Some macroeconomic effects of tariff policy

David Alan Aschauer

The exchange value of the dollar against the currencies of most of the United States' major trading partners—especially Japan and West Germany—has fallen significantly since reaching a peak in early 1985. Yet U.S. current account deficits with these countries have yet to show substantial reductions. Impatience on the part of export industries has been reflected in some recent protectionist legislation, with the promise of more to come.

A typical argument for protectionist legislation emphasizes two supposed results from higher tariffs. First, by making foreign goods more expensive, tariffs cause imports to fall and thus improve the current account. Second, as domestic residents shift expenditure patterns from foreign to domestic goods, home employment and production are stimulated. Fewer Americans driving Toyotas and BMW's mean more jobs for blast furnace operators in Gary, for tire producers in Akron, and for assembly line workers in Flint.

This article explores some of the effects of tariff policy on the macroeconomic levels of employment, output, and the trade deficit within a simple model that describes our economy functioning over a period of time. This model allows us to manipulate economic factors to analyze the effects of various policies (see box). The focus of the analysis is on the validity of the two asserted results of import taxation listed above. Although it is possible for tariff policy to engineer a reduction in the trade deficit, by altering the structure of foreign goods prices over time, it is crucially important to distinguish between tariffs which are temporary and those which are permanent. Indeed, permanent tariffs may have little discernible impact on the trade deficit.

Also, the likely associated effect of increased tariffs will be a reduction in the level of domestic production. The taxation, via tariffs, of the consumption of foreign-produced goods will ultimately encourage a substitution into nonmarket activities, such as leisure and household production, and away from market activities of labor force participation, employ-

ment, and measured production. Thus, the basic conclusion of this article is that it may be well to avoid protectionist policies if the goals of macroeconomic policy are to sustain high levels of employment, output, and exports.

Macroeconomic effects of tariffs

Using the model described in the box on pages 12 and 13, we can examine some of the effects of temporary and permanent tariffs. Figure 1 shows how tariffs affect the levels of domestic consumption of domestic goods (c_0 in the figure) and imported goods (c_0^*) ; of domestic output (y_0); and of the balance of trade (ϕ_0). The level of domestic demand ($y_0^d = c_0 + c_0^*$) depends negatively on the world rate of interest (r) because a higher rate of interest implies a higher cost (in terms of future goods forgone) of current consumption. For instance, higher credit rates induce some consumers to postpone buying both domestic and import goods. On the other hand, the aggregate supply of domestic goods (y_0^s) depends positively on the world rate of interest because a higher rate of interest implies (in terms of future goods) a higher return to current production. For example, by producing when interest rates are high, a company could invest the net revenues from production in financial assets and get a higher payoff in the future. The current trade deficit equals the difference, at any interest rate, between the aggregate demand curve (y_0^d) and the aggregate supply curve (y_0^s) as by definition it equals the amount we consume above what we produce. For an interest rate below r, a trade deficit arises because the low rate of return has raised the quantity of goods demanded while lowering the quantity of goods supplied. However, for an interest rate above r a trade surplus arises since the higher interest rate has the opposite effect on production and demand. Thus, the trade deficit depends inversely on the rate of interest; it is graphed as the ϕ_0 curve.

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Figure 1
Domestic consumption, output, and the balance of trade

Domestic consumption and output

Balance of trade
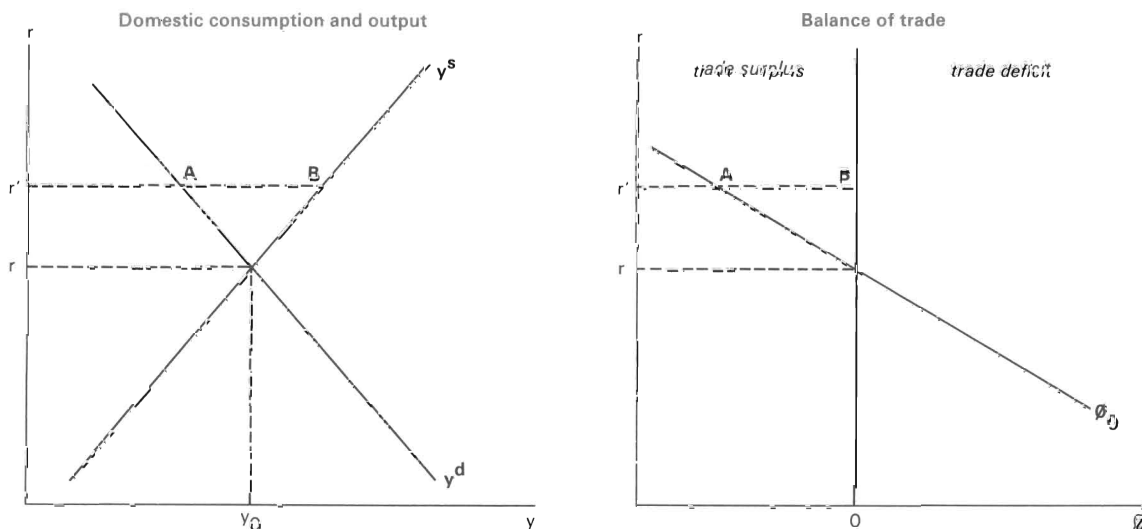
NOTE: $y^d \equiv$ domestic consumption (home and foreign goods); $y^s \equiv$ domestic production; $\phi \equiv$ trade balance ($\phi > 0$ denotes a trade deficit, $\phi < 0$ a trade surplus); $r \equiv$ world interest rate.

Figure 2
A temporary tariff

Domestic consumption and output

Balance of trade
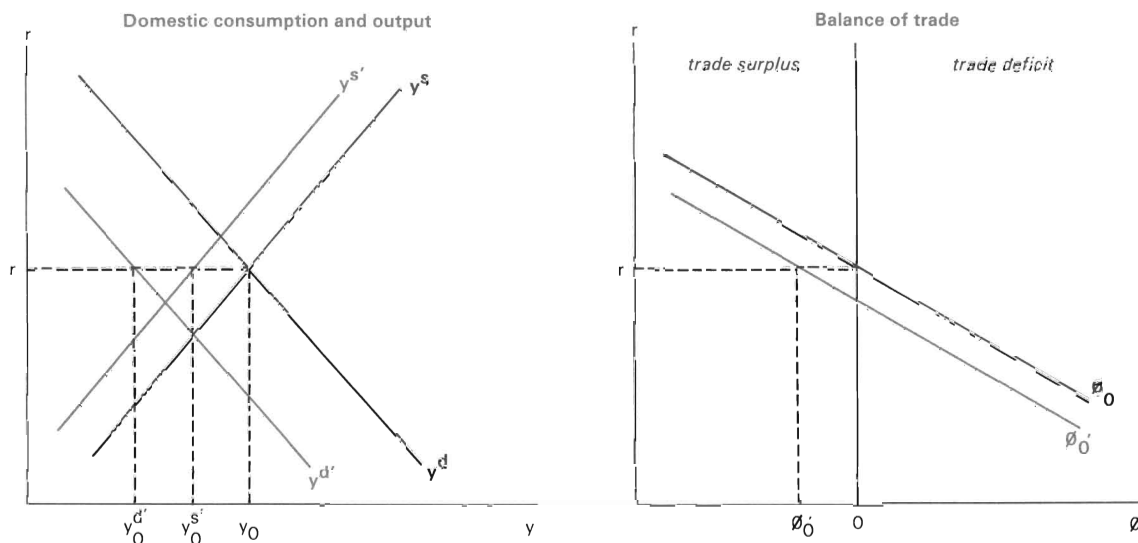
A temporary tariff

Consider, now, the effect of a temporary tax on the importation of goods so that $\mu_0 > 0$ while $\mu_1 = 0$. This tariff raises the contemporaneous price of foreign goods and induces a substitution into current home-produced goods and, over time, into future home- and foreign-produced goods. Thus, on net, the tariff will reduce the consumption of current foreign goods by more than it raises the consumption of domestic goods and the *total* demand for goods falls. In Figure 2, the y^d curve shifts from y^d to $y^{d'}$ reflecting this incom-

A macroeconomic model of an open economy

In this box a model is constructed for the purpose of analyzing the macroeconomic effects of tariffs. The model economy is composed of a representative agent with an infinite planning horizon who chooses levels of consumption of domestic and foreign goods as well as the level of work effort over all periods. These choices are made to maximize the utility function

$$\underline{u} = u(c_0, c_0^*, n_0) + \frac{1}{\rho} u(c_1, c_1^*, n_1) \quad (1)$$

where $c_i \equiv$ consumption of domestic goods in period i, $c_i^* \equiv$ consumption of foreign goods in period i, n_i work effort in period i, and $\rho \equiv$ a subjective rate of time preference such that $0 < \rho < 1$. The momentary utility function $u(c_i, c_i^*, n_i)$ is assumed to depend positively on the consumption of home and foreign goods and negatively on work effort. Further, the function is characterized by the feature that successive unit increases in consumption (work effort) raise (lower) utility by lesser (greater) amounts. Implicitly it is assumed that all "future" periods 1,2... are identical so that it is appropriate to consider period 0 as the present and period 1 as the future.*

The agent's opportunities are summarized by the intertemporal budget constraint

$$c_0 + (1 + \mu_0)c_0^* + \frac{c_1 + (1 + \mu_1)c_1^*}{r}$$

$$= f(n_0) + t_0 + \frac{f(n_1) + t_1}{r} \quad (2)$$

which states that the present value of expenditures on home and foreign goods must equal the present value of income from production and transfers from the domestic government to domestic residents. Here, μ_i is the tax rate imposed on foreign goods in period i, t_i are transfers in period i, and $f(n_i)$ is production in period i, accomplished with the use of labor input. The production technology is assumed to be characterized by a positive but nonincreasing return to labor. The form of equation (2) implies that if the individual's planned consumption and production levels do not match for a particular period, he may visit the domestic or international capital markets to borrow or lend at the world rate of interest r, subject only to the constraint that such borrowing and lending cancel over time. In this section, the world rate of interest is assumed to be unaffected by actions taken by the domestic economic agents.

The maximization of the objective function subject to the budget constraint leads to the first order necessary conditions

$$u_n(.i) = -f'(.i)U_c(.i) \quad 1 = 1,2 \quad (3.1, 3.2)$$

$$u_c*(.i) = (1 + \mu_i)U_c(.i) \quad 1 = 1,2 \quad (4.1, 4.2)$$

$$u_c(.0) = \frac{r}{\rho} U_c(.1) \quad (5)$$

along with the budget constraint (2). Equation (3) states that the marginal disutility of work effort in any period, U_n, must be equal to the marginal return to work effort, f', times the marginal utility of the consumption of that return, U_c. Equation (4) dictates that the marginal utility of the consumption of foreign produced goods, U_c*, must be equal to the foregone utility from consumption of domestic goods, $(1 + \mu_i)U_c$. Finally, equation (5) ensures that the individual chooses consumption over time in an optimal fashion; by forgoing a unit of current consumption the utility loss would be $U_c(.0)$, which must be matched by the utility gain of r extra units of consumption in all future periods, $(r/\rho)U_c(.1)$.

The government derives revenue from the taxation of foreign goods, which could be used to purchase goods and services. However, to isolate the pure effects

of tariff policy, it is assumed here that the government transfers the tariff revenues in a lump sum way to the private sector. Accordingly, its intertemporal budget constraint is given by

$$\mu_0 c_0^* + \frac{\mu_1 c_1^*}{r} = t_0 + \frac{t_1}{r} \qquad (6)$$

which equates the present value of tariff revenue to the present value of transfers. The form of this constraint allows the government to borrow or lend in the international capital market on the same terms as the private agent.**

The model is closed by defining the trade deficit to be equal to the difference between total consumption and total production, or

$$\phi_i = c_i + c_i^* - f(n_i). \qquad (7.1, 7.2)$$

For instance, if the consumption of home produced and foreign produced goods were to equal domestic production, exports $(f(n_i) - c_i)$ and imports (c_i^*) would be balanced and the trade deficit (ϕ_i) would be zero. Alternatively, one may view ϕ_1 as the surplus in the capital account because, if the current account is in deficit, individuals must be borrowing (exporting bonds) in an equivalent amount for overall balance in international payments.† Lastly, equations (2), (6), and (7) imply that the trade account must balance intertemporally, or

$$\phi_0 + \frac{\phi_1}{r} = 0 \qquad (8)$$

Equilibrium

The model's general equilibrium is described by equations (3), (4), (5), (7), and (8) in the endogenous variables $(c_0, c_0^*, n_0, c_1, c_1^*, n_1, \phi_0, \phi_1)$ These can be reduced to five equations by first using equation (7) to substitute for c_0 and c_1 in equations (3), (4), and (5) and then using

equation (8) to eliminate ϕ_1 in these revised equations. This yields

$$U_n(f(n_0) - c_0^* + \phi_0, c_0^*, n_0) =$$
$$-f'(n_0)U_n(f(n_0) - c_0^* + \phi_0, c_0^*, n_0) \qquad (9)$$

$$U_n(f(n_1) - c_1^* - r\phi_0, c_1^*, n_1) =$$
$$-f'(n_1)U_c(f(n_1) - c_1^* - r\phi_0, c_1^*, n_1) \qquad (10)$$

$$U_c^*(f(n_0) - c_0^* + \phi_0, c_0^*, n_0) =$$
$$(1 + \mu_0)U_c(f(n_0) - c_0^* + \phi_0, c_0^*, n_0) \qquad (11)$$

$$U_c^*(f(n_1) - c_1^* - r\phi_0, c_1^*, n_1) =$$
$$(1 + \mu_1)U_c(f(n_1) - c_1^* - r\phi_0, c_1^*, n_1) \qquad (12)$$

$$U_c(f(n_0) - c_0^* + \phi_0, c_0^*, n_0) =$$
$$\frac{r}{\rho} U_c(f(n_1) - c_1^* - r\phi_0, c_1^*, n_1) \qquad (13)$$

which are five equations in current and future imports, current and future employment, and the current trade deficit. Comparative statics techniques may be used to determine the impact of changes in tariff policy on these endogenous variables.

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*See Aschauer (1985) "Fiscal Policy and the Trade Deficit."

**As it turns out, whether or not the government actually runs a surplus or deficit is irrelevant to the analysis. This is because lump sum transfers do not appear in the set of equations (9) through (13) which describe the economy's general equilibrium. Hence the timing of the transfer of tariff revenue back to the private sector is irrelevant.

†As there is no initial debt in this model, in the first period the trade and current accounts are equivalent.

Figure 3
A permanent tariff

Domestic consumption and output

Balance of trade
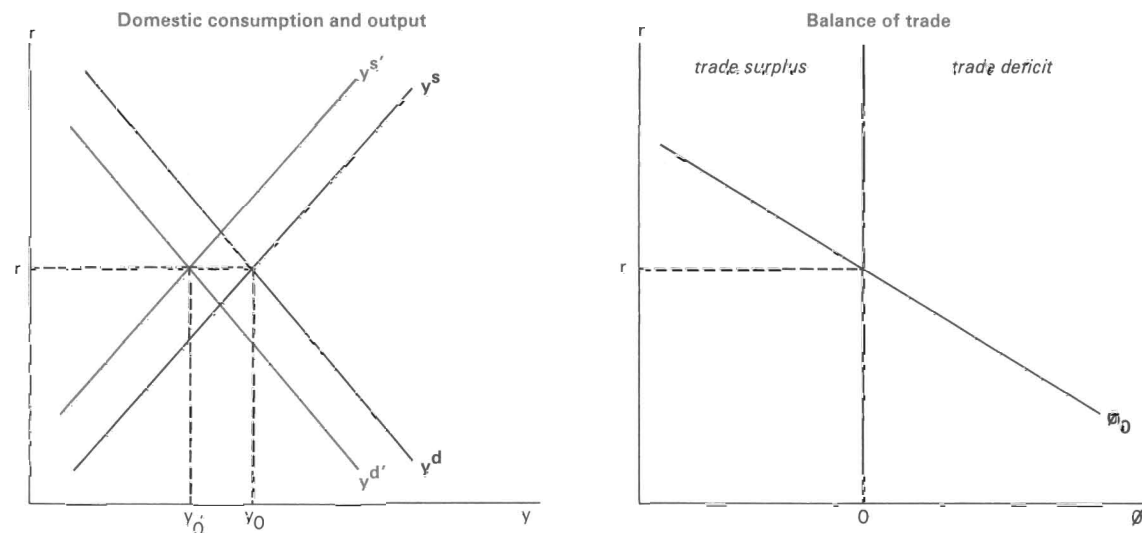
plete current substitution of home for foreign consumption goods.

On the supply side of the economy, an effect of the tariff is to raise the price of imported consumption goods relative to leisure; this promotes a shift away from the market activity of production, because the return to current production as measured by the ability to purchase foreign goods has been diminished. For example, rather than working as much and spending his earnings at an expensive restaurant serving Japanese beef, a lawyer may instead buy cheaper domestic beef and use the time to cook at home. In Figure 2, this effect is illustrated by a shift in aggregate supply from y^s to $y^{s'}$.

The net effect of the temporary tariff is to reduce the total demand for goods by a larger amount than the fall in the level of domestic production. This is because individuals recognize that the tariff is a temporary tax on total consumption and increase savings in order to shift consumption to the future where consumption goods are now relatively less expensive. This, in turn, creates a capital account deficit and a current account surplus equal to $\phi_0' = y_0^s - y_0^{s'}$. So, the temporary tariff has the effect of improving the trade account.

The improvement in the trade account, however, comes about by a reduction in domestic production. Along with the result that

the consumption of domestic goods has risen, we see that exports

$$x_0 = y_0^s - c_0$$

must fall in response to the temporary deficit. The current account improves because the reduction in import demand dominates the reduction in exports.

In summary, a temporary tariff acts as a tax on foreign goods, domestic production, and exports, and as a subsidy to domestic goods consumption and leisure. In the formulation of public policy, it is important that these general equilibrium effects on production, exports, and so on, be kept in mind so as to avoid significant policy blunders. In particular, *the argument that a tariff will have the effect of raising domestic employment and output is found to be erroneous in this particular model.*

A permanent tariff

Now let us investigate the impact of a permanent tariff on foreign goods. As before, the rise in the price of foreign goods relative to home goods causes a demand shift away from foreign products and toward domestically produced consumption goods. On net, the level of total demand for consumption goods falls and, in Figure 3, the y^d curve shifts to $y^{d'}$. Also, the return to production as measured in

Figure 4
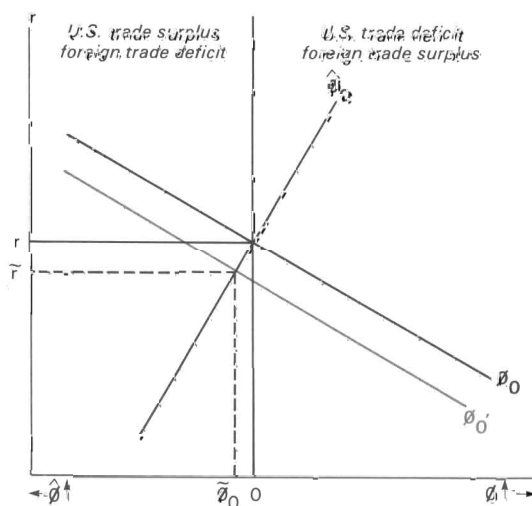World equilibrium interest rates
and trade flows

Figure 5
U.S. temporary tariff
(no retaliation)
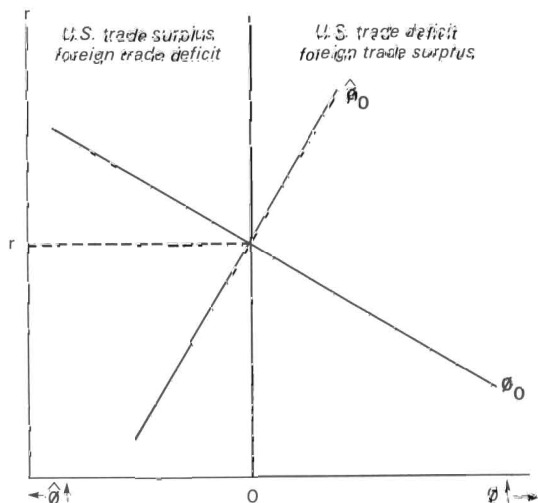
units of foreign goods has fallen; this induces a decrease in domestic production, which shifts y^s to $y^{s'}$.

The major qualitative difference between a temporary and permanent tariff is reflected in the fact that the former brings about a change in the price structure of foreign goods over time. A permanent tariff raises the relative price of foreign goods in all periods so that there is no reason for agents to reallocate resources over time in the pursuit of relatively cheaper goods. Thus, the shifts to total consumption demand and supply are equal to one another and the permanent tariff has no effect on the trade account.

Although net exports are left unaffected, this is accomplished through a mutual, equal reduction in imports and exports. In this sense, a permanent tariff, as a tax on imported goods, is identical in its effect on the trade balance as would be a tax on exports. This points out, dramatically, the likely fruitlessness of a policy of tariffs: *The net result of a policy of imposing and sustaining higher tariffs is to reduce employment and output while leaving the trade balance virtually unchanged.*

Finally, note that the logic of the model implies that the anticipation of an increase in tariffs in the future will bring about an increase in the current trade deficit as agents attempt to avoid the tax on future foreign goods by importing and consuming in the present. The

expectation by economic agents that the government will respond to a trade deficit of a certain magnitude by future tariff legislation may very well help to increase the severity of the external trade imbalance. Of current relevance, it may partially explain why the trade account appears to be taking such a long period of time to respond to the large depreciation of the dollar since early 1985.

World equilibrium, interest rates, and retaliation

In order for the analysis to be relevant to the current situation in the international economy, two assumptions of the model must now be relaxed. First, as the United States is a major player in international capital markets, it is unreasonable to maintain that world interest rates generally will be unaffected by U.S. tariff policies. Second, the analysis so far assumes that foreign economies respond passively to any changes in their net exports as a result of U.S. tariffs.

We may conceive of the rest of the world as being aggregated into a second "country" with much the same characteristics as those of the home economy. Let us denote variables determined in the foreign economy by a caret (for example, foreign consumption of home-produced goods—our exports—is given by $\hat{c}^{*}$).

Figure 6
Temporary tariff with foreign retaliation
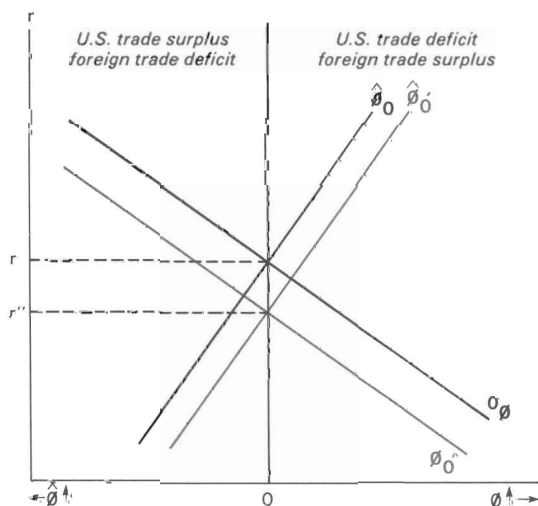
NOTE: $\hat{\phi} \equiv$ foreign trade balance.

Now, the world interest rate changes in such a way as to clear the world market for goods, or

$$\phi_0 = \phi_0 + \hat{\phi}_0 = 0 \qquad (14)$$

in the world economy, which means that a domestic current account deficit must be matched by a foreign current account surplus.

Next, consider Figure 4, wherein the world level of interest rates and the pattern of trade is determined graphically. Here, the curve ϕ_0 is as derived in Figure 1. However, the curve $\hat{\phi}_0$ is plotted differently. Measurement of the quantity $\hat{\phi}_0$ is such that to the left of the vertical line the foreign current account is in deficit while to the right it is in surplus. The intersection of the two lines is the graphical counterpart of equation (14), that is, world equilibrium.

We restrict our attention to the impact of a temporary tariff. The result depicted in Figure 2 when translated to Figure 5 implies that the world level of interest rates declines in the face of a transitory tariff imposed by the U.S. The fall in world interest rates reestablishes equilibrium in the world economy by raising demand—and by reducing supply—in both the domestic and foreign economies. In this fashion, *the negative effect of tariffs on U.S. employment is transmitted to the foreign economy, with the result that the world level of employment falls.* Still, the

pattern of trade has shifted in favor of the U.S., in the sense that in the world equilibrium the U.S. current account has shifted into a surplus position.

However, the implied fall in foreign employment would very likely be cause for retaliation on the part of the government of the foreign economy. This would have the effect, shown in Figure 6, of restoring the world pattern of trade to its pre-tariff position (assuming the exact extent of retaliation required) but of reducing the level of world interest rates even more significantly. This is because the foreign tariff also works to reduce foreign consumption by more than it reduces foreign production, just as in the domestic case. Thus, at the initial level of interest rates, the foreign tariff creates a surplus of goods world-wide. To eliminate this surplus, world interest rates must fall by more than before, which further reduces both home and foreign production and employment levels. As an example, U.S. tariffs on Japanese autos and Japanese tariffs on U.S. autos have the effect of creating a general surplus of autos. As the prices of both U.S. and Japanese cars rise, a reduction in interest rates would be needed to stimulate purchases. As world interest rates fall, car purchases will expand and production will fall (because future production becomes more profitable relative to present production) until equilibrium is reestablished, with the same direction of trade flows. Thus, *accounting for the possibility of foreign retaliatory legislation allows for further skepticism of the presumed favorable impact of U.S. tariffs on the position of the U.S. trade balance.*

Conclusion

The analysis of the effects of tariffs within a simple intertemporal optimizing model leads to the following conclusions. Abstracting from foreign retaliatory protection, a U.S. tariff which is perceived by private agents as a temporary measure will, by distorting the intertemporal pricing structure, bring about an improvement in the trade account. However, such improvement is at the expense of a reduction in employment, output, and gross exports; the trade deficit falls because agents purchase debt to shift consumption of foreign goods to future periods when they will be relatively less expensive. In a more detailed model, this attempt to save would also drive down the

Temporary and permanent tariffs, a technical example

The impacts of temporary and permanent tariffs are here reported for the particular case of logarithmic utility

$$u = \ln(\iota_0 c_0^* (\bar{n} - n_0)) +$$

$$\frac{1}{\rho} \ln(c_1 c_1^* (\bar{n} - n_1)) \qquad (1')$$

and linear technology $y_i = \alpha n_i$. The maximization yields the following set of five equations in $(\phi_0, n_0, n_1, c_0^*, c_1^*)$:

$$2\alpha n_0 - c_0^* + \phi_0 = \alpha \bar{n} \qquad (9')$$

$$2\alpha n_1 - c_1^* + r\phi_0 = \alpha \bar{n} \qquad (10')$$

$$(2 + \mu_0)c_0^* + \alpha n_0 - \phi_0 = 0 \qquad (11')$$

$$(2 + \mu_1)c_1^* - \alpha n_1 + r\phi_0 = 0 \qquad (12')$$

$$\phi_0 - \frac{1}{1+\rho}[\alpha(\frac{\rho}{r} n_1 - n_0) -$$

$$(\frac{\rho}{r} c_1^* - c_0^*] = 0 \qquad (13')$$

Totally differentiating this system of equations and using standard comparative statics techniques leads to the results in the table below. For instance, a temporary tariff has the effect of lowering the trade deficit in the amount

$$\frac{d\phi_0}{d\mu} = \frac{1}{A} \frac{6\alpha^2 c^*}{1+\rho} < 0$$

while a permanent tariff leaves the trade account unaffected

$$\frac{d\phi_0}{d\mu} = 0$$

The results listed in the table are for the case of zero tariffs in the original equilibrium. For the case where $0 < \mu_0 \leq 1, 0 < \mu_1 \leq 1$, some qualifications to the analysis above arise. For example, a permanent tariff now has the following effect on the trade account:

$$\frac{d\phi_0}{d\mu} = \frac{1}{\hat{A}} \frac{2\alpha^2 c_0^*}{1+\rho}(\mu_1 - \mu_0)$$

where $\hat{A} < 0$. Suppose, for instance, that the original equilibrium entailed a higher tariff in the future than in the present. Then, raising the tariff by equal amounts in the present and future would reduce the distortion in the intertemporal relative price of foreign goods. Consequently, there would be a relative shift away from current consumption into future consumption which would require a capital account deficit (the purchase of debt instruments) and would induce a current account surplus, i.e.,

$$\frac{d\phi_0}{d\mu} < 0.$$

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temporary tariff

$d\mu_0 > 0$	ϕ_0	c_0^*	c_0	y_0	x_0
	$\frac{1}{A}\frac{6\alpha^2 c_0^*}{1+\rho}$	$\frac{1}{A}\frac{6\alpha^2 c_0^*}{1+\rho} + \frac{4\alpha^2 c_0^*}{1+\rho}$	$-\frac{1}{A}\frac{2\alpha^2 \rho c_0^*}{1+\rho}$	$\frac{1}{A}\frac{2\alpha^2 \rho c_0^*}{1+\rho}$	$\frac{1}{A}\frac{4\alpha^2 \rho c_0^*}{1+\rho}$

permanent tariff

| $d\mu_0 = d\mu_1 > 0$ | 0 | $\frac{1}{\hat{A}} 4\alpha^2 c_0^*$ | $\frac{1}{A} 2\alpha^2 c_0^*$ | $\frac{1}{A} 2\alpha^2 c_0^*$ | $\frac{1}{A} 4\alpha^2 c_0^*$ |

$$A = \alpha^2(\rho - 1)/(1 + \rho) < 0$$

spread between domestic and foreign interest rates, induce a move toward a capital account deficit and, as the balance of payments must balance, a fall in the dollar to accomplish the reduced trade account deficit. A temporary tariff would help bring down the dollar, but also would reduce the gross volume of exports and domestic production.

On the other hand, a tariff which is viewed by the private sector as more or less permanent will have little or no impact on the current account position in the balance of payments, while lowering domestic production and exports. The absence of any significant impact on the trade account arises because foreign goods have now been made equally costly across time through the permanent rise in their after-tax price and, as a result, agents do not attempt to shift resources, by saving, to the future. In a more elaborate model, there would be no downward pressure on domestic interest rates, no effect on the dollar, and no impact on the status of the current account.

Allowing for the likelihood of higher foreign tariffs in response to raised U.S. tariffs further offsets the ability of protection to have a positive net effect on the trade position of the U.S. Indeed, given complete retaliation, the result of a "tariff war" would be to lower world interest rates, employment, and output levels while maintaining the level of net capital flows.

Consequently, from the perspective of positive analysis, the model indicates that if tariff policy is to be successful in reducing the trade deficit it is essential that tariff legislation be such as to leave the perception that the imposed taxes on foreign goods will be of only short duration and not induce retaliation by foreign governments.

From the viewpoint of normative analysis, tariffs—temporary or permanent in nature—should be avoided since what effects they do have on macroeconomic variables come about by a distortion of resources both contemporaneously and across time. Unless particular examples of market failure to which tariff policy is an appropriate response can be cited, such distortions of market activities typically will culminate in a reduction in aggregate social welfare.