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ABSTRACT

This paper looks at the problem of making multiple lending decisions which affect the supply of the product when the consequences of these lending decisions are interrelated via the effect on the world price of the product. This is termed the "adding up problem". It is argued that thinking of this problem from the point of view of the targeting literature helps to clarify the nature of optimal policies. In order to do so, three factors need to be specified. First, the objective function of the lender (the Bank) as compared to those of the borrowers (the countries) must be clear. Second, the extent of the lenders' ability to influence total investment in the product, and the instruments available to it, must be understood. Third, the distortions present in the environment must be identified.

The lender is thought of as trying to implement policies which maximize its objective function. There are distortions in the system which prevent this objective function from being maximized automatically. These distortions could arise because (1) the objectives of the lender do not match those of the borrowers, (2) because of misconceptions about how the system operates on the part of the borrowers, (3) because of a lack of access to funds on the part of the borrowers relative to the lender, among a host of other distortions not focused on here. The environment and policies available to the lender limit its ability to influence the outcome.

In this context, it is argued that targeting models can be used to help guide policy. The basic rule is to correct the distortions where they occur using the appropriate instrument to do so. If instruments are limited, the available instruments are used to target multiple distortions, and the first best need not be attainable.

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1. INTRODUCTION

This paper looks at what has come to be known as the "adding up problem" from the point of view of the optimal targeting literature. It is argued that by thinking about the problem in this way we can step back a bit, and look at the problem as a whole, rather than focus on its parts. While the parts are clearly important, focusing attention on them can obscure the big picture. The framework makes clear how the environment in which policies are made, the objectives of the lender (which is called the "Bank" from here on) as opposed to those of the borrowers (the countries) as well as the instruments available, all impact on the optimal policies which can be 'prescribed. The optimal policies relate existing distortions to policies to combat them.

What is the adding up problem? One interpretation is that this refers to the issue of whether loans for projects, or policy advice, could lead to a fall in the world prices facing exporters thereby resulting in lower export revenues. This definition is however rather narrow, since by focusing on export revenues alone, it implicitly assumes that increasing export revenue is desirable at any cost. Thus, we may have situations where this test of increasing export revenues is passed, in spite of adverse welfare consequences. Moreover, this approach usually looks at countries or even projects in isolation assuming that output from other sources is fixed. This could result in the fallacy of composition: what is good for the part may not be good for the whole.

Thus a broader definition is desirable. More broadly, the adding up problem is taken to refer to the problem of making

multiple lending decisions which affect the supply of a product, when the consequences of these lending decisions are interrelated via the effect on world price of the product. This definition avoids advice which could result in policies which are good for the part but not for the whole.

The basic point made in this paper is that the adding up problem is one example of a broader set of problems where the targeting approach can help in formulating policy. Essentially, the lender is trying to implement policies which maximize his objective function. There are distortions in the system which lead to this objective function not being maximized automatically. These distortions could arise because (1) the objectives of the countries do no match those of the lender, or (2) because of misconceptions about how the system operates on the part of the countries, or (3) because of a lack of access to funds on the part of countries relative to that of the lender. A host of other distortions not focused on here could also be incorporated. Here we focus on these three distortions.

The problem being studied here is of considerable importance in practice, as well as a delicate issue for any international lending organization. The World Bank, for example, has followed a restrictive lending policy for cocoa and coffee since 1972, and has for all practical purposes, not financed development in tea since 1982. In addition, many of the poorer exporting countries, especially those with limited alternative revenue sources, have used export taxes, or used cartels (as with the international

coffee agreements) to restrict supply, raise revenues, and keep product prices high. This has met with implicit or explicit approval from the World Bank.

However, the higher product prices encouraged the expansion of output of low export tax countries and the entry of non traditional exporters in the longer run. In other words, supply was more elastic in the long run than in the short run as might have been expected. In effect, the export taxes restricted output of traditional suppliers, who one might argue have a natural comparative advantage, and encouraged expansion in those less well suited. For example, the share of Ghana in the world production of beverage crops fell from 4.6% in 1972 to 2% in 1989. The share of Indonesia and Malaysia combined rose from 3.5% to 7.9% in the same period. Ghana had significant export taxes, 25% on Cocoa, while Indonesia and Malaysia had none.[1]

In this context, this paper looks at the role for an intentional lending organization in such markets. I examine the optimal policy regarding investment intervention by such an organization. How does the ability to coordinate export taxes as well as affect investment alter these prescriptions? What is the effect of countries and the Bank having differential access to lending?

I show that when only investment can be used as an instrument, with countries setting their export taxes non-cooperatively, there are three distortions which the investment levels in the respective countries have to target. First there is an investment distortion

as individual firms do not have access to funds on the same terms as the Bank. Second, there is a "strategic distortion" which arises from the fact that the implicit conjectures made by each country in setting its export taxes need not be the actual ones. Third, as the objective functions of each country, namely their own welfare, are not those of the lender who is concerned about their total welfare, there is a spillover effect which also enters.

Following this, I show that if the countries have different objective functions, for example if one country maximizes welfare while the other maximizes export revenues, the lender's optimal lending policy for both countries is affected. Following this, I look at the effect of having more instruments available to the lender. If the lender can coordinate export taxes as well as affect investment, then it is optimal for a common export tax to be set and for investment policy to target the investment distortion only. This shows that analyzing either policy alone is suboptimal.

Finally, I look at the assumption made throughout that the Bank can affect total investment. Here I show that to the extent that the Bank has better access to funds than the producer, Bank investment crowds out private investment one for one with no effect on total investment unless all private investment is crowded out. However, Bank lending need not be substitutable for private lending. In fact the rationale for the existence of such lending is that it be <u>complementary</u> with private lending, not substitute for it.

The analysis thus suggests that the policy of banning or

severely restricting lending in beverage crops is counterproductive. It only affects those countries with no access to private lending and does not look for complementary lending as it should.

The broad outline of the paper is as follows. In Section 2, I take a look at some recent work related to the adding up issue to give some idea of the state of the debate. This review is not meant to be exhaustive. The sheer amount of work of the issue makes an exhaustive review impractical. Section 3 through 5 contain the heart of the paper. In Section 3 and 4 I argue that the optimal lending decisions should be based on the effects on production costs of the investments, and on other distortions existing. Section 5 looks at the optimal policy when export taxes as well as investment policy can be targets. Section 6 contains some concluding remarks.

2. SOME RELATED WORK

A commonly used first test of whether an adding up problem, in the narrow sense of the term, exists for a country is a comparison, for each commodity, of the share of world exports of that commodity by that country, with the world price elasticity of demand for that commodity. A common rule used, see Godfrey (1985), is that if the latter exceeds the former, then output growth would not have adverse revenue effects. It is illuminating to see what lies behind this rule.

Let $Q(t)$ denote the world output of the good at time t. Let $P(Q(t))$ denote the inverse demand curve for the good. Let $q^i(t)$ denote the output of country i. Then revenue of country i is given by $P(Q(t))q^i(t)$. Totally differentiating this gives:

$$\begin{aligned}
\frac{d(P(Q(t))q^i}{dt} &= P'(.)\frac{dQ(t)}{dt}q^i + P(.)\frac{dq^i}{dt} \\
&= -\frac{1}{\epsilon}\frac{P(.)q^i}{Q}\frac{dQ}{dt} + \frac{dq^i}{dt}\frac{P(.)q^i}{q^i} \\
-\overset{\wedge}{Pq^i} &= -\frac{1}{\epsilon}\left[\sum_{j=1}^{n}\frac{q^j}{Q}\hat{q}^j\right] + \hat{q}^i \\
&= \hat{q}^i\left[1 - \frac{s^i}{\epsilon}\right] - \frac{1}{\epsilon}\left[\sum_{j\neq i}^{n} s^j q^j\right]
\end{aligned} \tag{1}$$

where $\hat{}$'s refer to proportionate changes, s^i denotes country i's share of world output and ϵ denotes world demand elasticity defined as a positive number. Thus, if all but the ith country's output is fixed, its revenue rises with sales if the elasticity of demand exceeds its share in world output. This makes intuitive sense. If the ith country was a monopolist, its revenue would rise if

elasticity was more than its share, of unity. Since it shares the market, this condition is less stringent as other countries bear part of the burden of falling prices assuming their outputs don't change.

However, this rule is conditional on other countries output remaining fixed. If information on the expected changes in other countries outputs, and their shares in world output is available, it can be used in the general version of this formula to provide back of the envelope estimates of the projected change in country i's revenue. For this reason, this approach is more general than it seems. Despite this, the basic problem remains that revenue increasing with output is not sufficient for the policy to be desirable. However, the approach can provide useful information as argued above.

In contrast to the approach described above which focuses on value of output, is the traditional approach which derives and compares policies which maximize a stated objective function. A well known result in the literature is that the welfare maximizing export tax is less than the tariff revenue maximizing export tax (Johnson 1950, 1951 and Tower (1977). Welfare includes producer surplus as well as tax revenue. Raising taxes above the welfare maximizing level raises revenue at the expense of producer surplus. If only tax revenue matters, then an increase in taxes above the welfare maximizing level is called for, although this results in lower welfare.

More recently, Panagaria and Schiff (1992) extend the analysis

of Johnson (1954) to deal with many exporting countries. They point out that with many exporting countries the Nash equilibrium with tariff revenue maximizing countries could result in a higher equilibrium level of welfare than the Nash equilibrium with welfare maximizing countries. The reason is pretty straightforward. It is well known that in general, Nash equilibrium is not Pareto optimal. Thus there exist tariffs which can raise both countries welfare. The structure of the problem is such that ideally each country would like the other country to restrict its exports a lot so that it has a larger residual demand. Thus, each country's welfare rises with the tariff of the other country. This results in iso-welfare contours like those depicted in Figure 1. If the optimal tax for one country to set, rises with the tax imposed by its competitor, then best response functions are upward sloping. If the opposite is true, the best responses are downward sloping. As the revenue maximizing best response function in tax space, lies outside the welfare maximizing best response function for each country, the Nash equilibrium with symmetric countries and revenue maximizing policies (point S) lies above the Nash equilibrium with welfare maximizing countries (point N). However, the region above N also contains the set of points which Pareto dominate N and are given by the shaded area. Thus, N can be associated with lower welfare than S!

For policy purposes, the message of their paper is that with many countries involved in production, a coordination problem arises. The pursuit of welfare maximizing policies by each will

result in a jointly suboptimal outcome, while pursuing a non optimal policy, like revenue maximization, could do better.

Panagaria and Schiff (1991) use a linear calibration model to simulate the effects of various policies on cocoa exports and real incomes in Africa. They show that profits under actual taxes are higher than under Nash behavior for all countries except Ghana. This is another application of the fallacy of composition at work. What is good for the part need not be good for the whole, and conversely, what is suboptimal for the part could be better for the whole. Thus it provides a note of caution for advisors to consider the whole market and all players in formulating policy advice.

Goldin et al (1993) use a simulation model of tropical beverage exports to show that the fallacy of composition is a valid concern for policy makers in these markets. In contrast, Akiyama (1992) models the expectations of prices on the part of farmers and finds that using a computer model for Ghana's cocoa sub sector reveals that national welfare does not vary much over a wide variety of export taxes close to the optimal level, but that there is an important impact of such variations on the distribution of national welfare between the farmers and the government.

The adding up problem, in the narrow sense of the term, has also been studied for other markets. Coleman and Thigpen (1993) show that an adding up problem is unlikely to exist for expanded cotton exports by Sub Saharan African (SSA) countries. Their result is due primarily to the low share of the cotton market of these countries. Akiyama and Larson (1993) look at the adding up problem

in the context of primary commodity exports in Sub-Saharan Africa. They conclude that individually, only a few countries in this region face an adding up problem in the narrow sense of the term. While there is a problem for these countries as a whole, they point to difficulties in coordinating policies to equitably distribute gains among SSA countries. In addition, their analysis suggests that even if SSA countries agreed to impose the optimal export tax for SSA as a whole, the main benefit would go to producers in Latin America and Asia. Also, given that these commodities are often the only cash crops in which these countries have a comparative advantage, they argue that it would be counter productive to discourage production of these crops.

Martin (1993) uses a simple computable general equilibrium model to show that for manufactured goods, " the incorporation of general equilibrium interactions and intra-industry trade may completely overturn the conventional view of the fallacy of composition. At least for export growth propelled by investment and technological advance, increases in exports from developing countries are mutually reinforcing rather than competitive." (pg 171).

Besley (1993) looks at the problem of time consistency of export taxes. he argues that countries may set low taxes initially to encourage plantings but then have an incentive to raise taxes once these investment decisions are made. Rational producers anticipating this would not invest even with low taxes in place. This credibility problem constrains the tax rate which can be

imposed. Schiff (1993) contains a thoughtful summary, from a policy perspective, of the literature on the adding up problem.

The work described above points to differences in the importance of the adding up problem across countries and products. It also highlights the role of distributional effects, and the importance of responses by other countries. However, none of the existing work takes a targeting approach and asks what all the distortions might be and what role different instruments might have in correcting them.

A third approach, followed here, is to look for optimal policy on the part of the lender to correct, as far as possible, the existing distortions in the system. The basic rule is to correct the distortions where they occur using the appropriate instrument to do so. A production distortion is best corrected using a production tax/subsidy, a factor market distortion is best corrected using a factor tax/subsidy and so on. If there are enough instruments available to the lender, each targets the distortion it can affect directly. If instruments are limited, the available instruments are used to target multiple distortions, and the first best need not be attainable.

The targeting literature has a long and distinguished history in trade and public economics. The work of Bhagwati (1971) as well as a host of others in international trade and public finance in this area is central. Recent work by Krishna and Thursby (1991), (1992) shows that the principle of targeting can often be applied even in the presence of oligopolistic behavior. In this case, they

argue, a strategic distortion can exist and can be targeted appropriately to derive targeting rules analogous to those developed previously for non-oligopolistic situations. However, optimal policies will depend on the distortions present and the instruments available to correct them.

It is, of course always possible to derive optimal policies for a particular market by setting up a computable model which can be used to give precise policy prescriptions. However, this can obscure the simple economics in the background and computable models should be thought of as complementary to the approach taken here. Moreover, since developing good computable models can take a considerable amount of time and resources as well as experience, this approach may not be feasible in some instances. Intuition based on simple targeting models can help focus the debate, even if it does not yield exact prescriptions for policy.

3. A SIMPLE MODEL OF TARGETING

This section outlines a simple model which highlights the targeting approach. There are two countries who export to a third country, the rest of the world. For simplicity, we assume that there is no domestic consumption of the product in question, and that the product is supplied by competitive producers in each country. I assume that the government in each country wishes to maximize national welfare. The lender's problem is to allocate investment between the two countries to maximize the sum of their welfare[2]. The framework is a partial equilibrium one, with the lender moving first, governments choosing their policies after this, and finally competitive suppliers maximizing their profits given the policies in place. Note that the lender and both countries wish to maximize welfare. In this sense they are like minded. Yet, there are distortions present. First, each country cares about its own welfare, and not that of both. Thus, each neglects the effect of its own action on the other countries welfare. Second, each takes that the other country's strategic variable, in this case export tax, as given while it is responsive to changes in its own export tax. Finally, the country does not have access to capital markets on the same terms as the lender[3]. In fact, in this and the next section, we assume that the country does not invest at all, or if it does, its investment is unaffected by that of the lender. This allows us to abstract from the "crowding out" issue until Section 5. These provide the distortions for the lender to target in choosing its policies optimally.

Let $P(x, x^*)$ and $P^*(x,x^*)$ denote world inverse demands for the products of the two countries where x and x^* are their outputs. Note that the outputs of the two exporting countries could be differentiated. We assume that they are substitutes for one another so then an increase in either output reduces $P(.)$ or $P^*(\cdot)$. Let $C(x, I)$ and $C^*(x^*, I^*)$ denote the <u>total cost</u> of production in the two countries as a function of outputs and investment in each. Let t and t^* denote the levels of export taxes imposed by each country[4]. Finally, let $c(x, I)$ and $c^*(x^*, I^*)$ denote the <u>marginal cost</u> of production or inverse supply functions in each country. We assume that total and marginal costs fall with increases in investment.

Competitive producers in the non * country choose output to maximize profits, taking price as given. This leads them to equate the price they receive, $P - t$, to their marginal cost $c(x, I)$. This, in turn, defines the inverse supply curve:

$$P = c(x,I) + t \tag{2}$$

Producers receive profits of $Px - C(x,I) - tx$. National welfare is the sum of producer profits and tax revenue as we are assuming there is no domestic consumption of the product, and as we are working in a partial equilibrium setting. Welfare is given by:

$$W(x,x^*;I) = P(x,x^*)x - C(x,I) \tag{3}$$

Since the government takes I as given, I is placed after the

semicolon. The government maximizes welfare by choosing t optimally taking t* as given. Recall that although t and t* do not enter the welfare function directly, they do matter since they affect the decisions of the competitive firms, via (2) above and (5) below.

The first order condition for welfare maximization is given by:

$$\begin{aligned} \frac{dW(x,x^*;I)}{dt} &= \{ W_x(.) + W_{x^*}\frac{dx^*}{dt}/\frac{dx}{dt} \} \frac{dx}{dt} = 0 \\ &= \{ W_x(.) + W_{x^*}\lambda \} \frac{dx}{dt} = 0 \end{aligned} \qquad (4)$$

Note that changing t induces explicit responses on x and x* of changes in t, given t*. These explicit responses can be obtained by performing comparative static on (2) above and (5) below, as a system.[5] These comparative statics are denoted by $\frac{dx}{dt}$, $\frac{dx^*}{dt}$, $\frac{dx}{dt^*}$ and $\frac{dx^*}{dt^*}$. Let λ denote $\frac{dx^*}{dt}/\frac{dx}{dt}$. λ gives the implicit conjectured response of x* relative to that of x, as t changes, corresponding to the assumption of t* fixed. Recall that I am assuming that each country takes the other's tariff rate as given. In general, subscripts denote partial derivatives.

For the * country, there are analogous equations defining supply, welfare, and welfare maximizing policies respectively. These are given by (5) - (7) below.

$$P^* = c^*(x^*, I^*) + t^* \qquad (5)$$

$$W^*(x, x^*; I^*) = P(x, x^*)x^* - C^*(x^*, I^*) \tag{6}$$

$$\begin{aligned} \frac{dW^*}{dt^*}(x, x^*; I^*) &= \{ W^*_{x^*}(.) + W^*_x \frac{dx}{dt^*} / \frac{dx^*}{dt^*} \} \frac{dx^*}{dt^*} \\ &= \{ W^*_{x^*}(.) + W^*_x \lambda^* \} \frac{dx^*}{dt} \end{aligned} \tag{7}$$

Let λ^* denote the implicit conjectured response of x, relative to x* , in response to a change in t*. Thus, $\lambda^* = \frac{dx}{dt^*} / \frac{dx^*}{dt^*}$.[6]

Note that (4) and (7) define the equilibrium levels of t and t*, and hence of x and x*, (via (2) and (5)) for given values of I and I*.

At the first stage, the lender must choose I and I* to maximize total welfare. Lending a total of (I+I*) results in a net cost of V(I+I*) to the lender. Since x and x* depend on I and I* via the system given by (4) and (7) the lender's objective function can be written in terms of I and I*. The lender's objective function is to maximize:

$$\begin{aligned} T(I, I^*) &= W[x(I, I^*), x^*(I, I^*); I] \\ &\quad + W^*[x(I, I^*), x^*(I, I^*), I^*] - V(I+I^*) \end{aligned} \tag{8}$$

The first order conditions for the lender's problem are:

$$\frac{dT(.)}{dI} = \left\{ W_x + W_{x^*}\frac{dx^*}{dI}\Big/\frac{dx}{dI} + W^*_x + W^*_{x^*}\frac{dx^*}{dI}\Big/\frac{dx}{dI} \right\}\frac{dx}{dI}$$
$$+ W_I - V'(I+I^*) = 0 \qquad (9)$$
$$= \left\{ W_{x^*}(g-\lambda) + W^*_x\,(1-\lambda^* g) \right\}\frac{dx}{dI} + W_I - V'(I+I^*) = 0$$

The second equality is obtained by substituting from (4) and (7), and denoting by g the actual response of x^* relative to x to changes in I.[7] Thus, $g = \frac{dx^*}{dI}\Big/\frac{dx}{dI}$. The analogous procedure for choosing I^* yields:

$$\frac{dT(.)}{dI^*} = \left\{ W^*_x(g^*-\lambda^*) + W_{x^*}(1-\lambda g^*) \right\}\frac{dx^*}{dI^*}$$
$$+ \left\{ W^*_{I^*} - V'(I+I^*) \right\} = 0 \qquad (10)$$

where $g^* = \frac{dx}{dI^*}\Big/\frac{dx^*}{dI^*}$. Now (9) and (10) together define the optimal levels of I and I^*. Recall that $W_I = -C_I(x,I)$ and that $W^*_{I^*} = -C^*_{I^*}(x^*,I^*)$.

It is worthwhile to interpret the economics behind (9) and (10). Consider (9). There are three distortions at work and only two instruments, investment in each country, which must target all three. Ideally, investment should target only the investment distortion. Individual firms do not have access to funds on the same terms as the lender. If they did, their profit maximizing

decisions on investment would lead them to a situation where the reduction in costs was equated to the cost of investment and the second term in (9) would equal zero. Since this is not the case," I" would be set to make this term vanish IF there were no other distortions. However, there are other distortions, and their presence is reflected in the first term of (9).

There is a "strategic distortion" which arises from the fact that the no * countries conjecture about how x* changes relative to x, implicit in the assumption that t* is fixed, does not equal the actual response of x* and x as I changes. The former is given by λ, while the latter is given by g. If, for example, $(g - \lambda) > 0$, then the no * country is choosing x on the basis of mistaken beliefs about x*. If g is negative, as is λ, then x* is falling less than conjectured. Thus the no * country is being overly optimistic about its prospects in setting t, so that it taxes less, and produces more, than it should. Since $W_{x^*} < 0$ as the goods are substitutes and if reducing I reduces x, then this calls for a adjustment in I in the downward direction. The first part of the first term in (9) captures this strategic distortion. If $g - \lambda > 0$, and $dx/dI > 0, W_{x^*}(g - \lambda)dx/dI < 0$. This term thus reduces the level of I below that if no other distortions than the investment one was present.

In addition the objective functions of the lender and each government are not the same. Each country neglects the spillovers caused by its actions on the other country. This results in the second part of the first term. If $W_x^* = 0$, or if $\lambda * g = 1$, so that g, the actual response of x* relative to x, the changes in I, was

equal to $1/\lambda^*$, the implicit conjectured ratio of the change in x^* relative to x as t changes, there would be no effect of these spillovers and no distortion. Analogous interpretation for (11) can also be offered.

Thus, investment allocation serves two purposes. In the absence of other distortions, it corrects the investment distortion by equating the cost reducing benefits to the marginal cost of investment. However, it must also target the additional strategic and spillover distortions since there are limited instruments available. This leads to correction terms added to the rule with no other distortions which partially correct these distortions as well.

While the above outlines the targeting principles to look for in choosing investment policy, its implementation is far from trivial. Such models can be implemented using calibration models. However, there are at least two reasons to be careful in using such models. First, there is a fair amount of information needed to do so. Information, not only on the demand and production side, but on behavioral parameters, is needed to implement the policies. While such parameters can be estimated or evaluated using calibration models, the results could be very sensitive to the model used to do so. Policies based on the wrong parameters or model could easily be worse than the status quo!

Second, the extent of the potential gains from following optimal investment policies is not clear. This is for two reasons. First, the impact on welfare of designing optimal policies depends

very much on what the distortions present are. For example, in calibrated models of trade policy, such as Dixit (1986), correcting strategic distortions, when these are the only distortions present, does not result in large gains from policy. It is only when there are other domestic distortions that the gains become significant. However, these distortions might be better corrected by using other policies. Second, it is not clear how much lending by the Bank influences the extent of investment in total. If increased investment by one lender merely reduced lending by others so that total investment was unaffected, the lender would in effect be unable to affect market outcomes. If this were true, the lender would be well advised not to try and affect total lending, but to look for more direct policies to influence the distortions it wishes to target.

4. DIFFERENT OBJECTIVE FUNCTIONS

In this section I consider how the lender's investment policy would be affected by one of the two countries <u>not</u> maximizing their welfare, but their export revenues. This is likely to be the case if foreign exchange is scarce because of non-convertability permitting an exchange rate different from the market clearing rate.

Let the non '*' country maximize export revenues while the '*' country maximizes its welfare. The lender, as before is assumed to maximize total welfare.

In this case, the choice of t for the country is given by:

$$\begin{aligned} \underset{t}{Max} \quad & \tilde{W}(.) = P(x, x^*)\,x \\ \Rightarrow \quad & \left\{ \tilde{W}_x + \tilde{W}_{x^*} \frac{dx^*}{dt} \Big/ \frac{dx}{dt} \right\} \frac{dx}{dt} = 0 \\ \Rightarrow \quad & \left\{ W_x + C_x(x, I) + W_{x^*}\lambda \right\} \frac{dx}{dt} = 0 \end{aligned} \tag{11}$$

as

$$\tilde{W}_x = P_x(x, x^*)\,x + P(x, x^*) \tag{12}$$

$$\begin{aligned} W_x &= P_x(x, x^*)\,x + P(x, x^*) - C_x(x, I) \\ &= \tilde{W}_x - C_x(x, I) \\ W_{x^*} &= \tilde{W}_{x^*} = P_{x^*}(x, x^*)\,x \end{aligned} \tag{13}$$

The choice of t^* is as before given by (7). Similarly, the choice of I and I^* is given by (9) and (10).

Substituting from (11) into (14) and using (7) gives:

$$\begin{aligned}\frac{dT}{dI} &= \left\{ W_x + W_{x^*}\frac{dx^*}{dI}\Big/\frac{dx}{dI} + W_x^* + W_{x^*}^*\frac{dx^*}{dI}\Big/\frac{dx}{dI} \right\}\frac{dx}{dI} \\ &\quad - C_I(x,I) - V'(I+I^*) \\ &= \left\{ W_{x^*}(g-\lambda) - C_x(x,I) + W_x^*(1-\lambda^* g) \right\}\frac{dx}{dI} \\ &\quad + W_I - V'(I+I^*) = 0\end{aligned} \tag{14}$$

Comparing (14) to (9), the earlier first order condition shows that the term $-C_x(x,I)\frac{dx}{dI}$ is added on as a correction factor. Note that if $\frac{dx}{dI} > 0$, since $-C_x(x,I) < 0$, this term <u>reduces</u> the benefit from investing in this country and hence pulls down I. This makes sense since the maximization of export revenue equates marginal revenue with zero, not marginal costs, thereby leading to too high an output relative to that which maximizes total welfare. To correct this, investment is reduced.

What about the optimal choice of I*? This is also affected:

$$\begin{aligned}\frac{dT}{dI^*} &= \left\{ W_{x^*}^* + W_x^* g^* + W_x g^* + W_{x^*} \right\}\frac{dx^*}{dI^*} + W_{I^*}^* - V'(.) \\ &= \left\{ W_x^*(g^*-\lambda^*) + W_{x^*}(1-\lambda g^*) - C_x(.)g^* \right\}\frac{dx^*}{dI^*} \\ &\quad - C_{I^*}^*(x^*,I^*) - V'(I+I^*) \\ &= 0\end{aligned} \tag{15}$$

Thus, this equation is adjusted by the term $-C_x(x,I)g^*\frac{dx^*}{dI^*}$. If

increasing I^* reduces x and raises x^*, $g^* < 0$, and $dx^*/dI^* > 0$. In this case, the above term is positive. Thus, over production on the part of one country, could call for an increase in the investment in the other country.

The lesson that this section has for designing optimal policies is that if countries have different objective functions than others, Bank lending policy for <u>all</u> countries is affected. Moreover, since the comparative static terms which affect the optimal policy prescriptions are not easy to sign or evaluate, using such models to prescribe exact policy, without its computable counterpart being developed, is difficult. Similarly, if more instruments are available, such as export taxes, for some countries and not for others, the optimal policy prescriptions of the next section will be altered in possibly complex ways.

5. MORE INSTRUMENTS

In order to better understand the investment allocation issue, it is useful to look at a related problem. In the previous section the lender could only affect the tax decisions of the governments by altering its investment policies. It could not control taxes, and hence output directly. Thus the optimal investment decision which involved equalizing the effects of investment on total costs on the margin, had to be augmented by factors correcting for inappropriate tax choices on the part of the government. These occurred because of "spillovers", the effect of each government on the others welfare, which were not taken into account, as well as because of strategic distortions, implicit conjectures not being equal to actual responses. Investment decisions were hence targeting tax policies, as well as allocating investment appropriately.

In this section, I look at what the optimal policy would be if the lender could set taxes, and hence output optimally, as well as choose its investment levels. For simplicity, I assume a homogenous good here. In this case, the problem for the lender is:

$$\begin{aligned} Max\ \ T(x,x^*,I,I^*) &= P(x+x^*)x + P(x+x^*)x^* \\ &\quad - C(x,I) - C^*(x^*,I^*) - V(I+I^*) \end{aligned} \tag{16}$$

$$\frac{\partial T}{\partial x} = P(x+x^*) + P'(x+x^*)(x+x^*) - C_x(x,I) = 0 \tag{17}$$

$$\frac{\partial T}{\partial x^*} = P(x+x^*) + P'(x+x^*)(x+x^*) - C_{x^*}^{*}(x^*, I^*) = 0 \qquad (18)$$

$$\frac{\partial T}{\partial I} = -C_I(x, I) - V'(I+I^*) = 0 \qquad (19)$$

$$\frac{\partial T}{\partial I^*} = -C_{I^*}^{*}(x^*, I^*) - V'(I+I^*) = 0 \qquad (20)$$

The first order conditions, (17) and (18), are easy to interpret. They say that, given I and I*, world marginal revenue should be equated to world marginal costs. World marginal costs are the horizontal sum of the individual country's marginal costs. Equating them with world marginal revenue gives total world output. This output is then allocated across countries to equalize their marginal costs. This results in each country's marginal costs being equated to world marginal revenue as in (17) and (18). In Figure 2, $\bar{x}$, which equals total output, is given by the intersection of the horizontal sum of $C_x(.)$ and $C_{x^*}^{*}(.)$, which equals $\bar{C}_{\bar{x}}(.)$, to world marginal revenue. x and x* are read off from allocating this total output to minimize world costs, i.e., where each countries' marginal cost equals this world marginal cost. This is depicted in Figure 2. Note that t and t*, as depicted, ensure these levels of x and x*. Note also, that if the products are homogenous, t = t*. I and I* are then

allocated, as in (19) and (20), to equate the benefit from reductions in total cost from investing in the two countries to a common cost of capital $V'(I+I^*)$.

Thus, the optimal policy, if t, t*, I, and I* could be controlled directly, and the product was homogenous, is to have both countries set a common tax which maximizes these joint revenues less cost,, and to allocate investment where it does the most good in terms of reducing total costs thereby equalizing the benefits on the margin. Finally, to invest till benefits equal the cost of capital.

The output allocation would of course be attained by a cartel. leaving the investment decision to be made solely on the basis of cost reduction benefits. If producers had access to capital on the same terms as the lender, these investment choices would automatically be made, and the optimal export taxes would be all that were needed.

However, the analysis above assumes that the investment levels can be controlled by the lender. If private investment is incorporated into the model, and Bank lending is a perfect substitute for private lending, Bank lending crowds out private lending one for one. Hence, if the Bank has better access to capital markets, private lending is reduced to zero, as assumed here. Bank lending is totally ineffective in augmenting private lending. A quick sketch of the model follows.

Producers receive profits of $P(x+x^*)x - C(x, I_p + I_b) - tx - rI_p$ from producing x and investing I_p privately at cost r per unit,

if the export tax is t and the Bank invests I_b. Competitive producers take price as fixed and choose x and I_p to maximize their profits. Similarly, producers in the "*" country choose output and private investment. These four first order conditions can be analyzed to look at the effects on private investment of an increase in Bank lending to the country. These comparative statics results reveal that private investment is reduced one for one with increases in Bank lending.

The Bank maximizes an objective function like (16) but which includes the cost of capital to private investors. If the cost of capital is lower for the Bank, all private lending is crowded out and we return to the earlier model. The result makes sense. If the Bank has better access to funds than private agents, Bank investment should replace private investment. If the cost of funds to the Bank rises with lending, then an interior solution could arise, with the lender being totally ineffective in terms of affecting total investment.

However, Bank lending need not be perfectly substitutable with private lending. In fact, this is often a key part of arguments for the existence of development lending. Lending for projects which would not be undertaken by private agents and which are complementary to private investment is one of the rationales for development lending. This model thus suggests that lending policy consider the effect of Bank lending on private investment and look for projects which are complementary to private investment rather than substitutable.

6. CONCLUSION

The results so far, though theoretically enlightening, are far from satisfactory as a guide to policy. Despite the limitations of implementation stressed throughout, the paper does have some rather pragmatic messages which are worth emphasizing.

First, the paper highlights the importance of clearly specifying the objective functions of the Bank and those of the countries since differences in these are one source of distortions and affect the prescriptions. In this paper I focused on very simple objective functions. In reality, things are even more complex. If government revenues are not seen as having the same weight in the Banks objective function as producer welfare, but less, as in the case of a wasteful government, the case for an export tax is reduced. If distributional considerations exist, such as trying to maintain the incomes of farmers, the case for export taxes is again reduced. Such consideration must be addressed. This is not usually done as government revenues and producer surplus are given equal weight in most analyses.

Second, all the instruments available to the Bank need to be considered in making lending decisions. Investment decisions cannot be made in isolation, but as part of an overall strategy. In this, the recent move towards conditionality in lending decisions could be a step in the right direction.

Third, the ability of the Bank to influence total investment and to affect long run outcomes in desired directions needs to be evaluated.[6] Is there crowding out, or is Bank investment

complementary to private investment?

If increased investment by the Bank merely reduced investment by others so that total investment was unaffected, the Bank would in effect be unable to influence market outcomes. Branson (1993) suggests emphasizing investments which reduce the cost of existing production and would not raise supply and reduce price but would just raise producer surplus and hence welfare.

Similarly, even if export taxes raise profits in the short run, this does not warrant advise to implement them. The long run effect of such taxes on supply from other sources and long run consequences on demand need to be evaluated, as well as their distributional consequences. This has been pointed out in the literature. See for example Akiyama (1992) and Akiyama and Larson (1993). The emphasis on non cooperatively set export taxes or quotas on the grounds that they are self enforcing as in Schiff (1993) neglects the longer run supply responses from other suppliers which could end up in effect killing the goose that lays the golden eggs for traditional exporters.

FIGURE 1

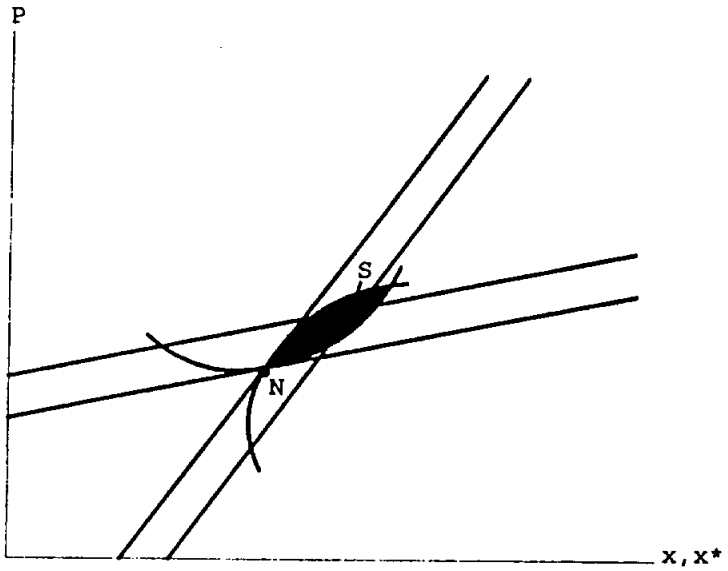
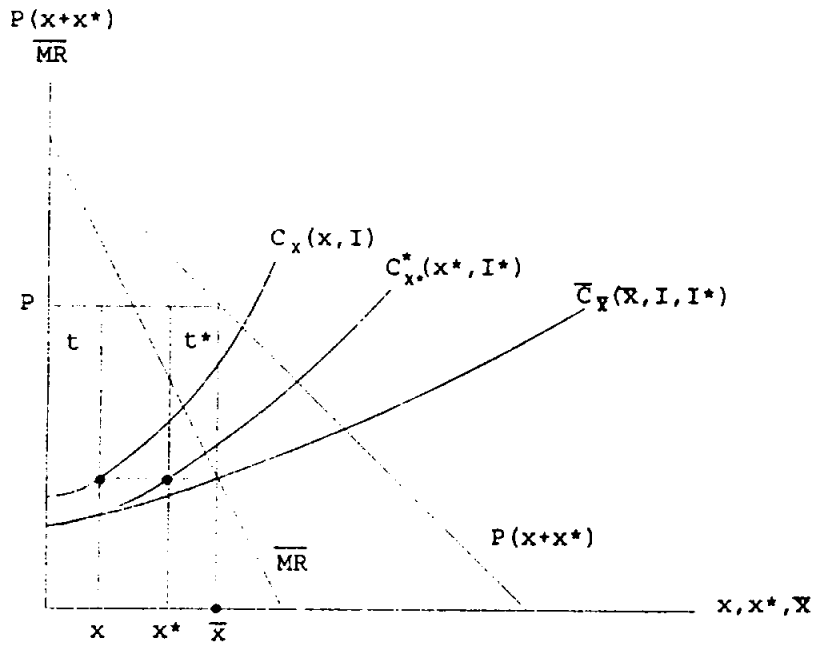


FIGURE 2



ENDNOTES

1. See Panagaria and Schiff (1990) and Table 2, pg. 12 of the Annexes to the Operations Evaluation Department of the World Bank document on Bank Lending for Plantation Crops, March 9th, 1993.

2. The model developed here differs from that in Krishna and Thursby (1991, 1992) as we are not looking at the effects of marketing boards here. Instead, we are adding a lender who must allocate his funds to meet some objective. Although the setup here is the simplest one needed to make the point, it can be extended in a number of directions.

3. If the country had equal access to capital, it could borrow at the cost to the lender and would choose to do so until incremental borrowing was not desirable.

4. Since there is no domestic consumption, this is the same as a production tax. Allowing for domestic consumption would expand the instruments available.

5. It can be shown that increases in t reduce x and raise x^*, and increases in t^* reduce x^* and raise x. Thus $\lambda < 0$.

6. Using (2) and (5) it can be shown that λ^* is less than zero as well.

7. The effect on output comes from performing comparative statics on (4) and (7) in order to get the effects on t and t^* of a change in investment. These are then used to get the implied effect on x and x^* via (2) and (5).

8.There is a surprising lack of work on the effect of, for example, World Bank investments on private investment. Even the World Bank OED (Operations Evaluation Department) report which criticizes the Bank's lending ban in beverage crops, only points to the lack of correlation in Bank lending and overall lending growth (table 5.1, pg. 43) in suggesting that Bank lending policy is not influential. This of course is not evidence either way.

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