Journal of International Economics 28 (1990) 71–91. North-Holland

TARIFFS AND SAVING IN A MODEL WITH NEW GENERATIONS

Charles ENGEL

University of Virginia, Charlottesville, VA 22901, USA

Kenneth KLETZER*

Yale University, New Haven, CT 06520, USA

Received February 1988, revised version received May 1989

We explore how a tariff may affect saving through intergenerational redistribution of income that is caused by changes in factor prices and by the distribution of tariff revenue. The model is a Blanchard-style overlapping generations model. Two types of revenue distribution schemes are examined: lump-sum distribution of current revenues to currently living individuals, and distribution as a subsidy to holders of physical wealth. Under both schemes the government budget is continuously balanced. We draw some general conclusions about the non-neutralities that arise in this type of model as opposed to single-generation models, or models in which perfect bequest motives exist

1. Introduction

In policy discussions, it is often suggested that increased tariffs will improve a country's current account. To the economic theorist, it is not immediately obvious how such a tax change should affect the incentives to save and invest – whose difference comprises a current account imbalance. Here we take a look at one aspect of the effect of tariffs on saving in a neoclassical model.

This paper analyzes the effects of tariffs on saving in a small open economy using the uncertain lifetimes version of the overlapping generations model developed by Yaari (1965) and Blanchard (1984, 1985). Several authors[1] have used this model to examine the role of public sector budget deficits because it fails to display Ricardian debt-neutrality, so that the intertemporal pattern of net lump-sum transfers to individuals has real effects. We examine the intertemporal effects of a permanent tariff change,

*We express our thanks to William Buiter, Jonathan Eaton and Jonathan Skinner for useful discussions.

[1]See Blanchard (1984, 1985). In the international context, see Buiter (1987, 1988a, 1988b), Frenkel and Razin (1986, 1987), Kouri (1986), van Wijnbergen (1985), Eaton (1989), Smith (1987) and our earlier paper, Engel and Kletzer (1986). See also Weil (1985).

abstracting from other aspects of fiscal policy. The distribution of the incidence of the tariff across different factors, and the method of distribution of the tariff revenue, have important consequences for aggregate per capita saving and, therefore, the current account. The intersectoral and intergenerational effects of the tariff cause intertemporal changes for the same reason that debt-neutrality fails; however, we constrain the public sector budget to be in balance continuously.

In a purely neoclassical intertemporal model with no distortions and no slow adjustment of prices or impediments to movements of factors of production, it may not be clear why a permanent tariff should have any effect on saving decisions. Razin and Svensson (1983) show how a permanent tariff could affect intertemporal consumption choices if consumers' sub-utility functions change over time. In that case, a given permanent ad valorem tariff will increase the consumer's exact price index by a different percentage at different times, and hence lead to a change in the effective real interest rate faced by consumers.[2] That effect is ruled out in our model because we assume that the consumers' felicity functions are identical over time.

A second way that a permanent tariff could affect the saving decision is if the tariff is large enough that it causes a first-order distortion. Then, if consumers' rate of time preference is related to their wealth, the decrease in wealth caused by the distortion will result in a change in saving behavior. In our earlier paper [Engel and Kletzer (1986)] we showed that in a model in which consumers' discount rate was positively related to felicity, that an increase in tariffs that caused a first-order distortion would lead to an increase in current saving. However, the effect of a tariff on saving in the model of this paper does not depend on the distortionary effects of tariffs. In fact, the effects we discuss are true even when we consider imposing a small tariff starting from a position of free trade, so that the distortion is second-order.[3]

After laying out the model in section 2, we proceed by examining first a special case of the model in which the import good is not produced domestically. We examine this model because it allows us to abstract from factor price changes. Tariff revenue is assumed to be redistributed lump-sum to living individuals. We find that under this distribution scheme, the change in the tariff has consequences for aggregate saving. This tariff and redistribution scheme redistributes income between living generations and generations that are not yet born. Hence, it changes current expenditure.

We next take up models in which the import good is produced. Here, a

[2]See also Edwards (1987) who introduces non-traded goods.

[3]This general feature of the uncertain lifespans model has also been noted by Buiter (1988a).

change in the tariff has additional effects on expenditure through its power to change the factoral distribution of income.[4]

It is important to note that these effects are different from those that appear in other models of the current account in which no new generations are born. Both of these effects are present even when the tariff would have *no* effect on saving in a model with a single generation.

In section 4 we consider an alternative scheme for redistribution of tariff revenue. If the economy has positive holdings of tangible assets (foreign currency bonds and land), the revenue is redistributed as a subsidy to tangible assets. If there are net negative holdings of tangible assets, the revenue is redistributed as a subsidy to net tangible debt. We show that for any given level of the tariff, the government has a choice of how to redistribute revenue. If they choose to subsidize steady-state tangible assets, the steady-state tangible asset position will be positive. If they choose to have a negative subsidy rate to steady-state tangible assets – hence, a positive subsidy to steady-state tangible debt – the economy will have a negative position in tangible assets in the steady state. So, remarkably, for any given tariff rate and under the constraint that the budget be balanced, the government can determine whether the country is a creditor or debtor in the long run by its choice of a positive or negative subsidy to tangible wealth – regardless of the relation of the discount rate of households to the world interest rate. We then show how changes in the tariff rate affect saving.

So, the plan of this paper is to examine the effects of tariffs under two redistribution schemes: lump-sum redistribution, and redistribution as a subsidy to certain types of wealth. In both sections we consider a simple set-up of the model in which the tariff has no effects on factor rewards. We also consider briefly in the section on lump-sum redistribution a version of the model in which factor rewards can change in response to the tariff.

Section 5 concludes.

2. The model

We study a small country that takes as given the world interest rate, r, and the world price of good 2 in terms of good 1, which we set equal to one. Both goods are traded and consumed. We consider the effects of increasing a tariff on good 2.

Goods are produced using standard neoclassical production processes. There are at least two factors of production, so factor returns and output levels are determined exactly. All factor supplies are constant (there are no intermediate goods, and all non-labor factors can be considered to be types of land) and are normalized to one. With unchanging factor supplies and relative price of commodities, factor returns and output levels are constant

[4]Our analysis of the distributional impact of taxes from changes in factor prices bears some resemblance to that of Chamley and Wright (1987).

over time. A permanent change in the tariff may lead to a once-and-for-all shift in factor prices and production levels. The production side of the economy can be left in this general form for the dynamic analysis, although we will compare the effect of a permanent tariff change for three special cases: only the export good is produced; both goods are produced in the Heckscher–Ohlin model; and both goods are produced in the specific-factors model.

Household consumption behavior is derived using the uncertain lifetimes version of the overlapping generations model developed by Yaari (1965) and Blanchard (1984, 1985). We adopt a continuous-time version in which each individual faces a constant (age and time independent) instantaneous probability of death, π, less than unity, and there is no bequest motive. At each instant, a new cohort of size $\pi+n$ is born, where n is the constant proportionate rate of population growth. The dynamics of per capita saving are identical for all values of $\pi+n$ that exceed zero [see Buiter (1988b)]. Weil (1985) shows that an overlapping generations model results when π is zero and n is positive. In a model with infinitely-lived dynastic families in which each individual possesses a perfect bequest motive, if there is birth of new dynasties, then the model will lead to the same saving dynamics as in Weil, because currently living families do not care about the consumption of future dynasties. We use Blanchard's version in which π is positive and n equals zero, because labor force growth is unessential to our examination of the savings effects of tariff changes. Therefore, the population is constant with size equal to one.

Because consumers have uncertain lifetimes, their effective subjective discount rate is $\delta+\pi$, where δ is the positive pure rate of time preference.

All forms of physical wealth are perfect substitutes, so that they earn the same rate of return, r, as an internationally traded bond. We assume that consumers have access to a perfect annuities market. Each consumer can contract with an insurance company to receive an additional rate of return on tangible assets while she lives. In exchange, the company receives her net wealth if she dies. With fair insurance, in equilibrium the additional rate of return equals π. Conversely, if a consumer has negative net holdings of tangible assets, then she agrees to pay a premium π per unit of debt on the condition that the insurance company assumes her debt upon death.

Two types of wealth are assumed not transferable to the insurer for an annuity. The consumer's human wealth (the discounted value of labor income) has no value upon death, so that the company is unwilling to pay anything for the privilege of owning this asset after the person's death. Also, since tariff revenue is distributed only to living persons, the individual has no claim to tariff revenue after death to transfer to the insurer. We refer to the sum of these two types of wealth as non-tangible assets.

In the Yaari–Blanchard model, an individual born at time i will maximize

the expectation of the discounted stream of felicity of current consumption. The objective function for an individual born at time i is given by:

$$V_i(t)=\int_t^{\infty} u(c_{1i}(s),c_{2i}(s))\,\mathrm{e}^{-(\delta+\pi)(s-t)}\,\mathrm{d}s, \tag{1}$$

where $c_{1i}(s)$ and $c_{2i}(s)$ are individual i's consumption at time s of goods 1 and 2, respectively. The individual's budget constraint at time t is:

$$\dot{w}_{it}=(r+\pi)w_{it}+\omega_{it}+R_{it}-I_{it}, \tag{2}$$

where w_{it} is tangible wealth.[5] Income from non-tangible wealth is given by the sum of labor income, ω_{it}, and net transfers, R_{it}. Expenditure at domestic prices on consumables is denoted by I_{it}, which equals the sum $c_{1i}(t)+pc_{2i}(t)$, where p is the domestic (cum tariff) price of good 2. The details of the derivation of individual and aggregate consumption dynamics are given in an appendix (which is available on request from the authors). We make the assumptions that the felicity function, $u(c_1,c_2)$, is homothetic and displays constant relative risk aversion to allow linear aggregation of individuals' consumption plans.

An important feature of the Yaari–Blanchard model is that the pure subjective rate of discount need not equal the world rate of interest to assure convergence of aggregate per capita wealth and consumption to steady-state values under individual intertemporal optimization. Because individuals face a positive probability of death at each instant, aggregate per capita wealth can converge to a finite level when r exceeds δ, even though each individual plans to accumulate unbounded wealth over an infinite horizon (and analogously, when δ exceeds r). Individuals born at any given time comprise an exponentially decreasing fraction of the population as they age [in Weil (1985), this happens through population growth alone]. The appendix restates Blanchard's condition for existence and stability of the steady state.

Output of the two goods is given by y_1 and y_2. Aggregate consumption is represented by c_1 and c_2. Total expenditure at domestic prices is given by:

$$I=c_1+pc_2.$$

Total expenditure at world prices is:

$$z=c_1+c_2.$$

Tariff revenue in the aggregate is given by:

[5]The dot above a letter refers to its time derivative.

$$R_t=(p-1)(c_{2t}-y_{2t}).$$

The aggregate lump-sum transfer to consumers at time t, R_t, equals the actual tariff revenue collected at time t. We assume a continuously balanced public sector budget. Because felicity is homothetic, the age distribution of total revenue has no consequences if the transfer is lump-sum and received only by those currently alive.

The aggregate value of non-tangible wealth (aggregating as in Blanchard) is given by:

$$N_t=[\omega/(r+\pi)]+\int_t^{\infty} R_s \mathrm{e}^{-(r+\pi)(s-t)}\,\mathrm{d}s.$$

(The wage rate is age independent so that ω depends only on r and p for the small country, and r and p do not change – except for the one time permanent change in p from the tariff.)

Aggregate tangible wealth, w_t, is defined by:

$$w_t=a_t+b_t,$$

where b_t is aggregate net claims on foreigners and a_t is the value of land. Under the constant returns to scale production assumption:

$$a_t=(y_1+py_2-\omega)/r. \tag{3}$$

Therefore, a_t depends only on the paths of p and r.

Aggregate consumption at any time t is given by the simple linear relationships (see the appendix):

$$\begin{aligned} I_t&=\Delta(w_t+N_t),\\ c_{1t}&=(1-\eta(p))I_t, \end{aligned} \tag{4}$$

and

$$pc_{2t}=\eta(p)I_t,$$

where

$$\Delta=r+\pi+(\delta-r)/\sigma,$$

and $0\leqq\eta\leqq 1$; $\eta'(p)\gtrless 0$. The coefficient of relative risk aversion is given by σ.

Aggregating as in Blanchard yields equations for the accumulation of tangible and non-tangible assets:

$$\dot{w}=rw_t+(\omega+R_t)-I_t \tag{5}$$

and

$$\dot{N}_t=(r+\pi)N_t-(\omega+R_t). \tag{6}$$

Note that tariff revenues may be expressed as:

$$R_t=\alpha I_t-(p-1)y_{2t},$$

where

$$\alpha(p)=\left[1-\frac{1}{p}\right]\eta(p).$$

In what follows, we will generally assume $\alpha'>0$. This would hold, for example, with Cobb–Douglas utility ($\eta'(p)=0$). It would be violated if the demand elasticity of substitution between goods is sufficiently high and initial tariff levels are sufficiently greater than zero.

The tangible wealth accumulation equation can be rewritten as:

$$\dot{w}_t=rw_t+\omega-(p-1)y_{2t}+\alpha I_t-I_t. \tag{7}$$

Since a_t is constant over time, $\dot{b}_t=\dot{w}_t$. Also note that

$$z_t=(1-\alpha)I_t. \tag{8}$$

Eqs. (3), (7) and (8) may be used to derive

$$\dot{b}_t=rb_t+y_1+y_2-z_t. \tag{9}$$

Eqs. (4), (5), (7) and (8) give the dynamics of expenditure at world prices:

$$\dot{z}_t = (r+\pi-\Delta)z_t - (1-\alpha)\pi\Delta(a_t+b_t). \tag{10}$$

(Remember, a_t is constant.)

Eqs. (9) and (10) constitute a second-order dynamic system that expresses the motion of the economy.

The steady-state levels of z and b can be obtained by setting $\dot{b}=0$ in eq. (9) and $\dot{z}=0$ in eq. (10). We get:[6,7]

$$\bar{z} = \frac{\Delta\pi(1-\alpha)}{(\Delta-r)(r+\pi)-\alpha\Delta\pi}(\omega+(1-p)y_2) \tag{11}$$

and

$$\bar{b} = \frac{\bar{z}-y_1-y_2}{r}. \tag{12}$$

The appendix shows the conditions under which the dynamic system is saddle stable. The accumulation of bonds over time is given by:

$$\dot{b}_t = \theta(b_t - \bar{b}_t), \tag{13}$$

where $\theta<0$ is the stable root of the system.

Fig. 1 shows the phase diagrams for this system in the two cases $\delta<r$ and $\delta>r$.

3. Effects of tariff changes

Here we examine the effects of increasing the tariff permanently at some time. We are particularly interested in the response of saving and the current account. At the moment the tariff is imposed, the country's claims on foreigners, b_t, cannot jump. So, from eq. (13) the effect of an increase in tariffs on saving and the current account, starting from a position of steady state is given by (recall the assumption that $\alpha'>0$):

$$\mathrm{d}\dot{b}_t/\mathrm{d}\alpha = -\theta(\mathrm{d}\bar{b}/\mathrm{d}\alpha), \tag{14}$$

which has the same sign as $\mathrm{d}\bar{b}/\mathrm{d}\alpha$.[8]

3.1. Specialization in production of the export good

In the case in which the import good (good 2) is not produced, the wage

[6]A bar over a variable represents its steady-state value.

[7]The stability condition implies $(\Delta-r)(r+\pi)-\alpha\Delta\pi>0$, and $\Delta>r>0$. So, $\bar{z}>0$. These facts are demonstrated in the appendix.

[8]If we are initially away from the steady state, $\mathrm{d}\dot{b}/\mathrm{d}\alpha = -\theta(\mathrm{d}\bar{b}/\mathrm{d}\alpha)+(b-\bar{b})\,\mathrm{d}\theta/\mathrm{d}\alpha$. From the expression for θ in the appendix, $\mathrm{d}\theta/\mathrm{d}\alpha = \Delta\pi((\Delta+\pi)^2-4\alpha\Delta\pi)^{-1/2}>0$. If initially the current account is in deficit, so $(b-\bar{b})>0$, then the effect of a tariff increase on the current account is more positive relative to a starting position of current account balance, and vice versa for a current account initially in surplus.

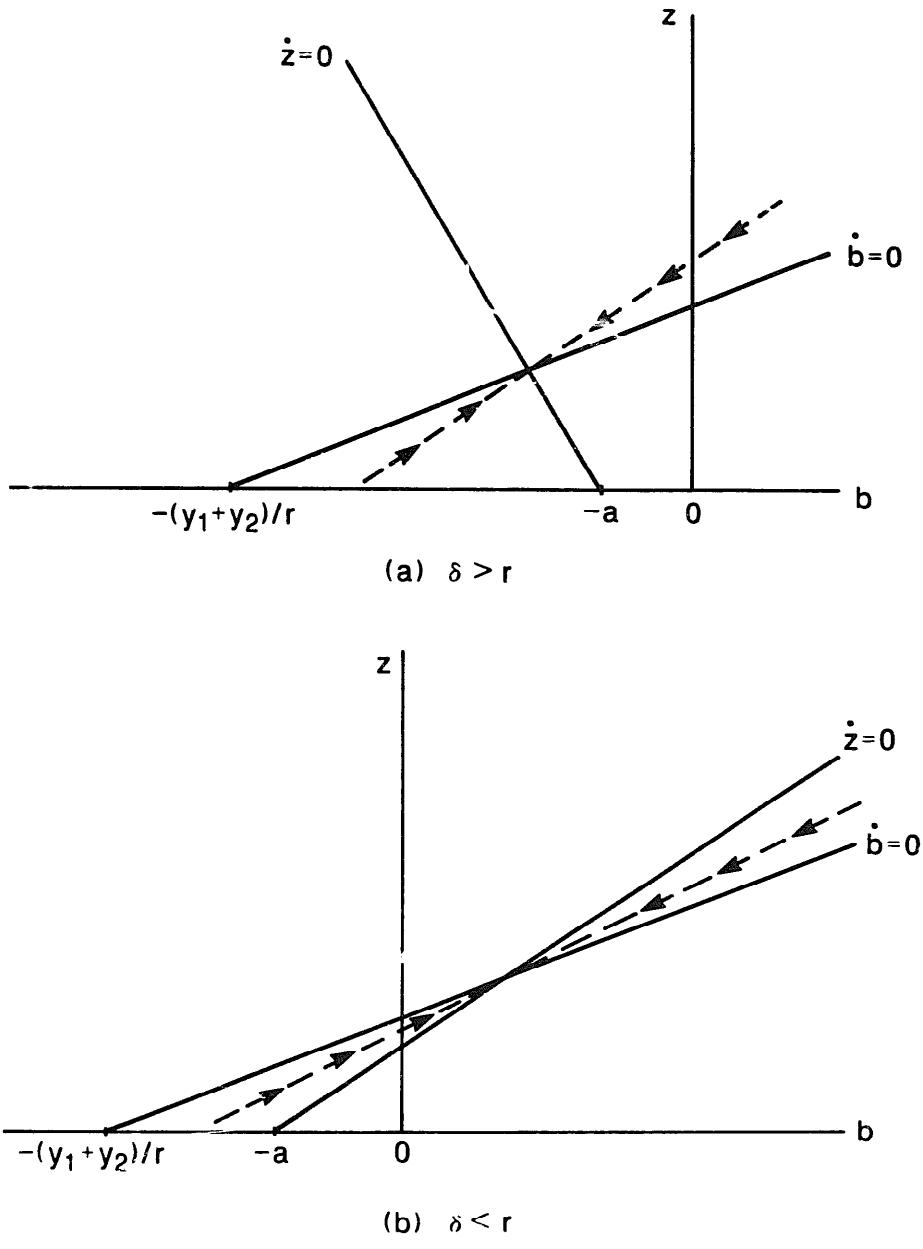


Fig. 1

rate, ω, and the value of land, a, are unaffected by changes in the tariff. Output of good 2, y_2, is zero, and output of good 1 will not respond to tariff movements. We examine this special case first, because there will be no factor price changes when the tariff increases.

From eq. (12):

$$d\bar{b}/d\alpha = (1/r)(d\bar{z}/d\alpha). \tag{15}$$

From (11):

$$\frac{\mathrm{d}\bar{z}}{\mathrm{d}\alpha}=\frac{r\Delta\pi(r-\delta)\omega}{\sigma[(\Delta-r)(r+\pi)-\alpha\Delta\pi]^2}\gtrless 0, \quad \text{as} \quad r\gtrless\delta. \tag{16}$$

Hence, from (14), (15) and (16) it follows that an increase in tariffs will improve the current account (increase saving) when the personal discount rate is less than the world interest rate, but will worsen the current account (lower saving) when the discount rate exceeds the world interest rate.

More directly, from eq. (9):

$$\mathrm{d}\dot{b}_t/\mathrm{d}\alpha=-\mathrm{d}z_t/\mathrm{d}\alpha.$$

Hence,

$$\mathrm{d}z_t/\mathrm{d}\alpha=(\theta/r)(\mathrm{d}\bar{z}/\mathrm{d}\alpha).$$

When long-run expenditure, $\bar{z}$, rises, current expenditure, z_t, falls. An increase in the tariff will cause z_t to rise when $\delta>r$ and fall when $r>\delta$. Note that this result holds even when $t=0$ initially [so $\alpha=0$ in eq. (16)]. Fig. 2 displays the dynamics of the system when the tariff is increased. The initial position is point A. The economy jumps to point B when the tariff is increased, then proceeds over time to the new steady state.

In models in which no new families are born and there is a perfect bequest motive, if there were no distortions in the economy (such as existing tariffs) a small increase in tariffs would have no effect on expenditure (except possibly through a 'pure substitution effect' which is ruled out here by our assumptions on preferences).[9] In this model even when the initial tariff is zero, a small increase in tariffs has a first-order effect on expenditure.

The tariff has a first-order effect because it redistributes income across generations. The incidence of the tariff is greatest on individuals who consume the most. These are individuals with the greatest wealth. At any point in time the impact of a tariff with a lump-sum redistribution (that is, equal for all living individuals) is to redistribute income away from those who are wealthier – that is, those who consume more – toward those who are less wealthy. The redistribution in the current period has no effect on current saving, because all individuals have the same marginal propensity to consume out of wealth (see the appendix). However, there is an effect on current consumption because in the future when tariffs are collected and redistributed, there will be a redistribution of income between those who are currently alive and those who are not yet born.

In particular, if $\delta<r$, then all currently living individuals will have greater

[9]See Engel and Kletzer (1986) for a demonstration of this in a model with a representative consumer who has an infinite horizon and an endogenous rate of time preference. Razin and Svensson (1983) discuss a 'pure substitution effect' that is ruled out by assumption in this model. Because the felicity function is identical in all periods, and prices are constant, the exact price index does not change over time in our set-up.

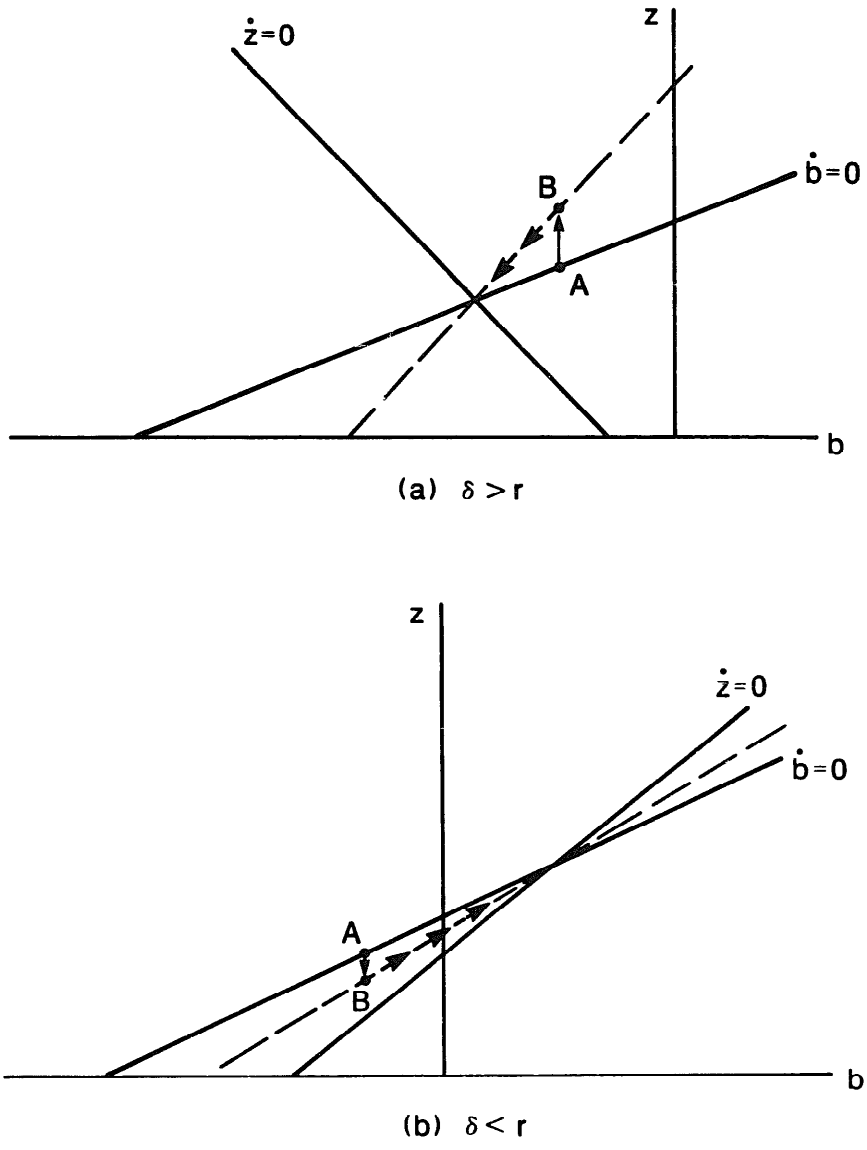


Fig. 2

wealth in every future period than members of all generations that are not yet born. Then this tariff-cum-redistribution scheme will redistribute income away from currently living individuals. Thus, the wealth of current generations will decrease, so their spending will decrease. This means saving will rise and the current account will improve. When $\delta > r$, all individuals currently alive will have less wealth than all future generations at all times, so income will be distributed toward the currently alive. Current expenditure will increase, and the current account will decline.[10]

[10]Note that the relation of δ to r is critical for the way fiscal policies affect current spending in Frenkel and Razin (1987).

Consider for a moment a scheme for redistributing tariff revenue that makes the imposition of a tariff neutral. Since tariff revenue is proportional to expenditure measured in terms of the domestic good, I, a subsidy to expenditure clearly would neutralize the effect of the tariff. In this case we know

$$z_t = \Delta(w_t + N_t).$$

But, then using eq. (8), we would have:

$$I_t = (1/(1-\alpha))\Delta(w_t + N_t).$$

Tariff revenue would be given by:

$$R_t = (\alpha/(1-\alpha))\Delta(w_t + N_t).$$

Notice that in this case the tariff is effectively a proportional tax on total wealth, $w_t + N_t$, at the rate $(\alpha/(1-\alpha))\Delta$. The tariff is neutral when the revenue is rebated as a proportional subsidy to total wealth.[11]

In contrast, under the lump-sum redistribution to living persons considered in this section, the tariff is still a proportional tax on total wealth:

$$R_t = \alpha\Delta(w_t + N_t),$$

but the revenue is returned purely as a subsidy to non-tangible wealth. The tariff changes consumption because the redistribution scheme has first-order effects on expenditure.

When there is a permanent increase in the tariff, total wealth is taxed at a greater rate both now and in the future. The tax on tangible wealth is a fully-capitalized loss to living individuals (because of the perfect annuities market). The losses from the tax on future non-tangible wealth are only partially capitalized by living individuals. A neutral redistribution scheme would be to return the revenue in an equal subsidy to tangible and non-tangible wealth. Any other scheme has consequences for total expenditure measured at world prices. For example, the lump-sum redistribution considered in this section takes revenue from taxes on tangible and non-tangible wealth and redistributes it purely as a subsidy to non-tangible assets. In

[11]Under the 'neutral' scheme, the level of c_1 and c_2 will change (because the tariff is a tax on c_2, but all expenditure is subsidized). However, $c_1 + c_2 (= z)$ will not be affected. Of course, expenditure in domestic prices changes as $(p-1)c_2$ is altered, but this is exactly the change in tariff revenue.

section 4 we consider another non-neutral scheme in which the revenue is redistributed as a subsidy to tangible assets.[12]

In this section, both forms of wealth are being taxed by the tariff but the revenue is all coming back as a lump-sum transfer. In the future, that revenue (which will be generated partially by a tax on physical assets and partially by a tax on non-tangible assets) will be redistributed to all individuals who are alive at that time – some of whom are not yet born. Thus, living individuals are not fully compensated for the burden of the tax they bear (if they have positive tangible wealth; if they have negative tangible wealth – $\delta > r$ – they are over-compensated). The only neutral scheme would give as a lump-sum redistribution to individuals living at any time only that share of the revenue collected that is effectively a tax on non-tangible wealth. With lump-sum redistribution of revenues, the burden of the tax is not spread across generations in the same way as the redistribution of the revenue – which causes the pattern of saving to change across generations.

3.2. Both goods produced

In addition to the effect on saving generated by a redistribution of tariff revenue, there is an effect on total expenditure caused by changes in the factor composition of income. In a model where both the export and import good are produced domestically, and there are at least two factors of production, the change in the domestic relative price of the goods has implications for spending levels. In particular, if the tariff adjusts the size of income derived from tangible versus non-tangible forms of wealth, aggregate saving may be altered.

This effect is separate from any impact the tariff may have on saving by decreasing the total value of output at world prices from the distortionary effects of non-lump-sum taxes. To make this point most forcefully, we will first consider a small tariff starting from a point of free trade, so that distortions are second-order small. Thus, this effect is not present in those models with no new families and perfect bequest motives.

It is useful to note from eq. (3) above that the value of land, a_t, can be expressed as:

$$a_t = (1/r)[y_1 + y_2 - (\omega - (p-1)y_2)]. \tag{17}$$

The value of land equals the value of output at world prices less the value of the output of labor and the value of the tariff distortion of output.

Also, note that non-tangible wealth can be expressed as:

[12]Eaton (1989) considers a similar model, but one in which there are monopoly firms that have a claim on tariff revenue (yet another non-neutral redistribution scheme).

$$N_t = \frac{\omega}{r+\pi} - \frac{(p-1)y_2}{r+\pi} + \int_t^{\infty} \alpha I_s e^{-(r+\pi)(s-t)} ds. \tag{18}$$

If the tariff raises the wage rate (in terms of the exportable), the value of non-tangible wealth increases by $(1/(r+\pi))$ times the change in the wage. However, the value of land falls by $(1/r)$ times the change in the wage. The total effect of a given increase in wages on wealth and spending is negative, because the social discount rate that values the flow of income from tangible assets, r, is less than the corresponding interest rate for non-tangible assets, $r+\pi$. The future changes in the product of land are fully capitalized into the current value of land (because of the perfect annuities market), but future changes in wage income are not (because in the future the labor force will consist only partly of those living now, and partly of some who are not currently alive). Unlike models where agents have infinite lives, a change in the source of factor income has implications for the total value of wealth.

The change in expenditure at world prices, z_t, starting from free trade (which in this case equals the negative of the change in saving and the current account), is given by:

$$dz_t/dp = [(\delta - r)\alpha'/\sigma(r+\pi)]\bar{I} - [\pi\Delta/r(r+\pi)](d\omega/dp - y_2).$$

The change in expenditure depends on how wages in terms of the export good change, but the size and direction of this movement depends upon the production structure. In a Heckscher–Ohlin set-up, in which both goods are produced with intersectorally mobile land and labor, the wage will rise if the protected sector is labor-intensive and fall if that sector is land-intensive. The value of land will rise if the protected sector is land-intensive, and conversely if the protected sector is labor-intensive. The size of these effects also depends upon the exact production fuction. Thus, taking into account the effects of tariffs on factor prices makes the response of saving to tariffs ambiguous.

In a specific-factors model in which labor is free to move between sectors, but other factors cannot, the increase in the tariff will raise the wage in terms of the export good. The value of land in the export sector will decline, and the value of land in the import sector will rise. Again, the total effect of the tariff on saving is ambiguous.

The general expression for the change in saving starting from a position in which a tariff was already in place is given by:

$$\frac{d\dot{b}}{dp} = \frac{-\theta\Delta\pi(r-\delta)\alpha'[\omega-(p-1)y_2]}{\sigma[(\Delta-r)(r+\pi)-\alpha\Delta\pi]^2}$$

$$-\frac{\theta(1-\alpha)\Delta\pi}{r[(\Delta-r)(r+\pi)-\alpha\Delta\pi]}\left[-y_2+\frac{\mathrm{d}\omega}{\mathrm{d}p}-(p-1)\frac{\mathrm{d}y_2}{\mathrm{d}p}\right]$$

$$-\frac{\theta}{r}(p-1)\frac{\mathrm{d}y_2}{\mathrm{d}p}.$$

The sign of this derivative is indeterminate.

4. Alternative redistribution scheme

In the previous section all tariff revenue was redistributed as lump-sum transfers to the currently alive. This scheme has the effect of increasing the value of non-tangible wealth (for the 'usual' case in which α rises with the tariff rate). An interesting alternative is the redistribution of tariff revenue in the form of a subsidy to tangible assets. In this section we consider the remittance of all current tariff revenue through a linear subsidy to holdings of tangible wealth. This scheme is identical to a reduction of the tax on non-wage income (interest and rents) financed by the tariff increase in a model with a more complex fiscal policy in place.

To isolate the effect of the change in the redistribution plan, we assume that the country is completely specialized in production of the exportable. The tariff revenue is redistributed in proportion to each living individual's tangible wealth, so that the aggregate transfer is $\beta_t w_t$, where β_t is the proportionate rate. The effective market return on these assets becomes $r+\pi+\beta_t>0$.

Total tariff revenue is given by αI_t, where α is as previously defined. The balanced budget requirement implies that

$$\alpha I_t=\beta_t w_t \tag{19}$$

at all times. While α is a constant for a fixed tariff rate, β will vary with I and w. Therefore, the model is now non-linear.

In the Blanchard model, net holdings of tangible assets, w_t, can assume negative values. This can happen if total foreign indebtedness exceeds the total value of land. In order to satisfy eq. (19), clearly β_t must be negative in these cases, since α and I_t are always positive. Hence, $\beta_t<0$ if and only if $w_t<0$, and $\beta_t>0$ if and only if $w_t>0$.

The dynamics of aggregate tangible wealth and consumption expenditure valued in world prices are given by (see the appendix):

$$\dot{w}_t=(r+\beta_t)w_t+\omega-I_t, \tag{20}$$

$$\dot{z}_t = ((r+\beta_t-\delta)/\sigma)z_t - (1-\alpha)\pi_t\Delta_t w_t, \tag{21}$$

where Δ_t is defined by:

$$\Delta_t^{-1} = \int_t^{\infty} \exp\left(\int_t^s [(r-\delta)/\sigma - (r+\pi)] + ((1-\sigma)/\sigma)\beta(u)\,\mathrm{d}u\right)\mathrm{d}s.$$

Using (19) and recalling that $z_t = (1-\alpha)I_t$, eq. (20) becomes:

$$\dot{w}_t = rw_t + \omega - z_t. \tag{22}$$

Eqs. (21) and (22) are a dynamic system in two variables. The appendix demonstrates the conditions under which this system is saddle stable. An equation for the accumulation of foreign bonds near the steady state is given by:

$$\dot{b} = \lambda(b_t - \bar{b}).$$

As discussed at the beginning of section 3, the change in saving and the current account in response to a tariff increase, starting from the steady state, has the same sign as the change in $\bar{b}$, the long-run position in international bonds.

Setting $\dot{z}=0$ and $\dot{w}=0$, steady-state tangible wealth is given by:

$$\bar{w} = \frac{(r+\bar{\beta}-\delta)/\sigma}{(r+\pi+\bar{\beta})(\pi-(r+\bar{\beta}-\delta)/\sigma)}\omega. \tag{23}$$

The stability conditions imply $(\pi-(r+\bar{\beta}-\delta)/\sigma)>0$, so $\bar{w}>0 \Leftrightarrow r+\bar{\beta}-\delta>0$ and $\bar{w}<0 \Leftrightarrow r+\bar{\beta}-\delta<0$. From the discussion above, this implies $\bar{\beta}>0 \Leftrightarrow r+\bar{\beta}-\delta>0$ and $\bar{\beta}<0 \Leftrightarrow r+\bar{\beta}-\delta<0$. More will be said about this below.

Because only the export good is produced, the tariff will not change the value of land, which implies $\mathrm{d}\bar{w}/\mathrm{d}p = \mathrm{d}\bar{b}/\mathrm{d}p$. From (23) we have:

$$\frac{\mathrm{d}\bar{b}}{\mathrm{d}\bar{\beta}} = \frac{\bar{w}}{(r+\bar{\beta}-\delta)}\left[\frac{(\delta+\pi)\pi+(r+\bar{\beta}-\delta)^2/\sigma}{(r+\pi+\bar{\beta})(\pi-(r+\bar{\beta}-\delta)/\sigma)}\right] > 0. \tag{24}$$

This result is entirely plausible – an increase in the subsidy to tangible wealth increases the steady-state holdings of that type of wealth in the form of foreign bonds. We need to investigate how $\bar{\beta}$ changes when the tariff increases to understand the effects of tariffs on the current account. In those cases in which an increase in p causes $\bar{\beta}$ to rise, saving and the current

account will rise, and when an increase in p leads to a decrease in $\bar{\beta}$, saving and the current account decline.

Solving for relation (19) in the steady state yields a quadratic relationship between α and $\bar{\beta}$:

$$\alpha\pi\bar{\Delta}=\bar{\beta}((r+\bar{\beta}-\delta)/\sigma), \tag{25}$$

where

$$\bar{\Delta}=(r+\pi+\bar{\beta}-(r+\bar{\beta}-\delta)/\sigma).$$

This implies that the constraint (19) does not dcetermine $\bar{\beta}$ uniquely for any tariff rate. For any given α, there are two choices for $\bar{\beta}$ that satisfy (19).

This is perhaps easiest to understand in the case in which there is no tariff. Clearly, $\bar{\beta}=0$ satisfies the government budget constraint. But it is also true that $\bar{\beta}=\delta-r$ will ensure a balanced budget in the steady state. Such a choice will lead steady-state wealth to be zero, so total subsidies will also be zero.

We can derive an expression for local derivatives of $\bar{\beta}$ with respect to α:

$$\mathrm{d}\bar{\beta}/\mathrm{d}\alpha=\pi\bar{\Delta}^2/[(\bar{\Delta}-\bar{\beta})(r+\bar{\beta}-\delta)/\sigma+\bar{\beta}(r+\pi+\bar{\beta})/\sigma]. \tag{26}$$

By the stability condition, $\bar{\Delta}-\bar{\beta}>0$. Recalling that when $\bar{\beta}$ is positive when $r+\bar{\beta}-\delta$ is positive, then the derivative is positive if $\bar{\beta}$ is positive and conversely.

Fig. 3(a) shows the relation between α and β when $r>\delta$. This country would have positive steady-state holdings of tangible assets in the absence of any subsidy to wealth or debt. When α is zero ($p=1$), $\bar{\beta}$ is either zero or is negative ($=\delta-r$). For positive values of α, there is always a positive $\bar{\beta}$ that satisfies the government budget constraint (the top half of the graph). If this $\bar{\beta}$ is chosen, then clearly $r+\bar{\beta}-\delta$ is greater than zero, and steady-state wealth is positive. But it is also true for all positive values of α there is a negative value of $\bar{\beta}$ (less than $\delta-r$) which satisfies eq. (19). In this case, $r+\bar{\beta}-\delta<0$, and steady-state foreign debt exceeds the value of land ($\bar{w}$ is negative). Here the tariff revenue is rebated as a subsidy to negative holdings of tangible wealth.

Fig. 3(b) takes up the case in which in the absence of subsidies the country would be a long-run debtor in tangible wealth – that is, the case in which $\delta>r$. If α is zero, $\bar{\beta}$ is either zero or $\delta-r>0$. Again, for any positive value of α there is a positive value of $\bar{\beta}$ that satisfies the balanced budget requirement. In this case $\bar{\beta}>\delta-r$, which implies that $r+\bar{\beta}-\delta>0$, and $\bar{w}$ is positive. It is also the case that there is a negative value of $\bar{\beta}$ that sets total subsidies equal to total tariff revenue. For these choices of $\bar{\beta}, r+\bar{\beta}-\delta<0$, and $\bar{w}<0$.

The government can always choose a value of $\bar{\beta}$ to ensure that long-run

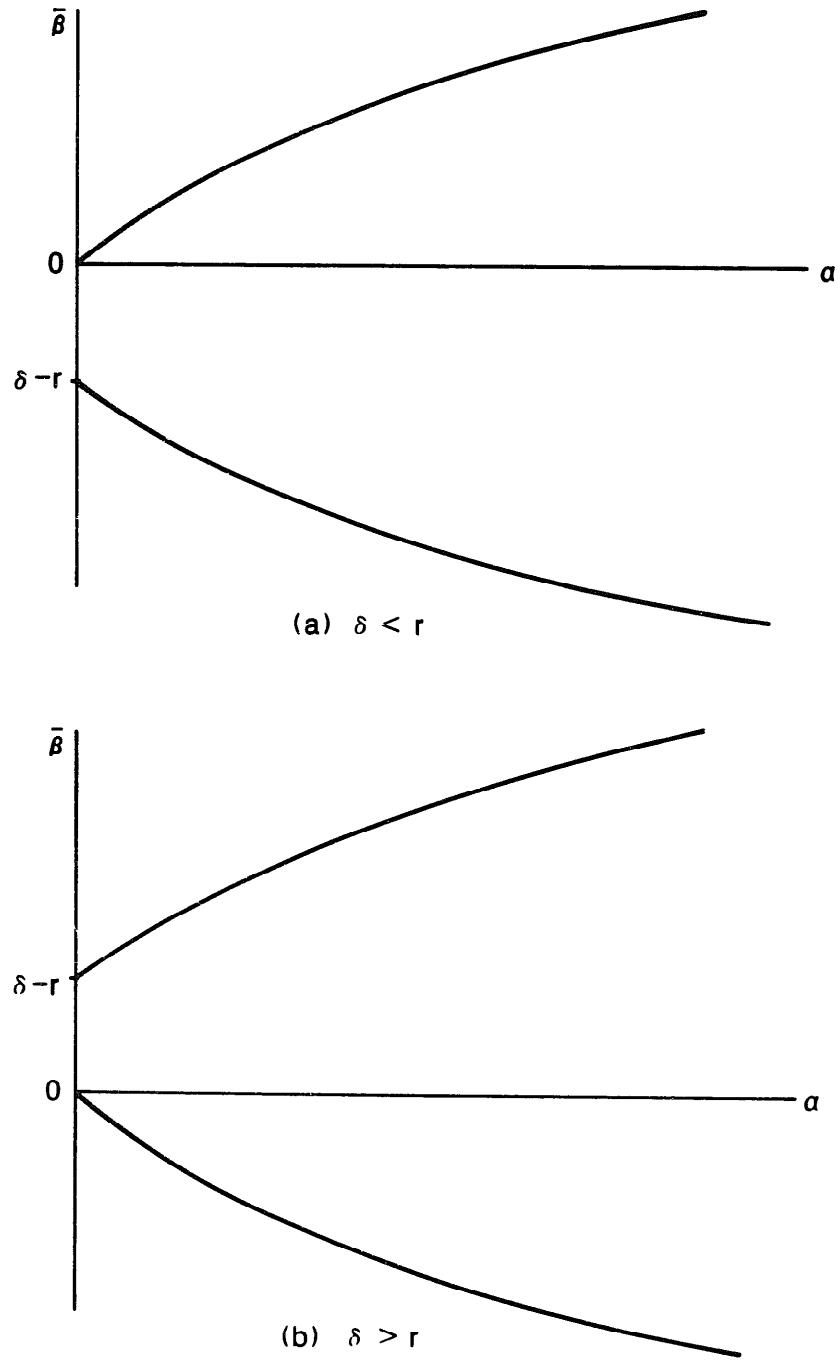
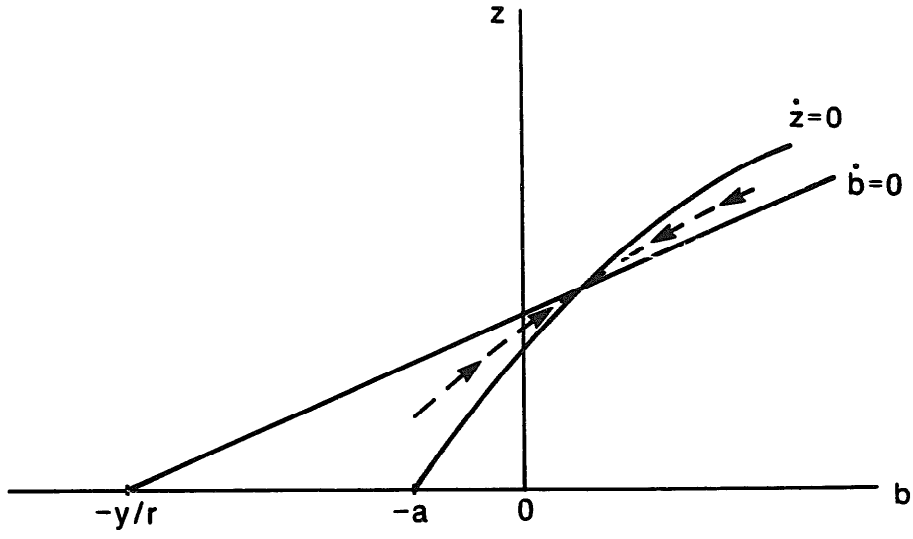
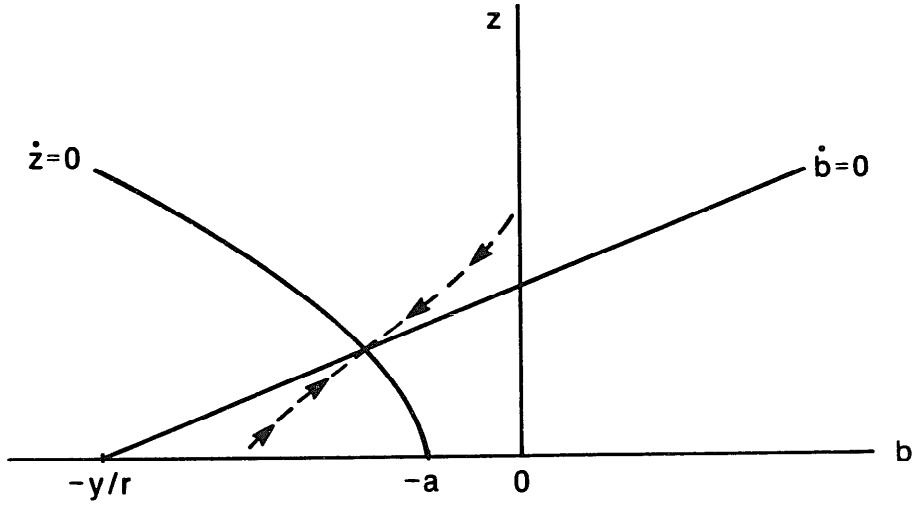


Fig. 3

foreign debt is less than the value of land if it wants steady-state wealth to be positive ($\bar{w}>0$) (and vice versa if it wants $\bar{w}<0$). By altering the rate of return on tangible assets available to residents, aggregate saving can be raised or lowered. (In this model, this just changes the country's international debt position, since in the aggregate the value of land holdings cannot be



(a) $\beta > 0$



(b) $\beta < 0$

Fig. 4

altered.) Perhaps the surprising thing is that it always has the choice between two subsidy rates which keep the budget balanced irrespective of the relation of δ to r.

Fig. 4 displays phase diagrams for any given values of δ and r under this redistribution scheme. Fig. 4(a) portrays consumption and wealth dynamics when the government chooses to subsidize the holding of tangible assets (β_t is positive). Fig. 4(b) shows the optimal adjustment path when debt holding is subsidized (β_t is negative).

Using eqs. (24) and (26) we can see how the current account must change

as tariffs increase. When $\bar{\beta}$ is positive, so that $\bar{w}$ is positive, an increase in the tariff will increase the subsidy to tangible wealth and therefore increase current saving and the current account. Likewise, when $\bar{\beta}$ is negative, so that $\bar{w}$ is negative, as the tariff rises the subsidy to tangible debt goes up, and present saving and the current account decline.[13]

5. Conclusion

In this paper we consider channels through which tariffs can effect saving that are special in models in which new generations are born. The tariff can change total wealth through redistributing income between tangible and non-tangible assets. This happens in the first place when tariff revenue is redistributed lump-sum and takes on the characteristics of labor income. It also occurs because tariffs change factor prices, which in turn alter the distribution of wealth between land and human wealth.

We also explore a mechanism by which the proceeds from tariffs can be rebated in a way to affect the incentives to hold tangible assets. We show that government has some scope to significantly affect the net holdings of international bonds while still maintaining budget balance.

The analysis in this paper is purely positive. Conclusions about the welfare effects of the tariffs are not drawn, and would in general depend upon the weights given to the utility of the different generations.[14] We cannot contribute to the issue of whether tariffs should be used to alter the current account.

[13]This analysis assumes that when the tariff changes infinitesimally, the subsidy rate does not jump discretely.

[14]Calvo and Obstfeld (1988) examine welfare issues in this type model.

References

Blanchard, Olivier, 1984, Current and anticipated deficits, interest rates and economic activity, European Economic Review 25, 7–27.

Blanchard, Olivier, 1985, Debt, deficits and finite horizons, Journal of Political Economy 93, 223–247.

Buiter, Willem, 1987, Fiscal policy in open, interdependent economies, in: A. Razin and E. Sadka, eds., Economic policy in theory and practice (Macmillan, London).

Buiter, Willem, 1988a, Structural and stabilization aspects of fiscal and financial policy in the dependent economy, Oxford Economic Papers 40, 220–245.

Buiter, Willem, 1988b, Death, birth, productivity growth and debt neutrality, Economic Journal 98, 279–293.

Calvo, Guillermo and Maurice Obstfeld, 1988, Optimal time-consistent fiscal policy with finite lifetimes, Econometrica 56, 411–432.

Chamley, Christophe and Brian Wright, 1987, Fiscal incidence in an overlapping generations model with a fixed asset, Journal of Public Economics 32, 3–24.

Eaton, Jonathan, 1989, Monopoly wealth and international debt, International Economic Review 30, 33–48.

Edwards, Sebastian, 1987, Tariffs, terms of trade, and the real exchange rate in an intertemporal optimizing model of the current account, National Bureau of Economic Research working paper no. 2175.

Engel, Charles and Kenneth Kletzer, 1986, Tariffs, saving and the current account, National Bureau of Economic Research working paper no. 1869.

Frenkel, Jacob and Assaf Razin, 1986, Fiscal policies in the world economy, Journal of Political Economy 94, 564–594.

Frenkel, Jacob and Assaf Razin, 1987, Fiscal policies and the world economy (MIT Press, Cambridge, MA).

Kouri, Pentti, 1986, Trade, capital flows and dynamics of the real exchange rate, New York University.

Razin, Assaf and Lars Svensson, 1983, Trade taxes and the current account, Economics Letters 13, 55–57.

Smith, William, 1987, A Blanchard model with aggregate risk, Virginia Tech.

Van Wijnbergen, Sweder, 1985, Fiscal deficits, exchange rate crises and inflation, World Bank.

Weil, Philippe, 1985, Overlapping families of infinitely lived agents, Harvard University.

Yaari, Menahem, 1965, Uncertain lifetime, life insurance, and the theory of the consumer, Review of Economic Studies 32, 137–150.