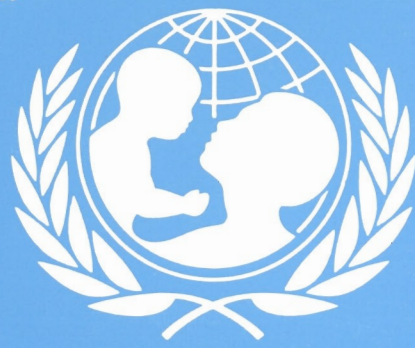

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TWO ERRORS OF TARGETING

Giovanni Andrea Cornia[a] and Frances Stewart[b]

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[a] UNICEF International Child Development Centre, Florence.
[b] International Development Centre, Queen Elizabeth House, University of Oxford.

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CONTENTS

TABLES

EXECUTIVE SUMMARY

A major criticism of nutritional schemes in general, and a fortiori of untargeted schemes, is that a large proportion of the people covered by the schemes does not belong to the target population, and that often an even larger share of the value of the total subsidy accrues to the non-poor population. According to this viewpoint, the best way to achieve maximum resource transfer to poor households (or to reduce the budgetary cost of the programmes) is therefore to design interventions which minimize the leakage to the non-poor.

The mainstream literature in this field therefore discusses the size of this excessive coverage -- described in the paper as E-mistake -- and the administrative and efficiency costs associated with alternative targeting instruments. The literature thus largely ignores the other major error of targeting - described in the paper as F-mistake -i.e. the cost of the failure to cover all the target population. F-mistakes have two elements: the welfare costs of not covering the target population; and the income foregone as a result of the decline in current and future productivity caused by the ensuing malnutrition. A review of the empirical evidence suggests that in poor countries the "income foregone" element is often large. In view of this, assessing the efficiency of alternative food intervention only on the basis of E-mistakes may lead to misleading conclusions since reducing E-mistakes can raise F-mistakes. The paper reviews food interventions in nine countries, showing that in most cases E and F-mistakes are inversely related.

Valuation of the total targeting mistake - described in the paper as the E+F-mistake - requires some way of weighing E and F-mistakes so as to add them up. Two alternative approaches are presented in the paper. The comparison of the efficiency of a number of schemes in a few countries shows that inclusion of F-mistakes can alter the preferred intervention, away from narrowly targeted schemes towards more broadly based schemes.

When the poor form a relatively small proportion of the total population, and/or have defined objective characteristics which differentiate them from the rest of the population, narrowly targeted schemes may be preferable, even allowing for F-mistakes. But when the poor form a large proportion of the population and do not have differentiating characteristics, more broadly based schemes are likely to be preferable if F-mistakes are considered as well as E-mistakes.

Acceptance of fairly large E-mistakes (accompanied by low F-mistakes) depends on the possibility of clawing-back the benefits received by the non-poor through additional taxes on these income groups. This possibility is reviewed with reference to tax incidence studies on India. Raising taxes on income, or progressive indirect taxes, can offset the costs of E-mistakes, although it is normally not possible to devise a tax system whose burden precisely falls on those who benefit from the E-mistakes. Nonetheless, some claw-back can reduce the significance of E-mistakes.

"This scheme [noonday meals] is the outcome of my experience of extreme starvation at an age when I knew only to cry when I was hungry. But for the munificence of a woman next door who extended a bowl of rice gruel to us and saved us from the cruel hand of death, we would have departed this world long ago. Such merciful womenfolk, having great faith in me, elected me as chief minister of Tamil Nadu. To wipe the tears of these women I have taken up this project.... To picture lakhs and lakhs [thousands upon thousands] of poor children who gather to take up nutritious meals in thousands of hamlets and villages all over Tamil Nadu, and blessing us in their childish prattle, will be a glorious event." M.G. Ramachandran, chief minister of Tamil Nadu, quoted in Harriss (1992, page 10)

I. INTRODUCTION

This paper considers the appropriate design of food interventions in developing countries if these interventions are to meet their objectives effectively.

The first issue is: *What is the objective*? Until one knows this one cannot assess alternative policy instruments. In practice, food subsidies have been intended to meet a variety of objectives, including keeping urban wages low, maintaining political support and avoiding inflation, as well as the more obvious ones of reducing poverty and improving nutrition (see Pinstrup-Andersen 1988). In fact, one reason why some food subsidies have been ineffective in transferring incomes to the poor is that this was *not* their main objective.

This paper assumes that the overriding objective of food interventions is to transfer incomes to poor households. It ignores issues of intrahousehold distribution, although it examines aspects of how the functioning of the household affects the appropriate design of food interventions (see the Annex, pages 40-44).

At first it might appear that the best way to achieve resource transfers to poor households is to design interventions to achieve minimum leakage to the non-poor, so that any given resource transfer will have maximum impact on poor households. A well-targeted programme, then, will be one which achieves minimum leakage. This is a common view in the literature (for example, see Mateus 1983, Grosh 1992). However, this may be incorrect for a number of reasons, including administrative costs, efficiency effects and political factors. These will be considered only briefly below. In addition, an important reason why the criterion of minimizing leakage may not be the right one lies in the existence of *two errors of targeting*: the error of the omission of the poor from the scheme and the error of the inclusion of the non-poor. These two errors are the main focus of this paper.

Section II defines these two errors, considers likely relationships between them and suggests ways of measuring them. Section III summarizes evidence with respect to the two errors from a variety of food subsidy programs. Section IV evaluates the two errors, estimating the costs of omission, as well as those of inclusion (of the non-poor), and shows how the "optimum" scheme can change when errors of omission are included. The net budgetary costs of leakage to the non-poor depend on how far the additional benefits conferred on the non-poor can be "clawed back" through the tax system. This issue is considered in Section V. Conclusions are presented in Section VI.

II. TWO TYPES OF MISTAKES IN TARGETING

In terms of the efficiency of the targeting mechanism, any intervention may be subject to two types of mistakes. The first is that of failing to reach the target population. In this paper this type of mistake is called an "F"-mistake, that is, a *failure* in the prime objective of the intervention. The second type of mistake is that made if the intervention reaches the non-target population; this will be called an "E"-mistake, since what is involved is *excessive* coverage.

A major criticism of nutritional schemes in general, and a fortiori of untargeted schemes, is that E-mistakes are high. For example, in a study of targeting, Mateus (1983) argues that total costs are higher than they could be because of the high number of E-mistakes in a variety of interventions; he notes (page 9) that in Morocco it was estimated that 80 percent of the budgetary costs in rural areas and 70 percent in urban areas "increased the consumption of the already well nourished".

In the design of targeted interventions, attention has tended to be almost exclusively focused on mistakes brought about by excessive coverage (E-mistakes), with much less attention concentrated on mistakes resulting from failures to reach the target group (F-mistakes). Narrowly targeted interventions often show apparently favourable cost-benefit ratios (Mateus 1983). This arises from the smaller size of the target groups and the fact that the more the interventions are restricted to groups in extreme deprivation, the greater one would expect the improvements to be that are due to the interventions (measured, say, by weight gains among malnourished children). However, these apparently favourable cost-benefit ratios do not account for the costs incurred because groups in need of nutritional supplements are left out. F-mistakes are particularly serious where it is the ultradeprived

who are left out; they are likely to be largest where malnutrition is widespread. The larger the proportion of the population which is malnourished, the higher the potential F-mistakes and the lower the potential E-mistakes. This is one reason why the controversy (see Sukhatme 1977, Dasgupta and Ray 1987) over the extent of malnutrition is so relevant to the design of nutrition interventions.

For the most part, the pursuit of low E-mistakes tends to raise F-mistakes because some of the target group tends to be eliminated from the scheme along with the non-target population. This is due to:

- The lack of information about the targeted schemes among the target group.
- The costs of acquiring entitlements to targeted schemes. Depending on the targeting mechanism, these may require travel, the registration of applications, appearance at a clinic and so on.
- Qualifications for entitlement, while excluding the non-poor, also almost invariably exclude some of the target group (for instance, through the use of geographical qualification for entitlement).
- Social stigmas (especially applicable in developed countries).

Measuring E and F-Mistakes

Given a population ("N") composed of poor people ("P"), who constitute the target of the food intervention, and non-poor people ("NP"), for each intervention one can observe four distinct situations illustrated below in Table 1:

Table 1: E AND F-MISTAKES IN THE COVERAGE OF FOOD INTERVENTIONS

	Poor	Non-poor	
All covered by nutritional intervention	P^c	NP^c (E-mistakes)	N^c
All not covered by nutritional intervention	P^{nc} (F-mistakes)	NP^{nc}	N^{nc}
	P	NP	N

Source: Compiled by the authors.
^{c} Covered. ^{nc} Not covered.

where: $$P + NP = N^c + N^{nc} = P^c + P^{nc} + NP^c + NP^{nc} = N$$

In the ideal case, E and F-mistakes are nil, that is:

$$P^c + NP^{nc} = N$$

On the other hand, in the case of total mistargeting (that is, when none of the poor are covered by the intervention and all the non-poor are covered):

$$NP^c + P^{nc} = N$$

F-mistakes consist of P^{nc} and may be measured as a proportion of the total population N, i.e. P^{nc}/N, or as a proportion of the target population, i.e. P^{nc}/P. The latter is the measure of F-mistakes which is used here. It is a good indication of how far a scheme is failing in its primary intention to reach the target group.

E-mistakes consist of NP^c and may be measured as a proportion of the total population, NP^c/N, or as a proportion of the total non-target population, NP^c/NP. E-mistakes may also be estimated as the money cost of the excess coverage, or vNP^c, where "v" is the average money cost of the subsidy received by the non-target population, and may be expressed as a proportion of the total costs of the subsidy, that is, vNP^c/S, where "S" is the total money value of the subsidy. Where the subsidy consists of a given sum equal for each recipient (as with school meals), this ratio is equivalent to the ratio of $NP^c/(NP^c + P^c)$.

The most common measure of E-mistakes is vNP^c/S, as it gives an estimate of the financial costs of the mistake. This is shown below as E′. Where data is available, the proportion is also shown of the non-target population covered, NP^c/NP, which is described as E″: E″>E′. Where the non-target population is a small proportion of the total population, as in very poor areas, a high E″ can be associated with a low E′.

III. THE TWO ERRORS IN PRACTICE

This section reviews evidence from nine countries showing how the two major errors vary with the type of food support scheme; the country studies illustrate that the magnitude of the errors depends not only on the design of the scheme but also on the environment in

which the scheme is introduced. The cases examined include countries from each of the three developing regions and both middle income and low-income countries.

(i) **Tamil Nadu, India**

A scheme to introduce free school meals and infant feeding was initiated in Tamil Nadu in 1982. The noon meals scheme is very popular politically and was one factor behind the re-election of the ruling party, ADMK, in 1984. In addition, people were given access to subsidized rice through the public distribution system (PDS).

Coverage (in principle): Pre-school children registered in nurseries (2-year-olds and above) and all registered school pupils below 10 years of age. This was extended to the elderly, ex-servicemen, widows and those below a poverty line.

Cost: Ten percent of the state budget. This is equivalent to the deficit of the state electricity board and exceeds the state's annual investment in agriculture. It is financed out of general revenue, additional taxes on "luxury" items and some voluntary contributions, plus compulsory contributions from government salaried workers.

Mistakes: The most detailed evidence is provided by Harriss (1992) in a study of two villages in North Arcot, a "richer" village and a "poorer" village (Table 2). In both villages the same proportion (over 80 percent) of children from higher income groups attend school. However, a lower proportion of children eat at school in the richer village, so that the richer village had a lower "E-error". Significantly fewer children from poor households attend school in the richer village (56 percent) than in the poor village (77 percent) because of the greater employment opportunities in the richer village. Hence, the poorer village had a lower "F-error". Overall, 60 percent of dropouts were female, so that girls suffered proportionately more F-mistakes. In both villages there was an almost universal uptake of pre-school meals (which could be taken home); therefore, E-errors were high, and F-errors low.

In the public distribution system, the ration of subsidized rice per household had more or less universal uptake. A more general all-India investigation of the public distribution system found that it did not, as is often suggested, exhibit an anti-rural or pro-rich bias, but was broadly universally accessible (Mahendra Dev and Suryanarayana 1991). This implies low F-mistakes and substantial E-mistakes, but the study did not provide data to permit calculation of E-mistakes on an all-India basis.

Table 2: E AND F- MISTAKES IN NORTH ARCOT (TAMIL NADU, INDIA)*
(In Percentages)

	The Noon Meals Scheme	
	Richer Village	Poorer Village
Pre-school and school		
F	36.3	20.7
E′	32.0	37.5
E″	53.2	88.6
Pre-school		
F	17.0	--
E′	31.2	--
E″	76.9	--
School		
F	54.3	--
E′	33.1	--
E″	36.1	--
	The Public Distribution System (both villages)	
F	0	
E′	37	
E″	100	

Source: Harriss (1992).
* F = the percentage of the target group (defined as the bottom three income classes) not covered. E′ = the percentage of the subsidy going to the non-target population. E″ = the percentage of the non-target population covered by the subsidy.

(ii) **Zambia**

In 1989, a general subsidy for maize was replaced by targeted coupons restricted to those earning less than 20,500 kwacha per year, although rural households were excluded. In principle, all the poor in urban areas qualified, but anecdotal evidence suggests that some of the poorest did not register for the coupons, partly because of complex administrative requirements. The real value of the coupons was considerably less than that of the previous subsidy, involving a minimum cut of 20 percent for those receiving maximum coupons, or a cut of 5 percent in real income (Pearce 1990).

Total cost savings were substantial, at least two-thirds. However, extra administrative costs amounted to about 5 percent of the value of the new subsidy.

Conclusions: E-mistakes were reduced by the exclusion of all rural households and by means testing in urban areas that doubtless was not perfect, but must have lowered E-mistakes. F-mistakes certainly increased as a result of the exclusion of rural residents, the incomplete coverage of the urban poor and the smaller real value of the subsidy received. The administrative costs were raised.

(iii) **Jamaica**

Jamaica abolished general food subsidies in 1984 and replaced them with a more targeted food stamp scheme and a school feeding programme. Some general food subsidies were reinstated in 1986-8. The general food subsidies were again phased out in 1989 and replaced by increased benefits via the targeted programme, but without full replacement in value (Grosh 1992).

The targeting was toward all pregnant and lactating women, under-5-year-olds, the elderly, the handicapped and the poor. The benefits were broadly maintained in real terms. Targeting was of two types: self-targeting (as, children and mothers have to attend clinics or schools to get benefits) and targeting by income and successful registration.

Conclusions: E-mistakes were significantly reduced as a result of the switch to targeting from general subsidies, but F-mistakes were sharply increased (Table 3). The F-mistakes occurred because not all the poor attended clinics and because registration was required for the means-tested food stamps and for the elderly. The F-mistakes were high: about one-half of all households with malnourished children did *not* receive benefits.

Table 3: E AND F-MISTAKES IN JAMAICA
(In Percentages)

Type of Mistakes*:	F (poorest 20%)	E′ (richest 60%)	E″ (richest 20%)
General subsidy	0	66	100
Food stamps	50	43	6
Pregnant and lactating women	25	--	4
Under-5-year-olds	39	--	11
The elderly	45	--	13

Source: Grosh (1992).
* F = the percentage of the target group not covered. E′ = the percentage of the benefits going to the non-target population. E″ = the percentage of the non-target population covered by the benefits. The percentage figures in the parentheses after "poorest" and "richest" refer to segments of the population.

Grosh (1992, page 39) concludes that, "the targeting of food stamps is much better than the targeting of general food subsidies" (that is, judged entirely in terms of E-mistakes and not F-mistakes).

(iv) **Pakistan**

Formerly, Pakistan had a system of subsidized rations available only from ration shops. This system was replaced in 1987 by a smaller general subsidy on unlimited quantities of wheat that was intended to be temporary. The pre-1987 subsidized rations were for an inferior brand of flour and were available much more readily in urban areas than they were in rural areas because of the lack of rural ration shops. The budget share of rationed flour was 0.056 for the poorest group and 0.006 for the richest group. There was considerable diversion because the flour subsidy went for wheat released to mills and a large proportion (estimated at 69 percent) of subsidized wheat did not reach the ration shops (Table 4). The general subsidy saved 20 percent of the costs of the ration scheme. The rate of subsidy was lower per recipient because of the lower cost and the greater coverage (Alderman 1988).

Table 4: E AND F-MISTAKES IN PAKISTAN*
(In Percentages)

	Rural	Urban
	Panel A: *The Ration Scheme*	
F	65	50
E′	--	52[a]
	--	81[b]
E″	20	21
	Panel B: *The General Subsidy Scheme*	
F	--	0
E′	--	78[c]
E″	--	100[d]

Source: Alderman (1988).
* For an explanation of F, E′ and E″, see the note to Table 3, page 7.
[a] percentage leakage to the top two-thirds of the population, assuming no diversion; [b] same as in [a] but assuming 60 percent diversion; [c] and [d] percentage leakage to the top two-thirds of the population.

Conclusions: The ration shop scheme was much worse in terms of F-mistakes. E-mistakes were probably fewer in the targeted scheme because of the diversion problem. The administrative costs of the new general scheme were lower than were those in the rationed scheme.
"While the concentration... of the ration system [in Pakistan] on low-income users achieved a degree of targeting," according to Alderman (1988, page 251), "it also isolated users from a broader political base." Thus, the more targeted subsidy had low political support and was replaced.

(v) Egypt

Egypt has a generous food subsidy system with two main elements: a general unrestricted subsidy on coarse and refined flour and bread, and ration cards for other basic commodities. The schemes are very expensive (10 to 15 percent of total Government spending in the 1970s and 80s) and are associated with large budget deficits (for which they are often blamed, though defence spending, at 14.4 percent of Government expenditure, might equally be held responsible). The international financial institutions have devoted considerable efforts to persuading Egypt to move away from the general subsidies toward more targeted schemes.

Unlike many other countries, Egypt has a good network of rural ration shops, and rural coverage is nearly as good as urban coverage. In urban areas the total values of food interventions are considerably greater for the poor than for the rich (for whom they are negative), but in rural areas the absolute value is somewhat greater for the top income group (Table 5). However, food interventions are seen to be sharply progressive for both rich and poor when expressed as a percentage of income, being (according to data in 1981-2) 13 percent of the total expenditure of the bottom quartile and minus 4 percent of the top quartile in urban areas and, in rural areas, 18 percent of the bottom quartile and 5 percent of the top quartile.
Nutrition: Egypt has better standards of nutrition than might be expected based on the country's per capita income. This is likely to be due to the food subsidies, as calorie consumption exhibits a high-income elasticity. Alderman and von Braun (1984) calculate that the calorie consumption of poor households is 100-200 calories more per day than it would be in the absence of the interventions.

Mistakes: The uptake of rations is very high in both rural and urban areas, well over

Table 5: E AND F-MISTAKES IN EGYPT*
(In Percentages)

	Urban	Rural
	Panel A: *F-Mistakes*	
Households without ration cards	6.9	8.1
Individuals without ration cards	4.5	7.0
Nonavailability of subsidized bread	21.7	74.7
Nonavailability of subsidized bread/flour	2.9	12.2
	Panel B: *E' Mistakes*	
Top 75 percent	55.7	75.0
Top 25 percent	-5.2	22.9
	Total (urban and rural)	
Top 75 percent	69.5	
Top 25 percent	14.9	

Source: Compiled by the authors based on Alderman and von Braun (1984), (1986).
* Data for the calculation of E"-mistakes are not available. However, the reasons for the failure of comprehensive coverage include the fact that some heads-of-household are working abroad, as well as the desire not to allow newly weds to claim separate ration cards. Both reasons are likely to be more common among the non-poor, so that coverage is probably greater among low-income groups. The true F-mistakes are likely to be lower than shown above, while E"-mistakes are likely to be lower than F-mistakes. "Top 75 percent" and "top 25 percent" refer to portions of the population. For an explanation of F, E' and E", see the note to Table 3, page 7.

90 percent of households. In rural areas the limited number of bakeries means that the bread subsidy is often not accessible, and rural consumers rely on the flour subsidy. However, the careful investigation of Alderman and von Braun (1986) indicates that, for around 12 percent of households, neither bread, nor flour is available.

Conclusions: Egypt's food subsidies show very low F-mistakes in both rural and urban areas, although they are slightly higher in rural areas. E-mistakes are large if all subsidies going to the top three-quarters of the income distribution are included. Naturally, they are much lower if only the subsidies going to the top one-quarter of the population are included. In terms of E-mistakes, targeting would be improved if the basic rations and the subsidy on coarse flour were maintained, while other interventions were abolished. This would reduce the E-mistakes without raising the F-mistakes.

As is well established through the bitter resistance to their removal, the food interventions have strong political support.

(vi) **Sri Lanka**

Before 1979 Sri Lanka had a universal rice, wheat and sugar subsidy which provided to each person in the population a minimum of two pounds of rice per week at highly subsidized prices. Starting in 1977 a new, more market-oriented Government began to reduce and then replace the subsidies. Entitlement was means tested, and the subsidy, which was administered via ration shops, was subsequently replaced by food stamps issued to households according to income and number of children. Registration was frozen in 1980. A fixed nominal sum was allocated for the stamps, the real value of which declined over time. Changes in June 1986 extended the number of beneficiaries from 6.8 million to 7.2 million and provided some increases in the value of stamps for under-12-year-olds.

Costs: The universal rice subsidy was expensive, amounting to 15 percent of Government expenditure in the mid-1970s, whereas by 1984 the cost of food subsidies had dropped to only 3 percent of Government expenditure. As a result of the failure to index the value of food stamps, their real value fell severely relative to that of the rice rations, by over one-half per recipient by 1981/2.

Mistakes: The pre-1979 system assured virtually complete coverage of the target population at the cost of high E-mistakes (Table 6). In absolute amounts, per capita receipts were greater among high-income groups than they were among low-income groups because the former could afford to buy the full ration. However, as a percentage of income, the subsidies were much greater for low-income groups. (The per capita subsidies were equivalent to 25 percent of the expenditure of the bottom income quintile of the population, while the corresponding figure for the top income quintile was 8.7 percent.) In contrast, the new programme reduced E-mistakes, although not by as much as had been envisaged since a large number of the households with incomes above the cutoff line nonetheless secured stamps. However, the increase in F-mistakes was large, so that 30 percent of the bottom two income quintiles were not covered. These mistakes arose because of the complexity of the administrative process and the fact that registration was frozen beginning in 1980.

Nutrition: The switch to the targeted food stamp scheme was linked with a significant worsening in nutrition among the bottom 20 percent of the population, which cut its calorie

Table 6: E AND F-MISTAKES IN SRI LANKA*
(In Percentages)

Panel A: *Pre-1979 Rice Subsidies*	F-mistakes	0
	E-mistakes	
	E′, top 80 percent	82
	E′, top 60 percent	62
	E″	100
Panel B: *1981/2 Food Stamps*	F-mistakes	
	Bottom 20 percent	29
	Bottom 40 percent	30
	E-mistakes	
	E′, top 80 percent	64
	E′, top 60 percent	31
	E″, top 60 percent	34

Source: Edirisinghe (1987), Table 45.
* The "top" and "bottom" percentages in the middle column refer to population segments. See the note to Table 3, page 7, for an explanation of F, E′ and E″.

intake per capita by 9 percent from 1979 to 1981-2. The average calorie consumption per person among the next lowest quintile fell marginally, while that among all other groups increased. The worsening is attributed by Edirisinghe (1987) to the loss in income associated with the decline in value of (and lower access to) food subsidies as a result of the introduction of the scheme. Food subsidies contributed nearly one-third of the food budget of the bottom 20 percent of the population in 1978/9; this was reduced to one-fifth in 1981/2.

Politics: The political support was strong for the pre-1979 subsidies, as evidenced by the organized protests on several occasions against their removal. As Edirisinghe (1987, page 11) points out, "these subsidies continued in part because a remarkably high degree of active political participation by the population, particularly the organized sector of [the] labour force, provided sufficient pressure to ensure that they did." Once the change-over had been achieved, it appears that there was much less political support for the new scheme, so that the Government was able to reduce the value of the stamps without arousing much opposition (Edirisinghe 1987, 1988).

(vii) **Tunisia**

Tunisia is a middle income country, and malnutrition is estimated to affect less than 10 percent of the population. Tunisia has general unrestricted food subsidies on cereals, oils, milk and sugar. The subsidies amount to 8 percent of Government expenditure. High-income groups receive three times the absolute amount per capita received by low-income groups; nonetheless, the subsidies represent a smaller proportion of income for upper income groups than they do for lower income groups.

Mistakes: Since the subsidies are universally available and because there are very few subsistence farmers, F-mistakes are nonexistent. However, E-mistakes are high. E-mistakes are significantly worse for the urban population than they are for rural residents, mainly because there are more high-income people in urban areas (Yusuf 1989). The variation according to commodity is considerable, with extremely high E-mistakes for milk subsidies (over 90 percent), while E-mistakes are appreciably less for hard wheat than they are for other commodities (Table 7).

Table 7: E′ MISTAKES IN TUNISIA[a]
(In Percentages)

Panel A: *All Subsidies*[b]					
E′, top 90 percent				96	
E′, top 65 percent				75	
E′, top 50 percent				65	
Panel B: *By Commodity*					
	% of Subsidies Received by Top 65%[b]			% of Total Subsidies, All Groups[c]	% of Subsidies Received by Bottom 35%[b]
	Urban	Rural	Total		Total
Milk	93.1	74.3	91.4	3.2	1.6
Soft wheat	87.5	60.8	81.1	29.5	21.9
Sugar	89.0	55.3	74.9	14.4	13.8
Oil	87.6	52.1	72.1	6.2	12.2
Hard wheat	83.5	52.4	64.8	32.2	44.6

Source: Compiled by the authors based on Yusuf (1989), Table 10.
[a] See the note to Table 3, page 7, for an explanation of E′.
[b] It refers to the top 65 percent and to the bottom 35 percent of the population.
[c] Subsidies also exist for meat, eggs, soap and school supplies, so the column does not sum to 100.

Thus, E-mistakes could be substantially reduced, even while maintaining negligible F-mistakes, through a concentration on the subsidy on hard wheat. If the rate of subsidy on hard wheat were raised 2.1 times and the remaining subsidies were abolished, the poorest 35 percent of the population would be just as well off, while the total cost of subsidies would be cut by one-half. The one doubt about this procedure, which would also lower the cost of administration, is whether it would be viable politically. The support for the current subsidies is strong, as indicated by the food riots which occurred in 1984 after a proposal had been announced to eliminate the subsidies.

(viii) **Mexico**

Mexico has been in the process of replacing general subsidies to urban tortilla manufacturers for maize and maize flour with targeted subsidies on tortillas and milk (which are means tested through complex administrative procedures) for the urban poor and with the establishment of rural shops to provide subsidized maize flour.

Mistakes: The general and targeted subsidies both showed very high F-mistakes (Table 8). In the case of the general subsidies, this arose because of the failure to cover the rural poor, who accounted for approximately 54 percent of all poor families. However, complete coverage of the urban poor was achieved. The shift to targeting did not reduce E-mistakes, although this had been the main intention behind the change. The rural community shop programme, the best-targeted one from the perspective of F-mistakes, also involved the least expenditures, and the benefit per recipient was very small (World Bank 1991).

Table 8: E AND F-MISTAKES IN MEXICO

	Panel A: *The Outlays of the Programmes*	
	Total ($ millions, per year)	Per Beneficiary Household ($, per year)
General subsidies	1,652	151
Targeted subsidies		
Tortillas	98	91
Urban milk programme	193	106
Rural community shops	51	9
Food supplies	191	190

Table 8: (Continued)

Panel B: *E and F-Mistakes** (in percentages)	Urban	Rural	Total
	General maize subsidies		
F, bottom seven income deciles of the population	0	100	54
E′, top three income deciles of the population	39	0	--
	Targeted subsidies		
Tortillas			
F, poor families	73	100	88
F, poor pregnant/lactating women; 0-to-12-year-olds	75	100	90
E′, the "better-off"	40	0	--
The urban milk programme			
F, poor families	56	99	89
F, pregnant/lactating women; children in poor households	52	99	83
E′, the "better-off"	40	0	--
Rural community shops			
F, poor families	100	6	49
F, poor pregnant/lactating women and under-5-year-olds	100	7	61
E′, the non-poor	0	46	--
Food supplementation			
F, poor families	76	84	81
F, poor pregnant/lactating women and under-5-year-olds	--	--	60
F, 5-to-12-year-olds	--	--	88

Source: World Bank (1991).
* See the note to Table 3, page 7, for an explanation of F and E′.

(ix) **The Philippines**

A subsidized food ration scheme was introduced in the Philippines on a pilot basis for all households in a few villages (Garcia and Pinstrup-Andersen 1987). The scheme had very high uptake: 95 percent after three months. Because most of the villagers were poor, both E and F-mistakes were very low *in the villages covered*. However, since the scheme was confined to only a few villages, F-mistakes outside the selected villages were clearly very high, (during

the 1980s poverty rates in the Philippines were of the order of 50 to 60 percent, with a high incidence in both rural and urban areas; see Table 9).

Table 9: E′ AND F-MISTAKES IN THE PHILIPPINES*
(In Percentages)

F-mistakes (after three months in the villages covered)	5.0
E′ mistakes (villagers with >80% of the recommended daily calorie allowance)	8.8

Source: Garcia and Pinstrup-Andersen (1987).
* See the note to Table 3, page 7, for an explanation of F and E′.

Other Interventions

1. *Employment Schemes.* Public employment schemes are another form of income transfer. Since these schemes typically offer low wages, only people with low opportunity costs participate. Consequently, the schemes tend to involve low E-mistakes. The extent of F-mistakes depends on the magnitude of the employment offered relative to the magnitude of poverty, as well as on the participation of poor households, which may be constrained by incapacity to work (because of age or disability) or alternative occupations. In contrast to most food interventions, employment schemes can have significant opportunity costs for participating households, in part offsetting the benefits. For example, for the Maharashtra Employment Guarantee Scheme (MEGS), it has been estimated that about one-half of the wages received represented income foregone from displaced activities (Acharya and Panwalkar 1988). On the other hand, since they create assets, these schemes may also have long-run income raising benefits over and above the nutrition effects.

Data on the MEGS and on the Bangladesh Food for Work Programme (BFWP) suggest very low E-mistakes. For the MEGS, one survey has found that 90 percent of all workers were living below the poverty line (Dandekar and Sathe 1980, cited in Ravallion 1990a); another that the average income of participating households was 20 percent below the poverty line (Acharya and Panwalkar 1988).

Analyses of the BFWP have found that, no matter where one draws the poverty line, the participants came from households that were poorer than the rural population as a whole, while most of the rural population fell below a poverty line (Ravallion 1990a).

The data are less clear on F-mistakes. Dandekar and Sathe (1980) conclude that three-quarters of the unemployment among the landless was eliminated by the schemes, but another estimate (Osmani 1989) put the impact at one-third of the unemployment. Since in principle anyone can get a job under the schemes, they might be expected to have a big impact on able-bodied unemployment, but not to extend to households where the adult members are too old or disabled to work and also to be less effective in reaching female-headed households.

Non-wage costs (including administration) tend to be high in employment schemes, as compared with the administrative costs of food subsidies. It has been estimated that 30 to 40 percent of the costs of the two schemes above are non-wage costs (Ravallion 1990a). However, returns to assets must also be considered. Most estimates put the latter above the local opportunity cost of capital for the MEGS, but below the corresponding opportunity cost for the BFWP (see Ravallion 1990a, 1990b).

2. *Credit Schemes for Poor Households.* The Integrated Rural Development Programme (IDRP) and the Grameen Bank aim to provide credit for the poor on a major scale. Both these schemes are means tested. In general, they have had low E-mistakes. Pulley (1989) indicated that 95 percent of all IDRP participants fell below a poverty line. However, Drèze (1990) found that very few of the poorest households were included, implying significant F-errors. Assessments of the Grameen Bank suggest that participants do fall below the poverty line. Estimates of F-mistakes are not available, but the scheme, though extensive, is clearly not universal, and F-mistakes are likely to be substantial.

Major Conclusions from the Studies Surveyed

1. F-mistakes tend to be low with universal subsidies if the subsidies are unrestricted; they are usually low if the subsidies are rationed and if every household is entitled to rations. However, where the subsidies are rationed, it is essential that the ration shops be widely accessible. In some countries the lack of ration shops in rural areas has appreciably raised F mistakes, as in the Pakistan case. On the other hand, in Egypt and Sri Lanka the ration-subsidy shops were generally accessible, and F-mistakes were low.

2. Where "E" is defined as the proportion of benefits that goes to those outside the target group, the universal schemes tend to involve substantial E-mistakes, varying from 78 percent (Pakistan) to 62 percent (Sri Lanka). How significant these mistakes are depends on:

- The level and distribution of income and the patterns of consumption in the society.
- How narrowly the target group is defined.
- The nature of the subsidy.

In very poor societies with relatively even income distribution, a large proportion of the population is appropriately part of the target group, so the size of E-mistakes tends to be low. In such societies, even if some of the subsidies go to people outside the target group, most of these leakages still reach very poor people. This was the case in the villages in North Arcot, where the public distribution scheme showed E-mistakes of only 37 percent, and the E-mistakes for school meals and pre-school feeding ranged from 32 percent to 38 percent. In contrast, in higher income societies such as Tunisia, E-mistakes can be very large. In societies with considerable income inequality, E-mistakes may still be quite low if the subsidies are confined to staples, especially "inferior" staples; however, they can become very large if luxury items such as meat and eggs are subsidized. E-mistakes were much higher in Tunisia than they were in Egypt for this reason.

3. Universal unrestricted subsidies sometimes confer much larger absolute benefits on richer groups than they do on poorer groups, since the richer groups can afford to consume more. However, these subsidies may be designed to avoid this. Through the universal subsidy scheme in Egypt, richer groups in urban areas received much less than did poorer groups, while for the country as a whole there was little difference. In contrast, in Tunisia the per capita value of the subsidies received among the top 10 percent of the population was 3.7 times that of the subsidies received among the bottom 10 percent. However, even where subsidies appear to be highly regressive, as in Tunisia, they offer much greater benefits to poorer groups as a proportion of income. Thus, in Tunisia the ratio of per capita incomes between top and bottom groups was at least 8 to 1. Consequently, assuming the they are supported by taxes which are proportionate to income, the subsidies will improve secondary income distribution. In countries such as Egypt where they are designed more progressively, the subsidies greatly improve secondary income distribution.

4. In a number of countries (such as the examples of Jamaica, Sri Lanka and Zambia above) "targeted" schemes have replaced universal schemes. In almost every case the result has been a major increase in F-mistakes, with some reduction in E-mistakes (Table 10). In Jamaica F-mistakes rose from 0 to as much as 50 percent, and in Sri Lanka they increased from 0 to 30 percent, while in Pakistan, where the reverse process occurred, they fell from 65 percent (in rural areas) and 50 percent (in urban areas) to 0. The reduction in E-mistakes

Table 10: SUMMARY OF E AND F-MISTAKES IN SELECTED COUNTRIES[a]
(In Percentages)

Country/coverage	General Subsidies			Food Stamps or Rations		
	F	E′	E″[b]	F	E′	E″
Jamaica	0	66 (top 60%)	100	50	43	--
Pakistan/urban	0	78 (top 66%)	100	50	52-80	21
Egypt	7	70 (top 75%) 15 (top 25%)	100	--	--	--
Sri Lanka	0	62 (top 60%)	100	30	31 (top 60%)	34
Tunisia	0	75 (top 65%)	100	--	--	--
Mexico[c]	0	39 (top 30%)	100	73	40 (better-off)	--
				6	46 (non-poor)	--
Philippines/villages	5	9 (>80% rdca)[d]	100	--	--	--
Tamil Nadu/two villages	0	37	100	--	--	--
Tamil Nadu/"richer" village[e]	17	31	77	54	33	36

Sources: See Tables 2-9.

[a] For an explanation of F, E′ and E″, see the note to Table 3, page 7. The percentages and other breakdowns in parentheses refer to portions of the population. Thus, "top" refers to the (indicated) upper share of the population.

[b] The figure for E″ mistakes for general subsidies has been assumed to be 100 percent in all but the last case.

[c] The first row of columns under "Food Stamps or Rations" refers to tortilla subsidies in urban areas, and the second to subsidies for rural community shops.

[d] The portion of the villagers that benefits from more than 80 percent of the recommended daily calorie allowance.

[e] The first three columns refer to subsidies for pre-school feeding; the second three to those for school meals.

was usually substantial, but generally not as complete as had been expected, since non-target groups managed to secure some of the targeted benefits. For instance, in Sri Lanka the subsidy share of the top four-fifths of the population dropped from 84 percent to 62 percent and of the top three-fifths from 60 percent to 30 percent, but in Pakistan diversion of the targeted rations meant that there was little difference in E-mistakes between the old scheme and the new one.

5. At best, when there is a switch from a general to a targeted subsidy, the real value of the benefits remains unchanged; however, *this is unusual*. Mostly, it seems that the shift also leads to a drop in the real value of the subsidy over time (as in Zambia and Sri Lanka). Less strong political support for the targeted schemes probably accounts for this phenomenon. Sometimes, the reduced real value is due to an intentional cost cutting exercise.

6. The one study of school meals as a mechanism of nutritional support indicates that large numbers of poor children can be excluded if they do not attend school because they are working. School meals should discourage non-attendance (see Babu and Arne Hallam 1989), but, as Harriss (1992) shows, substantial F-mistakes may occur.

7. Other interventions to reach the poor can be effective in producing low E-mistakes (as in the case of the self-targeting mechanism of employment schemes), but may be linked with high F-mistakes, depending on circumstances and the design of the scheme.

8. Administrative costs are estimated to be higher for the targeted schemes, ranging from 2 to 5 percent of the total costs of the schemes. (The Sri Lankan scheme is estimated to cost 2 percent; the Jamaican scheme, 4 percent, and the Zambian scheme 5 percent of total costs.) Evidence from the UK and the US supports this conclusion. In seven UK programmes administrative costs have been estimated at around 3.5 percent of universal programmes, but at between 5 and 15 percent of means-tested programmes, while in the US the administrative costs of universal programmes have been found to be 2.5 percent, compared to 12 percent for two means-tested programmes and 95 percent for a means-tested veterans programme (Kesselman 1982). The administrative costs of non-food schemes such as employment or credit schemes tend to be appreciably higher than those of food subsidy schemes, but the former types of schemes also generate other benefits.

9. According to the evidence reported here, the political support for the general schemes which reach some of the non-poor (that is, those schemes exhibiting substantial E-mistakes) appears to be higher than that for the more narrowly targeted schemes.

IV. VALUING E+F MISTAKES

This section presents an attempt to value the E+F mistakes identified in the previous sections. Because of the lack of a data-set generated specifically for this purpose (and the consequent need to rely on secondary sources, which do not always provide the necessary information), this section cannot be conclusive. Nonetheless, the information which has been compiled offers some basis for assessing the significance of the E+F mistakes and, thus, for going beyond the normal methods used to gauge the effectiveness of food interventions.

(i) Measuring the Total E+F Mistake as the Weighted Sum of All Individuals "Mistargeted"

A focus on E-mistakes, the usual approach in the assessment of the relative efficiency of alternative nutritional interventions, would consider an intervention as optimum if it exhibits the lowest leakage to the non-target population. As noted earlier, there are various ways to measure these E-mistakes. The simplest is in terms of the number of non-target population covered, NP^c/N. A rather crude interpretation of the conventional approach would be that the aim is to minimize this ratio. However, following narrowly this criterion would lead to no subsidies at all, since this ensures zero E-mistakes. Therefore, it cannot be the sole criterion actually adopted.

In the approach adopted in this paper, in contrast, the ratio to be minimized would be some weighted valuation of $(NP^c + P^{nc})/N$, that is, $(aNP^c + bP^{nc})/N$, where "a" is the weight given to E-mistakes, and "b" the weight given to F-mistakes. In the conventional approach "a" is assumed to be equal to 1, and "b" to 0. In contrast, this paper argues that "b" is generally greater than "a".

The choice of values for "a" and "b" is therefore a critical issue. Relevant considerations in arriving at some system of weighting are:

- The costs of E-mistakes. These would be less if there is no major budgetary problem (a revenue-rich country like Kuwait before the Gulf War represents a good example), or if the tax system can be used to claw back E-mistakes (see Section V). In either of these cases "a" is less than 1.

- The damage caused by F-mistakes. This would include the welfare costs of not covering the target population and the investment costs of not reaching this population.

At this stage an illustration can be offered of how the ordering of food interventions is modified as the valuation of the weights varies. For this purpose, four methods have been used to add up the E and F-mistakes (Table 11): (i) only E-mistakes are considered; (ii) only F-mistakes are considered; (iii) E and F-mistakes are both given an equal weight of 1; and (iv) F-mistakes are weighted at three times the value of E-mistakes (b/a = 3).

Table 11 shows that the ranking of food interventions varies according to the weighting of E and F-mistakes. General subsidies are invariably inferior to targeted schemes if only E- mistakes are considered (which here may be exaggerated, as it is assumed that 100 percent of the upper income groups are covered). If only F-mistakes are considered, then general subsidies are invariably superior to targeted schemes in the cases examined. If both are incorporated, the outcome depends on the share of the population that is within or

Table 11: ALTERNATIVE MEASUREMENTS OF TARGETING MISTAKES IN SELECTED CASES

Mistakes/Weighting:	E-Only	F-Only	E + F [a = b = 1]	E + 3F [a=1, b= 3]
Measure Adopted:	NP^c/N	P^{nc}/N	$(NP^c+P^{nc})/N$	$(NP^c+3P^{nc})/N$
		Sri Lanka[a]		
General subsidy	0.60	0	0.60	0.60
Food stamps	0.20	0.12	0.32	0.56
		Jamaica[b]		
General subsidy	0.20	0	0.20	0.20
Food stamps	0.12	0.10	0.22	0.42
		Pakistan[a]		
General subsidy	0.60	0	0.60	0.60
Food rations	0.12[c]	0.24[d]	0.36	0.84
		Tamil Nadu ("richer" village)[e]		
General subsidy	0.39	0	0.39	0.39
School meals	0.14	0.32	0.46	1.10
Pre-school meals	0.30	0.12	0.42	0.66

Sources: See Tables 2-9.
[a] Poor and non-poor: bottom 40 percent and top 60 percent of the population.
[b] Poor and non-poor: bottom 20 percent and top 20 percent of the population.
[c] Estimate.
[d] Assuming that 40 percent of the poor are covered.
[e] Poor and non-poor: the three lowest classes and the three highest classes.

outside of the target group and the magnitude of errors of omission and commission, as well as the relative weight given to the two types of errors. For instance, in Pakistan the targeted scheme is superior to the general subsidies if the two types of errors are given equal weight, but the general subsidies are superior to the targeted scheme if the F-errors are weighted at three times the weight of the E-mistakes. For Jamaica, if only the top 20 percent of the population is regarded as causing E-mistakes, the general subsidy is superior if E and F-errors are weighted equally, but this changes if E-mistakes are extended to a wider segment of the population.

(ii) Measuring the Total E+F Mistake as the Sum of the Program Leakage, Welfare Cost and the Future Foregone Income due to Mistargeting

In this subsection the value of the E+F mistake is assessed by assuming for the moment that the E-mistake may be measured as the leakage of financial resources (that is, a = 1). As for the F-mistake, it is important to differentiate clearly two elements: first, the immediate welfare cost (W) and, second, the future income forgone (Y*).

As far as the *welfare cost* (W) is concerned, the valuation hinges on how the incomes of different groups are gauged; the welfare costs are likely to depend on how poor those not covered are (for example, whether they are near to starvation or can count on nearly adequate incomes). From this perspective, F-mistakes should be valued more if they relate to the ultra-poor, rather than to the poor, and it would be desirable to have two types of F-mistake according to this distinction. However, the data at hand do not permit one to pursue this avenue.

Another way to look at the welfare costs is to adopt equity weights and measure F-mistakes according to society's valuation of the income going to the target group as against other groups. Thus, an Atkinson utility index could be employed whereby the income of a particular group is valued as:

$$W(y) = \frac{1}{1-e} y^{1-e}$$

For the most part, however, the detailed information necessary to estimate the value of the welfare costs of F-mistakes using this approach is not available, nor is the value of "e" known.

(iii) **Valuing the Present Value of the Foregone Income (Y*)**

In assessing the value of the forgone income, the analysis which follows focuses on three important relationships:

- The relationship between adult nutrition and short-term labour productivity.
- The relationship between growth retardation at an early age, I.Q. scores, school achievement and long-term labour productivity.
- The relationship between maternal malnutrition, the incidence of low birthweight among female infants and their reproductive efficiency during their adult life.

1. **Adult Nutrition and Labour Productivity**. The following review focuses on two general types of study as evidence on this relationship: experimental studies and non-experimental studies. The first type usually provides more accurate estimates of productivity increases since these studies are generally able to control for simultaneity, sample attrition, non-observed household decisions affecting nutrition, and the random assignment of the individuals included in the tests, although the tests may be subject to "Hawthorne" effects (that is, process-related characteristics of the projects may have contributed to the outcomes). The results of the second type of studies should be interpreted more carefully, since this type is often affected by an unknown estimation bias due to the problems just mentioned. In our review we will focus on both types of analysis.

(a) *Calorie Intake and Productivity.*

Kraut and Muller (1946) examined the productivity changes among different groups of German wartime workers whose overall calorie intake was fully controlled. The output per hour of railway workers shifting debris increased by 47 percent when calorie intake was raised from 2,400 to 3,000 calories per day. Similarly, a boost from 2,800 to 3,200 calories per day increased the productivity of mineworkers by 37 percent. When intake was raised to 3,600 calories, productivity increased at the margin by another 7 percent. Among steelworkers a 400 calorie rise in intake increased productivity by 22 percent. However, part of these phenomenal increases may have been due to improvements in morale and changes in non-labour inputs, which were not controlled.

- In the Minnesota starvation experiment (Keys et al. 1950), a dramatic decline in intake (from 3,500 to 1,500 calories per day) over 24 weeks reduced muscle strength by nearly 30 percent and precision of movement by 15 to 20 percent among the test group, despite a decline in basal metabolic rates. Hence, the capacity to perform physical work fell sharply.

- In a carefully controlled study of Kenyan road construction workers having an average daily intake of 2,000 calories per day, Wolgemuth et al. (1982) compared the productivity increases among two groups of workers who had received calorie supplements of 1,000 and of 200 calories per day, respectively. Actual average intake rose by only 500 calories in the first group, while it remained constant in the second group, as the workers decreased their food consumption at home. The gains recorded in labour productivity among the first group was equal to 12.5 percent.

- A study of farm workers in Sierra Leone (Strauss 1986) showed a highly significant effect of calorie intake on labour productivity. The implicit elasticity of output per worker per day vis-à-vis a 1 percent increase in calorie consumption was found to be equal to about 0.5 for workers with a low daily consumption of calories, 0.34 for workers consuming 3,000 calories per day and only 0.12 for workers at 3,750-4,500 calories.

- In a study of the effects of dietary improvements on productivity in Guatemala (Viteri et al. 1975), a group of cane-cutters (consuming normally 2,800 calories per day) received an energy supplement of 650 calories per day. Because of the reduction of food consumption at home, the additional net intake was equal to about 350 calories. Labour productivity per worker per day in the intervention group increased by 0.2 tonnes of cane harvested, while the figure was 0.1 tonnes in the control group. In the latter group, however, the rise in productivity disappeared over time.

- In a study of agricultural households in a semiarid region of South India, Deolalikar (1988) found a positive and statistically significant impact of calorie intake *and* weight-for-height on labour productivity. A 1 percent increase in weight-for-height raised the product of output per day by 2 percent. The effect of a 1 percent rise in calorie intake on the daily wage rate was lower, only 0.2, which was also lower than the value found by Strauss (1986).

- In a similar analysis of rural Sri Lanka, Sahn and Alderman (1988, cited in Strauss and Thomas 1989) found that a 1 percent increase in calorie intake was associated in a statistically significant manner with a 0.2 percent rise in the male wage rate.

- A few studies, however, have detected no or only a weak relationship between calorie intake and productivity. For instance, a controlled three month study of 20

agricultural workers in India (Belavady 1966), with one-half of the workers receiving 2,400 calories and the other half receiving 3,000 calories per day, found no relation between calorie intake and productivity. However, the small size of the sample and the brevity of the study likely diminish the validity of these findings.

(b) *Body-mass and Labour Productivity (or Wage Level).*

Although there are problems associated with the experimental design of several studies in this field, there is strong evidence of a positive relationship between body size, muscle mass, aerobic capacity and work endurance. Shorter people with a history of chronic undernutrition since childhood tend to have less muscle mass and, ceteris paribus, lower aerobic capacity. Aerobic capacity has been found to influence labour productivity among lumberjacks, sugarcane-cutters, road and construction workers and other manual workers in countries as diverse as Australia, Brazil, Colombia, Costa Rica, Guatemala, India, Jamaica, Kenya and others (see Horton and King 1981, Scrimshaw 1986, McGuire and Austin 1987, Strauss and Thomas 1989). From such review it appears, for instance, that:

- In a cross-sectional study of the productivity of female factory workers, Satyanarayana et al. (1977) found that productivity correlated with weight and lean body weight (but not with height or weight-for-height). An increase in weight from 45 to 55 kilogrammes raised productivity by 13 percent, while an increase from 45 to 60 kilogrammes raised productivity by 27 percent. In a further cross-sectional study along these lines (Satyanarayana et al. 1978), the same authors found that productivity declined with obesity.

- In a study of sugarcane-cutters from Guatemala, Immink et al. (1984) estimated that the discounted value of the lifetime earnings of taller workers was 16 percent higher than that for shorter workers.

(c) *Micronutrient Deficiency and Labour Productivity.*

Horton and King (1981) cite a study by Borzok (1945), in which vitamin supplements raised the output of California aircraft workers by 4.1 percent per year. Increases in productivity accounted for 2.6 percent of the rise, a fall in absenteeism for 0.9 percent, and a reduction in turnover for 0.6 percent.

- In a controlled study of rubber plantation workers in Indonesia, Basta et al. (1979) found that a 60 day treatment of anaemic workers with iron tablets resulted in a gain in productivity of 15 percent for rubber-tappers and 25 percent for weeders. The benefit-cost ratio of the intervention was estimated at 260 to 1.

- The above findings were confirmed in a cross-sectional study of road construction workers in India, Kenya and the Philippines (see the review by Horton and King 1981).

(d) *Summary.*

While it is not always possible (particularly in non-experimental studies) to control for the influences of omitted variables, simultaneity between variables, and household decisions, from the above review it appears that:

- Calorie intake, body size and micronutrient supplementation (with iron, vitamin A and iodine) are clearly correlated with the labour productivity of manual workers.

- The relationship is strongest for micronutrients and less intense (but still clear and statistically significant) for calorie intake and body size. The effects of calorie intake and body size are often inseparable, although these effects reflect the influence of two different factors, that is, the current level of nutrition and long-term stunting.

- The relationship between nutrition and productivity is more pronounced for workers at low levels of intake (that is, 1,500-2,000 calories or with very low levels of haemoglobin). It is also positive and significant, but with lower elasticities, for workers who are in the 2,000-3,500 calorie range or who are mildly anaemic. The impact of calorie or micronutrient supplementation is nil (or even negative) for workers consuming more than 4,000-4,500 calories per day and who have adequate levels of haemoglobin.

- Changes in nutritional status may not affect productivity over the short term (for instance, see the study by Belavady 1966), since limited, gradual increases or decreases in intake may be accommodated by an adaptation of the basal metabolic rate (Scrimshaw 1986).

- Apart from the results found by Kraut and Muller (1946) and Belavady (1966), it appears that the provision of a supplement of 800-1,000 calories per day to manual workers with low intake levels may result in a rise in actual consumption of 500-600 calories, which in turn is likely to be associated with a productivity gain in the range of 20 to 30 percent. If the intake is equal to the supplementation provided, the climb in productivity could in most cases be assumed to be in the range of 30 to 40 percent (Table 12). Assuming that the yearly

productivity of low-income workers in poor developing countries is in the $300 to $500 *per capita* bracket, the gains associated with a rise in calorie intake would be roughly in the $60 to $150 *per capita* per year range in the case of the 20-30 percent productivity increase and in the $90 to $200 *per capita* per year range in the case of the 30-40 percent increase. These figures compare favourably with the cost of a food subsidy programme (or with that of a similar child feeding or school lunch programme), which is currently estimated at around $30 per year per 1,000 calories effectively transferred per day (World Bank 1989, Kennedy and Alderman 1987).

2. **Malnutrition, Growth Retardation at an Early Age and Labour Productivity in Adulthood**. Malnutrition at an early age that is caused by dietary deficiency, infection or lack of sensory stimulation leads to stunting and severe impairment of cognitive capacity. There are essentially three mechanisms through which different forms of malnutrition in infancy and childhood affect labour productivity in adulthood:

- Persistent protein energy malnutrition in infancy and childhood leads to stunting.

- Severe malnutrition at an early age (before the age of 5) has been shown to affect I.Q., learning ability (both directly and through the amount of schooling, which also depends on I.Q.), skill acquisition and future productivity.

- Undernourishment and iron deficiency among school pupils affect their attention span, learning ability and school achievement and, through these, their skill acquisition and future productivity.

The literature and the evaluations available in these three areas are substantial, although there seems to be no well-controlled longitudinal studies which measure the relationship among child nutrition, physical and mental growth retardation, and productivity. In contrast, quite a few experimental and cross-sectional studies exist relating the first two and the last two of these three sets of variables.

(a) *Protein Energy Malnutrition and Physical Growth Retardation*

(see "Body-mass and Labour Productivity", page 26).

Table 12: ESTIMATES OF THE ELASTICITY OF THE NUTRITION-PRODUCTIVITY RELATION

Study	Initial Level (kilocalories)[a]	Increase (kilocalories)[a]	Productivity Gains (%)	Elasticity of: Wages vs Calories	Elasticity of: Productivity vs Calories	Elasticity of: Productivity vs Weight-for-height
Kraut and Muller (1946)						
Railway workers	2,400	600	47	--	1.80	--
Mineworkers	2,800	400	37	--	2.60	--
Mineworkers	3,200	400	7	--	0.56	--
Steelworkers	--	400	22	--	--	--
Keys et al. (1950)	3,500	-2,000	-30[b]	--	--	0.52
Wolgemuth et al. (1982)	2,000	500	12.5	--	0.50	--
Strauss (1986)	3,000	-1,500	-40	--	0.66	--
	3,000	1,500	17	--	0.34	--
	3,750	750	--	--	0.12	--
Viteri et al. (1975)	2,800	350	0.2[c]	--	--	--
Deolalikar (1988)						
Calorie	--	--	--	0.2	--	--
Weight/height	--	--	--	--	--	2.0
Sahn and Alderman (1988)	--	--	--	0.2	--	--
Satyanarayana et al. (1977)	45[a]	10[a]	--	--	0.58	--
	45[a]	15[a]	--	--	0.81	--
Belavady (1966)	2,400	600	0	--	0	--

Source: Compiled by the authors.
[a] Except for "Satyanarayana et al. (1977)", which is in kilogrammes.
[b] Refers to muscle strength, not to labour productivity.
[c] Tonnes of additional sugarcane cut.

(b) *Acute Malnutrition, I.Q. and School Achievement.*

Pollitt (1984), in a review of the effects of severe protein energy malnutrition in infancy and early childhood on I.Q. and school achievement, found that children with a history of malnutrition had scored appreciably worse on intelligence tests and on school tests in 10 out of the 13 studies he surveyed. Altogether the studies supported the hypothesis that the severity of the nutritional deficit is associated with the cognitive deficit during school age. The magnitude of the deficit varied from 25 I.Q. points (that is, roughly 30 percent) in the case of a study on South African children (although the control group in that study enjoyed better living conditions), as well as in the study by Selowsky and Taylor (1973) on Chile (see later), to only a few points in the case of a study of Korean children (Winnick et al. 1979). In

most studies, such as that on school children between 5 and 11 years of age in Barbados (Galler et al. 1983), the I.Q.'s of children with histories of severe malnutrition during the first years of life were 10-15 percent lower on average than those of the control group. Part of this variability depends on factors which could not be standardized for the analysis (such as age at the onset of malnutrition, or the severity and the type of malnutrition), or on the influence of interfering variables.

(c) *Current Nutritional Intake of School Children and Academic Achievement.*

Pollitt (1984) reviewed five studies which linked nutritional status to learning ability and school performance in Indonesia, the Philippines, Singapore and the US. The Indonesian study, for instance, found that anaemic children had lower school scores than did non-anaemic children. After a three month treatment with iron supplements the scores of the former significantly improved, while no changes were registered in the control group. The studies reviewed were not immune from the usual methodological problems and permit only tentative inferences. Nonetheless, Pollitt concludes (page 21) that "it must be recognized that most [of the] studies... concur in suggesting that the nutritional status of the student is a variable that determines in part educational performance."

(d) *Summary.*

The evidence on the relationship between child malnutrition, learning ability and the amount of schooling completed can be combined with that on the relationship between early ability, levels of schooling and later earnings to assess the potential losses of future income due to malnutrition in childhood (and to deal with F-mistakes, that is, the exclusion from public nutrition programmes). While there seem to be no longitudinal studies on the effects of child malnutrition on future earnings, a few authors have attempted to quantify this relationship on the basis of two different data sets. A well-known study using data from Chile on differential I.Q.'s among normal and undernourished children and on differential earnings of construction workers ranked by I.Q. levels (Selowsky and Taylor 1973) comes to the conclusion that had nutritional supplements been provided during the first two years of life to the 25,000 or so children who were becoming malnourished in Chile every year, the

additional benefits which would have been generated would have equalled 1 percent of GNP, or around *six times* the cost of the intervention.

Similarly, in a comprehensive study of the impact of a health-nutrition intervention on children in low-income households that was conducted in Cali, Colombia, Selowsky (1981) noted that, at 43 months, low-income children had ability scores which were 1.5 standard deviations below the scores of the high-income group. The intervention reduced the gap by about one standard deviation. The total value of the increase in lifetime earnings induced by the intervention was calculated to be between 2.5 and 4.6 times (depending on the years of schooling completed) the yearly wage of an illiterate worker, in the case of a rise in I.Q. equal to one standard deviation, and between 5.6 and 8.9 times such a yearly wage in the case of a rise in I.Q. equal to two standard deviations. (Selowsky pointed out that in the early to mid-1970s the wage of a typical illiterate worker in six developing countries varied between 40 percent and 95 percent of the GDP per capita; only in one case was it above that level.)

3. **Intergenerational Effects: Malnutrition among Mothers and Reproductive Efficiency**. Perhaps the most negative and the most frequently overlooked of the effects of maternal malnutrition on female infants is the effect on their *reproductive efficiency* during their adult life. Studies have found a positive relationship between low birthweight and poor nutrition during a mother's childhood and the low birthweight or birth defects of her infants (see Hackman et al. 1983). Thus, the probability is high that maternal malnutrition will be passed on through at least two successive generations (Martorell and Gonzalez-Cossio 1987), as is the probability that it will affect the physical growth, learning ability and future earnings of these offspring. However, maternal supplementation during pregnancy can reduce this influence. For instance, for the US, Kennedy and Kotelchuck (1984) found such interventions to be highly cost-effective, since $3 were saved on the hospital care for low birthweight babies for every $1 spent on prenatal supplementary and health care. (However, estimating the forgone income effect of this kind of intergenerational malnutrition is highly conjectural and will not be pursued in this paper.)

4. **Adding up the Costs of F-Mistakes and Weighing Them together with the E-Mistakes**. Part of the evidence presented in this paper suffers from various methodological problems which may bias some of the estimated coefficients. However tentatively, the results of the above survey can nonetheless be used in the valuation of F-mistakes.

For each intervention the value of the E-mistakes ought to be compared with the immediate welfare cost and the discounted value of the expected gains forgone because of the failure to incorporate the needy population in the nutritional programme. As noted, the discounted value is normally composed of two elements: (i) the immediate labour productivity effect on adult workers and, (ii) the discounted value of the future forgone gains of children. (Note that this is an underestimate of the actual value of "forgone income", since it excludes the positive effects of nutritional interventions on mortality, morbidity and reproductive efficiency.) On the basis of the preceding discussion one can *very* tentatively assess the value of the E+F mistake as:

$$E + F = L + W + Y^*$$

where:

$$Y^* = \alpha\pi P^{nc}w + \beta\pi P^{nc}c$$

and where:

L = the value of the leakage of the nutrition programme.
W = the immediate welfare cost.
α = the percentage average loss in the productivity of malnourished manual workers not reached by the nutrition programme.
π = the yearly productivity of a low-income manual worker.
w = the share of adult manual workers in P^{nc}.
β = a multiple of the present value of the future forgone incomes of malnourished children not reached by the nutrition programme expressed in terms of the current productivity of low-income manual workers.
c = the share of under-5-year-olds in P^{nc}.

While the lack of information has rendered it impossible to estimate the values of Y* and W for any of the nine programmes reviewed in Section III, the value of the forgone future incomes tentatively assessed in Section IV on the basis of a broad survey of the literature appears quite large in relation to the cost of the programmes. With α and β estimated to range, respectively, between 0.3-0.4 and 2.5-4.6, π estimated at \$300-\$500 and w and c estimated to range, respectively, between 0.2-0.3 and 0.4-0.5, it appears that the F mistakes can be extremely large, even if W is assumed to be equal to zero.

V. THE POSSIBILITY TO CLAW-BACK E-MISTAKES

The discussion has shown that targeted schemes can sometimes be designed so that they involve low E and F-mistakes and, a fortiori, a low E+F total. This occurs whenever all the target population possesses some easily verifiable characteristic (for example, a common geographic location, age, gender, or consumption pattern) which it does not share with the non-target population.

However, such a situation is rare. In most cases, characteristics are more evenly spread across the population, so that efforts to reduce E-mistakes tend to increase F-mistakes. This means that there is a choice between two unsatisfactory circumstances:

- If the F-mistakes are to be minimized, the E-mistakes tend to be large (and the government deficit may increase).
- If the E-mistakes are to be minimized and the budget constraints respected, the F-mistakes (and the administrative costs) tend to be high.

A possible way out of this dilemma would be to claw-back the leakage in the first case above through the tax system. Ideally, such an effort ought to involve the recovery of the leakage from the same non-target population benefiting from the food intervention. However, to achieve this objective, one must know the value of the leakage, the distribution of the leakage by income level (and if possible by other characteristics such as location, etc.), and the tax incidence by main tax instruments.

(i) The Value of the Leakage

The evidence in Section III has shown that the proportions of the benefits accruing to the non-target population are typically 60-70 percent in the case of generalized food subsidies and 30-40 percent in the food stamp schemes, while they are lower in child feeding programmes.

The cost of most food subsidy schemes is from 0.4 to 1.6 percent of GDP, according to Bird and Horton (1989) and the World Bank (1989), with costs in a few countries, including Egypt (3-6 percent), Sri Lanka (3 percent in 1964-74) and Tunisia (around 3 percent), substantially higher. The cost of child feeding schemes (administered through the health care system or the school system) amounts to 0.1-0.6 percent of GDP (World Bank 1989).

The total cost of the leakages through food subsidies and food stamp programmes may thus be estimated typically to be 0.3-1.0 percent of GDP (and proportionately greater in the high cost countries). A less restrictive definition of the target population (identified in most of the studies reviewed in Section III as those people in the bottom 25 or 30 percent of the population in terms of income, probably a "low" estimate of absolute poverty) might reduce this total to 0.2-0.7 percent of GDP. In contrast, the cost of the leakage is considerably smaller for infant and school feeding schemes.

(ii) The Distribution of the Leakage by Income Group

The distribution of the leakage by income group varies with the type of intervention adopted. In some instances the benefit *per capita* is constant among all income groups (as in the case of school meals). In generalized food subsidies it is broadly proportional to the overall consumption of the food subsidized by each income class. For some goods the leakage therefore tends to grow with household income, while for others it might take the shape of an inverted "U". When expressed as a share of the income of each group, in almost all cases the leakage tends to decline rapidly for each successive income decile.

(iii) Tax Incidence by Income Group and by Main Tax Instrument

Knowledge of the distribution of consumption and tax incidence (by main types of tax instruments) by income group is required to identify those tax instruments best suited for clawing-back the leakage.

Ideally, the leakage ought to be clawed back through income taxes (so as to avoid inflationary pressures and possible distortions in consumer preferences). The recourse to direct taxation is also justified by the low level of incidence of direct taxes in most developing countries. Equity considerations would require that the additional direct taxes levied on the various income deciles are broadly equivalent to the value of the leakage accruing to each group. This would therefore require that the tax yields from each income group be raised by a (generally declining) proportion of their incomes.

Raising the tax yields can often be achieved by improving tax collection rather than by increasing tax rates. This is, of course, an important objective per se, but it gains special

justification in the context of a need to claw-back. The potential for improved collection is usually considerable, as indicated by the divergence between nominal and effective tax rates.

When adjustments in tax rates are required to achieve a claw-back, these generally would be rather small and would thereby help to avoid negative effects on savings, labour supply, tax evasion and tax elusion. Writing about India, Guhan (1992) notes, for instance, that the introduction of a small surcharge of 1, 2.5 and 4 percent on the three top income groups would likely yield 0.3 percent of GDP (Table 13). He points out that the absolute value of the individual surcharge (that is, 25, 100 and 200 rupees per month, respectively, for the three income groups mentioned) seems moderate, particularly in view of the fact that in India the effective income tax threshold is quite high.

Table 13: THE ESTIMATED TAX YIELDS OF AN INCOME TAX SURCHARGE IN INDIA

Annual Income Range (rupees, 000s)	% Total Households	Assumed Mean Income (rupees, 000s)	Surcharge Rate (%)	Rounded Surcharge (rupees)	Estimated Annual Yield (rupees, millions)	GDP Share (%)
25-40	8.7	32.5	1.0	25 x 12 = 300	4,320	0.1
40-56	2.3	48	2.5	100 x 12 = 1,200	4,560	0.1
>56	1.2	60	4.0	200 x 12 = 2,400	5,040	0.1
Total	12.2				13,920	0.3

Source: Compiled by the authors based on Guhan (1992).

A similar approach to the claw-back proposed here is already being followed in a number of developed countries in the case of universal income transfers to households. For instance, in Sweden all families with children are entitled to child allowances. However, these allowances are included in the tax base and are therefore taxed in all those cases in which the combined family income exceeds a certain threshold. In view of the strong progressivity of the tax schedule, such an approach is able to claw-back an important part (but not all) of the child allowances paid to the high-income group, while reducing administrative costs and avoiding F-mistakes (which can also be substantial in developed countries).

However, this approach is not always practicable. In Hungary, for example, the particular characteristics of the tax system (no pooling of family incomes, child allowances

accruing to women, and the limited progressivity of direct taxes) substantially lower the possibility of clawing-back the leakage (Jarvis and Micklewright 1992).

The difficulties encountered in clawing-back the leakages through direct taxation are obviously more acute in developing countries where income tax administration is subject to a number of problems (such as exemption of agricultural incomes from direct taxation, weak tax administration and limited monetization and extensive informalization of the economy), which in fact cut into the possibility of clawing-back adequate amounts of resources. In addition, because of the limited number of (mostly urban formal sector) people subject to direct taxation, such an attempt at clawing-back the leakage might cause equity problems, since the high-income group taxed may not coincide precisely (or even to a significant extent) with the groups benefiting from the leakage. Direct taxation would be likely only on the first and second deciles but not, say, on the intermediate ones.

For all these reasons, the claw-back can best be effected through the use of indirect taxes. This requires the identification of those goods:

- Consumed predominantly by the income groups which benefit from the leakage.
- Which generate a sizeable proportion of the revenue from indirect taxation.
- With a fairly low own-price elasticity of demand.

While it is not easy to generate this data, studies exist which provide information making it possible to indicate fairly accurately how a claw-back could be achieved through indirect taxation. Two recent studies on India (Jha and Srinivasan 1988a, 1988b) examine the effect of an hypothetical 10 percent increase in indirect taxes on tax yields, the progressivity of indirect taxation and inflation. The simulation is carried out on the basis of a fully specified model, including an input/output table with 50 sectors and a final consumer demand system. The two studies identify the share of indirect revenue originating from each of the 50 sectors and the distribution of the indirect tax burden between the "rich" (broadly corresponding to the top two income deciles of the population) and the "non-rich" for each group of products.

From the studies it appears that, while product groups 12 and 28, consisting of petroleum, natural gas and petroleum products (Table 14), constitute a sizeable tax base for raising revenue, about 60 percent of the tax burden accounted for by these products falls on the "non-rich". The recovery of the leakage could be effected by increasing indirect taxation on other goods the tax burden of which is distributed more progressively. Such goods include cotton, silk and other textiles, rubber products and synthetic fibres, electric

machinery, motor vehicles originating from "other" manufacturing goods (groups 19, 20, 26, 32, 39, 41 and 42), for which between 65 and 75 percent of taxation falls on the top 20 percent of the population (and, probably, close to 100 percent on the top four income deciles). The share of indirect taxes originating from these products is about 30 percent. If "other chemicals" and "other food and beverages" are added, the share climbs to 40 percent.

Table 14: THE INCIDENCE OF INDIRECT TAXATION IN INDIA

Number	Product Group	Share of the Tax Paid by the Rich (%)	Share of Indirect Tax Revenue from each Sector (%)
12	Petroleum & natural gas	0.434	7.64
18	"Other" food & beverages	0.513	12.88
19	Cotton textiles	0.684	2.31
20	Art silk & synthetic fibres	0.753	2.69
26	Rubber products	0.644	4.11
28	Petroleum products	0.431	14.35
32	"Other" synthetic fibres & resins	0.699	10.21
33	"Other" chemicals	0.575	7.00
34	Cement	0.486	5.89
38	Non-electric machinery	0.712	2.65
41	Motor vehicles	0.669	3.15
42	"Other" manufacturing goods	0.658	5.83

Source: Jha and Srinivasan (1988a).

A 10 percent rise in indirect taxes on the above products (and other less important commodities not mentioned here for reasons of space) would generate an additional 0.3-0.4 percent of GDP, lead to a small improvement in the progressivity of indirect taxation and, assuming no wage indexation, have only limited effects on inflation (except in the case of some intermediary goods, such as cement, synthetic fibres and steel).

Though obviously tentative, these calculations show that there are potentially viable tax policies which would permit the recovery, via indirect taxation, of a considerable portion of the leakage even in low-income and highly rural countries like India. The scope for such a claw-back would obviously be greater in middle income countries. Such an approach,

which relies on non-uniform rates of indirect taxation, would also be consistent with optimal tax theory (Ahmad and Stern 1990).

Finally, it should be noted that any general increase in direct or indirect taxation, while not representing a precise claw-back, would still fall more than proportionately on the non-target groups and would thus help offset the costs of E-mistakes.

VI. CONCLUSIONS

This paper has argued that up to now the design of targeted food interventions has focused almost exclusively on E-mistakes, that is, those mistakes involving the wastage of resources because some or all non-target groups are covered by the interventions. In so doing, it has neglected the F-mistakes, that is, those mistakes involving a failure to reach the entire target population.

Empirical studies show that, in general, as E-mistakes are reduced through targeting, F-mistakes are increased. While E-mistakes imply additional expenditure, F-mistakes generate a different kind of cost, which encompasses both the immediate welfare loss and the future income forgone because of malnutrition among the individuals in the target group who are "missed" by the intervention. This paper proposes that both types of mistakes should be considered in the design of good schemes.

The paper has presented two approaches to the valuation of the aggregate E and F-mistake. In the first approach, the proportions of the two population groups which are "mistargeted" are added together after appropriate "welfare weights" have been assigned to each. These weights are chosen to reflect the relative importance of the E and F-mistakes. In the second approach, the cost of the leakage is compared with the welfare loss and the present value of future income forgone due to the failure to reach the whole target group.

While these two approaches require further refinement and while more accurate testing on an appropriate data-set generated for this purpose needs to be carried out, the preliminary results examined in this paper suggest that, in several cases, "narrow targeting" may generate large welfare and efficiency costs. Given such costs, the twin objectives of covering the highest possible number of the poor and minimizing leakage may best be achieved by clawing-back some or all of the leakage through a variety of direct and indirect tax measures.

This paper has examined some of the tax mechanisms through which such a claw-back could be achieved, by illustrating a few concrete cases in which this approach would appear to be feasible from a quantitative perspective. While more work is obviously needed in this area, particularly to improve the precision of claw-back measures, it appears that such an approach could substantially offset the cost of E-mistakes, while largely avoiding F-mistakes.

ANNEX: HOUSEHOLD AND FOOD INTERVENTIONS: ANOTHER SOURCE OF ERRORS

Most individuals, including nearly all children, live in households. The way a household functions, particularly in relation to the allocation of food, therefore mediates between any outside intervention the household and individual food consumption. This is so no matter whether the intervention is direct (as in feeding schemes) or indirect (as in food subsidies or work schemes) because the household can reallocate the resources over which it has discretion to offset the effects of the intervention if it so wishes.

Household decisions concerning food can be thought of as a two-stage process, (although the two stages may be decided upon simultaneously):

- Decisions on the amount of total household income to be allocated to food.
- Decisions on how food is to be distributed within the household.

If the aim of a food intervention is simply to raise the incomes of poor households, leaving the households to decide on allocation and distribution, then one needs only to be concerned with whether the intervention really does raise the incomes of these households. This is the assumption regarding objectives that has been made throughout this paper. However, if the goal is to improve the nutritional status of particular categories of people within poor households (children, for instance), then one needs also to consider the issues of allocation and distribution.

Different models of how households function lead to different conclusions on the links among food interventions, food consumption and family food distribution. Two widely divergent types of model are the neoclassical model and the bargaining model of the household. The first assumes joint utility maximization (for example, by a benevolent but dictatorial head-of-household) in which decisions on allocation and distribution are taken with family utility maximization as the objective (see Becker 1981, Rosenzweig 1986). In contrast, bargaining models assume that different objectives exist within the household. Allocation and distribution are thus the outcome of a bargaining process among the various individuals (or bargaining groups) within the family (Manser and Brown 1980, McElroy and Horney 1981, Folbre 1984, 1986).

Depending on the model, conclusions on the effects of food interventions can be significantly different.

The Neoclassical Model

According to the joint-utility maximization model, since "all resources are essentially pooled and reallocated to individuals, it does not make any difference to whom subsidies are given, or, for the most part, whether such subsidies are in cash or kind" (Rosenzweig 1986, page 235). Unless the consumption of a target group through direct nutrition interventions exceeds the total pre-intervention consumption of the group (which is unlikely except in special intensive programmes), the intervention will be no more effective in raising the group's food consumption than would a general increase in household income of the same magnitude, since the rational neoclassical family will reallocate its resources to achieve the efficient utility-maximizing optimum.

According to the neoclassical model, the family is a complex maximizing entity which makes adjustments at work and in consumption in order to achieve utility maximization. An intervention may therefore affect the level and distribution of food consumption through a general equilibrium process, which incorporates the productivity effects of the food consumption of particular individuals. For instance:

- Higher wages among males would raise family food consumption as a result of an income effect and might increase the consumption share of the male family members so as to permit higher male labour force participation. Similarly, higher wages or greater employment opportunities among females might raise total food consumption, as well as the consumption share of the female family members.

- The share of children in food consumption might be affected by changes in the current and future earning streams, if this were related to their current nutrition.

- General food subsidies would raise household food consumption as a result of both income and substitution effects, but they would normally not affect food distribution within the family.

Bargaining Models

Bargaining models may subsume the neoclassical distributional effects arising from the general equilibrium process just noted, but they also include the bargaining effects of food interventions. Various bargaining groups have been distinguished leading to different outcomes. The most common is the male-female distinction; another distinction is

generational. In these models, the distribution of family food resources depends in part on the bargaining strength of such groups. For example, the consumption of females will vary positively not only with household income, but also with the amount of control females have over family income (for instance, through outside earnings).

In this context, children may be treated in a variety of ways:

- Version B1: Children are part of the bargaining groups of their mothers.
- Version B2: Daughters are part of the bargaining groups of their mothers, and sons are part of the bargaining groups of their fathers.
- Version B3: Children form bargaining groups of their own.

According to the first version (B1), children will fare better if mothers receive income directly (through their own earnings, or through subsidies they receive), or if food support goes directly to children (direct feeding schemes), rather than if the extra income goes to raising household income via male earnings.

According to the second version (B2), daughters will fare better where the extra income or subsidies goes directly to the mothers or to themselves, while sons will benefit from extra male incomes.

According to the third version (B3), food interventions have the greatest effect if they are aimed directly at children. Child nutrition would also benefit from extra child earnings.

What is the Reality?

Empirical research is at a very early stage in this area. Moreover, the observed facts are often consistent with more than one model, while one can never directly observe objective functions (Folbre 1986). But, both the facts and intuition lend support to the view that no single one of the models accurately represents reality, while aspects of each are present - to a varying extent - in different context.

The altruistic view of the family in the *neoclassical model* may contain some (Darwinian) truth, but the evidence suggests that this model does not tell the whole story, as it is inconsistent with the observed inequalities, especially between men and women. While inequalities in relation to recommended calorie needs have been widely observed in Asia (for example, in Bangladesh, India and the Philippines: see Haaga and Mason 1987,

Folbre 1986, Chen et al. 1981), such inequalities have not been obvious in Africa (Deaton 1987, Svedberg 1990). Although neoclassicists have suggested that this type of inequality is consistent with joint family utility maximization because of the greater earning capacity of males, this does not appear sufficient to explain the discrepancy in Asia entirely, and Behrman and Kenan have suggested that a "pro-male bias" exists over and above investment considerations.

As to the *bargaining models*, there is substantial evidence that basic needs consumption rises as a proportion of family income (and that child nutrition improves) as the bargaining position of females is strengthened through greater female earnings or better female education (for example, see Guyer 1980, Miller 1981, Tripp 1981, Sahn 1990, Hoddinott and Haddad 1991). This supports version B1 of the bargaining model. However, while child nutrition in general improves with an improved position of mothers in the family, there is some evidence that the nutrition of daughters improves the most (for an example from the Philippines, see Villasenor 1982), lending some support to model B2. Finally, there is some evidence that the nutrition of girls improves as their actual or potential wages rise (Villasenor 1982) and that the nutrition of boys improves with their earnings (Harriss 1992), lending some credence to the model B3.

Despite this rather confusing situation, the following conclusions can be made regarding the alternatives among food interventions.

1. In so far as all poor families belong to the target group, any intervention which increases the income of poor families will be satisfactory.
2. If improvements in the nutrition of the whole family are the objective, general food subsidies are preferable to other mechanisms for transferring income because of the substitution effect. Mechanisms which transfer income to women are also more effective than are general increases in income because of the greater propensity of women to spend any extra resources they control on food.
3. If a subset of the family, such as women or children, is the target, then the evidence supporting bargaining-type models is strong enough to suggest that mechanisms which increase the control of women or children over resources will be preferable to those which increase male incomes. Thus, in this case, the mechanisms which should be favoured include:

- Raising the wages of and the employment opportunities and credit available to females.

- Providing subsidies directly to women.
- Using direct feeding schemes such as pre-school or school meal programmes.
- Mechanisms which raise the incomes of children would also be effective, but most forms of child labour are undesirable for other reasons.

This brief examination of household "models" clearly suggests the existence of another source of potential E and F-mistakes that has been otherwise ignored in this paper. Assuming that the target population is a subcategory within poor households, both the E-mistakes and the F-mistakes are likely to be more serious than is implied by the data presented earlier on in this paper, which treated the entire family as the target. E-mistakes inevitably arise as non-target family members share in additional consumption. F-mistakes arise if the real target group does not receive extra consumption. However, most of the evidence shows that the food consumption and nutrition of children increase with family income, so that children are not usually left out as income rises (for example, see Villasenor 1982). Thus, while F-mistakes may not be greater than suggested in the estimates presented earlier in this paper, the target group may not benefit to the maximum extent.

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