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Center for Latin American Development Studies

A NOTE ON DISTRIBUTIONAL CONSIDERATIONS IN SOCIAL BENEFIT/COST ANALYSIS

by

Daniel M. Schydlowsky

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A NOTE ON
DISTRIBUTIONAL CONSIDERATIONS IN SOCIAL BENEFIT/COST ANALYSIS

Daniel M. Schydlowsky*

I

The Rationale for Including Distributional Considerations in Social Benefit/Cost Analysis

The basic justification for including distributional considerations in Social Benefit/Cost Analysis resides in the realization that the social value of a unit of benefit depends, at least in part, on who gets that benefit. In other words, it is not sufficient to undertake the usual translation of the physical benefits and costs of a project into units of contribution to income or consumption of the representative citizen. This representative citizen is different for each project, since the distribution of benefits of the projects are different and hence it is necessary to go further and standardize the consumption of income-denominated benefits and costs in terms of a utility numeraire. Such standardization is solidly grounded in the theory of consumer equilibrium. Each individual equates the marginal utility of a unit of expenditure on different goods and services with a single marginal utility of income arising for each individual. Yet the marginal utility of income is very likely to be different for different individuals. Expressing physical benefits in a common money numeraire therefore implies assuming consumer

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(*) This Note has been prepared in the context of a consulting agreement with the Inter-American Development Bank.

equilibrium and in addition assuming that the marginal utility of income is equal for all individuals. The inclusion of distributional considerations involves replacing the second assumption by a more empirically grounded alternative.

Two types of distributional considerations are usually of interest:

a) Adjustment by size distribution of income:

The basic notion here is that the marginal utility of income declines as income rises. Such a consideration lies at the heart of Pigovian welfare economics and has been extensively used in the theory of taxation. Making an adjustment for different marginal utilities of income by size group implies lowering the valuation of benefits accruing to higher income groups and raising the valuation of benefits to the lower income groups. As a result benefits become standardized in utility terms.

The total project evaluation sequence implied by this adjustment is the following:

1. The existing income distribution generates a pattern of demand;
2. The project adds goods and services to the economy which are sold on the market and fetch a price;
3. The demand price for the products of the project measure the private marginal utility of each buyer who in fact acquires these products;
4. The private marginal utility is standardized by the social utility standardization factor to arrive at the social marginal utility of the products for each purchaser;

5. The total social utility is derived by summing the social utilities of each individual buyer.

It should be noted that the exclusion of distributional considerations involves going directly from Step 3 to Step 5. It is easy to see that this procedure is equivalent to assuming that the ratio of social marginal utility to private marginal utility of income is equal for all buyers.

It is also important to note that the introduction of distributional considerations in (4) does not imply a change in the income distribution itself. It proceeds on the basis of a given income distribution and makes use of the differences in the marginal utility of income implicit therein. A completely different situation would emerge if we began by positing a change of income distribution and then went on to calculate the social benefits of a project on the assumption that this new and different income distribution in fact obtained. In such a case, both the demand prices and marginal utilities corresponding to the new distribution would have to be used. The difference between the two procedures resides in the usual distinction between first and second best. Adjusting for different marginal utilities of income arising from an existing distribution is a second best procedure, since the existing distribution is taken as given, even if it is sub-optimal.

Readjusting the income distribution at the outset implies a first best procedure since we can chose the optimal income distribution as the point from which we start. As usual, however, the first best solution will not correspond to reality unless the redistribution of income is in fact implemented. In the absence of such implementation, using a first best procedure would yield biased estimates of the social marginal utility in fact generated.

b) The distribution by regional location:

In addition to the distribution by size group of income, the social marginal utility of a project is often regarded as being affected by its regional location. The argument here is twofold. On the one hand, inequality in the regional distribution of income implies differences in the marginal utility of income across region and therefore requires adjustments similar to those undertaken for the size distribution of income. However, adjustments for regional income differentials will not be additional to size distribution adjustments if only declining marginal utility of income is to be compensated for. If geographical location directly affects the marginal utility of income, then an adjustment for the regional distribution over and above the size distribution is in order.

On the other hand, externalities and/or economies of scale may result from the location of production itself. The adjustment for such "direct" benefits of location is additional to any adjustment made on grounds of regional or size distribution of income.

Differences in the marginal utilities of income by size or region and externalities or economies of scale by location are necessary conditions for the inclusion of distributional considerations in social benefit/cost analysis. They are not, however, sufficient conditions. In order to justify taking into account such distributional considerations in project evaluation, it is necessary in addition that it be impossible to achieve the desired distributional objectives by policies other than project choice. The usual assumption in the literature is quite the opposite: production is divorced from distribution, since adequate redistributional tools are said to exist in the form of government taxation and expenditure. If indeed such macroeconomic tools are fully effective in achieving the desired distributional objectives, there is no need whatsoever to include distributional considerations in project choice. It would be sufficient to maximize the aggregate consumption benefit through project choice; any redistribution needed to maximize the distributionally weighted sum of social benefits could be achieved by redistributional tools.

If, on the other hand, the redistributional tools are either totally nonexistent or in their effectiveness fall short of achieving the desired distributional goals, then the inclusion of distributional considerations in project choice becomes justified. In such situations, the redistribution desired is attained in part by the macroeconomic policies and in part by project choice. The

sufficient condition for the inclusion of distributional considerations in project choice is then the inability to achieve the desired distributional goals through other policy tools.(1)

II

Assessing the Distributional Impact of a Project

The distributional impact of a project can most simply be assessed by analyzing the changes in supply and demand caused by the project. In general terms, the additions to supply originating in the project are equivalent to the project benefits whereas the additions to demand generated by the project arise from the factor incomes it produces. The precise transition from project's benefits and cost to supply and demand in the market is complicated by the divergence of shadow and market prices.

Since project benefits are measured in terms of the marginal physical contribution to goods and services, it is plausible that they should also represent additions to aggregate supply in the marketplace. On the other hand, project benefits are valued at shadow prices whereas transactions in the marketplace occur at market prices. Thus it is necessary to explore to what extent the shadow-priced project output is the precise

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(1) An interesting problem arises when the non-project policy tools achieve, say, 60% of the redistributional objective and the use of project choice for distributional considerations achieves another 60%. Then both sets of tools taken together yield an overkill of 20%. In such an eventuality, it would be necessary to reduce the use of both kinds of tools somewhat, a rather difficult problem where project choice is concerned since it would be almost impossible to know *a priori* from which project evaluations to exclude the distributional considerations. In such a situation some outright efficiency loss is likely to occur.

equivalent to the market-priced supply. Under second best disequilibrium shadow pricing, benefit and cost evaluations at shadow prices are derived fundamentally from consumer's willingness to pay through simple transformations of market prices. As a result, all benefits are in fact taken at the value which consumers would ultimately be willing to pay for them. It follows that with this form of shadow pricing, the social benefits of project output also measure the contribution of the project to the aggregate supply.

The adjustment from project income to market demand is somewhat less straightforward. In this case, the marginal income to factors generated by the project is relevant; where factors have been previously employed, the difference between their incomes in the previous employment and their incomes in the project is the increase of demand. Naturally, project incomes will diverge from project social cost, since the latter depends on the social opportunity cost of factors whereas the former depends on the market price.

Once contribution to supply and contribution to demand have been separately determined, it is possible to set up a supply and demand balance which shows the net distribution of income arising from the project. In what follows such a supply balance is portrayed for four hypothetical but typical cases.

Consider an import-substituting project producing steel from imported pig iron. Imported steel costs $50 per ton CIF and the import duty thereon is 20%. The exchange rate is P5=$1. The domestic cost structure per ton of steel output is as follows:

			Pesos/ton.
Pig iron	$30 @ 5 =	150	
	Tariff	-	150
Labor			100
Profit, depreciation, interest			50
			300

Case I: Labor used in steel production is openly unemployed; the average tariff on marginal imports is 60% and there is no excess capacity in the economy.

Under these circumstances the shadow price of foreign exchange is P.8 (5x1.6) and the shadow price of labor can be taken at zero.

The contribution of the project to aggregate annual supply is then equivalent to the new imports made possible by the project, i.e. $20 per ton, at their sales price, i.e. P 8 per $. Thus the contribution to supply is P 160 per ton of output. This amount is precisely equal to the net benefit of the project, i.e. the net foreign exchange savings, $20/ton, at the shadow price of foreign exchange, P 8 per $.

The P 160 of additional supply will be absorbed as follows:

a) Laborers' income has increased by 100 of which they spend, say 90% (i.e. they have a marginal propensity to consume of .9). Hence new consumption by labor equals 90.

b) Profit receivers' income has increased by P 50 of which they spend P 25 on consumption and P 25 on investment.

c) The Government loses P 50 steel duty per ton of imports substituted (20% on $50), but gains P 60 (60% on $ 20) on the new imports made possible. It spends, say, 80% on consumption.

d) Any excess supply remaining is absorbed by credit creation for investment purposes.

The supply-demand balance then looks as follows:

Δ Supply		Δ Demand		
Net New Imports $20 @ 8 =	P 160	Consumption:		
		1. Labor	90	
		2. Profits	25	
		3. Gov't	8	123
		Investment:		
		1. Profits	25	
		2. Gov't	2	
		3. Credit	10	37
	P 160			P 160

Case II: Labor used in steel production is openly unemployed; the average tariff on marginal imports is 60% and there is excess capacity in the economy.

Under these circumstances the shadow price of foreign exchange is, say, P 18, composed of a demand price element of P 8 and a macroeconomic activation element of P 10 per $. Let us continue to take the shadow price of labor at zero.

The contribution to supply now arises from two sources: a) the new imports made available which continue to equal P 160; and b) the additional domestic output arising from the higher use of domestic productive capacity, which equals P 200 ($20x10).

On the other hand, new demand will arise from two sources as well: a) project income, distributed as before; and, b) new income generated in the macroeconomic activation, distributed according to the marginal income distribution.

The supply and demand balance then looks as follows:

Δ Supply		Δ Demand			
1. Direct Project Benefit		1. Direct Project Demand			
Net New Imports	P 160	a. Consumption			
		i) Labor	90		
		ii) Profits	25		
		iii) Gov't	8	123	
		b. Investment			
		i) Profits	25		
		ii) Gov't	2		
		iii) Credit	10	37 = 160	
2. Macroeconomic Activation Benefit		2. Macroeconomic Activation Demand			
$20 import base @ P 10 =	P 200	a. Consumption			
		i) Labor	Marg. Distrib.		
		ii) Profits			
		iii) Gov't			200
	P 360				P 360
	=====				======

Case III. The same as Case II but with labor valued at the cost of leisure foregone, say at 20% of market wage.

In this case net direct project benefits are valued at P 160 less P 20 for the opportunity cost of labor, whilst macroeconomic activation benefits also decline (since the cost of labor used elsewhere now also has a non-zero opportunity cost), say to P 9 per $ or P 180 in total. Supply of goods and services, however, still increases by P 160 directly from the project and by P 200 from macroeconomic activation. At the same time the supply of leisure decreases by a total of P 40.

Demand for goods and services increases as in Case II, by a total of P 360. In addition, however, account must be taken of a reduction in the demand for leisure of P 40.

The total supply and demand balance for goods and services, and leisure looks as follows:

Δ Supply		Δ Demand			
		A. Goods and Services			
1. Direct Project Benefit	P 160	1. Direct Project Demand			
		a) Consumption			
		i) Labor	P 90		
		ii) Profits	P 25		
		iii) Gov't	P 8	123	
		b) Investment		37	160
2. Macroeconomic Activation	P 200	2. Macroeconomic Activation			200
	P 360				P360

Δ Supply		Δ Demand	
B. Leisure			
1. Direct Project Benefit	P 20	1. Direct Project Demand a) Consumption i) Labor	-P 20
2. Macroeconomic Activation	P 20	2. Macroeconomic Activation a) Consumption i) Labor	-P 20
	-P 40		-P 40

C. Consolidated					
1. Direct Project Benefit	P 140	1. Direct Project Demand a) Consumption i) Labor	P 70		
		ii) Profits	P 25		
		iii) Gov't	P 8	103	
		b) Investment		37	140
2. Macroeconomic Activation	P 180	2. Macroeconomic **Activation**			180
	P 320				P320

Case IV. The same as Case III, however, part (say 30%) of the labor used was previously employed; thus its opportunity cost is equal to its market wage.

Project benefits now become the following:

1. Direct Project Benefits

Fx. Saved $20 @ 8	=	160	
Cost of labor 30% at market wage	–	30	
70% at cost of leisure	–	14	116

2. Macroeconomic Activation Benefits

$20 @ 9 1/			180
	TOTAL		296

It follows that the supply of goods and services will increase by P 130 (direct benefit) + P 200 (macoreconomic activation); while leisure decreases by P 14 (direct) + P 20 (macroeconomic).

On the demand side marginal income of labor is only P 70, i.e. wage bill of P 100 less P 30 of income foregone. Demand for leisure has decreased by P 14 + P 10.

The consolidated (goods and services, and leisure) supply and demand balance can be summarized as follows:

Δ Supply		Δ Demand				
1. Direct Project Benefit	P 116	1. Direct Project Demand				
		a) Consumption				
		i) Labor	49 2/			
		ii) Profits	25			
		iii) Gov't	8	82		
		b) Investment			34	116
2. Macroeconomic Activation	P 180	2. Macroeconomic Activation				180
	P 296					P296

1/ This coefficient may well decrease if part of the labor is not unemployed.

2/ Increase labor income = P 70 x marginal propensity to consume of .9 = P 63 less change in demand for leisure P 14.

It should be noted that the categories of labor and profit receivers can naturally be disaggregated further into size groups and their individual propensities to consume used. Each category of consumer can then be assigned its own marginal utility of income. The marginal utility appropriate for benefits absorbed with government and investment use depends on the distribution of the benefits from the government activities or from investment. In the absence of such information, a convenient proxy, however, is the marginal income distribution in the economy.

III

The Determination of the Weights for the Size Distribution Adjustment

Once the size distribution of income generated at the margin by a project has been determined, it is necessary to sum up the different components on a utility-standardized basis. In order to do this, it is necessary to have a conversion factor for the marginal utility of income for each size group to the average marginal utility of income of the economy as a whole. By means of such conversion, the income accruing to the lower income groups will be valued more highly and income accruing to the higher groups valued less highly. The resulting standardized evaluation will then be in terms of the marginal utility of income of the average income recipient.

At the bottom, what is needed for the standardization is the marginal utility of income curve for the economy discriminated by size group of income. This curve can naturally not be observed directly but there are two possible indirect procedures to derive the slope of this marginal utility of income curve.

a) Aggregate procedure:

From the derivation of the social time preference, an estimate of the income elasticity of the marginal utility of income is available. This estimate is in turn derived from information on price and income elasticities of demand.

At the same time, this elasticity perforce contains considerable information on the shape of the marginal utility of income curve. Assuming that this elasticity, as measured at the average consumer's point, is constant over all income ranges, we know that the marginal utility curve must be a rectangular hyperbola and its parameters can be derived from the elasticity of the marginal utility of income. Once the curve is numerically defined, the ratios of the marginal utility of income at any specified level to that obtaining at the average income level can easily be calculated.

b) Disaggregated procedure:

Elasticities of the marginal utility of income can be estimated for different income groups on the basis of disaggregated information on their demand functions for commodities. These estimates provide information on the shape of the marginal utility curve at different

levels of income. Using this information in conjunction with the estimate for the average elasticity of the marginal utility of income allows determination of the shape and slope of the marginal utility curve which in this case will no longer be a rectangular hyperbola. Nonetheless, the ratios of marginal utilities of specified and average levels of income are readily calculated.

IV

Summary

Distributional considerations may enter social benefit/cost analysis when (i) the value of a unit of benefits depends on the income or location characteristics of the recipient; or (ii) location of production generates externalities and/or economies of scale. Adjustment for such distributional effects is only appropriate, however, when macroeconomic policies are unable by themselves to achieve the society's distributional objectives.

The distributional impact of a project can be assessed by examing the project's effect on market supply and demand. Supply is directly related to the net project benefits, when demand is related to project factor incomes. The transition from shadow-priced benefits and costs to market-priced supply and demand requires careful arithmetic.

The appropriate adjustment for income-linked differences in evaluation of benefits requires ascertaining the slope of the marginal utility of income curve. The estimates of the elasticity of the marginal utility of income used to determine the social time preference can be used to evaluate this required slope as well.

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