution away from current consumption in favor of future consumption. As long as the world relative price of the home country's importables falls, an opposite substitution effect will influence the foreign residents demands for consumption and saving.

The third effect is the relative wealth effect from a change in the terms of trade. This mechanism is crucial to derivation of the "optimal" tariff result in standard trade theory: As lower demand for imports by residents of the tariff-imposing country suppresses world demand, the world price of home-importables falls. This terms of trade change raises real income in the tariff imposing country, and lowers real income in the other country. Inter-temporal trading opportunities give individuals the ability to partly smooth consumption in the face of these relative income effects. However, it is precisely this type income divergence which complete contingent claims markets are able to pool that simple borrowing and lending cannot fully accomplish. Therefore, by assuming that the inter-temporal substitution effect tends to dominate the relative income effect (as has been done in this analysis), equilibrium outcomes more closely parallel the forces underlying the Dellas/Stockman complete-markets reversal phenomenon, and the examination of the bonds-only asset market regime provides intuitive insight into the forces giving rise to this outcome.

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Endnotes

[1]A general discussion of interactions between international goods markets and financial markets is provided by Stockman (1987).

[2]The analysis of the optimal tariff is attributed to Kaldor (1940). Humphrey (1987) describes some earlier diagrammatic contributions to the issue.

[3]The notion that temporary tariff changes are a relevant phenomenon to consider is supported by evidence presented in Sadorsky (1994), who finds that the long-run time series process of U.S. tariff rates does not contain a unit root.

[4]These three effects are closely related the ones examined by Svensson and Razin (1983), in their examination of a small open economy's response to exogenous terms-of-trade changes.

[5]The dual role of γ as a risk aversion and inter-temporal elasticity parameter owes to the assumption that preferences are time-separable.

[6]The parameter s will be a function of the preference share parameter α, the substitution elasticity $1/\delta$ and the baseline tariff $\bar{\tau}$. The permanent distortion $\bar{\tau}$ implies $s > 1/2$ even for $\alpha = 1/2$.

[7]The expression for aggregate consumption can also be derived from $C = p_x c_x + p_y c_y$, where p_x and p_y are utility-denominated prices (marginal utilities) of X and Y.

[8]In particular, $s/(1-s) = [\theta/(1-\theta)](1+\bar{\tau})$. For $\bar{\tau}=0$, $s=\theta$. Note that θ also represents the marginal propensity to consume domestic goods.

[9]The deadweight loss is proportionate to the baseline consumption distortion, $(\theta-s)$, multiplied by the elasticity of substitution between x and y. For "small" baseline tariff rates, the deadweight losses will be negligible. (The terms vanish in the case where the baseline is undistorted free trade.)

[10]An expected future increase in the tariff rate has exactly the opposite effect: Current consumption increases and the country runs a current account deficit. A permanent change in the tariff $(\hat{\tau}_1=\hat{\tau}_2)$ engenders no inter-temporal substitution.

[11]The derivation of equation 7 also makes use of the bond-market equilibrium condition, $B + B^* = 0$.

[12]That is, $(s/A)<1$ rules out the possibility of a Metzler (1949) tariff paradox, in which the terms of trade fall so far that the domestic price of importables declines.

[13]The possibility that an upward-sloping y* demand curve might dominate to make the world demand schedule upward sloping is ruled out by the stability condition $A>0$. Hence, the tariff paradox attributed to Lerner (1936) [in which the world price of the taxed good rises] cannot occur in the portfolio autarky setting of this model.

Figure 1:

Inter-temporal Trade for a Small Open Economy

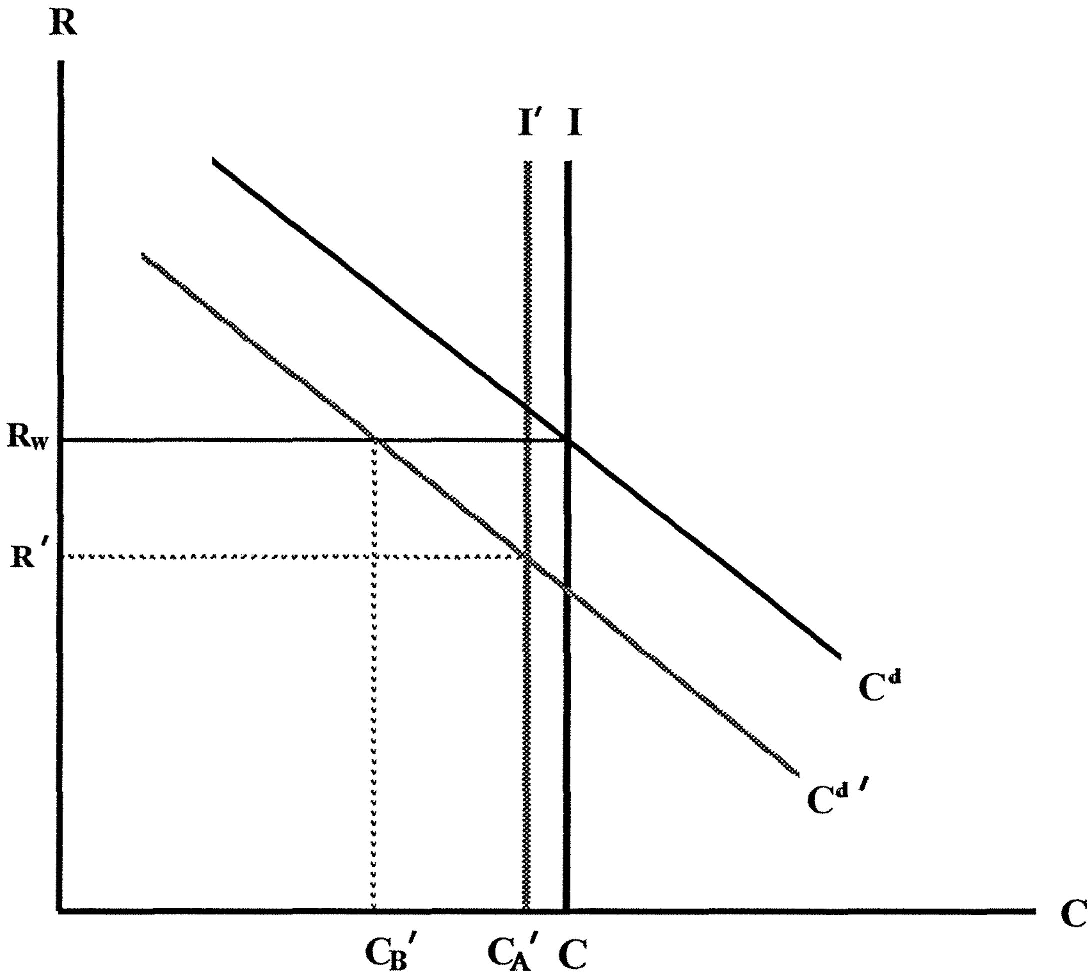

Figure 2:

Intra-temporal Goods Market Equilibrium

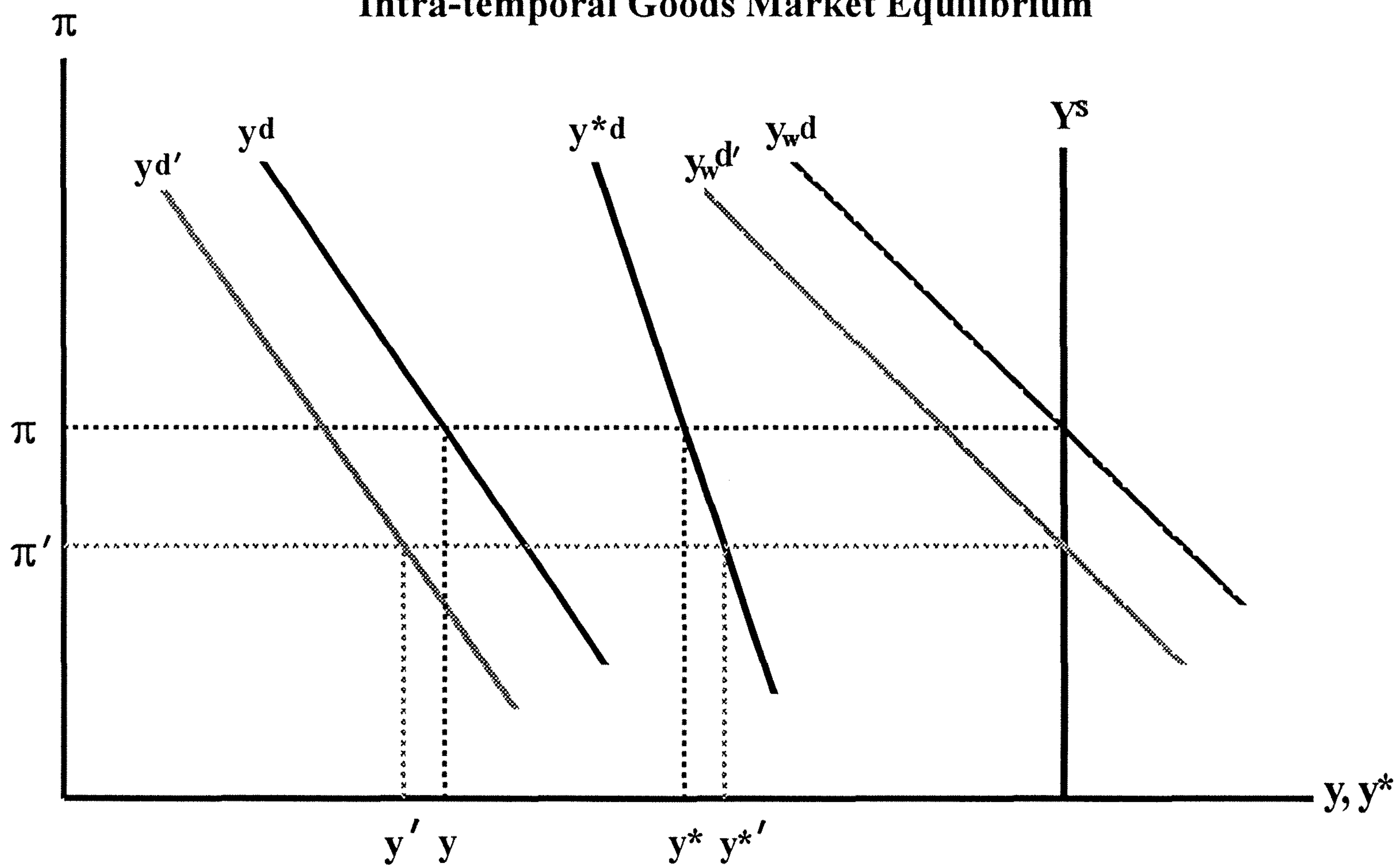

Figure 3:

Bond Market Equilibrium

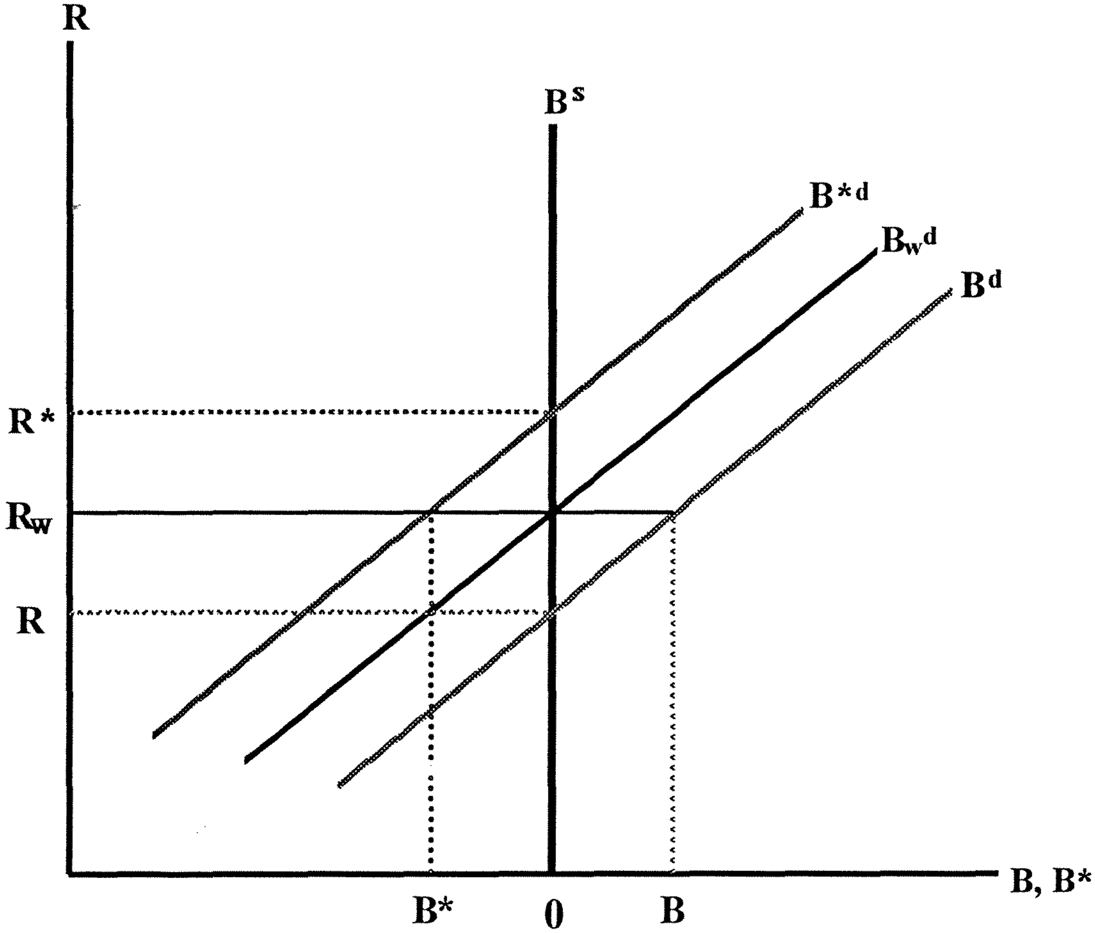

Figure 4:
Inter-temporal Equilibrium and Aggregate Consumption

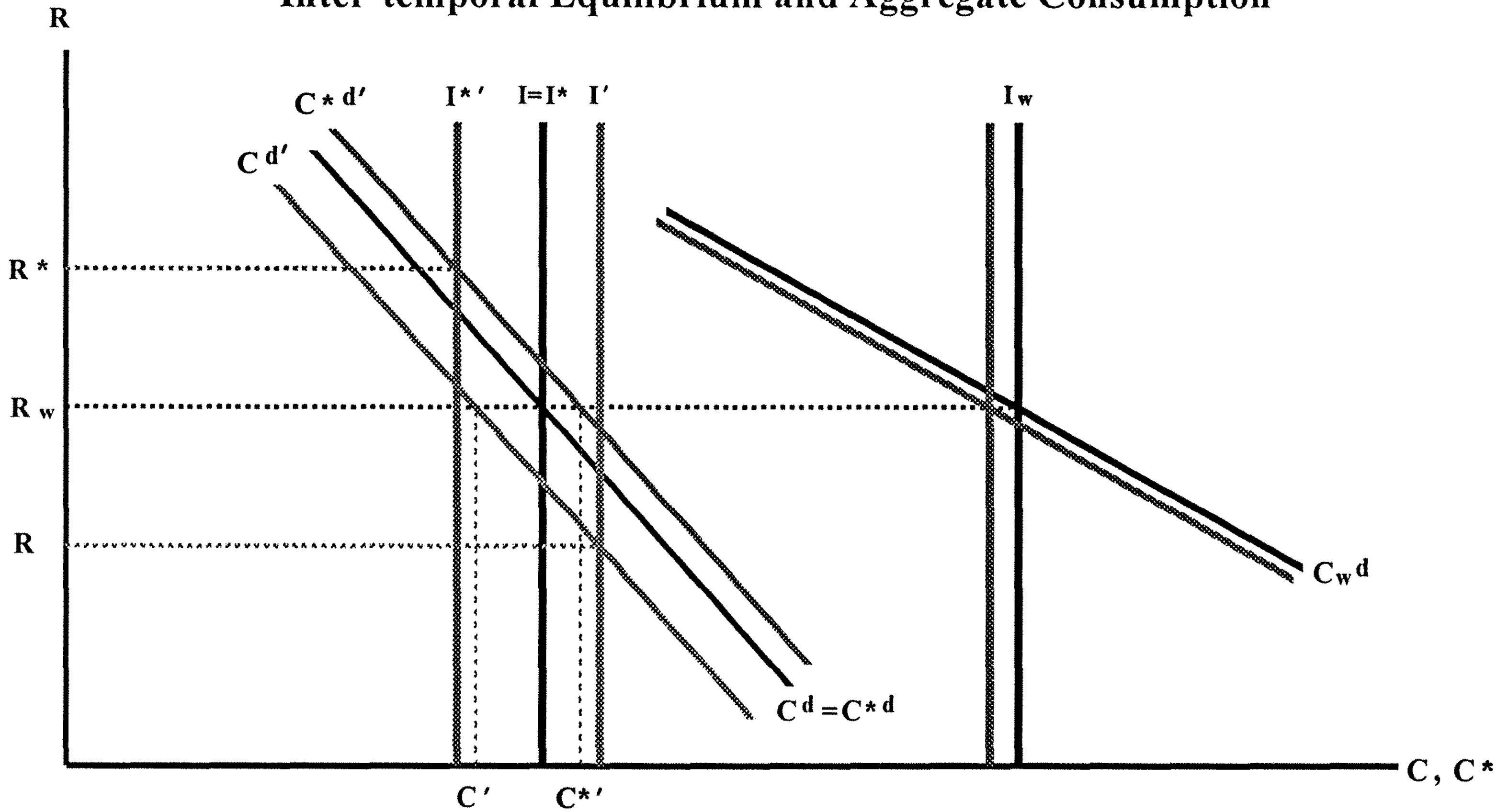

Figure 5:

General Equilibrium
in Intra-temporal and Inter-temporal Markets