

PROJECT EVALUATION IN ECONOMIES
IN GENERAL DISEQUILIBRIUM:
AN APPLICATION OF SECOND BEST ANALYSIS
by
Daniel M. Schydlofsky

Economic Development Report No. 220

May 1972 (revised)

DEVELOPMENT RESEARCH GROUP
Center for International Affairs
Harvard University
Cambridge, Massachusetts

PROJECT EVALUATION IN ECONOMIES IN GENERAL DISEQUILIBRIUM

by

Daniel M. Schydrowsky

Abstract

This paper considers shadow prices for use in the evaluation of investment projects from the point of view of a public authority under conditions of general disequilibrium. It is assumed that institutional rigidities and public policies prevent the markets for foreign exchange, labor, and savings from being cleared by unconstrained competitive market prices and that this situation may be expected to persist throughout the life of the project. In addition, the level of taxation is assumed to be suboptimal.

Under these conditions the use of "first best" shadow prices -- the prices that would obtain in a general competitive equilibrium -- is incorrect. The disequilibria are defined in detail and the case is made for developing second best shadow prices suitable for project evaluation in such an environment. Partial disequilibrium shadow prices are derived for foreign exchange, labor, time, and investment by considering each market disequilibrium in turn. Then, in order to take account of the disequilibria existing concurrently in the various markets, the appropriate general disequilibrium shadow prices are derived. It is concluded that neither the conventional first best shadow prices nor partial disequilibrium shadow prices are satisfactory substitutes for the correct general disequilibrium shadow prices.

Portions of this research were supported by the Development Research Group through funds provided by the Agency for International Development, the National Science Foundation, and the Ford Foundation. However, the views expressed in this report are those of the author and do not necessarily reflect those of the sponsoring agencies.

PROJECT EVALUATION IN ECONOMIES IN GENERAL DISEQUILIBRIUM

by

Daniel M. Schydrowsky

Harvard University*

I. Introduction

The topic of this paper is the evaluation of investment projects from the point of view of a public authority, regardless of whether these projects will be executed by the public sector or by the private sector. The vantage point is that of an institution which can affect the execution of many if not all investment projects, be they public or private. In the case of public investment, such impact may be exercised by direct authorization; in the case of projects to be executed by the private sector, the agency may wield an influence by approving or withholding licenses or tax incentives.

The economy within which the projects to be evaluated will be implemented is assumed to participate actively in world trade but is a small enough buyer on world markets to confront given import and export prices. In addition, the economy is characterized by having markets for foreign exchange, labor, and savings which are not cleared by unconstrained competitive market prices. Instead, quantities demanded and supplied are brought into equality through a combination of public policies and institutional rigidities which leave only a residual function to prices as equilibrating mechanisms. In addition, the level of taxation

* Research support from the Inter-American Development Bank and from the Harvard Development Advisory Service is gratefully acknowledged. Discussions over the years with G.F. Papanek, R.D. Mallon and Marcelo Diamand were of singular usefulness in fashioning the general disequilibrium concept. They are, however, not responsible for the specific content of this paper.

is assumed to fall short of the optimal. These conditions are expected to hold during the planning period, and probably throughout the length of the project life, although the extent of the disequilibria may change from time to time. The economy is, therefore, appropriately considered to be in general disequilibrium.

The objective against which projects are to be evaluated is the maximization of the welfare of the average consumer which is assumed to be a direct function of his consumption and his leisure. Such a formulation takes the distribution of consumption as given. The modification required in the analysis when the distribution of the benefits is specifically taken into account will be briefly outlined in a separate section. Since the benefits and costs of the project accrue over time and some of the project returns will be reinvested, the objective function implies the need for calculating the present value of the net consumption stream generated by the project, i.e. of the ultimate consumption stream originated by the initial investment and all successive reinvestments associated with it.

II. The General Disequilibrium

In this section we will discuss in some detail the form of the disequilibria in the various product and factor markets that characterize the economy in general disequilibrium.

1. Disequilibrium in the market for foreign exchange:

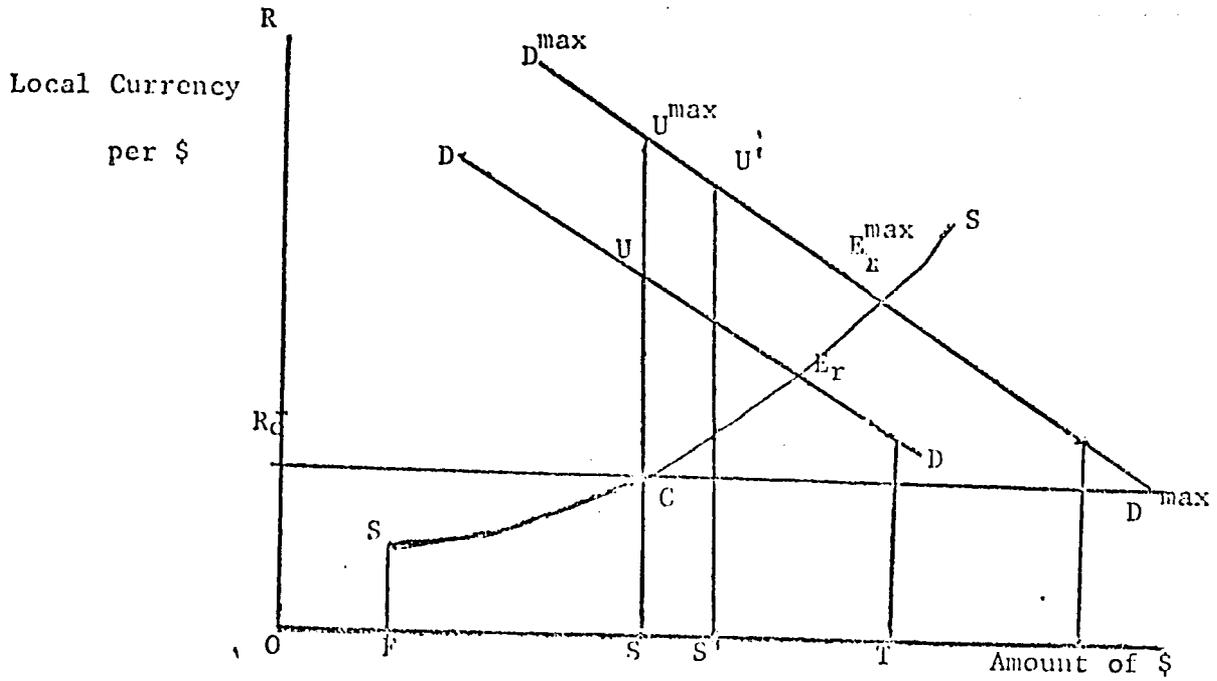
Supply in this market is generated from three sources: (a) by the interaction of a supply curve of exports and an officially established

exchange rate, (b) by the interaction of a supply curve of private capital inflow and the official exchange rate, and (c) from an amount of public capital inflow determined without direct reference to the exchange rate.

At the official exchange rate, the quantity of foreign exchange demanded for imports and outward transfers exceeds the availability of foreign exchange from exports and capital inflow. In consequence, the government adopted an aggregate demand policy and has imposed a set of import restrictions which limit the quantity of foreign exchange demanded to the availability of foreign exchange for their payment.^{1/}

This situation is depicted in figure 1. OF is the exogenous inflow of public funds, SS is the supply curve of foreign exchange from exports and private capital flow, $D^{\max} D^{\max}$ is demand curve of foreign exchange for imports consistent with full utilization of installed capacity and with investment of all domestic savings. R_0 is the official exchange rate fixed by the government which is received by exporters for their foreign exchange. At this rate, R_0 , a quantity OP of foreign exchange is demanded for imports which exceeds the quantity supplied, OS. To bring the quantity demanded down to the supply available, the government (i) reduces aggregate demand in the economy shifting the demand curve for foreign exchange to DD and, (ii) raises

^{1/} In the remainder of this section the demand for foreign exchange for outward transfers will be regarded as demand for one more import commodity. This convention simplifies the diagramatics substantially without loss of generality. The disaggregation of demand for foreign exchange into demand for different imports (visible and invisible) will be reintroduced in detail in Section V.1.



Disequilibrium in the Foreign Exchange Market

Fig. 1

the price of foreign exchange to importers to point U by imposing tariffs equal to CU/CS or quantitative restrictions with equal effect. We shall assume in what follows that tariffs are used. With this combination of aggregate demand and tariff policies, demand for imports is reduced to OS thus equalling total supply.

A competitive equilibrium in this market would take place at points E_r^{\max} or E_r depending on whether aggregate demand is depressed or not. Neither equilibrium price is attainable, however, unless the government removes the import duties. As long as tariffs exist, a differential is maintained between the price of foreign exchange received by exporters and other suppliers and the price paid by importers, and as a result if any imports take place, the situation depicted in figure 1 will obtain. If the official exchange rate were raised from R_o to E_r , and tariffs were maintained, in the first instance exports would increase and imports decline. The increase in exports would cause a rise in domestic money income and the decline in imports would route an increased share of expenditure to domestic suppliers.^{1/} Foreign exchange reserves will be accumulated. Higher levels of domestic activity or price increases or both would ensue depending on domestic supply conditions. The former would shift the demand for imports to the right, the latter would shift the supply and demand schedules for foreign exchange upwards. This process would continue until the demand for foreign exchange again equals the supply and reserves do not increase,

^{1/} Assuming the demand for imports is price elastic.

a point such as OS' . At that time the proportionate excess of the price paid for foreign exchange by importers over the price received by exporters and other suppliers would be equal to that obtaining initially, i.e. $UC'/C'S' = UC/CS$.

Within the foreseeable future, a free trade policy is not likely to be implemented. The official exchange rate will be adjusted from time to time in order to maintain the competitive position of export production and/or offset domestic inflation. The real exchange rate for exporters will thus stay roughly constant. On the other hand, the extent and severity of the import duties will change over time as well, increasing or decreasing the relationship between the net exchange rate received by exporters, C , and the price paid for foreign exchange by importers, U . Furthermore, the extent to which aggregate demand is maintained low for balance of payments purposes may change as well, thus affecting the difference between U^{\max} and U .

2. Disequilibrium in the market for unskilled labor:

The economy is characterized by involuntary unemployment. There is a "protected" sector of the labor market in which the market wage is kept above the supply price through minimum wage legislation and union-management contracts. Furthermore, there is an urban free market in which wages are partially affected by minimum wage legislation but where much labor income comes from self-employment, e.g. street vending. In this market, there is open unemployment. Finally, there is a "traditional" rural sector in which customary rules for dividing

the product between the various factor prevail.^{1/}

When demand in the protected sector expands, workers are drawn in from the free urban sector (or from the traditional rural sector if say "industrial agriculture" is the demander). Moreover, emigration takes place from the traditional rural to the free urban sector. No emigratory equilibrium equating income forgone with expected income is achieved, however.^{2/}

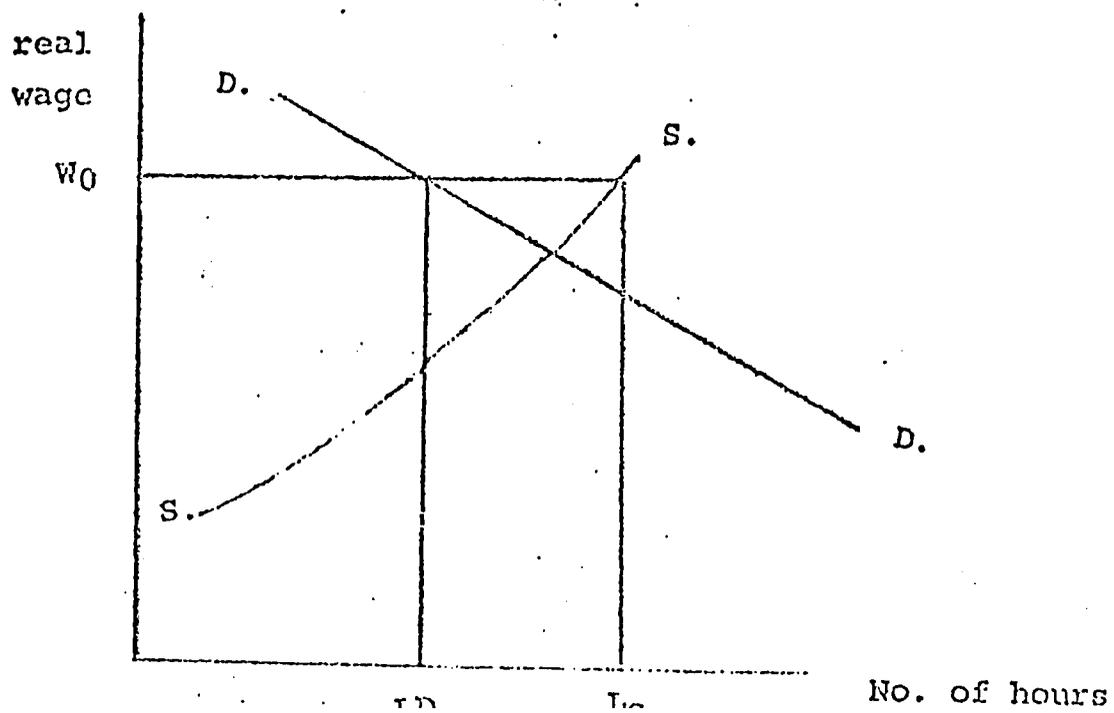
Figure 2 summarizes this situation. The demand curve for labor, DD, is derived from the marginal productivity of such labor at market prices. The supply curve, SS, shows the price at which different amounts of labor units are forthcoming and reflects the utility of leisure as well as the relation between wage rate and perceived income of the wage recipient.^{3/} The ruling wage, W_0 , yields involuntary unemployment of $L_s - L_D$.

In this market, once again, there is no substantial change in policy to be expected. The government will not repeal its minimum wage legislation, nor will the unions accept a lower wage. On the other hand, it is possible that with economic growth, (i) the demand curve for labor will gradually shift to the right until the institutional and legal

^{2/} This is not to say that some emigrants may act in such a rational manner. The system is simply "not yet" in equilibrium and will take some time to get there.

^{1/} In some economies customary wages (e.g. a fixed share of the crop for the harvester) are observed regardless of changes in the labor market or the real value of the wage. Customary wages may, of course, differ between occupations.

^{3/} Wages may differ from perceived income by some of the following elements: (i) fringe benefits, (ii) social security deductions, (iii) taxes, (iv) family transfers foregone by wage earner upon becoming employed, (v) family transfers to others obligatory by wage earner upon becoming employed.



Disequilibrium in the Labor Market

Fig. 2

minima no longer keep the wage above the market clearing price, and, (ii) customary wages will become eroded or will become non-binding as a floor. At that time this market would no longer remain in disequilibrium.

3. Disequilibrium in the market for savings:

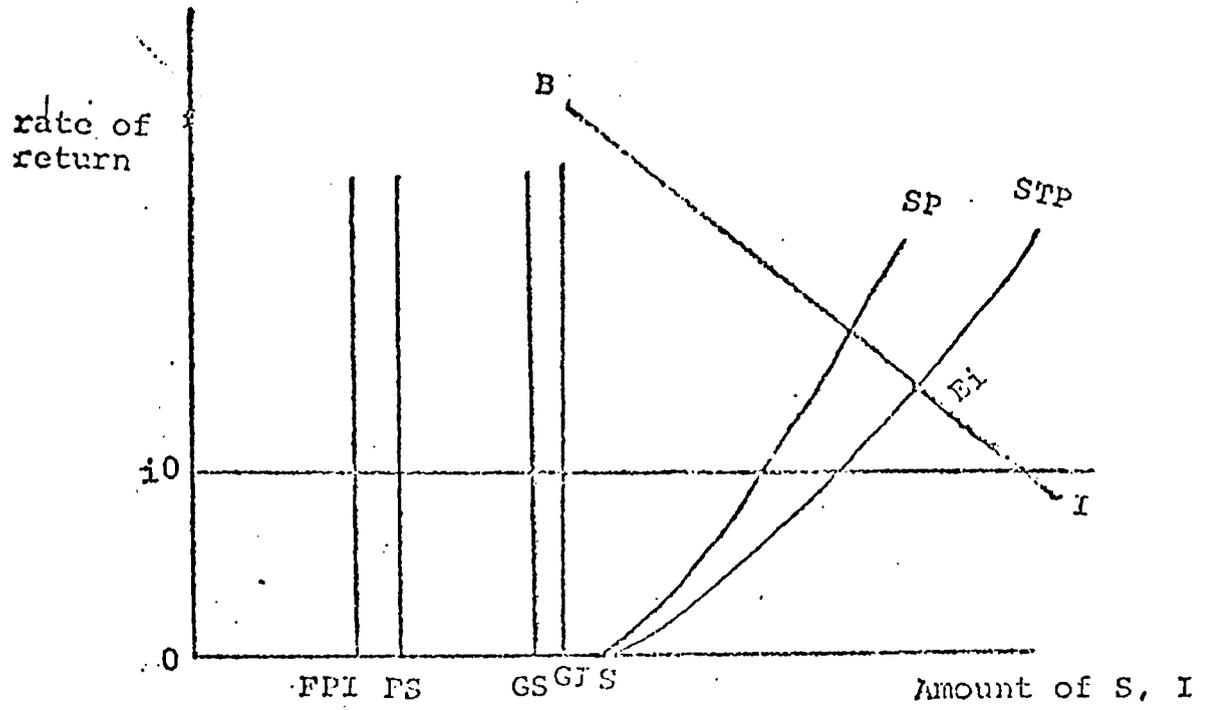
This market is segmented both on the demand and on the supply side. On the supply side, savings are provided (i) by foreigners who extend a given amount of foreign aid and/or undertake a given amount of foreign investment, (ii) by government which uses a part of its revenue for purposes other than current consumption, and (iii) by a variety of savers, who operate in several different sub-markets. At the low end of the yield spectrum among these markets are the group of savers who have no other alternative than accumulating cash. These may get a negative net rate of interest if the price level is rising. At the other end of the yield spectrum are the group of savers who own their own business enterprises and who decide simultaneously on their consumption and their investment in their own enterprises. Between these two extremes, are a variety of financial sub-markets comprising bank savings deposits, mutual savings bank deposits, unifunds, etc. etc. These yield a variety of rates of return, all of them higher than the return attainable for holding money, but all of them lower as well than the rate obtainable from investing in a self owned enterprise. Furthermore, the access to the different savings markets is hierarchically ordered. Savers having access to investment in their own enterprises also have access to all the other ways of saving. The converse is generally not true: savers in the other categories do

not have the option of investing in their own enterprises since they do not own such enterprises. Thus, at any given time it is possible for any saver to move down the rate of return to savings curve from the rate obtained in his sub-market, but it is much more difficult to move upwards to a higher yielding market except over a period of time.

On the demand side, the market is fragmented as well. On the one hand are government investments which are determined from the budget and which may exceed government savings. On the other is investment by the enterprise sector which has a net demand for investable funds schedule arising from the residual demand after own savings have been invested.

The situation in the savings market is depicted in figure 3. The supply of savings originates in the following sources: (i) foreign savings FS, (ii) government savings GS-FS (iii) supply schedule from private savers without access to investing in own enterprises, SSP, and (iv) supply schedule of private savers with access to investment in own enterprises, STP-SSP. On the demand side we have: (i) foreign private investment, FPI (ii) government investment, GI-FPI, which is depicted as greater than government savings, and (iii) private investment, BI. The interest i_0 is the average rate paid to savers not able to invest in own enterprises. It can be readily seen that at this rate there is excess demand for savings. As a result, the average rate paid must go up to E_1 , the equilibrium rate, or borrowing must be limited in some other way. Since both the borrowing rates and lending rates of financial institutions are typically subject to maxima determined by the government, the interest rate cannot rise to clear the market; rationing takes place instead.^{1/}

^{1/} It may, of course, occur that rationing is only binding on some investors and r



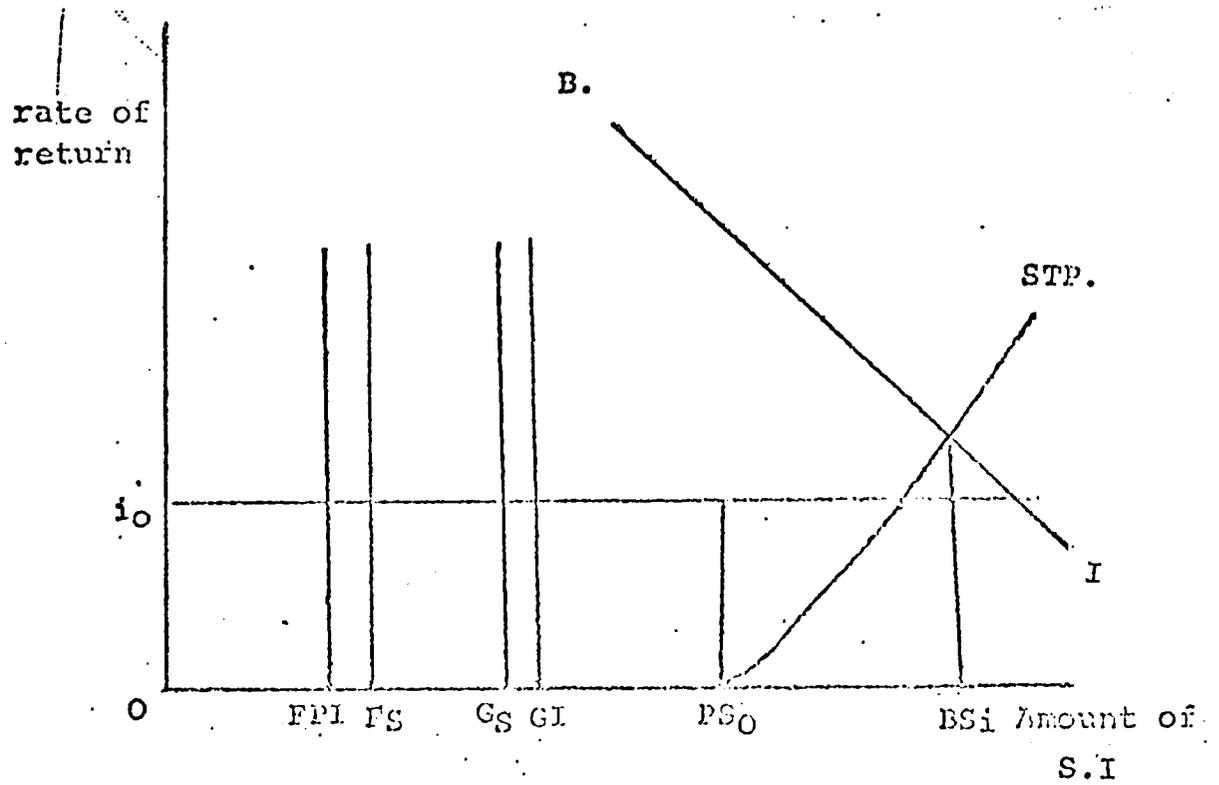
Disequilibrium in the Savings Market

Fig.3

The rules by which the rationing system functions are rarely clearly specified but it can be said with certainty that they do not correspond precisely to a net social benefit criterion.

The presence of rationing changes the behaviour of the savers able to invest in their own firms for whom the allotment falls short of their demand for loans. The relevant demand curve facing own savings then arises out of the rate of return on own funds rather than total funds invested, with the interest cost of the borrowing allotment becoming a fixed cost. Equating returns on own funds with own time preference now will yield a higher level of own savings. Figure 4 depicts the new disequilibrium in the savings market. Foreign and government savings and investment are as before, however, private savings of non own-investors is pegged to PS_0 as a result of the interest ceiling. On the other hand private savers who are own-investors now save $DS_1 - PS_0$. These own invested savings will be greater than the savings forthcoming from own investors in an equilibrium market; however, aggregate savings from all private sources can be greater or smaller than in an equilibrium market depending on the relative size of the interest elasticities of the supply of savings of own investors and non-own investors and on the share each contributes to total private savings.

As in the other markets, no basic policy change is expected, i.e. government will not eliminate the interest ceilings. However, with economic growth they may in time become redundant. Domestic savings may increase sufficiently, market segmentation may be reduced enough, capital inflow may rise sufficiently and price stability may be such as to generate



Disequilibrium in the Savings Market with Borrowing Allotment

Fig. 4

equilibrium in the savings investment market at a real interest rate below the government enforced ceiling.

4. Disequilibrium in the fiscal sector:

It is not appropriate to speak of a market with regard to government revenue and expenditure. Nonetheless it is possible to derive a market analogy of the suboptimality of the level of tax revenue that has been assumed at the outset. In figure 5(a) a total cost curve of taxes, OT, has been derived in terms of the net consumption given up due to the tax payment. The shape of this "cost curve" will depend on the way the consumption-savings mix of domestic expenditure changes as tax revenue rises. If this mix is constant, the cost curve will be a straight line, if marginal taxation falls increasingly on investment, it will be concave downward; conversely, if marginal taxation falls increasingly on consumption, the curve will be concave upwards.

The government expenditure generates consumer satisfaction equivalent to some amount of private consumption. As government expenditure increases, its marginal consumption equivalent increases less than proportionately due to a decreasing marginal rate of substitution. Hence, the total expenditure curve, OE, is concave downward. The respective marginal curves T'T' and E'E' are shown in Figure 5(b). At the point where the two marginal curves intersect, the marginal consumption given up due to tax revenue is exactly equal to the marginal consumption equivalent gained from government expenditure. Less than optimal taxation

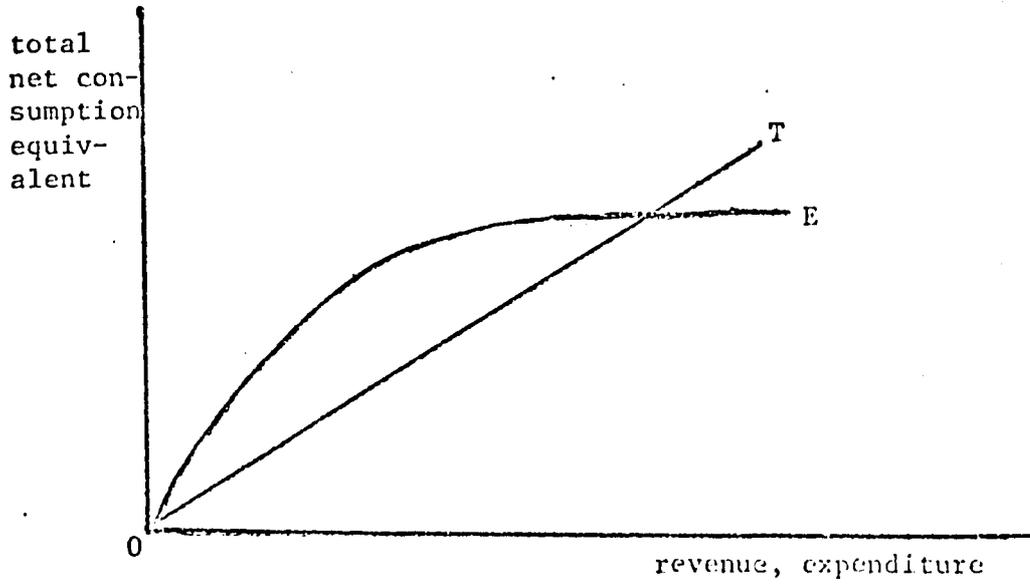


Fig. 5(a)

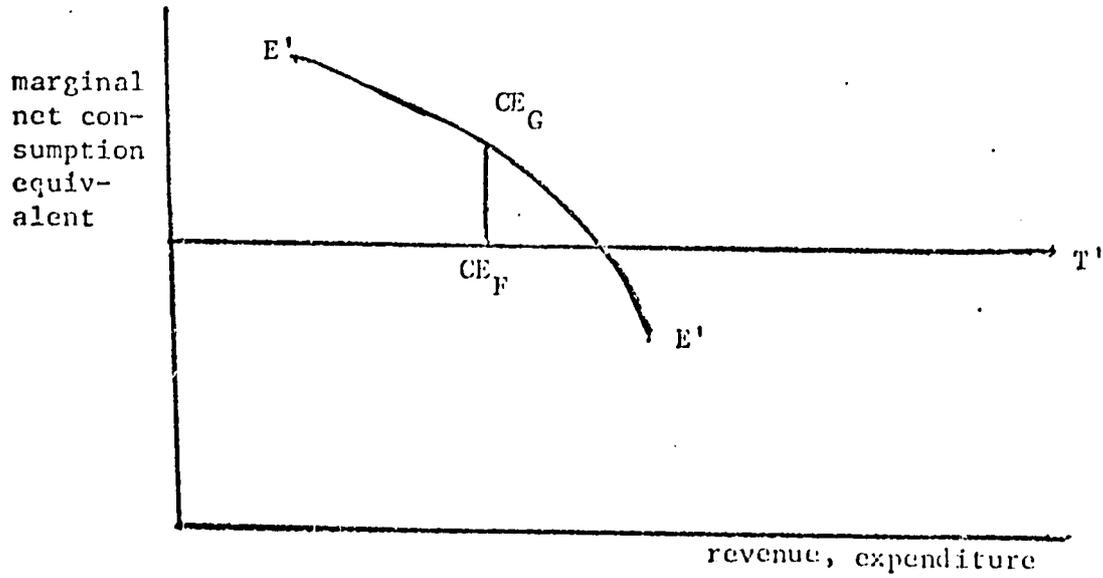


Fig. 5(b)

Disequilibrium in the Fiscal Sector

in this context implies that the consumption equivalent of marginal tax revenue is lower than the consumption equivalent of marginal government expenditure. This is shown in figure 5(b) as $CE_T < CE_G$.^{1/}

Such a situation may be the result of three interacting elements:

- (i) the availability of public goods in comparison with private goods is too low, hence the marginal utility of having more public goods is greater than the marginal utility cost of giving up private goods;
- (ii) the government has a higher savings rate than the private sector, and a unit of investment expenditure has a consumption equivalent of more than one; therefore the consumption equivalent of a unit of fiscal income is higher than the consumption equivalent of a unit of private income;
- (iii) The consumption equivalent of a unit of government investment exceeds the consumption equivalent of a unit of private investment.

At given tax rates, the disequilibrium in the fiscal sector will change with growth in accordance with the revenue and expenditure elasticities of the fiscal system. Depending on their relative magnitudes and the size of the initial disequilibrium, the gap may widen or narrow at various rates.

^{1/} If taxation exceeded the optimal level, the converse would hold and $CE_T > CE_G$.

III. The Marginal Physical Social Contribution of a Project

The contribution of a project to the welfare of the society can be divided into two parts: (i) increase or decrease in the availability of commodities or services produced directly by the project, and (ii) increase or decrease in the availability of commodities or services caused indirectly by the project through its impact on the demand structure of the economy as a result of induced changes in income distribution or prices. Each of these contributions will be discussed in turn.

In an open economy of the kind under discussion, the output from a project can be used for three purposes: (i) it can be exported, (ii) it can substitute for existing imports, which are then no longer undertaken, and (iii) it can be directly utilized in the economy. In the first case it is obvious that the outputs add to the availability of foreign exchange an amount equal to the FOB value of the output. Assuming constant reserves and foreign debt, the exporting project effectively contributes absorption of new imports to the economy. In the second case, the output does not increase the total foreign exchange available, yet since it frees existing foreign exchange equal in amount to the CIF value of the output from a previous use it in fact adds to the net availability of "uncommitted" foreign exchange in the economy. On the assumption of constant reserves and foreign debt, the effective contribution of import substituting projects is therefore also the availability of new imports. In the third

case an increase in absorption (consumption or investment) of the domestically produced output takes place. In this case the contribution of the project is not the availability of new imports but the increased availability of the particular product produced.

It is important to note that the above classification cuts across the differentiation between traded and non-traded goods. Not all production of traded goods is appropriately taken at its foreign exchange value. ^{1/} Only the production that is in fact exported or in fact substitutes for imports generates as marginal physical social product the increased availability of foreign exchange, and only such output should be taken at its CIF or FOB value. The output of traded goods that is in fact absorbed by the domestic market neither adds to available foreign exchange nor frees existing exchange from previous commitment. In consequence the CIF value of such output does not represent its marginal physical social product. ^{2/}

^{1/} For a contrary view Cf. Little, I.M.D. and J. Mirlees "Manual of Industrial Project Analysis in Developing Countries" vol. 2, OECD Development Center.

^{2/} Consider the case of a country which imports no automobiles. The establishment of an automobile assembly plant is to be evaluated. The output of the plant clearly saves no foreign exchange, none is spent for automobile imports in any case. The output does, however, increase the availability in the economy of cars. The marginal physical social product is therefore automobiles and not foreign exchange. Consequently the contribution of the project to welfare will be given by the marginal utility of the cars made available and not by the marginal utility of the foreign exchange value of such cars.

The situation of material inputs is similar to that of outputs. Material inputs may either be (i) export products, (ii) products competing with imports at the margin and (iii) products that do not compete with imports at the margin and that may be either non-traded goods or traded goods subject to prohibitive protection. The use of a material input in the first two categories implies a use of foreign exchange equal to the FOB or CIF value of the inputs. Use of a material input in the third category detracts directly from domestic absorption.

The use of factors will effect the availability of goods and service as well. If the factors used by the project were previously employed, their marginal product elsewhere in the economy will cease to be available. This marginal product may consist of goods exported, goods substituting for imports, or goods absorbed domestically. In the first two cases, the utilization of these factors of production costs the economy an availability of foreign exchange. In the last case the cost to the economy is the availability of domestically absorbed goods themselves.

If the factors of production utilized were unemployed, the economy would have lost no output. It has been argued that in this case the economy may give up future consumption through a reduction of the average savings ratio consequent to a higher utilization of labor.^{1/} This implies that if the unemployed factors had not been employed and some other factor combination had been used, the growth rate would have been higher and there-

^{1/} cf. Little & Mirrlees, op. cit.

fore utilization of such unemployed factors causes a short fall which should be included in their cost. The consistent application of this reasoning, however, would require evaluating projects not in terms of their contribution to the consumption stream but in terms of their short fall from the marginal project in the optimal project package. In the context of an evaluation framework that makes the realistic assumption that both the optimal package and its marginal project are unknown, and in which projects are evaluated by their contribution to consumption directly and through reinvestment, any short fall calculation is out of place.^{2/}

The most important indirect impact of a project on the availability of commodities or services arises from its impact on the fiscal balance. A project may make a direct contribution to tax revenue. It may also extinguish some preexisting source of revenue. For example, import substituting projects reduce import duty collections to the extent that they in fact displace imports. On the other hand, part or all of the reduction in collections may be recouped on the new imports made possible by the project: the net impact depending on the relative height of the duties.

A net transfer of resources from the private to the public sector will cause an increase in the availability of public goods compared to private goods. A transfer in the opposite direction will have the converse effect. In economies

^{2/} Note that the factor intensities will affect the reinvestment arising from each project, thus automatically incorporating the attendant differential growth impact.

where the provision of public goods is suboptimal, such changes in the mix of output have a welfare impact. The project also affects the structure of demand and the mix of goods and service availability to the extent that its implementation causes a change in relative prices. This impact is likely to be smaller, the more open the economy and the smaller the proportion of output from the project which is not exported or substitutes for imports.

IV. The Valuation of the Benefits and Costs of a Project

It is well established in the literature that in the absence of competitive markets in equilibrium and /or when externalities in production or consumption are present, the use of market prices in project evaluation will lead to mistaken project choices. Instead, the use of the prices that would obtain were the economy in competitive equilibrium is recommended.^{1/} Such prices, appropriately called "first best

^{1/} Bruno, H. "The Optimal Selection of Export Promoting and Import Substituting Projects", UN, Planning the External Sector: Techniques, Problems, Policies, New York, 1965, H. B. Cheney "Comparative Advantage and Development Policy", AER, March 1961, Papanek G.F. and A. Quereh, "The Use of Accounting Prices in Planning", Organization, Planning and Programming for Economic Development, UN Conference on Application of Science and Technology for the Benefit of Less Developed Areas, 1962.

shadow prices" measure the marginal utilities and marginal costs of goods and factors in the optimal situation from which they are derived and therefore are clearly the correct valuations, if the economy has reached that optimum state by the time the evaluated project is implemented.

The assumption made so far in this paper is that the market disequilibria will persist during the lifetime of the projects to be evaluated. In this context, the first best shadow prices measure neither marginal utilities nor marginal costs of outputs and inputs. It becomes necessary instead to derive second best shadow prices which reflect the real situation which will eventually.^{1/} Naturally, second best shadow demand prices will typically diverge from second best shadow supply prices. Furthermore, second best shadow prices will change over time as a result of shifts in the disequilibria affecting the various markets, thus a time series of shadow prices is needed.^{2/}

The difference between first best and second best shadow prices can easily be illustrated by recourse to an example from the foreign exchange market. The balance of payments policy that has been assumed (and which is a not uncommon one) is biased in favor of import substitution

^{1/} Cf. Harberger, A.C. "Survey of Literature on Cost-Benefit Analysis for Industrial Project Evaluation" UN Inter-regional Symposium in Industrial Project Evaluation, 1965, Feldstein, H.S. "Financing in the Evaluation of Public Expenditure" Harvard Institute of Economic Research, Discussion Paper No. 132, Aug. 1970

^{2/} The markets themselves will in turn be affected by the use of second best shadow prices instead of first best or market prices through the different choice of projects they imply.

and against exports. Fig. 1 portrays this situation. The first best shadow price would be E_r^{\max} , yet the marginal utility of foreign exchange is given by U and the marginal cost by C .^{1/} Using the first best shadow price will therefore underestimate the benefit of saving or earning foreign exchange.

V. Partial Disequilibrium Shadow Prices

If each market disequilibrium is assumed in turn to be the only disequilibrium in the economy and all other markets are assumed to function perfectly, a set of partial disequilibrium shadow prices can be derived.

1. Partial disequilibrium shadow price of foreign exchange:

If the economy is in competitive equilibrium everywhere except in the foreign exchange market, the points on the supply and demand schedules for foreign exchange on which the market settles can be given a welfare interpretation.^{2/}

The point at which the government's official exchange rate intersects the supply curve thereby determining the quantity of export generated and the quantity of foreign exchange supplied, measures the marginal cost of producing foreign exchange through exports in the existing economic activities. This would be point C in fig. 1.^{3/}

^{1/} This is strictly a partial disequilibrium interpretation. For a discussion of this and a general disequilibrium extension Cf. V and VI below.

^{2/} For a complete survey of the literature Cf. Bacha, E. and L. Taylor "Foreign Exchange Shadow Price: A Critical Review of Current Theories", QJE, May 1971.

^{3/} If the equilibrium is not of the competitive kind, i.e. if the monopolies, monopsonies and/or monopolistic competitors exist, point C will overstate the marginal cost.

On the other hand, the point at which the vertical line showing the amount of foreign exchange available cuts the demand curve for foreign exchange will measure the marginal utility of foreign exchange in imports. This would be point U in fig. 1.^{1/}

If more foreign exchange becomes available as a result of the undertaking of a new project, and reserves are kept constant, the new foreign exchange could be used to increase imports or decrease exports. The former would require a decrease in the real price of imports and/or an increase in the level of real aggregate demand in the economy. In turn, the decrease in exports would require a revaluation of the real exchange rate facing exporters. Our assumption is, however, that the real export rate is maintained roughly unchanged precisely to avoid a reduction in the profitability of existing export production. Thus the condition needed for absorbing additional foreign exchange through export reduction is explicitly ruled out. Hence any new foreign exchange perforce has to be used to increase the availability of imports and will therefore generate an amount of marginal utility measurable on the demand curve for foreign exchange. Therefore, point U, the marginal utility of foreign exchange, is the second best partial disequilibrium shadow price of foreign exchange. The marginal cost for generating such exchange will naturally be given by the project costs itself. Point C, the marginal cost of producing foreign exchange in other activities, would be of relevance only if the undertaking of

^{1/} Again, in imperfect competition, point U will understate the marginal utility of foreign exchange.

a new project and the consequent availability of more foreign exchange were to cause a modification in the exchange rate, an eventuality ruled out by assumption.

The marginal utility of foreign exchange can be built up from the marginal utility of various uses to which it is put. Under perfect competition and if no domestic indirect taxation is levied, the marginal utility of imports is merely the weighted sum of the demand prices of the individual imported commodities. For final consumption goods, it is obvious that if consumers are in equilibrium, the demand price for each good will equal its marginal utility in consumption.^{1/} For intermediate goods, the demand price reflects both the marginal physical productivity of the intermediate goods, the price of the output and any producer monopoly power. If producers are in competitive equilibrium and no sales or excise tax is levied, the marginal utility of the product will be swept back to the intermediate input demand price, which will thus accurately measure the marginal utility of such inputs. If producers are imperfect competitors, a part of the marginal utility of the product will not be swept back and the demand price will understate the marginal utility of the inputs. If the market for saving and investment is in equilibrium, the demand price of capital will reflect marginal utility in the same way as the prices for intermediate goods.

In the partial disequilibrium context, under perfect competition,

^{1/} This holds regardless of whether the seller is a competitor, monopolist or monopolistic competitor. It would not hold if there were consumer monopolies, a very rare occurrence indeed.

the marginal utility of imports, in the absence of other indirect taxation is:

$$U_M = \sum m_i P_i$$

where U_M is the marginal utility of imports, m_i is the marginal import share of good i , P_i is the demand price of one dollar's worth of import value of good i .

If the binding import restrictions are tariffs and there is competition between importers, the domestic demand price for one dollar's worth of each commodity will equal the official exchange rate plus the tariff. If we define:

$$t_i = \text{ad - valorem tariff on commodity } i$$

$$R_o = \text{official exchange rate}$$

we have:

$$P_i' = (1 + t_i)R_o$$

$$U_i = \sum m_i (1 + \sum t_i)R_o = R_o (1 + \sum m_i t_i)^{\frac{1}{2}}$$

If domestic indirect taxes are levied, the demand price for imports underestimates the marginal utility of foreign exchange since only a part of the price the consumer pays is swept back to the demand for the imported commodity itself, the remainder being absorbed by the government. If a uniform sales tax is applied, the understatement is

^{1/} Cf. Harberger A.C., "Survey . . ." Op.cit., E.R. Fontaine, "El Precio Sombra de las Divisas en la Evaluacion Social de Proyectos", Universidad Catolica de Chile, 1969, D.M. Schydrowsky, "On the Choice of a Shadow Price for Foreign Exchange", Economic Development Report 108, Harvard University.

exactly proportional to the rate and

$$U_M(s) = \sum m_i (1+t_i) R_o (1+s) = R_o [1 + \sum m_i t_i + s(1 + \sum m_i t_i)]$$

where $U_M(s)$ is the marginal utility of imports in the presence of sales taxation, and s is the uniform rate of the sales tax.

Monopoly elements have precisely the same effect as indirect taxes. Thus if s is redefined to include indirect taxes and monopoly margins, $U_M(s)$ will represent the marginal utility of imports in the presence of indirect taxation and imperfect competition.

The use of foreign exchange for outward transfers on service or capital account can be incorporated in these formulae. Payments for services can be considered imports of services and in consumer equilibrium the marginal utility of a dollar's worth of such services equals the local currency price of a dollar's worth. Similarly, investment abroad or repurchase of foreign debt can be regarded as an import of securities.

Redefining:

m_i = marginal expenditure share of foreign exchange on import i or financial transfer i .

t_i = tariff on import of good i or tax on financial transfer i ,

we have, in the absence of domestic indirect taxes:

$$U\$ = \sum m_i (1+t_i) R_o = R_o (1 + \sum m_i t_i)$$

where $U\$$ is the marginal utility of foreign exchange. In presence of a generalized uniform sales tax collection on all final purchases, the marginal utility of foreign exchange would become:

$$U\$(s) = \sum_i m_i (1+t_i) R_o (1+s) = R_o (1+s) (1 + \sum_i m_i t_i)$$

2. Partial disequilibrium shadow price of unskilled labor

The point on the demand curve for labor on which the system settles, i.e. point P in fig. 2, measures the marginal productivity of labor. The point at which the vertical line showing the quantity of labor used cuts the supply curve, i.e. point L in fig. 2, measures the marginal utility of leisure and other amenities foregone^{1/} by the employed laborer adjusted by the difference between the wage rate and the perceived income of the laborer.

The laborers are willing to work at the cost of the foregone leisure and associated amenities. The foregoing of such leisure and the associated amenities represents a welfare reduction for the average consumer and as such is a cost to the economy to the extent that it is not offset by the social stigma of being idle and social costs of unemployment such as famine, epidemics, rise of theft, etc. In addition, the employment of labor causes a social cost equal to the relocation costs, if any, of locating laborers sufficiently near their job. Such costs are, however, more appropriately regarded as additional project costs than as a component of the shadow price of labor.^{2/} Hence, the major component of the partial disequilibrium shadow price of labor is the utility of leisure and other amenities foregone.

^{1/} The amenities may include such important values as a rural life, a small town environment, proximity of family, etc. I am indebted to G.F. Papanek for this point.

^{2/} Spread over the employed lifetime of the workers, such relocation costs would in most cases be of negligible magnitude.

Defining:

w/h = wage per hour at which unemployed workers would accept employment for an hour in the absence of coercion to the contrary.

y/h = support (per hour) received by the unemployed from family, etc.

$1-k$ = proportion of wage earned transferred to unemployed dependents

then the marginal social cost of labor (MCL) would be:

$$MCL = \left(\frac{w}{h}\right)k - \frac{y}{h}$$

which in turn equals the marginal utility of leisure and associated amenities.

3. Partial disequilibrium prices of time and capital

In equilibrium the interest rate results from the equation of the time preference of consumer-savers and the productivity of capital. In disequilibrium, the interest rate can no longer measure both concepts, since the lack of equilibrium means precisely that the time preference is now no longer equal to the technical rate of transformation through time. As a result two parameters are necessary to measure these now unequal quantities.^{1/}

^{1/} On this point Cf. Eckstein, O., "Investment Criteria for Economic Development and the Theory of Intertemporal Welfare Economics", QJE, Feb. 1957, "A Survey of the Theory of Public Expenditure Criteria" Public Needs, Sources and Utilization, NBER 1961, Feldstein, M.S. "The Social Time Preference Discount Rate in Cost Benefit Analysis" EJ, June 1964, Marglin, S.A., "The Social Rate of Discount and the Optimal Rate of Investment", QJE Feb. 63, and Marglin, S.A., "The Opportunity Cost of Public Investment" QJE, May 63.

Figure 6 shows this disequilibrium in the traditional Fisherian intertemporal production and consumption diagram. It is the production frontier for conversion of income in time t to income in $t+1$, whereas WW is the corresponding indifference curve. TT measures the productivity of capital and PP the time preference of consumers. Due to the imperfection of the capital market, the two rates differ.

The time preference that is relevant is the one that corresponds to the point at which the economy comes to rest, i.e. with the level of savings which are in fact forthcoming. Such a rate will naturally differ from the rate which would clear the market. If the market for savings were not fragmented, the time preference rate would be measured by the rate of interest received by savers which would be the same on all savings (except for risk and liquidity premiums). In a fragmented market, this concept will still hold for the average interest rate received, but it is now necessary to include the multitude of individuals who do not save at all as a result of not being offered a sufficiently attractive rate of interest. Whereas savers can be expected to adjust the volume of their savings in such a way as to equate their time preference to the return on savings available to them, non-savers must have time preferences greater than the return they can obtain on their savings or they would be savers. As a result, it is no longer sufficient to have an average of interest rates actually paid; it becomes necessary as well to

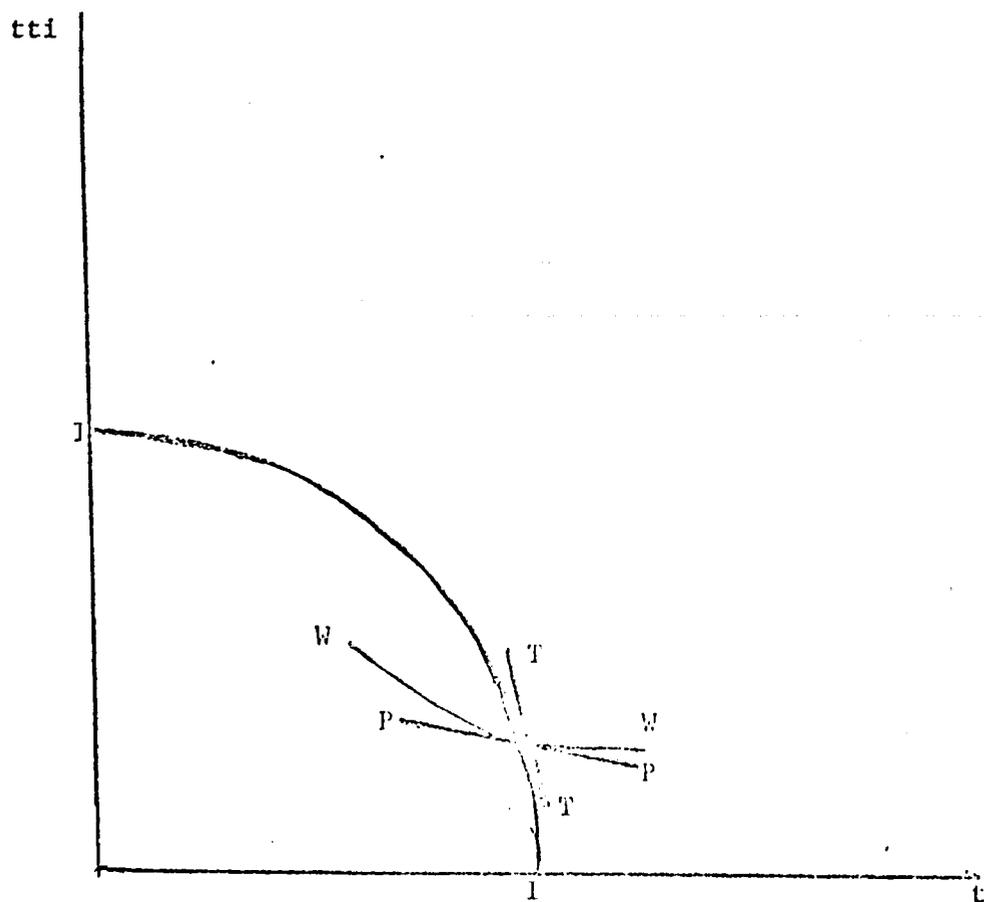


Fig. 6

take into consideration the time preference of those who chose not to save as a result of receiving insufficiently high rates of return on their savings. Since even in mildly inflationary situations, many forms of savings yield negative interest rates, non-savers need not have high time preferences in an absolute sense. ^{1/}

The evaluation of the time preference of the average consumer, including the non-saver, becomes possible if attention is redirected from the examination of savings to the examination of consumption. Since consumption and savings are the income complements of each other, both reflect the same determinants of behaviour. On the other hand, whereas not everyone saves, everyone does consume. Thus, consumption is a richer source of information on representative behaviour.

^{1/} Note that liquidity has utility itself. Thus time preference is compared to yield of liquid assets plus yield equivalent of utility conferred by liquidity itself. Thus an interest rate of -4%, may well be consistent with a positive time preference if liquidity is worth more than 4%.

Assuming the marginal utility of consumption is declining and can be represented by a constant elasticity function, time preference can be expressed as a function of the growth of per capita consumption and the elasticity of the marginal utility of per capita consumption.^{1/}

Define:

C = per capita consumption

MUC = marginal utility of per capita consumption

e = elasticity of the MUC

g = rate of growth of per capita consumption

t = time subscript

STP = rate of social time preference

d = pure time preference

$$MUC_t = C_t^{-e}$$

$$MUC_{t+1} = C_{t+1}^{-e} (1+d)^{-1} = (1+d)^{-1} [C_t (1+g)]^{-e}$$

$$1+STP = \frac{MUC_t}{MUC_{t+1}} = \frac{C_t^{-e}}{(1+d)^{-1} C_t^{-e} (1+g)^{-e}} = (1+g)^{+e} (1+d)$$

$$1+STP \sim (1+ge) (1+d) \approx 1+get+d$$

which if pure time preference is zero, reduces to

$$1+STP \sim 1+ge \text{ or } STP \sim ge$$

The shadow price of investment in disequilibrium measures the marginal contribution to the welfare of consumers of savings invested. This contribution will be equal to the present value of all the future returns deriving from that investment including the proceeds of any

^{1/} Cf. Eckstein "Investment Criteria . . .", Op.cit., Feldstein, M.S., "The Derivation of Social Time Preference Rates", Kyklos, 1965 Fasc. 2, Frisch, R. "Dynamic Utility", Econometrica July 1964.

reinvestment that may be involved.

If the rate of return on investment over time is assumed constant (i.e. the marginal productivity curve of capital is very flat) and returns are assumed to be uniform and perpetual over time, a simple expression for the shadow price of investment can be derived.^{1/}

Define

r = annual perpetual rate of return of 1 unit invested

d = social rate of time preference

s = reinvestment rate out of project returns

P_K = shadow price of investment

Then

$$P_K = \frac{r(1-s) + rsP_K}{STP}$$

$$P_K SP - rsP_K = r(1-s)$$

$$P_K = \frac{r(1-s)}{STP - rs}$$

The interaction between the social time preference, the shadow price of investment and the market rates of interest can be seen in fig. . In part (a) the savings market is shown: i is the social time preference; s is the quantity saved; a higher STP is assumed to be associated with higher savings. In part (b) we have the investment market. To every STP there corresponds a schedule relating the quantity borrowed (I) to the shadow price of investment (P_K). Given any STP, as the quantity borrowed rises, P_K falls. Likewise, for any given quantity borrowed, P_K will be higher, the lower the STP. Finally, due

^{1/} Cf. Marglin, S.A. "The Opportunity Cost . . .", Op lit.

to the rationing in the capital the quantity saved must always equal the quantity invested. Assume S_1 is saved, the associated STP is i_1 and we can read of curve $D(i_1)$ that the resulting P_K is P_{K1} . If the greater quantity S_2 is saved, the STP will be higher ($i_2 > i_1$), we read of $D(i_2)$ and find that $P_{K2} < P_{K1}$.

4. Partial disequilibrium price of fiscal resources

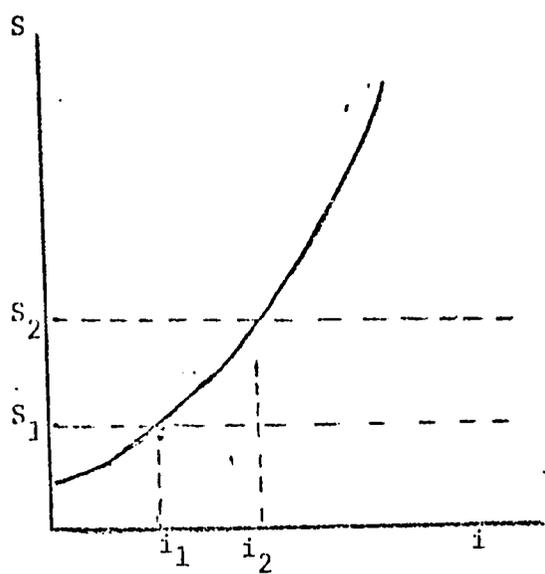
With the rest of the economy in full equilibrium, the only source of divergence between the marginal utility of income (i.e. command over resource use) in private hands and in public hands arises out of the suboptimal volume of provision of public goods. Since the marginal utility of public goods and services is impossible to measure, the only statement that can be made with some degree of assurance is that if the level of taxation is suboptimal, the disequilibrium shadow price of fiscal income is larger than one.

VI. General Disequilibrium Shadow Prices

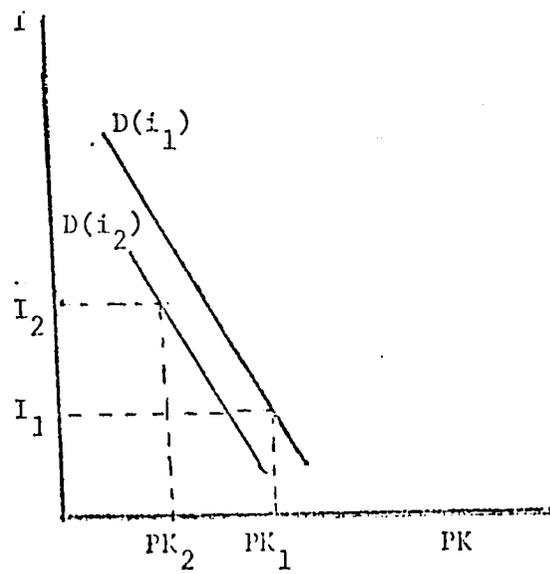
In this section we will derive the shadow prices for foreign exchange, labor, time and capital when account is taken of the disequilibria existing concurrently in the various markets.

1. General disequilibrium price for foreign exchange

Under general disequilibrium conditions the shadow price for foreign exchange will equal the marginal utility of foreign exchange and can be built up in a manner analogous to the procedure used to derive the partial



(a)



(b)

Fig. 7

disequilibrium shadow price of foreign exchange. The marginal utility of foreign exchange will now arise from two sources: (i) the marginal utility of the commodities or services into which it is embodied in use and (ii) the change in welfare arising from the transfer from the private to the public sector of command of resources associated with that pattern of foreign exchange use. In addition, however, the marginal utility of different foreign exchange uses itself is also affected by a going from a partial to general disequilibrium setting.

The marginal utility of final consumption imports is still equal to the demand price (adjusted for sales taxation and monopoly profits, if appropriate) for such goods.

The marginal utility of imports of intermediate goods, however, is now higher than the demand price (adjusted for sales taxes and monopoly profits, if appropriate) of such goods. An increased use of intermediate goods implies a higher level of domestic processing activities, the output of which will be used to satisfy a final demand. The marginal utility of the imported intermediate goods will therefore be equal to the marginal utility of the final output less the marginal cost of domestic intermediate inputs, capital and labor. If producers maximize at private prices, and under the conventional assumptions regarding the production function, the value of the output at market prices will just equal the marginal costs of the inputs. However, the marginal social cost of labor is below the private wage and the social cost of depreciation of installed capital is below its private cost as well. The marginal utility of intermediate good imports is thus equal to their demand price plus the value of the increased aggregate

output arising from the "macroeconomic" effect of additional foreign exchange availability:

$$U_{MI} = m_i^I (1+tm_i^I) + m_i^I \frac{dGNP}{d m_i^I} \left(1 - \frac{dL^e}{dGNP} - \frac{dL^n}{dGNP} \frac{PL}{w} - \frac{dtm}{dGNP} \right)$$

where the I indicates intermediate goods, L^e indicates use of labor previously employed, L^n indicates labor previously unemployed, w is the wage rate and PL is the marginal social cost of labor and tm is the average rate of tariff on intermediates.^{1/}

Capital good imports also have a marginal utility different from their private demand price, since the shadow price of investment is greater than one. With P_K defined as the social value of a unit of privately priced investment expenditure, the value of capital goods imports can be written as:

$$U_{MK} = P_K \sum m_i^K (1+tm_i^K)$$

where K stands for capital goods.

Bringing together its various components the marginal utility of imports into which foreign exchange is embodied can therefore be summarized as:

$$U_M = R_o \left\{ \sum m_i^c (1+tm_i^c) (1+s) + \sum m_i^I (1+tm_i^I) + \frac{dGNP}{dM} \left[1 - \frac{dL^e}{dGNP} - \frac{dL^n}{dGNP} \frac{PL}{w} - \frac{dtm}{dGNP} \right] + \sum m_i^K (1+tm_i^K) P_K \right\}$$

The contribution to the marginal utility of foreign exchange from the transfer of income claims from the private to the public sector is

^{1/} For a detailed discussion of the derivation of this formula, see DM. Schydlofsky, "Methodology for the Empirical Estimation of Shadow Prices".

equal to the product of the taxes paid on foreign exchange use and the excess of the marginal utility of a unit of fiscal income over a unit of private income. Defining this excess as G, yields:

$$\$ = R_n + R_o \left(\sum m_c t_m + m_s \frac{dGNP}{dM} \left[\left(1 - \frac{dl^c}{dGNP} \right) (1 + t_d PG) - \frac{dl^n}{dGNP} \frac{PL}{w} - \frac{dtm_1}{dGNP} \right] + m_k (1 + tm_k) (Pk - 1) + \sum m_c t_m PG \right)$$

The corrections to be made to the market price of foreign exchange in order to derive the shadow price can now be interpreted as follows: the first term in the bracket corresponds to the adjustment for the difference between the private demand price and the CIF price of imports; the second term corrects for the difference between demand and supply prices induced by sales taxes on final consumption goods; the third term adjusts for the macroeconomic impact of the additional availability of intermediate goods as well as all the taxes attached to additional output; the fourth term corrects for the difference between the private demand price and supply price of imported capital goods as well as for the additional value of investment over consumption in the private sector; and, the fifth term takes into account the additional value of the transfer of fiscal resources from the private to the public sector.

2. General Disequilibrium Price of Unskilled Labor

Under general disequilibrium the marginal productivity of labor differs substantially from its partial disequilibrium formulation. However, our partial disequilibrium price of labor was derived on the assumption of overt unemployment from the utility of leisure foregone and the income transfer obligations attendant upon becoming employed.

The marginal productivity of labor in no way affected the definition. Furthermore, no other market entered into the determination of this marginal cost; thus the partial disequilibrium price of labor is also the general disequilibrium price.

3. General Disequilibrium Price of Time

The partial disequilibrium price of time was derived from consumption behaviour and no market other than that for savings was involved. Hence, the partial disequilibrium price of time is also the general disequilibrium price.

4. General Disequilibrium Price of Investment

Under general disequilibrium, the private rate of return on investment no longer adequately measures the social rate of return for the following reasons: (i) a proportion of the production may well be for exports. The private rate of return on such production understates the social rate of return in view of the undervaluation of foreign exchange earnings from exports compared to the marginal utility of such earnings; (ii) a part of the production may well be destined to import substitution at protection rates which may exceed or fall short of the shadow price of foreign exchange, thus causing the private rate of return to exceed or fall short of the social rate; (iii) in the presence of indirect taxes, the producer price and hence private profits understate the social marginal utility of the output;

(iv) since the social marginal cost of labor is below the market wage, the private rate of return understates the social rate of return to capital; (v) the private rate of return before taxes does not include the increase welfare arising out of the transfer to government of command over resource that will take place through payment of corporate taxes.

The multiplicative adjustment coefficient, β , which converts private annual profitability to annual social net benefit is as follows:^{1/}

$$\beta = 1$$

$+ txPG$	<p>corporate tax transfer to public sector</p>
$+ \frac{X^{NT}}{\pi} ts(1+PG)$	<p>adjustment of profits from production of non-traded goods to buyers' prices and inclusion of indirect tax transfer to government</p>
$+ \frac{X^T(\alpha-1)}{\pi(1+t_T)}$	<p>adjustment of profits from production of traded goods to shadow price of foreign exchange</p>
$- \frac{M}{\pi} (\alpha-1) + \frac{M_i t m_i}{\pi}$	<p>adjustment of imported inputs to shadow price of foreign exchange</p>
$+ \frac{L}{\pi} (1+tx_w PG - \frac{PL}{w})$	<p>adjustment of cost of labor to shadow price of labor and inclusion of tax transfer from wage taxes</p>

^{1/} See my "Methodology for the Empirical Estimation of Shadow Prices" Section VI for a detailed derivation.

$$+ \frac{\text{Int}}{\pi} (1+tx_i PG)$$

consolidation of interest with profits
and inclusion of tax transfer from taxes
on interest

where the symbols are as follows:

tx	corporate tax rate
tx_w	wage tax rate
tx_i	interest tax rate
PG	shadow price of fiscal resources
ts	indirect taxes
α	premium of shadow over official exchange rate, i.e. $P\$/R_0$
π	private annual profit flow per unit of private investment
t_T	average rate of protection on traded good production
$\Sigma X^{NT}, X^T$	output of non-traded and traded goods respectively
PL	shadow price of labor
w	market wage
$Mit m_i$	revenue from import duties

The present value of the social benefits of a unit of investment
in the absence of reinvestment effects can now be easily written:

$$PK(\bar{Y}) = \sum_t (1+STP)^{-t} r\beta_t$$

If both STP and β are constant over time then the foregoing reduces to:

$$PK(Y) = \frac{rR}{STP}$$

In the usual case this constancy does not hold, since the STP may be constant but the elements entering into β , particularly the premium of the shadow price of foreign exchange, θ , are likely to change over time. In this more realistic case, the formula for the shadow price of investment even without reinvestment becomes considerably more complicated and introduction of reinvestment considerations adds to this complexity. For the derivation of formulae for these cases the reader is referred to my "Methodology for the Empirical Estimation of Shadow Prices" Section VI equations (34) - (41).

5. General Disequilibrium Price of Fiscal Revenue

Under general disequilibrium there are three sources of divergence between the consumption equivalent of a unit of fiscal revenue and the consumption equivalent of a unit of fiscal expenditure: (i) differences in the marginal utilities of public and private consumption at the relative quantities supplied; and, (ii) differences in the public and private savings rates, and (iii) differences in the consumption equivalents of private and public investment. The second and third of these can be given precise quantitative expression and if the higher marginal utility of each unit of public consumption is offset by the alleged inefficiency of the government apparatus, then it becomes possible to measure the contribution to welfare of shifting

a unit of income from the private to the public sector.

Define

GE = private consumption equivalent of one unit of government revenue.

PE = private consumption equivalent of one unit of private income.

sg, sp = savings ratios of the government and private sector, respectively.

$$\lambda = PK_g/PK$$

PG = excess of the consumption equivalent of government revenue over private income.

Then:

$$GE = (1-sg)+sgPkg = 1+sg(pkg-1)$$

$$PE = (1-sp)+spPk = 1+sp(Pk-1)$$

$$PG = GE-PE = (sp-sg) + (sg\lambda -sp)$$

VII. Explicit Consideration of Income Distribution Effects

Full consideration of the differential income distribution implicit in each project requires identifying the recipients of the marginal physical social product of each project as well as identifying the foregoers of the marginal physical social costs. Benefits should then be valued at the marginal utilities of the receivers and costs at the marginal utilities of the foregoers. Finally, an interpersonal addition

of utilities must be undertaken. ^{1/}

Since this full procedure is obviously unfeasible in practice an approximation must be devised. Such a surrogate can start from a stratification of the population by income group and the derivation of each major second best shadow price for each group. Finally the shadow prices would be aggregated by an acceptable weighting formula. ^{2/}

VIII. Summary and Conclusion

This paper has addressed itself to the problem of project evaluation in economies in general disequilibrium, i.e. whose major markets do not clear due to a combination of institutional and public policy rigidities.

The disequilibria have been defined in detail and the need for developing second best shadow prices suitable for project evaluation in such an environment has been made.

The consideration of the disequilibrium in each market at a time has allowed the derivation of a set of partial disequilibrium second best shadow prices. Consideration of all the disequilibria simultaneously yields substantially different shadow prices due to the interactions involved.

^{1/} For an application of this approach to the benefits of industrialization in a custom's union, Cf. D.M. Schydrowsky "The Allocation of Integration Industry in the Andian Market" J. of Common Market Studies

^{2/} Cf. Feldstein "The Derivation of Social Time Preference Rates", Op. cit.

Both partial and general disequilibrium prices differ substantially from conventional first best shadow prices. Neither first best shadow prices nor partial disequilibrium prices can therefore be used in general as surrogates for the correct general disequilibrium shadow prices.