An Introduction to the International Implications of U.S. Fiscal Policy

by Owen F. Humpage

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Introduction

A predominant characteristic of U.S. macroeconomic developments in the 1980s was the simultaneous emergence of large federal budget deficits and unprecedented international trade deficits. Many economists, relying on open-economy variants of the standard income–expenditure model, have linked these deficits in a causal chain that also ties them to high U.S. interest rates and to the dollar's appreciation earlier in the decade (see Hutchison and Pigott [1984]). The description has now become part of popular economic lore, but as is often the case with legend or myth, many of the intricacies of and important qualifications to a fundamentally plausible story have been lost in its common transmittal. Moreover, a paucity of hard empirical support for the simple and direct relationship offered by this popular view has done little to curtail its telling.[1]

This paper acknowledges that fiscal policies can create trade deficits, but argues that this need not be the case and typically has not been the case in the United States. Section I offers a simplified version of the two-period, representative-agent model found in Frenkel and Razin (1987).[2] Unlike the standard income–expenditure approach, this model does not assign a predominantly causal role to government budget deficits, but it does allow that, under certain circumstances, fiscal policies can influence the trade balance, real interest rates, and real exchange rates. The outcome depends on how the government's propensities to import and to consume out of current income compare with those of the private sector, and on the distortionary effects of taxes.

Section II offers an empirical investigation of U.S. fiscal policy during the floating-exchange-rate period, using Engle–Granger (1987) cointegration techniques. The empirical tests search for common long-run trends between economic variables suggested by the theoretical analysis and aggregate measures of U.S. federal fiscal policy. The results do not support the common contention of simple, direct relationships among these measures and U.S. trade balances, interest rates, or exchange rates. As

■ 1 The popular accounts derive from the open-economy version of the income–expenditure (or Keynesian) model. Frenkel and Razin (1987, part II) offer an unabridged account of this model.

■ 2 See also Aschauer (1986), Hill (1990), and Koenig (1989).

noted in the concluding section, however, such tests are subject to important qualifications and do not preclude the possibility of short-term relationships.

I. A Simple Model

A nation running a current account deficit absorbs more real economic resources than it produces. Its citizens accommodate differences between their desired consumption and production by purchasing additional goods from abroad, and they finance their activity by borrowing in world money markets. Because government spending and tax policies affect consumption and production decisions, a nation's fiscal policies can strongly influence its international trade patterns.

Frenkel and Razin (1987) show that the relationship is often similar to that described in international economics as the *transfer problem*. Because fiscal policies typically involve a transfer of funds from the private sector to the government sector, their international implications depend on a comparison of both the government's and the private sector's propensities to save and to import. Moreover, when government activities are deficit financed, the outcomes depend more on the existence of tax distortions than on public borrowing per se. Following Frenkel and Razin, this section develops a simple model to illustrate these points. To appreciate the argument, however, one must first understand the motives for international trade and the intertemporal nature of trade deficits.

Two-Period Trade and the Nature of a Deficit

Consider a hypothetical economy consisting of two countries (home and rest-of-world), each possessing and consuming quantities of two goods over two time periods. Each country consists of a single representative consumer and a government, which taxes and spends. Assume that no production takes place, but that both countries start each time period with a specific endowment of the two goods.

Let a single consumer with homothetic preferences represent each country.[3] Each consumer maximizes utility over two periods, subject to the constraint that the present value of private intertemporal consumption equals the present value of his two-period after-tax endowments. The consumer maximizes

$$(1) \qquad U = \sum_{t=0}^{1} \beta^t U_t(C_t)$$

subject to

$$(2) \qquad C_0(1+t_0) + T_0 + \frac{C_1(1+t_1)}{(1+r_x)} + \frac{T_1}{(1+r_x)} = Y_0 + \frac{Y_1}{(1+r_x)} .$$

Here, C_t refers to private after-tax consumption in time $t (= 0,1)$, such that

$$(3) \qquad C_t = c_{x,t} + \rho c_{m,t} ,$$

where $c_{x,t}$ and $c_{m,t}$ represent consumption of goods X and M in specific time periods. The terms of trade, ρ, expresses units of M in terms of units of X, β^t is a subjective discount factor applied to future utility, and r_x is the real interest rate. I express each in terms of good X, but the following arbitrage condition makes measurement arbitrary:

$$(4) \qquad (1+r_x) = {}^{\rho_1}\!/_{\rho_0}\,(1+r_m) .$$

With two goods and two time periods, however, unanticipated changes in the terms of trade within any period can affect intertemporal decisions.[4] The T_t terms represent lump-sum taxes, whereas the t_t terms are tax rates applied to private consumption.

At the beginning of each period, consumers receive an endowment, Y_t, of the two goods, such that

$$(5) \qquad Y_t = q_{xt} + \rho q_{mt} ,$$

where $q_{i,t} (i = x, m)$ refers to quantities of the two goods, X and M. I assume that consumers seek to smooth consumption over the two periods by borrowing or lending through international credit markets.

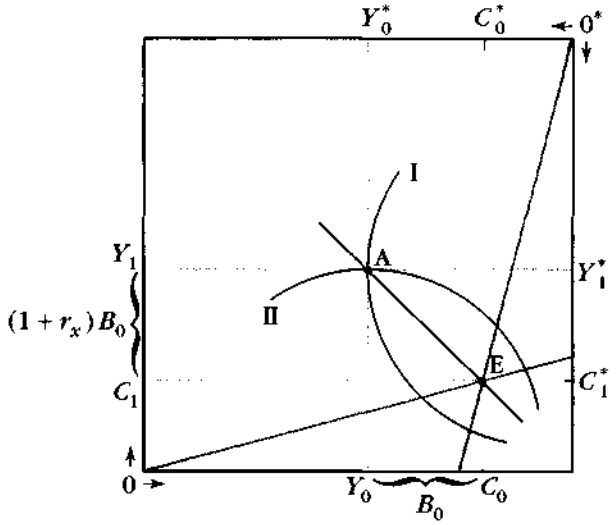
The government uses tax revenue to finance expenditures, G_t, subject to the constraint that the present discounted value of government expenditures over the two periods equals the present discounted value of tax revenue:

■ 3 Homothetic preferences are such that, for constant relative prices, any given percentage change in income results in the same percentage change in the consumption of all goods. Homothetic preferences cause the income expansion curves in figures 1 through 5 to be straight lines.

■ 4 For a discussion, see Frenkel and Razin (1987), pp. 168–71.

FIGURE 1

Optimization over Time and the Trade Deficit



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$$(6)\quad G_0 + \frac{G_1}{(1+r_x)} = T_0 + t_0 C_0 + \frac{T_1}{(1+r_x)} + \frac{t_1 C_1}{(1+r_x)}.$$

Solvency requires that the government retire any budget deficit incurred in the first period during the second period.

For each nation as a whole, the first-period budget constraint is

$$(7)\quad C_0 + G_0 = Y_0 + B_0.$$

Any nation can absorb, through private consumption and government spending, more or less than its current endowment, as equation (5) shows, but if it absorbs more than its endowment, the nation must borrow ($B_0 > 0$), and if it consumes less, it will lend the excess ($B_0 < 0$). The second-period budget constraint is given by

$$(8)\quad C_1 + G_1 = Y_1 - (1+r_x)B_0.$$

Since this model contains only two periods, each country must retire any first-period debts in the second period. Therefore, solvency requires that over the two periods,

$$(9)\quad C_0 + G_0 + \frac{C_1}{(1+r_x)} = Y_0 + \frac{Y_1}{(1+r_x)}.$$

Accordingly, the present value of private after-tax consumption plus government spending over the two periods must equal the present value of the endowments. The trade account must balance, and the countries must extinguish all international debts.

Equation (1) assumes that utility is intertemporally separable. Each consumer desires an optimal expenditure over the two periods. Within each period, the consumer chooses an optimal consumption bundle of the two goods, one that maximizes U_t. Although this choice is constrained by the overall level of expenditure within a period and by relative prices, the choice of a consumption bundle in any period is otherwise independent of the choice in any other period.

Intertemporal Consumption

Assuming no government sector for the moment, the representative individual allocates his consumption over the two time periods until the following condition holds:

$$(10)\quad \frac{U_0'}{\beta U_1'} = (1+r_x),$$

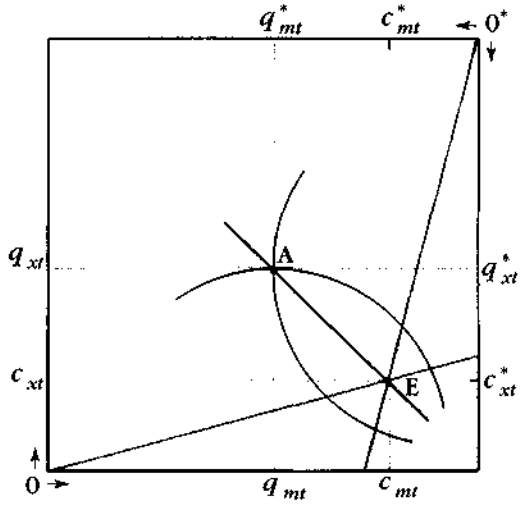
where U_t' is the marginal utility derived from consumption in period t. The first term in equation (10), the consumer's marginal rate of substitution between present and future consumption, measures his willingness to trade current for future consumption. The higher his subjective discount factor, the more the consumer prefers present to future consumption. The second term, one plus the real interest rate, is the intertemporal terms of trade—the market terms at which a consumer can trade current for future consumption. As equation (10) indicates, the utility-maximizing consumer will allocate his consumption over the two periods until his willingness to substitute between them equals the terms offered for this exchange in the market. If at any time this condition is not met, an exchange of resources can enhance the consumer's utility.

In figure 1, this maximization process is illustrated with an Edgeworth-box diagram, which shows the home country's origin in the lower left corner and the foreign country's origin in the upper right corner. (An asterisk designates foreign variables.) The utility curves I and II show, for a given level of utility, the willingness of the home country and the rest of the world to trade current for future consumption.[5] The ray extending from each origin, the income expansion path, shows

5 See also Hill (1990) and Koenig (1989).

FIGURE 2

Optimization across Goods and Trade at Time *t*



SOURCE: Author.

the respective country's optimal level of consumption for changing levels of income and a fixed real interest rate. The slopes of these two rays indicate that the home country prefers current consumption relatively more than does the foreign country.

Point A, at the center of the diagram, marks initial endowments and shows that each country receives equal consumption bundles in each period, $Y_t = Y^*_t\,(t = 0,1)$. At point A, however, the countries' subjective temporal preferences for consumption differ. The home country values present consumption more highly than does the foreign country. Consequently, both can increase their utility by agreeing to trade at some rate of intertemporal exchange passing within the ellipse formed by their utility curves. The line passing through points A and E, whose slope is $-(1 + r_x)$, is one such rate of exchange. Given the real interest rate r_x, the nations will trade to point E, at which the conditions for optimal consumption, given by equation (10), hold.[6] The home country now consumes more than its initial endowment in the first period, running a trade deficit, B_0, but it will run a surplus, $(1 + r_x)\,B_0$, in the second period. At point E, each country is on a higher utility curve than at point A. In fact, point E is a Pareto optimum; no country can be made better off without making the other worse off.

Intratemporal Consumption

After allocating consumption across time, each representative consumer will choose quantities of the two goods that maximize utility at each point in time. Consumers will choose among the two goods X and M until

$$(11)\quad \frac{U'_{m,t}}{U'_{x,t}} = \rho .$$

The term on the left side of equation (11) gives the marginal rate of substitution, the rate at which each consumer is willing to substitute between goods X and M. The term on the right side is the market-based relative price of the two goods, or the temporal terms of trade. If during any time period the condition depicted in equation (11) is not fulfilled, an opportunity exists for welfare-enhancing trade.

I again illustrate the maximization process by reproducing the Edgeworth box in figure 2 with appropriate changes in the axis and in the terms-of-trade line. I depict the home country as favoring consumption of good M, the importable good. At the initial endowment point, A, the home country values consumption of this good more than does the foreign country, and both countries can gain from exchange along the terms-of-trade line (with slope $-\rho$) to point E, where the condition given in equation (11) holds. At point E, the home country consumes the importable good in excess of its initial endowment, but it consumes less than its initial endowment of the exportable good.

Nature of Trade and Trade Deficits

Despite the simplicity of the model, figures 1 and 2 offer important insights into the nature of international trade and the causes of trade imbalances. Trade takes place in this model because of 1) differences in nations' time preference for consumption at the initial endowment point, or 2) differences in the relative preferences for the two goods in any time period given endowments.[7]

A trade imbalance results when a country desires a consumption profile that differs from its endowment profile. A country that consumes more (less) than its current endowment will run

■ 6 The home and foreign countries will negotiate the optimal interest rate.

■ 7 I do not include comparative advantage as a motive for trade, despite its predominance in the literature, because the model does not include production.

a trade deficit (surplus).[8] Changes in the real interest rate act to clear the intertemporal imbalance between endowments and consumption. This suggests that factors that influence decisions about intertemporal consumption—including government policies—also affect the trade balance. Hill (1989), for example, argues that a country's demographic profile influences its trade balance because younger households tend to save less than older households.

Moreover, because this model specifies the interest rate in terms of good X, and as a result of the arbitrage condition (4), factors that cause an unexpected change in the terms of trade can also influence the interest rate, intertemporal decisions, and the trade balance. The relationship between changes in the terms of trade and the trade balance depends on whether these changes are permanent or temporary, on the initial position of the trade balance, and on the parameters of the model (see Frenkel and Razin [1987], pp. 176–82).

The analysis in figure 1 also helps to dispel the notion that a trade deficit represents a state of economic disequilibrium or a deterioration in the economic well-being of the deficit country. Instead, the model illustrates that both the surplus and the deficit countries improve their economic welfare by running trade imbalances. A developing country, for example, might run a trade deficit in order to acquire capital goods, with the intention of eventually financing the acquisition by running a trade surplus. Such strategies are typically considered welfare enhancing.

Nevertheless, the figure does illustrate that the deficit country must eventually finance its debts though a reduction in future consumption. In the comparative static model presented here, the reduction is absolute. In a dynamic model, with growing economies, any change in future consumption is measured relative to where it would have been in the absence of trade. In such a model, it is not necessarily the case that a trade deficit must lower future standards of living.[9]

Government Fiscal Policy and the Trade Deficit

Much of the recent concern about U.S. fiscal policy centers on the impact of federal budget deficits on real interest rates, exchange rates, and the trade balance. The theoretical analysis of fiscal policy, therefore, begins by considering the effects of deficit-financed tax reductions, including 1) a lump-sum tax cut, and 2) a reduction in the tax rate on consumption.

Because many politicians and economists favor a balanced-budget amendment, I next consider the effects of balanced-budget fiscal policies in the form of 1) temporary and permanent balanced-budget spending, and 2) balanced-budget spending on the exportable commodity. As we shall see, different types of policies can have different combinations of effects on real interest rates, the terms of trade, and the trade balance.

Deficit-Financed Cut in Lump-Sum Taxes

With the introduction of taxes into the model, equation (12) gives the condition for optimal intertemporal consumption:

$$(12)\quad \frac{U_0'}{\beta U_1'} = \frac{(1+t_0)}{(1+t_1)}(1+r_x).$$

In maximizing welfare, the representative consumer now chooses an intertemporal consumption pattern that equates his marginal rate of substitution between current and future consumption to intertemporal terms of trade that include taxes on current and future consumption as well as on real interest rates. As is well known, lump-sum taxes in the consumer's budget constraint (equation [2]) do not affect the choice of the optimal consumption pattern, and therefore will have no effect on real interest rates or on the trade balance.

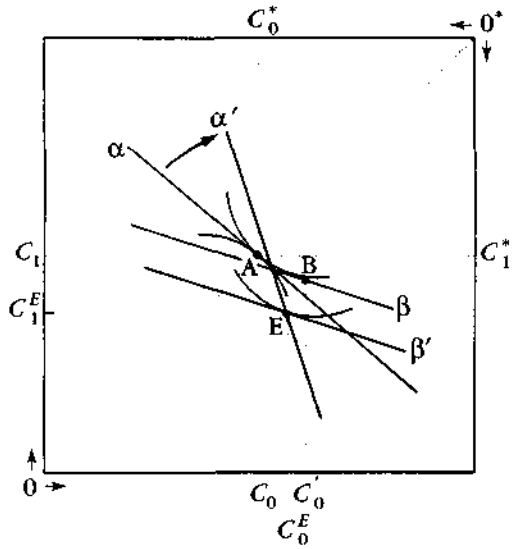
According to the principle of Ricardian equivalence, the intertemporal path of private consumption is invariant with respect to whether the government finances a given level of expenditure via lump-sum taxes or via borrowing. If consumers understand that the issuance of government debt implies a future tax liability to retire that debt, and if they also desire a smooth intertemporal consumption path, then a deficit-financed cut in taxes will not cause them to increase their present consumption. Instead, they

■ 8 In the National Income and Product Accounts, gross national product (GNP) equals consumption (C) plus investment (I) plus government purchases (G) plus exports (X) minus imports (M): GNP = C + I + G + X – M. Rearranging this expression, one obtains GNP – C – I – G = X – M, which shows the relationship between national savings on the left side and the trade balance on the right side.

■ 9 See Anderson and Bryan (1989).

FIGURE 3

Deficit-Financed Reduction in Consumption Taxes



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will save the additional purchasing power resulting from the tax cut in order to meet the future tax liabilities associated with retiring the government debt. The method of financing will, therefore, leave the interest rate unaffected.

The simple two-period model outlined above incorporates Ricardian equivalence in that the single representative agent must retire any government debt in the second period. The real-world application of Ricardian equivalence, however, seems more problematic given that taxes are distortionary, that the present generation might push the burden of retiring the debt onto future generations, or that the tax cut redistributes income to segments of the population with high marginal propensities to consume, while leaving the burden of servicing the debt spread across all citizens.[10]

Deficit-Financed Reduction in Consumption Taxes

When I allow a deficit-financed reduction in consumption taxes, equation (12) indicates that it will distort that optimal intertemporal consumption choice. This can be seen in figure 3, which illustrates the effects of a deficit-inducing reduction in taxes on current consumption.

Point A represents an initial equilibrium, at which present and future taxes on consumption are equal at home and abroad. Now consider a temporary tax reduction on current domestic consumption in time period 0. The line for tax-adjusted intertemporal terms of trade for the home country shifts from that designated as α in figure 3 to that designated as β. (The foreign country continues to face intertemporal terms of trade given by line α.)

As the figure shows, the deficit-inducing tax cut encourages current domestic consumption and results in an excess demand for current output given by $(C_0' - C_0)$. The real interest rate will subsequently rise, causing the world terms-of-trade line α to become steeper, until the markets for current and future consumption clear at a point such as E. Because at point E the home country is consuming more than its initial endowment, it runs a trade deficit amounting to $(C_0^E - C_0)$. At point E, the home country consumes less than its endowment of the future goods, thereby running a trade surplus in period 1, given by $(C_1 - C_1^E)$. Point E is also on a lower indifference curve because the higher interest reduces the present value of future income. Although not shown, the foreign country might share part of this effect.

At the new market-clearing point E, the tax creates a distortion between the market intertemporal terms of trade, given by line α′, which the foreigner faces, and the tax-adjusted intertemporal terms of trade, given by line β′, which the home country faces. The resulting lens between the two utility curves, which pass through point E, represents the welfare costs of the tax distortion.[11]

Figure 3 shows that a deficit-inducing tax reduction that encourages current consumption over future consumption will raise the real interest rate and create a trade deficit in the home country. Although the model does not include production, extrapolating from its underlying logic, one would expect that a deficit-financed tax reduction (for example, a payroll tax cut or a lower capital gains tax that stimulated current production relative to current consumption) could lower real interest rates and generate a trade surplus.

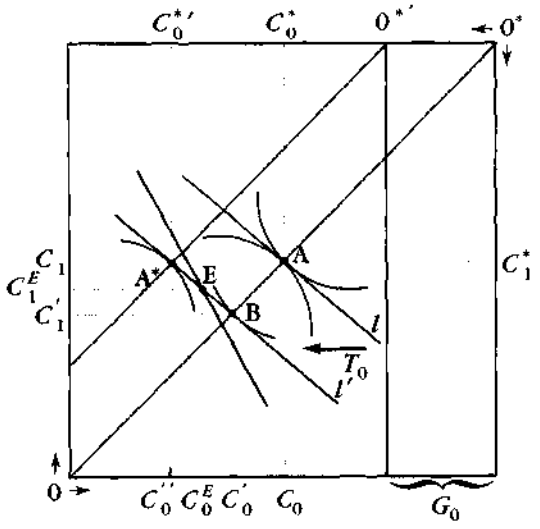
As the model suggests, no simple relationship exists among government budget deficits, real interest rates, and the trade deficit. In comparing the results of this section with those of the previous one, I find that it is the distortionary nature of the

■ **10** For an empirical application to the twin deficit issue, see Enders and Lee (1990).

■ **11** Although not drawn as such, the slope of line β′ will be higher than that of line β because of the rise in the world interest rate.

FIGURE 4

Balanced-Budget Spending on Current Output



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tax that is crucial and not the deficit per se (see Frenkel and Razin [1987], p. 223).[12]

Balanced-Budget Spending

The preceding suggests that the relationships among fiscal policy, real interest rates, and the trade deficit depend on the distortionary nature of taxes rather than on the use of deficit financing. This section extends the investigation by considering balanced-budget spending measures. If the observed correlations between deficits and the trade balance in the early 1980s stemmed from specific tax and spending policies, then a balanced-budget amendment would be of little avail in lowering real interest rates or eliminating the trade deficit.

Assume that the economy is initially in equilibrium with a balanced trade account. Point A in figure 4, which is similar to figure 1 in its initial construction, depicts such a situation, with the home country consuming C_0 in the current period and C_1 in the future period. In equilibrium at point A, the intertemporal terms of trade are given by line l with slope $-(1 + r_x)$.

Now allow a temporary rise in home-country government spending, financed entirely with a lump-sum tax on the home-country consumers.[13] The model depicts this as an increase in government spending on the current good only. The government's fiscal action reduces the amount of current output available for both domestic and foreign private consumption, which figure 4 shows as a shortening by G_0 in the horizontal dimensions of the Edgeworth box. Two other adjustments follow: First, for the foreign country only, point A shifts to point A*, where both current and future consumption are unaffected by the home government's fiscal policy. Second, because of the tax, T_0, home-country consumption shifts from point A to point B. (Notice that the horizontal distance measured by T_0 equals the horizontal distance G_0.) As its after-tax income falls, the home-country private sector reduces its consumption of both C_0 and C_1, but because individuals will attempt to smooth consumption over both periods, the reduction in current consumption will not match the increase in the government's current consumption.

Taking account of all of these initial effects in figure 4, we see that balanced-budget government spending initially creates an excess demand for current output, designated by $(C_0' - C_0'')$, and an excess supply of future output, designated by $(C_1 - C_1')$. These imbalances will cause the real interest rate to rise, increasing the attractiveness of future private consumption relative to current private consumption. Graphically, the rise in the real interest rate will pivot the intertemporal terms-of-trade line to a position such as that shown by l' until a new equilibrium, as defined by equation (10), obtains. Figure 4 shows such an equilibrium at point E. Here, the home country records a current-period trade deficit equal to $(C_0^E - C_0'')$.

The model indicates that a temporary increase in home-government, balanced-budget spending reduces both domestic and foreign private consumption and causes a home-country trade deficit. Intertemporal aspects of these resource transfers are accommodated through a rise in real interest rates.

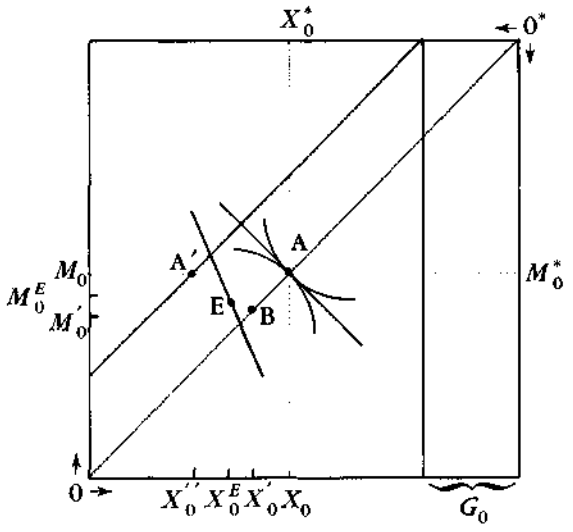
Extending the analysis to consider the effects of a permanent increase in balanced-budget spending helps to illustrate more clearly the nature of the relationship between government spending and the trade deficit. One can show the effects of a permanent increase in government spending in an Edgeworth-box diagram by altering both its horizontal and vertical dimensions. When both dimensions change,

■ **12** I do not consider taxes on specific commodities (such as tariffs); they are a standard topic of trade theory.

■ **13** Assume that the propensity of the government to spend on goods *X* and *M* exactly matches that of the private sector, so that the terms of trade do not change. This assumption is discussed below.

FIGURE 5

Balanced-Budget Spending on Exportables



SOURCE: Author.

however, many different configurations of results are possible, depending on the propensities of the government to spend on current and future consumption (see Frenkel and Razin [1987], pp. 195–98). If, for example, the government's propensities to consume current and future output exactly match those of the private sector, as indicated by the slope of the diagonal running from 0 to 0* in figure 4, then no trade imbalance or change in real interest rates would result from government spending. The equilibrium point would simply slide down the diagonal from A toward 0.

Frenkel and Razin argue that international repercussions of government spending are similar to those typically discussed in the literature as the *transfer problem*. Balanced-budget spending transfers resources from the home-country private sector to the government sector. If the home-country government's intertemporal preference for consumption differs from that of the private sector, the transfer will alter the overall world equilibrium for intertemporal consumption. If the overall propensity to spend on current output rises, as depicted in figure 4, real interest rates will increase and a home-country trade deficit may ensue. Conversely, if the overall world propensity to consume current output falls, real interest rates will decline and the home country may experience a trade surplus. According to the model, one must know more to predict the effects than simply that government spending increased.

Government Spending on Export Goods

The effects of government spending on a particular commodity within a specific time period are analytically similar. Assume that the private sector has obtained the optimal pattern of consumption over both time periods and across both goods. Figure 5 depicts the optimal domestic and foreign private consumption of the exportable and importable goods for a given time period at point A. I assume that the government has the same rate of time preference as does the private sector.

The initial effects of government balanced-budget spending on the export good are depicted as shifting the initial foreign position to point A′ and as shifting the initial domestic private-sector position to point B for reasons paralleling those offered in the explanation of the similar shift in figure 4. The tax and spending patterns then create an excess demand for the export good given by $(X_0' - X_0'')$ and create an excess supply for the import good equal to $(M_0 - M_0')$. The terms of trade will improve (the relative price of the exportable good will rise) until an equilibrium such as point E obtains.

The example outlined above is not a general case. I have assumed that domestic and foreign propensities to spend on the importable good are exactly the same and less than one, but I have set the government's propensity to spend on this good at zero. Allowing the government to spend on both the exportable and the importable good, additional outcomes are possible and reasonable. Frenkel and Razin (1987, pp. 202–03) explain this, again following the arguments that underlie the transfer problems. In general, the terms of trade will deteriorate (improve) if the government's propensity to import exceeds (is less than) the home country's propensity to import. The terms of trade will be unchanged when the propensities are exactly alike.

As noted earlier, with the interest rate defined in terms of the exportable good, unanticipated changes in the terms of trade can affect intertemporal decisions and, hence, the trade deficit. This results because of the arbitrage condition depicted in equation (4).

II. Empirical Evidence

The simple theoretical model shows that fiscal policy can be related to trade deficits, real interest

rates, and real exchange rates, but that the connection need not necessarily hold. Whether, as is often asserted, a simple, direct relationship between U.S. fiscal policies and the U.S. trade balance exists seems largely a matter for empirical analysis. Using Engle–Granger cointegration techniques, this section tests for a long-term relationship among various measures of U.S. fiscal policy, the trade balance, exchange rates, and interest rates.[14] Because cointegration looks for long-term relationships, one might view this exercise as testing the effects of the permanent component of fiscal policies.

Cointegration

Many macroeconomic time series are not stationary; that is, their mean, variance, and covariance can change over time. Intuitively, this suggests that, given a random shock, these series will move off to new time paths instead of returning to their original ones. The presence of nonstationarity can invalidate many standard statistical techniques for hypothesis testing, making it difficult to determine if two nonstationary series, such as government spending and interest rates, are related. Economists often model time series as ARIMA (p, d, q) processes, where d is the number of times the series must be differenced to achieve stationarity.[15] For most economic time series, $d = 1$. Economists refer to such series as containing a unit root or as being integrated of order 1, and designate such series I(1).

Engle and Granger (1987) propose a method by which one can determine whether two I(1) times series tend to move in tandem or drift apart over time. In the former case, even though the individual series are nonstationary, their joint relationship is stationary. Engle and Granger refer to such series as being cointegrated.

The Engle–Granger cointegration test is similar to the Dickey–Fuller (1979) test for unit roots. One must perform the latter tests as a first step in the cointegration test to see if the relevant series are each I(1), because time series that are integrated of different orders generally are not cointegrated. The Dickey–Fuller (DF) test involves regressing a time-series variable Y on its past value to see if the resulting coefficient is equal to 1. As is common, I specify the DF test with a constant and a time trend

$$(13) \quad Y_t = \beta_0 + \beta_1 t + \beta_2 Y_{t-1} + u_t,$$

where u_t is the error term.

Failure to reject the null hypothesis that $\beta_2 = 1$ indicates that Y is I(1). One calculates the DF test statistic exactly like a standard t statistic, but the DF statistic does not have a t distribution. TSP version 4.20 provides critical values based on the appropriate distribution. Fuller (1976, table 8.5.2) also provides critical values.

The presence of serial correlation in the error terms greatly weakens the power of the DF test, but one can correct for serial correlation by augmenting the above specification with lagged first differences of the dependent variable.[16] The augmented Dickey–Fuller (ADF) test is

$$(14) \quad Y_t = \beta_0 + \beta_1 t + \beta_2 Y_{t-1} + \sum_{i=0}^{\rho} \beta_{i+3} \Delta Y_{t-i-1} + \varepsilon_t,$$

where ε_t is the error term. The null hypothesis remains the same: $\beta_2 = 1$.

According to Engle and Granger, two I(1) time series, Y and X, are cointegrated if a linear combination of these two variables is stationary. Such a combination can be obtained from an ordinary least squares regression of Y on X, called the *cointegrating regression*. In what follows, I consistently specify the cointegrating regression to include a constant term (β_0):

$$(15) \quad Y_t = \beta_0 + \beta_2 X_t + \varepsilon_t.$$

The error term, ε_t, from the cointegrating regression is then a linear combination of X and Y, and one can use the DF procedures to test for a unit root in the error term. Following convention, I specify the test as

$$(16) \quad \varepsilon_t = \beta_1 \varepsilon_{t-1} + \sum_{i=0}^{\rho} \beta_{i+2} \Delta \varepsilon_{t-i-1},$$

including lagged first differences of the error term when necessary to adjust for possible serial correlation.

The null hypothesis is $\beta_1 = 1$. Failure to reject the null hypothesis indicates that the error term is not stationary and that it tends to drift away from its expected value, zero, over the sample period.

■ **14** Boucher (1991) uses similar cointegration tests to study the relationship between the nominal current account balance and a set of variables either related by virtue of the savings–investment identity or commonly held to "cause" the current account. Included among Boucher's causal variables is the nominal federal budget deficit.

■ **15** ARIMA (p, d, q) refers to Autoregressive Integrated Moving Average (see Box and Jenkins [1970]).

■ **16** DF tests are robust to heteroscedasticity.

BOX 1

Data Description

Description (Code)	Source
Trade-weighted dollar (*TWD*)	Board of Governors of the Federal Reserve System
10-year Treasury bill (*LTR*)	DRI/McGraw-Hill, Inc.
Trade balance:	
Net exports of goods and services (*NEX*)	National Income and Product Accounts
Government deficit:	
Change in publicly held federal debt (*DEF*)	Flow of Funds
Government spending:	
Federal expenditures (*FEXP*)	National Income and Product Accounts
Federal purchases (*FPUR*)	National Income and Product Accounts

NOTE: All series are inflation adjusted. I deflated *LTR*, *DEF*, and *FEXP* using the Consumer Price Index. Others are published in an inflation-adjusted format.

TABLE 1

Unit Root Tests

Variables	Dickey-Fuller Statistic	Augmented Dickey-Fuller Statistic
TWD	–1.11	–2.17
LTR	–3.06	–2.10
NEX	–1.31	–2.75
DEF	–6.14	–3.14
FEXP	–2.41	–1.66
FPUR	–2.74	–2.05
Critical values for:		
α = .01, DF = –4.09		
α = .05, DF = –3.47		
α = .10, DF = –3.16		

NOTE: All variables are inflation adjusted. All series start in 1973:IVQ and end in 1991:IIIQ. Dickey–Fuller tests include a constant and a time trend. Augmented Dickey–Fuller tests include four lagged first-differences of the dependent variables, which shorten the estimation period by four quarters.
SOURCE: Author's calculations on TSP version 4.20.

This, in turn, implies that the two time series Y and X do not share a common underlying trend; they tend to drift apart over the sample period.

One can extend the approach to consider cointegration among three or more time-series variables, each of which is I(1). In such a case, one adds the additional variables to the right side of the cointegrating regression (equation [15]) and proceeds with the DF tests described above. The test statistic, however, is sensitive to the number of right-side variables (exclusive of the constant) in the cointegrating equation. TSP version 4.20 provides appropriate critical values, based on work by MacKinnon (1990).

Causality is not an issue in cointegration tests. Consequently, the designation of dependent and independent variables for both bivariate and multivariate tests is arbitrary. Often, however, the results are sensitive to the ordering of the variables in the cointegrating regression. One should test all possibilities.

Data

Most popular discussions of the international ramifications of U.S. fiscal policy focus on the federal budget deficit and federal spending, so my measures of fiscal policy exclude the state and local sectors. I test for cointegration between either the federal budget deficit (*DEF*), federal government spending (*FEXP*), or federal government purchases of goods and services (*FPUR*), and long-term interest rates (*LTR*), the trade-weighted dollar (*TWD*), and net exports of goods and services (*NEX*). Box 1 describes the data sources.

Consistent with the theoretical analysis, all variables are in real, or inflation-adjusted, form. If an individual series was unavailable in this form, I deflated the nominal series with the Consumer Price Index. I initially ran all tests from 1973:IVQ through 1991:IIIQ to include 74 observations, but because augmented versions include four lagged variables, the tests run from 1974:IVQ to 1991:IIIQ and include 70 observations.

Results

Because cointegration presumes that the series under consideration are I(1), table 1 shows the results of applying DF and ADF tests to the individual time series. All of the series except *FEXP* and *FPUR* were serially correlated, so ADF tests were appropriate in most cases. None of the results, after any necessary adjustments for serial correlation, reject the null hypothesis of a unit root. Cointegration is an appropriate way to proceed with these data.

Table 2 presents the results of bivariate Engle–Granger cointegration tests. The first column lists the two relevant variables. The second column shows the ADF test statistics. The first sta-

TABLE 2

Bivariate Engle–Granger Cointegration Tests

Variables	Augmented Dickey-Fuller Statistic (1974:IVQ–1991:IIIQ)
DEF, LTR	−3.55; −2.46
DEF, TWD	−3.31; −2.44
DEF, NEX	−3.19; −2.50
FEXP, LTR	−0.84; −2.11
FEXP, TWD	−0.84; −2.27
FEXP, NEX	−1.35; −2.76
FPUR, LTR	−0.83; −2.36
FPUR, TWD	−0.37; −2.24
FPUR, NEX	−1.14; −2.64

Critical values for:
α = .01, DF = −4.56
α = .05, DF = −3.92
α = .10, DF = −3.60

NOTE: All variables are inflation adjusted. The first statistic in each pair is for the regression of the first variable on the second. The second statistic in each pair is for the regression of the second variable on the first. Because serial correlation was present in nearly all cases, I conducted ADF tests with four lagged first-differences of the dependent variables. In the few cases where serial correlation was not present, using ADF tests did not change any conclusions reached with a simple DF test.
SOURCE: Author's calculations on TSP version 4.20.

tistic in each set is for the cointegrating regression (equation [1]) of the first variable from column 1 on the second variable, and the second statistic is for the cointegrating regression of the second variable on the first variable. Because serial correlation was a problem in nearly every case, table 2 presents only the results of the ADF test. In the few cases where serial correlation was not present, using the ADF tests did not alter any conclusions reached with the DF test.

The bivariate results indicate that neither the federal deficit (*DEF*) nor federal expenditures (*FEXP*) nor federal purchases (*FPUR*) is cointegrated with real long-term interest rates (*LTR*), with the real effective dollar exchange rate (*TWD*), or with real net exports (*NEX*). Moreover, the results are robust to the designation of the dependent variable in the cointegrating regression.

Table 3 presents the results of multivariate cointegration tests. In these cases, I regressed the first variable listed in the table (to the left of the semicolon) on a constant and on the remaining three variables. Because serial correlation was again a problem in nearly all cases, I present only the results for ADF tests. The tests find no evidence of cointegration.

Interpretation of Empirical Results

The empirical test found no evidence that the U.S. trade balance, long-term U.S. interest rates, and the real trade-weighted dollar have shared a common trend with the U.S. federal budget deficit or with alternative measures of federal spending during the floating-exchange-rate regime. Such results, of course, do not preclude the existence of a relationship between fiscal policies and these economic variables.

Cointegration tests search for a stationary linear combination of hypothetically related variables. The inclusion of other variables could reveal a linear combination that is stationary. I did not, for example, include foreign variables, such as interest rates. Moreover, I did not scale the deficit relative to GNP, as many researchers do, nor have I attempted to take direct account of the level of public debt. Deficit-financed fiscal policies, when the level of public debt is very high, could have substantially different effects on real interest rates, exchange rates, and the trade balance than would similar policies at a low level of public borrowing. Similarly, the relationship between fiscal policy measures and the trade deficit might not be linear, and a linear approximation of that relationship might fail to show any connection at all. For these reasons, cointegration tests of times series may be sensitive to the time period investigated.

Although cointegration tests reveal long-term relationships among the hypothetically related variables, they may not find a shorter-term relationship. I have interpreted the cointegration tests as measuring the effects of the permanent components of U.S. fiscal policies. The temporary aspects, as the theoretical model shows, can have different and profound effects on important economic variables. Boucher (1991), for example, concludes that nominal U.S. current accounts and nominal U.S. government budget deficits are not cointegrated, but using Granger causality tests, she finds evidence that U.S. government budget deficits do help to predict current account deficits. Similarly, Abell (1990) considers the twin deficit relationship in a VAR model estimated strictly over the period of the dollar's rapid appreciation: February 1979 to February 1985. Although he does not find that budget deficits Granger-cause trade deficits over this period, he does conclude that deficits

TABLE 3

Multivariate Engle–Granger Cointegration Tests

Variables	Augmented Dickey–Fuller Statistic (1974:IVQ–1991:IIIQ)
DEF; LTR, TWD, NEX	–3.77
LTR; TWD, NEX, DEF	–2.94
TWD; NEX, DEF, LTR	–2.17
NEX; DEF, LTR, TWD	–2.53
FEXP; LTR, TWD, NEX	–1.22
LTR; TWD, NEX, FEXP	–3.27
TWD; NEX, FEXP, LTR	–2.50
NEX; FEXP, LTR, TWD	–2.16
FPUR; LTR, TWD, NEX	–1.53
LTR; TWD, NEX, FPUR	–3.77
TWD; NEX, FPUR, LTR	–2.75
NEX; FPUR, LTR, TWD	–2.53
Critical values for:	
α = .01, DF = –5.29	
α = .05, DF = –4.63	
α = .10, DF = –4.30	

NOTE: All variables are inflation adjusted. Because serial correlation was present in nearly all cases, I conducted ADF tests with four lagged first-differences of the dependent variables. In the few cases where serial correlation was not present, using ADF tests did not change any conclusions reached with a simple DF test.
SOURCE: Author's calculations on TSP version 4.20.

affect interest rates, which then influence exchange rates, which then alter the trade balances.[17] Hence, one should interpret the results here as a general conclusion about the relationship between federal fiscal policies and the trade deficit during the period of floating exchange rates, rather than as a comment on fiscal policy over a subperiod, such as the early 1980s, or as a prediction about possible future effects of U.S. fiscal policies.

■ **17** Because of the enormous volume of empirical studies on the relationships among measures of fiscal policy and interest rates, exchange rates, and the trade deficit, I do not survey the literature. The overwhelming conclusion from even a cursory review is that the results are mixed, with no clear pattern as to the source of the differences among the studies. In addition to articles cited in the text, other avenues for pursuing the empirical literature are the following: For results from large structural models, see Hooper and Mann (1987) and Throop (1989a, 1989b). For articles using VAR techniques, see Darrat (1988) and Rosensweig and Tallman (1991). For some cross-country results, see Bernheim (1988) and Laney (1984). For a look at deficits and interest rates, see Evans (1985) and Hoelscher (1986). On deficits and exchange rates, see Evans (1986) and Hutchison and Throop (1985).

III. Conclusion

This paper challenges the commonly held belief that aggregate U.S. fiscal policy measures, notably the federal budget deficit, bear a simple and direct causal relationship with U.S. trade deficits in particular, and with U.S. interest rates and exchange rates. The simple two-period, two-country models developed here from earlier work by Frenkel and Razin (1987) illustrate a complex relationship that is dependent, in terms of both degree and direction, on the distortionary nature of taxes and on relative differences between public and private propensities to consume and to import. Although fiscal policies and the trade balance can be related, they need not be.

The Engle–Granger cointegration tests, which this paper employs, find no evidence of a long-term relationship between common aggregate measures of U.S. fiscal policy and real long-term interest rates, real dollar exchange rates, and real net exports. This does not mean that the large U.S. federal budget deficits of the 1980s did not contribute to the sharp deterioration of U.S. trade in the early 1980s; nor does it imply that a rising federal deficit in the 1990s will not prevent further improvements in the U.S. trade balance. The findings, however, do serve to strengthen my main proposition, that the common story about the simple and direct relationship between federal fiscal policies and the trade balance is largely economic folklore.

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