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The Shadow Price of Foreign Exchange

An Exercise on the UNIDO Guidelines for Project Evaluation 1/

by

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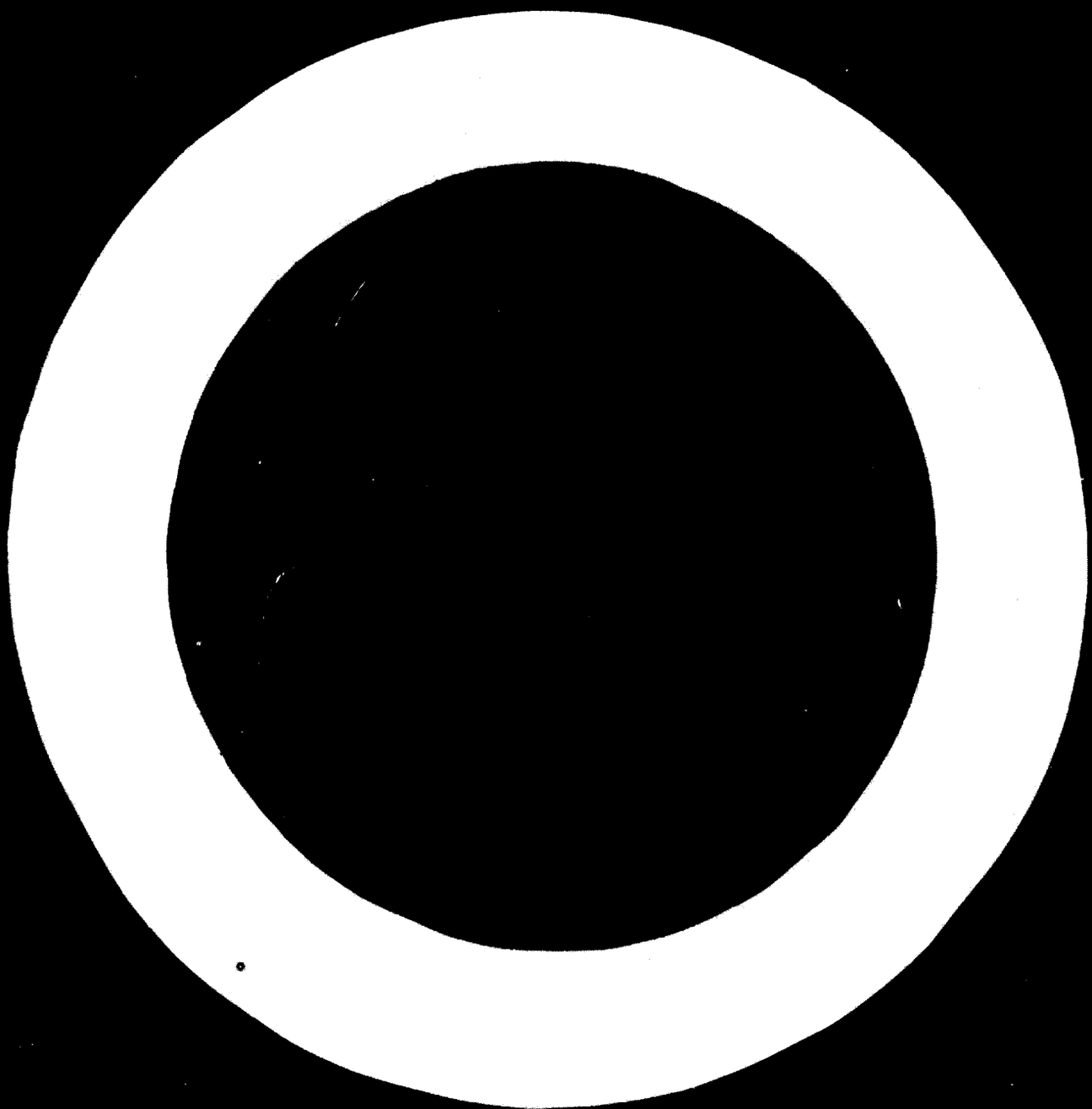

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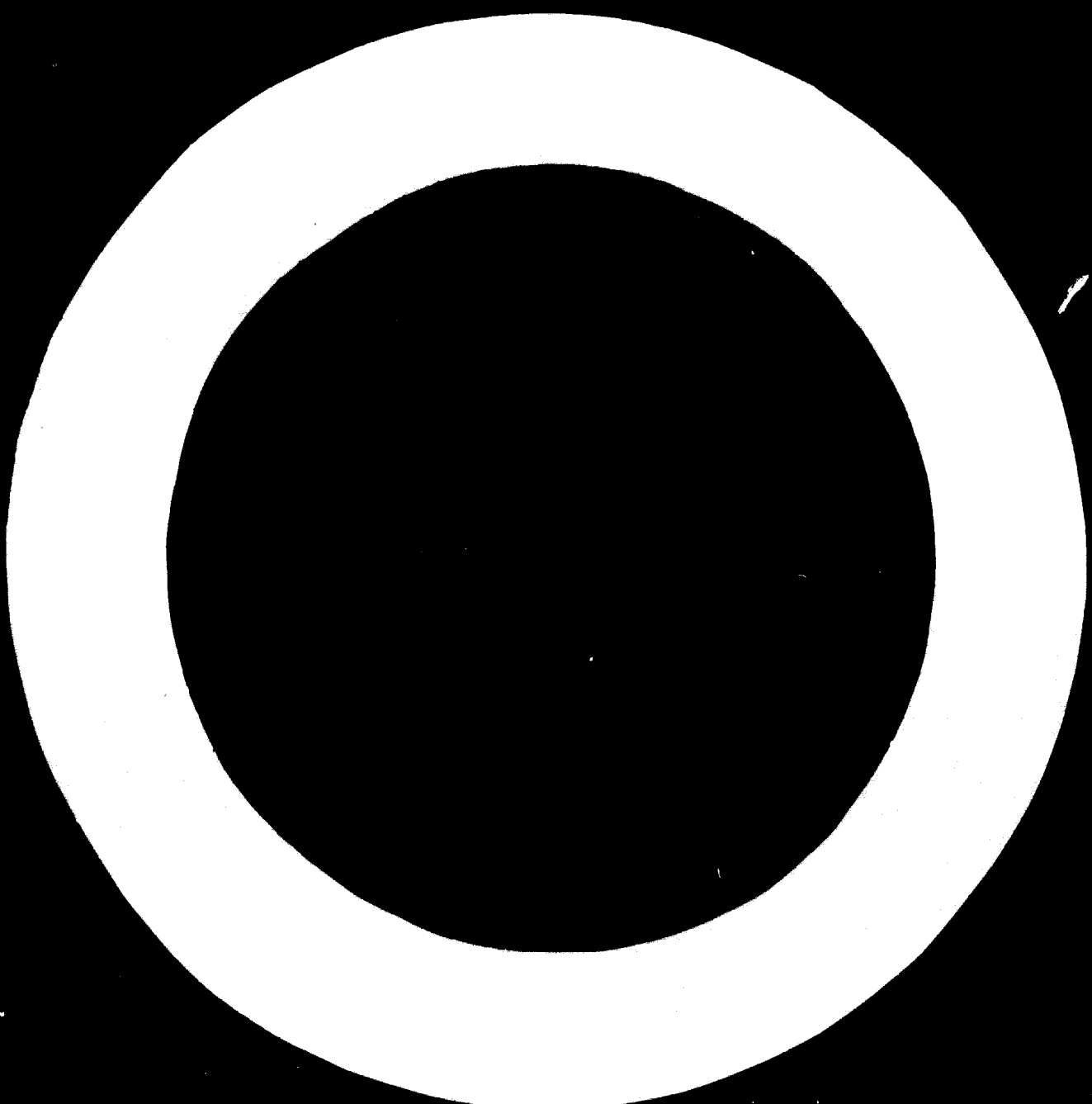


1. Introduction

It is quite possible that the shadow price of foreign exchange is the most misunderstood of the national parameters that one has to deal with in social cost-benefit analysis. It is certain that it is on par with the social rate of discount as the national parameter most often discussed. In the UNIDO Guidelines for Project Evaluation (henceforth referred to as the Guidelines) we discussed the concept of the shadow foreign exchange rate and methods of estimating it at some length. But in view of the audience which the Guidelines was trying to address, the discussion naturally had to be quite informal.

It was not, for example, clear what assumptions were required to justify the approach that was being advocated in the book for measuring it for any given economy. In the absence of such an account it is not very easy to see whether the argument stands up to the facts or, indeed, to one's beliefs about the nature of responses in developing economies one knows. In this paper I shall go somewhat deeper into this question. Section 2 of this paper will contain a detailed discussion of the concept and will eventually provide the particular method that the Guidelines advocates for measuring the shadow foreign exchange rate. By this I hope that one will better be able to see the arguments that are involved, in particular, the precise assumptions that are required to justify the Guidelines' approach. Section 3 will be concerned with an application of the

approach advocated by the Guidelines. In particular, there will be an attempt at evaluating the shadow price of foreign exchange for India.

2. The Theory

There is probably no developing country that is not supposed to suffer from a "chronic shortage" of foreign exchange. Some even regard the "limited availability" of foreign exchange as the crucial problem for such countries. It is, of course, patent that the very process of development puts strains on the economy's capacity to meet foreign payments. As a country's needs for capital goods from the world market increase in the course of economic development, it is often difficult to make payments for them by raising exports. Foreign reserves are often reduced and the country occasionally gets more and more into external debt. In such situations developing economies often maintain an over-valued exchange rate by the use of high tariffs and the outright ban on some goods. There is no doubt, then, that foreign exchange is a scarce resource. But then, so are most other things. Like any other scarce resources, it will have a scarcity value and it is quite likely that, like many other scarce resources, its scarcity value is not reflected in its market price. The natural question then is: What is the nature of the constraint that foreign exchange faces and what is the shadow price associated with this constraint? What I propose to do, then, is in this section to construct a rather simple general equilibrium model that will enable one to see precisely what issues are involved in considering the shadow foreign exchange rate.

I shall suppose a very stylized economy. Many of the assumptions are not at all crucial. I shall point this out whenever the occasion demands it. Nevertheless, I shall make many of them to keep the argument simple as well as to keep the notation from fogging what are in fact the essential points.

I shall suppose that one would not wish to regard foreign exchange as a merit good. Rather, I suppose that foreign exchange is valued for the extra consumption it provides. That is to say, I shall view the "...amelioration of a country's foreign exchange position... solely as instrumental to the aggregate consumption objective". (Guidelines, Chapter 16, p. 213.) In this case, foreign exchange earnings are amenable to evaluation solely in terms of the aggregate consumption that foreign exchange makes available. Now the concept of aggregate consumption is much discussed in the Guidelines. It is totally insensitive to the distribution of consumption among individuals. Thus it is patent that one may as well regard the economy as composed of one man (or many identical men). This is perfectly valid for the problem at hand, since distributional considerations are handled in the Guidelines by distributional weights, and one may as well view the value of foreign exchange through its impact on aggregate consumption. I shall thus suppose that the economy consists of a single individual. I shall suppose that the economy consists of n private goods (like shirts and shoes, apples and labour), labelled $i = 1,2,\ldots,n$; and m public goods (like hospitals and educational facilities), labelled $j = 1,2,\ldots,m$.

The political assumptions underlying the theory of project selection have been given an extensive treatment in the Guidelines. The Guidelines supposes invariably that the Central Office of Project Evaluation (COPE) is not in charge of the setting of tariffs and domestic taxes. For convenience of exposition only, I shall make the extreme assumption that all the tariff rates on producers are given and fixed (no doubt they are as well unoptimal). I shall also suppose (and this is also not at all crucial to the argument) that all the n private goods enter trade, as well as domestic production and they are all, at the same time, consumption goods. Intermediate goods like steel and bulldozers can easily be incorporated but it will make the notation somewhat untidy. But I shall

suppose, as is probably reasonable, that the m public goods are not tradeable. Let C_i be the quantity of the i^{th} private good that the individual consumes. It will be regarded as being positive if he consumes it and negative if he supplies it, as say, for labour. Let the consumption of the j^{th} public good be g_j. To keep the notation clear, I shall amalgamate all private sector producers into one unit and suppose that y_i is the net supply of the i^{th} private good by the private sector producers. It is positive if it is indeed a net output. It is negative if it is a net input. Again for convenience, I suppose that the m public goods are not produced in the private sector. Private production possibilities are, therefore, represented by the implicit relationship

$$F(y_1, y_2, \ldots, y_n) = 0 \qquad (1)$$

I suppose, as is usual, that the private sector faces constant returns to scale, so that if as a result it is a price taker, net profits are zero.

The economy, for the sake of ease of exposition, is assumed to be small, and so faces constant world prices for all tradeable goods (i.e. for all the n private goods). We can, therefore, without any loss in generality choose our units of measuring these goods so as to set all international prices at unity. Let the difference between the domestic producer price of commodity i and its international price to be τ_i. Then if we write the domestic producer price of i as p_i, we have

$$p_i = 1 + \tau_i. \qquad (2)$$

If τ_i is positive it is an import tariff (or export subsidy). It is negative if it is an import subsidy (or an export tariff). As we are supposing that all producer tariffs are fixed, τ_i must all be constant and not controllable by COPE. It follows from (2) that for all i, p_i is given and constant. Suppose now that the private production sector is price taking competitor. It would follow that for all i, y_i will depend only on the p's. But since the p's are

fixed, we can suppose that all the y_i's are fixed. Hence we are considering a situation where, because the tariffs are fixed, quantities produced in the private sector are all fixed and given. That is to say, when evaluating projects for the public sector, COPE will assume that for all i, y_i is given and constant.

There is, of course, no reason why one must suppose that domestic excise taxes are zero. So we assume that the consumer, who is a price taker, faces prices different from the p_i. Let q_i be the consumer price for commodity i. Let us write by t_i the difference between q_i and the international price (unity) for commodity i. That is

$$q_i = 1 + t_i \qquad i = 1,\ldots,n. \tag{3}$$

It follows that the domestic excise tax on good i is

$$\theta_i = q_i - p_i . \tag{4}$$

The individual's preferences over the goods and services, I shall assume, are representable by a utility function

$$U(c_1,\ldots,c_n, G_1,\ldots,G_m) . \tag{5}$$

That is to say, the individual has preferences over the private and the public goods that he "consumes". I shall assume, as is realistic, that the public goods are supplied free of charge to the consumer. Costs of providing them come, of course, from taxes imposed. We are simply supposing that the citizen does not have to make payment for the public goods in the market place. The individual, therefore, maximizes (5) subject to his budget constraint

$$\sum_{i=1}^{n} q_i c_i = Y \tag{6}$$

The budget constraint requires some explanation. Y consists of any lump sum payments made by the government to the consumer as well as the profits accruing to him from his owning the private sector. The income that he receives from the labour that he provides, or the machines that he rents out are all caught in the

left-hand side of (6), since many of the c_i's will be negative (by our sign convention). Now since the private sector faces constant returns to scale, there are in fact no net profits. Hence Y consists entirely of the lump sum payments made to him by the government. I now assume, quite realistically, that the government is unable to employ lump sum taxes (subsidies). It would follow that $Y = 0$. In other words, the consumer is concerned with maximizing (5) subject to the budget constraint

$$\sum_{i=1}^{n} q_i c_i = 0 . \tag{7}$$

Performing the usual calculations one obtains the result that

$$\frac{\partial U}{\partial c_i} = \lambda q_i \tag{8}$$

where λ is his marginal utility of income. Equation (8) is, of course, the standard result pertaining to the optimal choice of the consumption bundle by the consumer. Let us now write

$$V(q_1,\ldots,q_n, z_1,\ldots,z_m) = \max_{c_1,\ldots,c_n} U(c_1,\ldots,c_n, z_1,\ldots,z_m)$$
$$\text{subject to } \sum_{i=1}^{n} q_i c_i = 0 . \tag{9}$$

V is widely known as the individual's indirect utility function. One of the basic properties of V is the relationship

$$\frac{\partial V}{\partial q_i} = -\lambda c_i \qquad i = 1,\ldots,n \tag{10}$$

The simple formula embodied in (10) expresses the fact that the amount of income that the individual needs to be compensated with for an increase in the price of commodity i is equal to his consumption of this commodity. As such it is very intuitive as well. I shall need this result later on.

Turning now to the public sector, I shall assume, simply for ease of exposition, that it is concerned with the transformation (i.e. in the production of) of every commodity that appears in the economy. I do not need this assumption at all. But it will help to keep the notation clear. Suppose then that the public sector production possibilities are represented by the implicit relationship

$$G(z_1,\ldots,z_n, G_1,\ldots,G_m) = 0 \qquad (11)$$

where z_i $(i = 1,\ldots,n)$ is the net output of private good i in the public sector. It is positive if it is an output, and it is negative if it is a net input. G_j $(j = 1,\ldots,m)$ is, of course, the output of the public good j. I assume that the public sector also faces constant returns to scale, so that G is homogeneous of degree zero. I do not, of course, need to assume this, but it would be helpful for present purposes to avoid increasing returns and thus introducing the need for government subsidies for public projects.

Turning now to the trade sector, let x_i be the net import of private good i. It is positive if it is imported and it is negative if the good is actually exported. Remember that for ease of exposition, I am supposing that all private goods are traded and that no public good is traded. Now, in equilibrium, commodity flows must all balance. We would then have

$$c_i = x_i + y_i + z_i \qquad i = 1,\ldots,n \qquad (12)$$

Equation (12) simply says that net consumption of good i must equal the sum of net import, net private sector production and net public sector production. Of course, not all terms in (12) need to be positive.

In equilibrium, trade must balance as well. Remembering that we have assumed constant world prices, for convenience, and that we have chosen the units by which to measure goods so as to set international prices at unity, trade balance would be represented by the condition

$$\sum_{i=1}^{n} \bar{t}_i x_i = R \qquad (13)$$

In equation (13), R represents the totality of aid (say) that the country receives during the period of planning that we are concerned with. If R is negative it must mean that the country is a net repayer to the rest of the world. Notice that many of the terms in the left-hand side of (13) will be negative, showing earnings through exports of goods.

The description of the economy is now complete. The planning problem is to maximize the individual's indirect utility V [see (9)] subject to the constraints (11), (12) and (13), and the point is to choose optimally the controls (i) $G_1,..,G_m$, (ii) $z_1,...,z_n$, (iii) $x_1,...,x_n$, and (iv) $q_1,...,q_n$. Clearly a few comments on the optimization problem are called for. Quite in line with the view point of the Guidelines I am supposing that the optimization problem ought to be viewed from the vantage point of the COPE. Now clearly COPE is not in charge of tax rates. It may advise on them, but it cannot assume that its advice will be taken by the authorities in charge of setting taxes. We have thus made the simple assumption that the trade taxes on the producers, $\bar{t}_1,...,\bar{t}_n$, are all assumed fixed and given. This in turn implies that the producer prices p_i are all fixed and given, and thus that private domestic production of goods is fixed and given. It is then, of course, natural that COPE, being in charge of choosing the right projects, should be concerned with the setting of the levels of $z_1,...,z_n$ and $G_1,...,G_m$. But what of trade and the selection of the consumer prices? Why should COPE be in charge of setting optimally $q_1,...,q_n$ and $x_1,...,x_n$? Clearly it will not. Turning first to the consumer prices, it will presumably be the case that consumer tariffs will be altered when an extra unit of foreign exchange is made available to the economy. The question is, what assumption should one make about the response of the consumer tariffs, t_i, to the various decisions made in the economy? One may at first wish to suppose that they respond in a

predictable way to other decisions. But in fact, nothing will be lost in the final form of an expression for λ if we were to suppose that the consumer prices q_i are chosen optimally. The shadow price of foreign exchange will eventually be found to depend on the difference between the domestic consumer prices of goods and their international prices; and it does not matter whether these differences are optimal or not. Since it is easier notationally to assume that the distortions between domestic prices and international prices are optimal, I shall assume that they are.

Turning now to trade flows, clearly likewise, COPE will not be in charge of setting them. In which event there are two polar cases that come immediately to mind, the first of which is what I am making in this paper (A) Trade flows are either optimally chosen by the Ministry of Trade which is in constant dialogue with COPE, or that trade gets adjusted by the free play of the market. (B) Decisions on trade flows x_i are themselves functions of the selection of $z_1,\ldots,z_n$, $\zeta_1,\ldots,\zeta_m$. That is to say, that we may want to assume that some commodities, say, have quotas imposed on them, and that the trade flows of other goods respond predictably to the choice of public investment. In other words, in assumption (B) one supposes that COPE has to take into account the fact that, say, in recommending a steel mill in the public sector the imports of some equipment will be reduced due to the vagaries of the Ministry of Trade.

Now, of these two polar assumptions (B) is clearly the better one to make and is, in fact, broadly the assumption that the Guidelines considers. The Guidelines makes intermediate assumptions as well but never (A) very seriously. But in fact the formula for the shadow price of foreign exchange that we shall deduce is totally insensitive to which of the two assumptions we make. The difference in the implications of assumption (A) and (B) lies not in the formula for the shadow foreign exchange rate, but in whether one ought to value tradeable goods directly in terms of their international

prices in public sector project selection. That is to say, (A) is essentially the assumption that the Little/Mirrlees approach makes, and (B) is the assumption that the Guidelines spends a good deal of time over. (The Guidelines does not, of course, rule out the possibility of (A)).

Now in view of the fact that the notation is a good deal simpler if we assume (A), I shall assume that (A) is approximately correct. It will, naturally, result in the OECD recommendations regarding the pricing of specific goods. But the purpose of this paper is not to focus attention on the appropriate shadow prices for specific goods, but to look into the shadow foreign exchange rate. Since for the latter it makes no difference whether we assume (A) or (B), I shall assume (A).

The problem for COPE then is to

$$\text{maximize } V(q_1,\ldots,q_n, G_1,\ldots,G_m) \tag{14}$$

subject to the constraints

$$G(z_1,\ldots,z_n, G_1,\ldots,G_m) = 0 \tag{15}$$

$$c_i = x_i + y_i + z_i \;:\; i = 1,\ldots,n \tag{16}$$

$$\sum_{i=1}^{n} x_i = R \tag{17}$$

and it is to choose optimally (i) $G_1,\ldots,G_m$, (ii) $z_1,\ldots,z_n$ and (iii) $x_1,\ldots,x_n$, (iv) $q_1,\ldots,q_n$.

Recall that since the producer tariff rates are assumed fixed, the p_i's are uncontrollable, and therefore so are the y_i's. To solve the foregoing problem one writes down the standard Lagrangean of the problem as

$$L = V(q_1,\ldots,q_n, G_1,\ldots,G_m) - \mu G(z_1,\ldots,z_n, G_1,\ldots,G_m) - \sum_{i=1}^{n} \nu_i(c_i - y_i - x_i - z_i) + \lambda\left[R - \sum_{i=1}^{n} x_i\right]$$

where μ, ν_i and λ are the Lagrange multipliers (or shadow prices) associated with the corresponding constraints. It is patent that λ, the multiplier associated with the trade balance constraint, is our shadow foreign exchange rate. The purpose of this section is to derive a simple expression for this multiplier. We now look at the first order conditions for the optimization problem. Differentiating L with respect to each of the four sets of controls and setting each of these derivatives to zero yields the necessary conditions for the optimum as:

$$\frac{\lambda V}{\partial G_j} - \mu \frac{\partial G}{\partial G_j} + \sum_{i=1}^{n} \nu_i \frac{\partial c_i}{\partial G_j} = 0 \qquad j = 1,\ldots,m \qquad (19a)$$

$$-\mu \frac{\partial G}{\partial z_i} + \nu_i = 0 \qquad i = 1,\ldots,n \qquad (19b)$$

$$\nu_i - \lambda = 0 \qquad i = 1,\ldots,n \qquad (20)$$

$$\frac{\partial V}{\partial q_i} - \sum_{k=1}^{n} \nu_k \frac{\partial c_k}{\partial q_i} = 0 \qquad (21)$$

Equations (19a), (19b), (20) and (21) are our optimality conditions and they provide us with the most of the information that we need.

We have supposed that the public sector production processes are "constant-returns-to-scale". That is, G is homogeneous of degree zero. Hence it is the case that

$$\frac{\partial G}{\partial z_0} z_0 + \frac{\partial G}{\partial z_1} z_1 + \ldots + \frac{\partial G}{\partial z_n} z_n + \frac{\partial G}{\partial G_1} G_1 + \ldots + \frac{\partial G}{\partial G_m} G_m = 0 \qquad (22)$$

We can now multiply the left-hand side of (22) by μ to write

$$\mu \frac{\partial G}{\partial z_1} z_1 + \mu \frac{\partial G}{\partial z_2} z_2 + \ldots + \mu \frac{\partial G}{\partial z_n} z_n + \mu \frac{\partial G}{\partial G_1} G_1 + \ldots + \mu \frac{\partial G}{\partial G_m} G_m = 0 \qquad (23)$$

But we can use equations (19b) and (20) to re-write equation (23) as

$$\lambda z_1 + \ldots + \lambda z_n + \mu \frac{\partial G}{\partial G_1} G_1 + \ldots + \mu \frac{\partial G}{\partial G_m} G_m = 0 \qquad (24)$$

Equation (24) is fundamental. It says that the net social profit of the marginal public sector project must be zero. In itself this is

hardly surprising, but equation (24) also tells us what shadow prices to use for measuring the net social profit of the public sector projects. The equation says that the appropriate shadow prices in the public sector for all tradeables (here $z_1, \ldots, z_n$) are all equal to their international prices, unity. (Remember that we have made assumption (A), regarding the optimality of trade flows, so that here we are getting essentially OECD results pertaining to the shadow prices of specific goods.) But that one has to multiply the value of these tradeables in the project by the shadow price of foreign exchange (λ), so as to reduce their values into utility units. As regards the shadow prices of the non-tradeable public goods, that of good j is $\mu \frac{\partial G}{g_i}$. The value of $\mu \frac{\partial G}{\partial g_i}$ is clearly to be obtained from the optimality equation (19a). We do not discuss the shadow price of these non-tradeable public goods here. Public goods are among those commodities that the Guidelines refers to as "merit wants", and an elaborate discussion of merit goods has been provided there. What, in fact, we are after here is an expression for λ. It is to this that I turn now. The reader will wish now to recall a basic result in programming theory to the effect that the shadow price of a constrained resource is the increase in the maximum value of the objective function if cet. par. the constraint is relaxed by one unit. This is precisely why one would call the associated Lagrange multiplier a "shadow price"? This implies that $\lambda = \frac{\partial V}{\partial R}$ max. That is to say, the shadow price of foreign exchange is the gain in the maximum value of V that we can obtain if the economy were endowed with one unit more of foreign exchange, R. Given the form of V in equation (14), one sees immediately that

$$\lambda = \frac{\partial V}{\partial R} = \sum_{i=1}^{n} \frac{\partial V}{\partial q_i} \frac{\partial q_i}{\partial R} + \sum_{j=1}^{m} \frac{\partial V}{\partial g_j} \frac{\partial g_j}{\partial R} \qquad (25)$$

If we now use equation (10) in equation (25) we obtain

$$\lambda = -\alpha \sum_{i=1}^{n} c_i \frac{\partial q_i}{\partial R} + \sum_{j=1}^{m} \frac{\partial V}{\partial g_j} \frac{\partial q_i}{\partial R} \qquad (26)$$

Turning back to the individual's budget equation (7), if we differentiate it with respect to R, we obtain the fact that

$$\sum_{i=1}^{n} q_i \frac{\partial c_i}{\partial R} = -\sum_{i=1}^{n} c_i \frac{\partial q_i}{\partial R} \qquad (27)$$

Using now equation (27) in equation (26), we see that

$$\lambda = \sum_{i=1}^{n} q_i \frac{\partial c_i}{\partial R} + \sum_{j=1}^{m} \frac{\partial V}{\partial G_j} \frac{\partial G_j}{\partial R} \qquad (28)$$

The expression for λ as embodied in (28) is simple to interpret. The shadow price of foreign exchange is the value of the net alterations in the consumption of different consumer goods when the economy is endowed with an extra unit of foreign exchange - the net alterations being valued at their respective domestic consumer prices. For public goods, domestic consumer prices will not, of course, typically exist. Nor will the marginal utilities of such goods (viz. $\frac{\partial V}{\partial G_j}$) be acertainable directly. Thus the impact of a marginal increase in foreign exchange on the supply of public goods will need to be valued in terms of the national weights that the policy makers in the economy will wish to attach to such merit wants (see Guidelines, Chapter 3). But in the foreseeable future, such national weights are likely to be unknowns in planning exercises. For the present, one can hardly expect policy makers to be able to articulate the weights that they would wish to attach to specific merit wants. But in any case, this problem in all probability does not present a serious deterent to a calculation of the shadow price of foreign exchange. For it seems plausible that the supply of public goods (like medical facilities and education) does not depend at the margin on the availability of foreign exchange. Merit wants are often goods and services offered by "priority industries", and as such it is probably safe to suppose that marginal impact of a unit of foreign exchange on their availabilities (viz. $\frac{\partial G_j}{\partial R}$) is ignorable.

Making this approximation we note that equation (28) reduces to

$$\lambda = \sum_{i=1}^{n} q_i \frac{\partial c_i}{\partial R} \qquad (29)$$

Now λ is the shadow price of foreign exchange in terms of utility as the numeraire, and α is the marginal utility of income. Hence

$$\frac{\lambda}{\alpha} = \sum_{i=1}^{n} q_i \frac{\partial c_i}{\partial R} = \sum_{i=1}^{n} (1 + t_i) \frac{\partial c_i}{\partial R} \qquad (30)$$

is the shadow foreign exchange rate in terms of income (aggregate consumption).

It is expression (30) rather than (28) that is likely to be useable as a formula for evaluating the shadow exchange rate. But one may well be wondering how crucial some of the assumptions in the model were. Toward this one may note, in particular, the following points:

1. The introduction of intermediate goods would not have altered expression (30); that is, the shadow exchange rate depends simply on the net impact of an increase of foreign exchange on consumption goods.
2. The introduction of non-traded consumer goods would also not have altered expression (30). Like other consumption goods, the impact on their consumption of marginal increase of foreign exchange would have appeared in (30) and they would have been valued at their respective domestic consumer prices.
3. While a consumer good on which an import quota has been imposed is much like a non-traded good (and so comment 2. would cover this case), such a commodity is often rationed out rather than distributed through the competitive market mechanism. In the event such a commodity is rationed out, its market price will fall short of the commodity's contribution to welfare (the willingness to pay). But expression (30) is obtained

from the more primitive expression (25) on the assumption that the consumer is a competitive price taker for private consumer goods. Thus in the presence of rationing one will need (if it is regarded as being an important item) to simulate demand curves in order to estimate the willingness to pay (q_i). If this is judged too difficult, one may simply have to assume that the net impact of a unit increase in foreign exchange on the supply of such rationed goods is negligible.

But in fact expression (30) may still not be in an operational form. The coverage of statistics pertaining to the consumption of various commodities may typically be inadequate in developing countries. With this in view, it may be possible to think in terms of a further plausible approximation to the expression for the shadow exchange rate. Toward this, note that on using the commodity balance equation (12) in equation (30), one obtains

$$\frac{\lambda}{\alpha} = \sum_{i=1}^{n} q_i \frac{\partial x_i}{\partial R} + \sum_{i=1}^{n} q_i \frac{\partial}{\partial R}(y_i + z_i) \qquad (31)$$

In our present model, we have supposed that y_i = constant, for all i. It follows that $\frac{\partial y_i}{\partial R} = 0$. Let us next suppose that the net impact on the production of consumer goods in the public sector due to a marginal increase in foreign exchange is negligible. This may often be a reasonable assumption. For one thing, unlike in our world, the public sector may not be involved in the production of private consumer goods. In which event, $z_i = 0$ (and therefore $\frac{\partial z_i}{\partial R} = 0$) for all i representing consumer goods. For another, even if consumption goods appear in government production, the net impact of a marginal increment in foreign exchange may largely be on <u>trade</u> flows and not on domestic production. In either of which event expression (31) reduces to

$$\frac{\lambda}{\alpha} = \sum_{i=1}^{n} (1 + t_i) \frac{\partial x_i}{\partial R} \qquad (32)$$

But from (17) we know that

$$\frac{\partial}{\partial R} \sum_{i=1}^{n} z_i = \sum_{i=1}^{n} \frac{\partial x_i}{\partial R} = 1$$

Hence (32) reduces to the form

$$\frac{\lambda}{\alpha} = 1 + \sum_{i=1}^{n} t_i \frac{\partial x_i}{\partial R} \qquad (33)$$

The approximation formula expressed in (33) is well known and appears to have been suggested orginally by Harberger It states that the shadow price of foreign exchange is unity plus a weighted average of the differences between the domestic prices of consumer goods and their international prices; the weights being the fractions of the marginal net import bill going to these commodities.

Patently the formula expressed in (33) can not be used universally, but it may be fairly dependable for some developing countries, economies where it may be reasonable to suppose that the marginal increment in foreign exchange has an impact almost entirely on trade, and not on domestic production The main advantage of formula (33) is, of course, the fact that it requires only trade figures and even in those developing countries where there is a paucity of relevant statistics, trade figures appear to be reasonably documented.

Whether or not one would wish to use formula (30) or formula (33) for the shadow exchange rate depends naturally on whether one has reasons for supposing that foreign exchange at the margin does not affect domestic production of consumer goods. But one needs to remember that trade statistics may well be the only reasonable statistics available, in which event one may be forced to use formula (33) for the computation of the foreign exchange rate.

But it is possible that the reader will feel that the basic model of this section is not quite relevant for the kind of economies that the Guidelines has in mind Where, to be specific, did the

concept of a "dual economy", that is at the heart of the Guidelines, appear? As a matter of fact, of course, the formal model of this section did not capture a dualistic structure at all. But in fact, nothing is lost in not capturing it. As has been pointed out in the Guidelines at great length, "dualism" provides a reason for invoking a shadow wage rate (and equivalently, a shadow price of investment). "Dualism" is not a reason for considering a shadow price of foreign exchange. As has been argued in the Guidelines, the constraint that prohibits, in our view, an economy from attaining a desirable rate of investment is the inability of the government in mobilizing sufficient savings. It is a case, therefore, for setting a shadow wage rate that differs from the market wage rate, or indeed the direct opportunity cost of unskilled labour. To take a simple example, nowhere in Chapter 16 of the Guidelines does one need the concept of "dualism" to establish the formula for the shadow price of foreign exchange. If the official exchange rate is correct, so that domestic prices are in line with international prices, the shadow exchange rate is unity. This is so whether or not the economy under discussion is a dual economy. I emphasize this point precisely because it is of importance to discriminate between the reasons why one needs a shadow wage rate, or distributional weights for different regions (a feature of "dualism") and the reasons why one needs a shadow exchange rate (a feature of trade distortions).

3. The Application

While the arguments leading to the concept of a shadow price of foreign exchange are relatively straightforward, it is my impression that in actual practice it is the most difficult of the national parameters to compute. Even if one desires to obtain a very rough approximation for its value, the knowledge that the calculator will need to possess of the policies of the government in general and those of the different industries in particular is immense. Some of these problems will become apparent as I make

simplifying hypotheses for the case study at hand. Indeed, the present case study may be regarded as being a substantiation of the underlying view expressed in the Guidelines that national parameters, and hence projects, cannot be evaluated by agents who are not essentially a part of the planning machinery of a given country. Case studies, such as this, are meant merely to indicate the kinds of questions that will need to be asked in the process of project planning. To obtain reasonable answers to these questions, alas, is an entirely different matter.1/

To take the first question: Should capital goods feature in the computation of the shadow foreign exchange rate? In fact, of course, capital goods would have appeared in expression (31) had we introduced capital goods into the basic model. Now, in line with the broad viewpoint of the Guidelines, I shall suppose that for the purposes of calculating the shadow foreign exchange rate, the appearance of capital goods in the marginal import bill is illusory. This is discussed at length in the Guidelines (see Section 16.4), and so I shall merely draw the reader's attention to the fact that to assume that the net availability of capital goods is affected at the margin by the availability of foreign exchange is to assume that the rate of investment is constrained by the country's balance of payments.

For the case study at hand, I shall ignore capital goods from the marginal import bill. The justification for this procedure rests on a feeling that the ultimate constraint on the rate of investment in India (or anywhere for the present) is the constraint on raising the rate of domestic savings.

1/ This section is strictly preliminary. I have made only the crudest of estimates here, drawing on the very limited data that I have managed to obtain. More complete data pertaining to India exist. The results will be revised when the more complete data are collected.

In evaluating the shadow price of foreign exchange one needs essentially to know the actual consequences of an extra unit of foreign exchange. Are government policies such that only trade flows will be affected by this marginal increment or will domestic production be affected as well? Given the nature of the data that I have available at the moment, I shall assume that foreign exchange availability at the margin affect only trade flows. In other words, I shall work with expression (33). This is a serious approximation that may turn out to be undependable.

There are a number of consumer durables produced in India and not imported, which nevertheless, contain an extraordinary quantity of imported materials. It is as though these commodities were simply assembled within the country. Patently, then, the impact of a unit increase in foreign exchange on the production of such consumer goods (or equivalently, the marginal import content of the inputs in the production of these goods) needs to be looked at. Unfortunately, the data I have available at the moment do not allow me to make any assessment of this. For the moment, therefore, I shall merely assume that domestic production of consumer goods is unaffected by the availability of foreign exchange at the margin.

It follows, then, that in computing the shadow foreign exchange rate one will need to know (i) the domestic consumer prices of consumption goods, (ii) the international prices of these goods and (iii) the net import content of these goods in the marginal import bill.

Prices appear to vary considerably from year to year. Hence for the moment, instead of averaging prices over adjacent years, I shall suppose that the marginal import contents of these goods are roughly equal to their corresponding average import contents. This is tantamount to assuming linear import schedules that pass through the origin.

We have so far talked in terms of net imports; thus including commodities that are exported. I shall now suppose, in line with some of the suggestions in the Guidelines, that exports are not seriously altered when an extra unit of foreign exchange becomes available. This is probably not too outrageous an assumption. Typically, it is imports that respond to changes in the availability of foreign exchange. There does not appear to be much evidence that the export of tea, for example, decreases when foreign exchange becomes more available. We thus suppose that the terms in expression (33) that pertain to exports are negligible.

By this sequence of assumptions we are led to looking at the impact of a marginal increase in foreign exchange on the volumes of imports of consumer goods. But even for many of these problems arise. I am speaking of those imported consumer goods that are rationed. In the basic model of Section 2, it was assumed that imported goods are all distributed to the consumer through the competitive market mechanism. Import quotas, as such, pose no problems. Quotas, as I mentioned earlier, would not affect the validity of expression (33). But rationing in the distribution of the commodity will affect the expression, since the selling price under rationing will, of course, fall short of the consumer's willingness to pay, and it is the latter that one needs for evaluating the shadow foreign exchange rate. To the extent that the commodities chosen in this case study were rationed to the consumers (and some, like rice, were during the drought years of 1966-1967), the figure for the shadow foreign exchange rate will be an underestimate of the true value.

Assuming all this, it is clear that we need to compare the domestic prices of imported consumer goods with their c.i.f. prices. The concept of domestic prices is problematic, since they vary quite a bit from region to region. For convenience I have quoted the wholesale prices of these goods at the ports of entry.

The relevant data have been compiled from the Statistical Abstract: India (1969), pp. 248-249, and presented here as Tables 1 and 2. The figures pertain to the four years up to 1969; Table 1 represents the wholesale prices of six finished and semi-finished consumer goods: (i) milk and cream, (ii) wheat, (iii) rice, (iv) copra, (v) wool and fine hair and (vi) raw cotton, other than linters. They appear to be the major consumer goods imported (though the value of the imports of wool is also very small). Commodities that are also imported but which do not appear in the tables include edible nuts, dates and dried grapes. Their domestic prices do not appear to be available in the sources that I have consulted. Their absence, however, ought hardly to matter, since their import values are quite negligible.

Table 2 presents information concerning the imports of these commodities. It is divided into three basic columns. Column 1 shows the value of imports in Rs. 100,000 for the four successive years. The rupee was devalued in 1967. But in fact, the figures in Table 2 for the first two years are all in terms of the post-devaluation rupee. Column 2 presents the volume of imports of these goods during the four years under question and expressed in units of 10,000 quintals. Column 3 is obtained from the information given in columns 1 and 2 and yields the c.i.f. prices of these goods for the four years.

To evaluate the shadow foreign exchange rate during each of these four years we make use of formula (33). As an illustration, consider the year 1968-1969. The total value of imports during this year for these six commodities is Rs. 426.97 crores and is tabulated in the bottom row of the first column of Table 2. It follows that the average (equal by assumption to the marginal) import content of milk and cream for the year 1968-1969 is 1,371/42,697. The c.i.f. price of milk and cream is Rs. 314 per quintal (first row of column 3 in Table 2). The domestic price of milk and cream is Rs 133.67 per quintal. Hence the "contribution" of milk and cream to the shadow foreign exchange rate is (1317/42,697)(132/314).

We sum up such expressions for all six goods for this year and write down the shadow foreign exchange rate as

$$1 + \phi_{1968} = \frac{1,371 \times 134}{42,697 \times 314} + \frac{25,940 \times 83}{42,697 \times 30} + \frac{5,747 \times 125}{42,697 \times 61} + \frac{260 \times 324}{42,697 \times 87} + \frac{9,018 \times 350}{42,697 \times 347}$$

It is easily checked that

$$1 + \phi_{1968} = 2.2.$$

That is to say, the shadow premium, ϕ_{1968}, for the year 1968 is 1.2. The shadow price of foreign exchange for the remaining years is similarly calculated. They are:

$$1 + \phi_{1967} = 2.7$$

$$1 + \phi_{1966} = 2.8$$

$$1 + \phi_{1965} = 2.8.$$

4. Some Remarks

The assumptions made in Section 3 indicate that the figures obtained for the shadow foreign exchange rate must be very crude approximations and may well be misleading. On the other hand, the order of magnitude of the figures appears reassuring. They appear to be in line with the estimates of others (see, e.g. M. Datt-Chaudhuri and A.K. Sen, "An Economic Evaluation of the Durgapur Fertilizer Project", Indian Economic Review (1969). But quite apart from the assumptions that I made about Government policy in India that led to the selection of commodities for study, the methodology of the calculation was unsatisfactory. The years 1966 and 1967 were severely trying for the economy due to an unusual sequence of droughts. One needs to look at the annual increments in imports and run a regression over data acquired for different years to estimate the marginal import propensities for different consumer goods. Unfortunately, a run of only four years (the data available to me at the moment) makes for

such regressions pretty much worthless. The preliminary account in this paper must, therefore, be regarded simply as a vehicle for elaborating on the concept of the shadow foreign exchange rate and for indicating the kinds of issue that the planning office will need to be concerned with in estimating its value for an economy.

TABLE 1

Wholesale Prices of Certain Staple Articles of Trade at Selected Stations in India

Article	1965	1966	1967	1968
1. Milk and cream (incl. buttermilk, etc.) ≡ Milk F.A.Q. (per quintal)	88.75	100.21	120.62	133.67
2. Wheat and spelt (incl. meslin unmilled) [or ≡ wheat] (per quintal)	58.40	64.96	77.86	83.39
3. Rice ≡ rice coarse (Jayanagar)	90.56	124.98	175.79	129.94
4. Copra ≡ copra F.A.Q. (per quintal)	282.36	298.49	333.04	323.90
5. Wool and fine hair, carded and combed (incl. tops) ≡ wool raw Joria white chaitri (Bombay)	645.92	689.67	692.91	644.83
6. Raw cotton other than linters ≡ cotton raw: Madhya; Pradesh; MGM; Jarilla (Bombay) (per 3 quintals)	805.00	841.70	930.11	1050.33

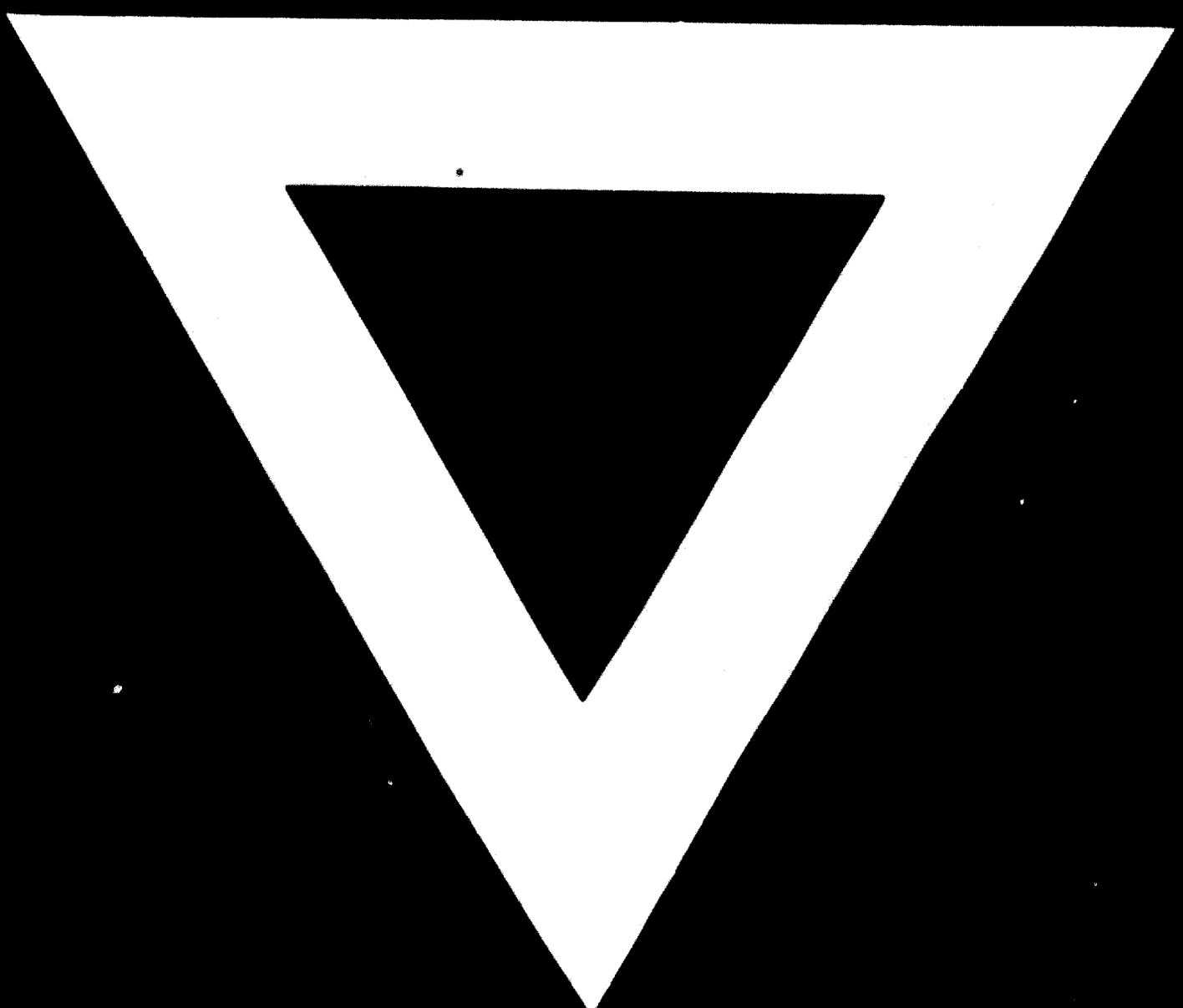
Source: Statistical Abstract, India 1969, Table 162.

TABLE 2

India 1965 - 1968

Principal Article	Value of Imports ('00,000 Rupees)				Quantity of Imports ('0,000 quintals) (unless otherwise specified)				Value of Imports/Quantity of Imports (Rupees/quintal)			
	1965-66	1966-67	1967-68	1968-69	1965-66	1966-67	1967-68	1968-69	1965-66	1966-67	1967-68	1968-69
1. Milk and cream (incl. butttermilk, etc.)	664	2,185	1,330	1,371	361	688	388	436	183.93	317.59	342.78	314.45
2. Wheat and spelt (incl. meslin unmilled)	26,473	42,304	37,847	35,949	14,236	19,752	12,624	8,700	18.60	21.42	29.98	29.83
3. Rice	3,771	8,164	5,476	5,747	1,274	1,858	942	944	29.60	43.94	58.13	60.88
4. Copra	626	420	442	260	98	58	50	30	63.88	72.41	88.40	86.67
5. Wool or fine hair (carded or combed incl. tops)	41	16	8	52	8,500	2,200	1,680	6,020	482.35	727.27	476.19	863.79
6. Raw cotton (other than linters)	4,620	5,647	8,348	9,018	216	186	280	260	213.88	303.60	298.14	345.85
Total Imports	36,154	58,736	53,451	42,697								

Source: Statistical Abstract, India - 1969, Table 82, pp.248-249.



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