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**A Theory of Child Targeting**

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# A Theory of Child Targeting\*

Olivier Bargain<sup>†</sup>      Olivier Donni<sup>‡</sup>

## Abstract

There is a large empirical literature on policy measures targeted at children but surprisingly very little theoretical foundation to ground the debate on the optimality of the different instruments. In the present paper, we examine the merit of targeting children through two general policies, namely selective commodity taxation and cash transfer to family with children. We consider a household that comprises an adult and a child. The household behavior is described by the maximization of the adult's utility function, which depends on the child's welfare, subject to a budget constraint. The relative effects of a price subsidy and of a cash benefit on child welfare are then derived. In particular, it is shown that 'favorable' distortions from the price subsidies may allow to redistribute toward the child. The framework is extended to account for possible paternalistic preferences of the State. Finally, it is shown that, in contrast to the traditional view, well-chosen subsidies can be more cost effective than cash transfers in alleviating child poverty.

**Key Words** : commodity taxation, child benefit, targeting, intrahousehold distribution, social welfare, paternalism, labeling.

**Classification JEL** : D13, D31, D63, H21, H31.

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# 1 Introduction

The rise in child poverty is a recent source of concern for governments in developed countries.<sup>1</sup> In response to a tightening of government finance, however, the emphasis on designing efficient poverty-alleviation programs is central. One of the most natural policy to improve child welfare consists in making cash transfers to families with children. This raises issues of agency because cash transfers are not made directly to the intended recipients (i.e., children), but supplement instead the income of adults with the assumption that the standard of living of children will improve as well. Even if adults and children are altruistically linked, decisions regarding children's consumption are ultimately made by adults and the impact of cash transfers may be partially or totally neutralized by the intra-household redistribution process.

Typically, cash transfers do not create distortions and have only an income effect on household behavior. A completely different strategy to improve child standard of living consists in modifying the price structure by subsidizing (or taxing) some well-chosen goods. The change in consumer prices due to subsidies will then create a distortion of the household consumption bundle that may be favorable to children. The result seems straightforward in the case of child-specific goods: price cuts may incite parents to purchase these goods and hence improve children's situation. Yet, the final impact on child welfare remains unclear since the subsidies may be offset by a reduction of intra-household allocations to children. To which extent these 'favorable' distortions can be used as a targeting device is an open question.

Despite the large literature on child poverty, there are surprisingly little theoretical grounds to assess alternative policies in the light of intra-household mechanisms.<sup>2</sup> The present paper contributes filling the gap. We consider a household comprising an egoistic child and a benevolent adult and suppose that the decisions about consumption are exclusively made by the adult. This simple framework allows us to characterize how variations in income and prices may affect the well-being of children and adults within the household. By this means, we can examine the cost efficiency of price subsidies and cash transfers in improving the child wel-

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<sup>1</sup>This is illustrated by numerous recent books and articles. The concern is especially acute in the US and in the UK. In the UK, for instance, the official objective of the Labour Government is to "eradicate child poverty" within 20 years. The recent policy orientations for that purpose are evaluated by Sutherland and Piachaud (2001). Dickens and Ellwood (2003) suggest a comparison of child poverty in the US and the UK.

<sup>2</sup>One of the rare exceptions is presented by Cigno et al. (2003). These authors use a principal-agent framework to study government policies that aim at improving the welfare of children.

fare in a representative household or in reducing child poverty in a continuum of households.<sup>3</sup> In particular, we suggest an original definition of child poverty based on the income accruing to the child, while the usual practice assumes instead that a poor child is one living in a poor family. Remark that we focus in this paper on instantaneous financial poverty and not on questions and policies related to children's development, equality of opportunities and lifetime poverty.

Our main results can be summarized as follows. First, we formally derive the conditions under which a subsidy placed on a particular good – whether consumed by both members or only by the child – improves child welfare. We also suggest a simple rule to select goods for which the subsidy will have the largest impact on child welfare. Second, we characterize the level of subsidy below which this policy dominates a cash benefit, when both instruments are implemented on the same cost basis. We study how results are altered when the social planner has paternalistic preferences. Third, we derive the conditions under which price subsidies dominate cash transfers in child poverty reduction. The traditional view tends to favor cash transfers since subsidies increase with the level of income and hence are less targeted at the poorest. Yet, in the case of child poverty, the intra-household redistribution due to price distortions counteracts this effect and provides an argument in favor of subsidies.

The paper is structured as follows. In Section 2, we present an overview of the empirical research on policies designed to reduce child poverty. In Section 3, we describe the altruistic model of household behavior and its implications on the intra-household distribution of resources. In Section 4, we compute the impact of the subsidies and cash transfers on the child's welfare. In Section 5, we evaluate the efficiency of both policies on child poverty. Section 6 concludes.

## 2 What Do Empirical Studies Tell Us?

Before presenting the model and our theoretical results, it is interesting to review the empirical findings on how children benefit from the current economic policies designed to alleviate child poverty. There is a large stream of empirical research that examines the efficiency of the recent pro-child reforms carried out in industrialized countries. Even if these results are not conclusive on what should be the

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<sup>3</sup>The approach is inspired from the literature on targeting but differs to the extent that the targeted person is located within a household. See Kanbur and Stern (1987), Besley and Kanbur (1988, 1993), Besley (1990), Keen (1992) and Kanbur et al. (1994) for seminal contributions in targeting theory and Haddad and Kanbur (1992) for an introduction to intra-household targeting.

best institutional strategy to reduce child deprivation, they highlight the different aspects that must be included in a theoretical framework like ours.

First of all, several authors exploit variations in the child benefit legislation from 1997 to 2000 in the United Kingdom. Results are mixed. Examining data from the Family Expenditure Survey, Gregg et al. (2006) show that low-income families spend a higher share of their budget on children's clothing and footwear and a lesser on adults' clothing than before reforms. In contrast, Blow et al. (2003) find that child benefits are disproportionately spent on alcohol and women's clothing. They interpret this as evidence that altruistic parents insure their children against shocks by spending constant amounts on child goods while unexpected fluctuations in child benefits are used to consume adult goods. This seems to be confirmed by Gordon et al. (2000). These authors present some evidence that low-income families do not spend much less money on children than (slightly) higher-income household since parents tend to make sacrifices to provide their children with essentials. In these circumstances, increasing cash transfers toward families with children may end up improving the situation of parents more than that of children.<sup>4</sup> These results have two consequences for our own purpose: (i) our child poverty measure must account for the fact that children in poor households – according to standard definitions – are not necessarily 'poor' themselves; (ii) while the degree of altruism is an empirical question, our model must clarify how household preferences, i.e., individual preferences and parents' altruism, shape household expenses on adult and child goods.

The specific instrument considered in aforementioned studies – child benefit – may produce more than a simple income effect. In particular, the money labeled as child benefit could be spent disproportionately more on child goods. On this account too, empirical results are mixed. Some studies find indeed a significant labeling effect (Kooreman, 2000, Madden, 1999, Grogan, 2004) while other do not (Edmonds, 2002). At least three different explanations underlie this effect. Firstly, recipients may use different mental accounts for different expenditure categories, a phenomenon which limits the fungibility of income and constraints consumption patterns in certain ways (Thaler, 1999). Secondly, the label alters adults' preferences because they feel a moral obligation to comply with it. Thirdly, the identity of the recipient in the household may matter, while child benefits are typically paid to the main carer. In addition, benefit payments may be treated differently from other incomes because they differ with respect to their periodicity, to their fluctu-

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<sup>4</sup>Similar conclusions are drawn by Mayer (1997) with US data.

ation over time, etc. In this case, the effect could be inverse compared to the usual labeling effect, i.e., the propensity to spend on children from child benefits could be smaller than from other incomes as suggested by the interpretation of Blow et al. (2003) above.

As in Besley and Kanbur (1988), we focus on two archetypal instruments, namely a price subsidy and a cash transfer. This choice is natural. First, these policies may be found as such in actual systems. Universal or means-tested child benefits are in force in many Western countries while several examples of VAT reductions on child-specific goods exist, e.g., children's clothing in the United Kingdom and Ireland, milk and nappies in Canada, dairy products, child furniture, school equipment and a variety of other child goods in Russia. Second, even if many other policies are suggested to combat child poverty, most instruments boil down to a combination of price and income effects, and are thereby covered by our model. There is one important restriction to this statement, however. When possible, governments impose a means-test on benefits to improve targeting and reduce costs. Child benefits or tax reduction for the presence of children are often conditional on the level of income. Therefore, we shall consider this additional feature in the last section, when treating the relative impact of price and income policies on child poverty.

Finally, a specific type of transfer which is not explicitly treated in our model is in-kind benefits. The latter deserve attention, though, as they are often implemented to support children. These benefits correspond to a ration of a certain good that is given or made available below the market price. First, the nature of the offered or subsidized good (e.g., free milk, free school) possibly reflects some paternalistic behaviors of the State. We explicitly extend our model to account for (de)merit goods hereafter. Second, these benefits can potentially be sold again, and are thereby presented as equivalent to cash transfers. Nonetheless, labeling effects may come into play so that this equivalence may not hold. This point is discussed in the case of food stamps in the US (Currie, 2002, Whitmore, 2002) or free milk and free lunch vouchers in the UK (Bingley and Walker, 2002).

### 3 An Altruistic Model of Household Behavior

#### 3.1 Preferences and the Decision Process

In our framework, a household which comprises an adult ( $a$ ) and a child ( $c$ ) makes decisions about consumption.<sup>5</sup> The  $n$ -vectors of goods consumed by the adult and the child are denoted by  $\mathbf{x}^a = (x_1^a, \dots, x_n^a)'$  and  $\mathbf{x}^c = (x_1^c, \dots, x_n^c)'$ , respectively. The child is egoistic and her utility is given by:

$$U^c = u^c(\mathbf{x}^c),$$

whereas the adult is altruistic in the sense of Becker, so that her ‘total’ utility can be written as:

$$U^a = W[u^a(\mathbf{x}^a), u^c(\mathbf{x}^c)], \tag{1}$$

where  $u^a(\mathbf{x}^a)$  is the adult’s sub-utility function. To make things easier, however, we use a slightly more restrictive form and suppose that the total utility function (1) is additively separable:

$$U^a = u^a(\mathbf{x}^a) + \rho u^c(\mathbf{x}^c), \tag{2}$$

where  $\rho > 0$  represents the weight given by the adult to the child.<sup>6</sup> The functions  $u^a(\mathbf{x}^a)$  and  $u^c(\mathbf{x}^c)$  are strictly increasing, strictly concave and differentiable in all their arguments. Note that, in this formulation, there is no difference between how the child and the parent perceive child welfare.

We suppose that the adult always gets her way. This seems reasonable for investigating economic policies that aim at reducing poverty among young children (who are not in position to voice an opinion). Thus, the optimization program can be written as:

$$\max_{\mathbf{x}^a, \mathbf{x}^c} u^a(\mathbf{x}^a) + \rho u^c(\mathbf{x}^c) \quad \text{s.t.} \quad \mathbf{p}'(\mathbf{x}^a + \mathbf{x}^c) \leq Y, \quad \mathbf{x}^a \geq 0, \quad \mathbf{x}^c \geq 0 \tag{3}$$

where  $\mathbf{p} = (p_1, \dots, p_n)'$  is the vector of prices and  $Y$  is the household total income. Solving first order conditions, with the budget constraint, yields:

$$\mathbf{x}^g = \mathbf{x}^g(\mathbf{p}, Y), \tag{4}$$

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<sup>5</sup>Our analysis can be seen as restricted to lone parents, which is a relevant focus group with respect to child poverty. We may also suppose that the father and the mother behave as a single decision maker.

<sup>6</sup>This simplification does not fundamentally alter the main conclusions of the paper.



where  $\mathbf{x}^g(\mathbf{p}, Y)$  denotes the vector of individual demands for the member  $g$  ( $g = a, c$ ). These functions are traditional Marshallian demands and thus satisfy the Slutsky condition. Since the optimization program is additively separable, these demands have other properties that will be examined below.

The present framework is completely standard. In particular, the separability of the child's consumption is accepted by the majority of economists, even if not without reservations (Gronau, 1988), and is a crucial component of the welfare analysis that follows. The decision process described by the optimization program (3) is also compatible with the various representations of multi-person households found in the literature such as the Rotten Kid model (Becker 1974, 1991), the Consensus model (Samuelson, 1956), the Pareto model (Apps and Rees, 1988) or the Rothbarth model (Gronau, 1991). The collective model (Chiappori, 1988), however, differs from our set-up in that the weight of each person in the household is supposed to be a function of the price system and income.

### 3.2 The Properties of Household Demands

The separability of the adult's optimization program allows us to proceed with a two-stage budgeting interpretation of the decision process. Firstly, income is divided between the adult and the child according to some rule; secondly, the consumption vectors are chosen *as if* each individual maximized her own utility subject to her own share of income.<sup>7</sup>

We shall first examine how the sharing rule is determined. To do so, let  $v^g(\mathbf{p}, \phi_g)$  be the member  $g$ 's indirect sub-utility function where  $\phi_g$  is her share of income. The latter is the solution to:

$$\max_{\phi_a, \phi_c} v^a(\mathbf{p}, \phi_a) + \rho v^c(\mathbf{p}, \phi_c) \quad \text{s.t.} \quad \phi_a + \phi_c = Y. \quad (5)$$

The first order condition of this program is:

$$\frac{\partial v^a}{\partial \phi_a} - \rho \frac{\partial v^c}{\partial \phi_c} = 0. \quad (6)$$

Once income is divided between the child and the adult, each of them maximizes her utility subject to her own budget constraint. That is,

$$\max_{\mathbf{x}^g} u^g(\mathbf{x}^g) \quad \text{s.t.} \quad \mathbf{p}'\mathbf{x}^g \leq \phi_g, \quad \mathbf{x}^g \geq 0. \quad (7)$$

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<sup>7</sup>Of course, we do not claim that young children actually maximize a utility function. This is only a convenient representation of the decision process.

Hence, the individual demands are characterized by the following structure:

$$\mathbf{x}^g = \mathbf{x}^g(\mathbf{p}, \phi_g),$$

where  $\mathbf{x}^g(\mathbf{p}, \phi_g)$  is a vector of Marshallian demands, expressed as functions of  $\mathbf{p}$  and  $\phi_g$ . To simplify notation, let  $\phi = \phi_c$  and  $Y - \phi = \phi_a$ , where  $\phi(\mathbf{p}, Y)$  is the ‘sharing rule’. This function has properties that we examine below.

### 3.2.1 The Effect of Income on the Sharing Rule

To compute the derivative of the sharing rule with respect to income, we differentiate the first order condition (6) with respect to  $Y$  and obtain:

$$\frac{\partial^2 v^a}{\partial \phi_a^2} \left( 1 - \frac{\partial \phi}{\partial Y} \right) - \rho \frac{\partial^2 v^c}{\partial \phi_c^2} \frac{\partial \phi}{\partial Y} = 0. \quad (8)$$

We use the following notation:

$$\frac{\partial v^g}{\partial \phi_g} = \lambda_g, \quad \frac{\partial^2 v^g}{\partial \phi_g^2} = \lambda'_g,$$

noticing that  $-\lambda'_g/\lambda_g$  is a measure of concavity of member  $g$ ’s sub-utility. This measure will hereafter be referred to as the (absolute) *income fluctuation aversion* of member  $g$ . Then, using expressions (6) and (8), the effect of income on the sharing rule can be written as:

$$\frac{\partial \phi}{\partial Y} = \frac{\lambda'_a}{\lambda'_a + \rho \lambda'_c} = -\frac{\lambda'_a/\lambda_a}{\theta} \quad \text{with} \quad \theta = -\left( \frac{\lambda'_a}{\lambda_a} + \frac{\lambda'_c}{\lambda_c} \right) > 0. \quad (9)$$

Thus, the effect of income on the sharing rule is comprised between zero and one: the expenditure devoted to the child is a normal good for the adult, which is hardly controversial.<sup>8</sup> Moreover, the share of each additional unit of income accruing to the child is equal to the ratio of the adult’s aversion to the sum of both members’ aversion. That is to say, the increment of income will accrue more importantly to the household member located on the least curve portion of her utility function. Hence the intuition of Blow et al. (2003), according to which children are insured against fluctuations in income, means that the child’s utility function at the equilibrium point is much more concave than that of the husband.

The sum of both members’ income fluctuation aversions, denoted above by  $\theta$ , has an attractive interpretation in terms of complementarity: as demonstrated in

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<sup>8</sup>The normality of the child’s welfare, however, is not general but comes from the additivity property of the adult’s utility function.

appendix A, it corresponds to the derivative of the benevolent parent's marginal rate of substitution, computed at the equilibrium, between the child's allocation  $\phi$  and the parent's allocation  $Y - \phi$  (i.e.,  $\partial^2 \phi_c / \partial \phi_a^2$  when the adult's total utility is hold constant). In other words, it measures the convexity of the preferences of the benevolent parent regarding allocations  $\phi$  and  $Y - \phi$ . If the latter tend to be perfect substitutes (complements), the indifference curve of the altruistic parent tends to be linear (right-angled) and  $\theta$  tends to zero (infinity). The term  $\theta$  will thus be referred to as an *index of complementarity* hereafter.

### 3.2.2 The Effect of Prices on the Sharing Rule

To compute the derivative of the sharing rule with respect to prices, we differentiate the first order condition (6) with respect to  $p_k$  and obtain:

$$\left( \frac{\partial^2 v^a}{\partial \phi_a \partial p_k} - \frac{\partial^2 v^a}{\partial \phi_a^2} \frac{\partial \phi}{\partial p_k} \right) - \rho \left( \frac{\partial^2 v^c}{\partial \phi_c \partial p_k} + \frac{\partial^2 v^c}{\partial \phi_c^2} \frac{\partial \phi}{\partial p_k} \right) = 0. \quad (10)$$

Now, from Roy's identity, we have:

$$\frac{\partial v^g}{\partial p_k} = -\lambda_g x_k^g, \quad \frac{\partial^2 v^g}{\partial p_k \partial \phi_g} = -\lambda'_g x_k^g - \lambda_g \frac{\partial x_k^g(\mathbf{p}, \phi_g)}{\partial \phi_g}. \quad (11)$$

Using these expressions in equation (10) leads to:

$$\frac{\partial \phi}{\partial p_k} = -\frac{1}{\theta} \left[ \left( \frac{\lambda'_c}{\lambda_c} x_k^c - \frac{\lambda'_a}{\lambda_a} x_k^a \right) + \left( \frac{\partial x_k^c(\mathbf{p}, \phi_c)}{\partial \phi_c} - \frac{\partial x_k^a(\mathbf{p}, \phi_a)}{\partial \phi_a} \right) \right].$$

This expression may be either positive or negative. Now, using expression (9) and simplifying, we obtain:

$$\frac{\partial \phi}{\partial p_k} = x_k^c - R_k - \frac{\partial \phi}{\partial Y} x_k, \quad (12)$$

where  $x_k = x_k^a + x_k^c$  and

$$R_k = \frac{1}{\theta} \left( \frac{\partial x_k^c(\mathbf{p}, \phi_c)}{\partial \phi_c} - \frac{\partial x_k^a(\mathbf{p}, \phi_a)}{\partial \phi_a} \right). \quad (13)$$

There are three terms in the right hand side of expression (12). Of course, the last term is a 'conventional' income effect: the child endowment decreases because the real income of the household is reduced by the rise in the price of good  $k$ . The first two terms play a major role in the derivation of optimal subsidies. They also have a precise interpretation, which is now examined.

### 3.2.3 The Interpretation of $(x_k^c - R_k)$

The sum of the first two terms in expression (12) can be seen as a compensated effect of the price  $p_k$  on the sharing rule. To illustrate this point, let us remark that the sharing rule coincides, by definition, with the expenditure made by the household on the child's consumption, that is,  $\phi = \sum_{j=1}^n p_j x_j^c(\mathbf{p}, Y)$ . If we differentiate this expression with respect to  $p_k$ , and use the Slutsky equation, we obtain:

$$\frac{\partial \phi}{\partial p^k} = x_k^c + \sum_{j=1}^n p_j \omega_{jk}^c - \sum_{j=1}^n p_j \frac{\partial x_j^c(\mathbf{p}, Y)}{\partial Y} x_k \quad (14)$$

where

$$\omega_{jk}^c = \frac{\partial x_j^c(\mathbf{p}, Y)}{\partial p_k} + \frac{\partial x_j^c(\mathbf{p}, Y)}{\partial Y} x_k$$

is a traditional substitution term. The last term on the right-hand-side of (14) is clearly the income effect described above and the first term is the variation in the sharing rule that maintains the child's utility constant. The second term is thus a money-metric measure of the variation in the child's utility induced by the price increase when the adult's total utility is maintained constant. The sum of the first two terms is the corresponding compensated effect, that is, the change in the child's share resulting from a simultaneous variation in the price  $p_k$  and in income  $Y$  that keeps the adult's total utility unaffected. Combining these results with expression (12), the term  $R_k$  can be written as:

$$R_k = - \sum_{j=1}^n p_j \omega_{jk}^c.$$

and compared to expression (13). It turns out that the sum of the substitution effects weighted by the prices is proportionate to the difference between the child's and the adult's Engel curves. This equivalence stems, as explained by Deaton and Muellbauer (1980), from the separability of the adult's total utility function and can be interpreted as follows. First, remark that the real value of a marginal income unit accruing to a family member depends on the price of the good on which this member tends to spend the income unit: the more expensive this good, the lower the purchasing power of the marginal income unit (Christiansen, 1983, p. 362). Then, an increase in the price of good  $k$  will affect the adult's trade-off between devoting a marginal unit of income to the maximization of her own sub-utility function or to the maximization of that of her child. The price increase will depress both members' purchasing powers, but more so for the child if she has a

larger propensity to spend on this good, i.e., if the slope of the Engel curve for good  $k$  is steeper for the child than for the adult. This implies a redistribution of resources from the child to the adult.

### 3.3 Example: The Complementarity Index

To illustrate the properties of the sharing rule and emphasize the role of the complementarity index, we shall consider the case where the adult's and the child's utility functions are of the CARA form:  $u^g = -\exp(-\alpha_g(\mathbf{p}) \cdot \phi_g)$ , where  $\alpha_g(\mathbf{p})^{-1}$  is a linearly homogeneous function of prices  $\mathbf{p}$ . First, the adult's and the child's Engel curves are easily computed using the Roy's identity and are written as:

$$x_k^a = -\left(\frac{\partial \alpha_a / \partial p_k}{\alpha_a}\right) \phi_a, \quad x_k^c = -\left(\frac{\partial \alpha_c / \partial p_k}{\alpha_c}\right) \phi_c,$$

i.e., the impact of the share of income is linear. Similarly, the child's share of income is linear and can be written as:

$$\phi_c = \frac{\alpha_a}{\theta} \cdot Y + \frac{(\ln \alpha_c + \ln \rho - \ln \alpha_a)}{\theta};$$

thus, the parameter of adult's altruism influences the intercept of the sharing rule. In the CARA specification, the individual measures of income fluctuation aversion are constant and corresponds to  $\alpha_g$ , so that the complementarity index  $\theta$  is simply equal to  $\alpha_a + \alpha_c$ . Computed at the equilibrium, this index coincides with the value of the second order derivative of the adult's indifference curve. Clearly enough, however, the value of the complementarity index is not invariant to changes in measurement units; hence its interpretation is complicated. To take a numerical example, let us suppose that  $Y = \pounds 20,000$ ,  $\alpha_a = \alpha_c$  and  $\rho = 1$  so that each member receives  $\pounds 10,000$ . The indifference curves for various values of the complementarity index ( $\theta = 0, \theta = 10^{-4}, \theta = 10^{-3}, \theta = \infty$ ) are drawn in Figure 1. We observe that the equilibrium is defined by the point where the first derivative of the indifference curve is equal to  $-1$  and, at this very point, the second derivative of the indifference curve is equal to  $\theta$ . Moreover, a value of  $\theta$  greater than  $10^{-3}$  represents a considerable degree of complementarity.

## 4 The Impact of Policies on Child Welfare

### 4.1 The Variations in Child's Welfare

In the present section, we examine the marginal impact of two standard policies on child welfare in a representative household: price subsidies – simply defined as

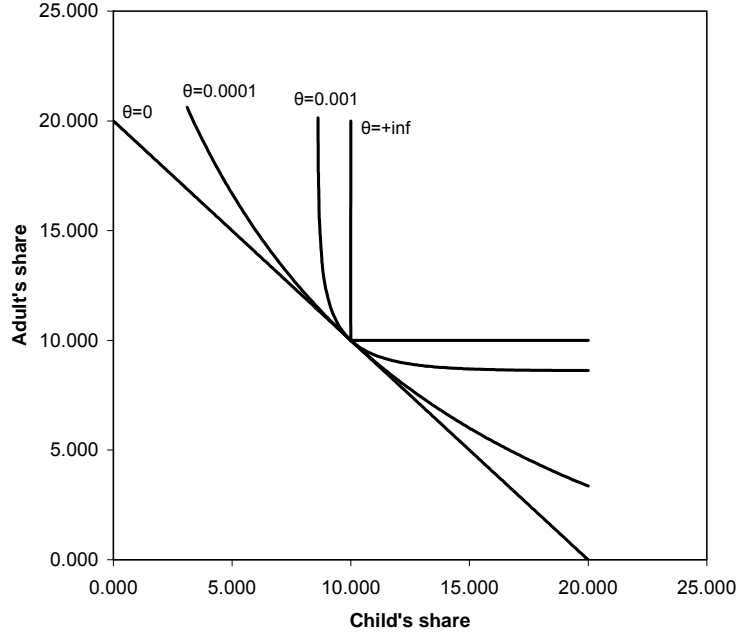


Figure 1: The Degree of Complementarity between Adult and Child Incomes in the Household.

a reduction in the free market price of one good – and lump sum transfers.<sup>9</sup> To do so, we implicitly suppose that (i) the child utility function incorporated in the benevolent parent’s decision process truly reflects child welfare and (ii) the social planner’s anticipation of the child welfare coincides with that of the adult. In addition, the analysis is partial in the sense that the producer prices are constant. One natural interpretation is that prices are determined by world markets.

To begin with, we define a one-dimension measure of the variation in the child’s standard of living. The Hicksian variation  $dV$  that compensates the child for an infinitesimal variation in prices  $d\mathbf{p}$  and income  $dY$  is defined implicitly by:

$$dv^c = \sum_{j=1}^n \left( \frac{\partial v^c}{\partial p_j} \frac{\partial \phi}{\partial p_j} + \frac{\partial v^c}{\partial \phi} \frac{\partial \phi}{\partial Y} \right) dp_j + \frac{\partial v^c}{\partial \phi} \frac{\partial \phi}{\partial Y} dY + \frac{\partial v^c}{\partial \phi} dV = 0.$$

As is usual, the Hicksian variation  $dV$  can be interpreted as a monetary measure

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<sup>9</sup>The study of child poverty necessitates the presence of several households with different income levels, and is postponed until the next section.

of the variation in child's well-being. The explicit form for the variation is:

$$dV = - \sum_{j=1}^n \left( \frac{\partial v^c / \partial p_j}{\partial v^c / \partial \phi_c} + \frac{\partial \phi}{\partial p_j} \right) dp_j - \frac{\partial \phi}{\partial Y} dY. \quad (15)$$

which define the necessary increase in the child's share to keep her as well off in the new environment.

## 4.2 The Marginal Impact of Subsidies<sup>10</sup>

The first question is then to determine whether a marginal increment of the subsidy actually improves the child's welfare and if so, how large is the improvement. To do so, we assume that each unity of good  $k$  is subsidized at a constant rate. Hence  $ds_k = -dp_k > 0$  where  $s_k$  is the subsidy placed on good  $k$ . Thus, if we use expression (15) and the Roy's identity, and we substitute expression (12) for the derivative of the sharing rule, we obtain the marginal impact of the subsidy on cash-equivalent welfare:

$$dV = \left( x_k \frac{\partial \phi}{\partial Y} + R_k \right) \cdot ds_k. \quad (16)$$

The first term in this expression,  $x_k (\partial \phi / \partial Y)$ , is positive. This is the traditional income effect described above. The second term,  $R_k$ , represents the distortions generated by the subsidy that are expected to be favorable to the child. As defined in equation (13), it is equal to the inverse of the complementarity index multiplied by the difference in the slopes of the Engel curves. Specifically, the subsidy will be very effective (i) if the complementarity index is small, i.e., there is some substitutability between the child's and the adult's welfares, and (ii) if the slope of the Engel curve of the child is very steep in comparison with that of the adult (and, in particular, if good  $k$  is superior and exclusively consumed by the child). On the contrary, if the slope of the Engel curve of the adult is large by comparison with that of the child, the subsidy will generate 'bad' distortions and *may* lead to a reduction of the child's well-being. Henceforth, the term  $R_k$  will be referred to as the redistributive or *targeting effect* of the subsidy.

The effectiveness of an economic policy also depends on its cost. Therefore, we compute the marginal impact of the subsidy per unit spent by the social planner. If some goods  $j$  ( $\neq k$ ) consumed by the household are taxed (or subsidized), the

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<sup>10</sup>Since the objective of the social planner is to improve the child's well-being, we concentrate on the marginal impact of subsidies. The marginal impact of taxes, which is simply the opposite, also has empirical relevance.

marginal cost of the subsidy on good  $k$  will incorporate the change in tax revenue due to the rise in the subsidy. This change will depend on the existence of gross substitutability and complementarity relations between good  $k$  and the taxed goods. To make the interpretation of the results easier, however, we thus suppose that the other goods consumed by the household are untaxed.<sup>11</sup> If the total cost of the subsidy is noted  $B = s_k x_k$ , the marginal cost of the subsidy is then given by:

$$dB = \left( x_k - s_k \frac{\partial x_k(\mathbf{p}, Y)}{\partial p_k} \right) \cdot ds_k. \quad (17)$$

We suppose that this expression is positive. Thus, the marginal impact in terms of child's welfare per unit of public budget is given by:

$$dV = \left( x_k \frac{\partial \phi}{\partial Y} + R_k \right) \left( x_k - s_k \frac{\partial x_k(\mathbf{p}, Y)}{\partial p_k} \right)^{-1} \cdot dB. \quad (18)$$

To gain insight into this rule, we compute the marginal welfare gain per budget unit at the no-subsidy situation, i.e., when  $s_k = 0$ , and obtain:

$$dV = \left( \frac{\partial \phi}{\partial Y} + \frac{R_k}{x_k} \right) \cdot dB. \quad (19)$$

Following this expression, the optimal rule for the practitioner who wants to improve children's welfare is simple: the subsidy must be put on the good for which the difference between the slope of the Engel curve of the child and that of the adult, divided by the level of consumption, is the largest.

### 4.3 The Income Elasticity Rule

To implement these results, the social planner must have information about the slopes of Engel curves. However, the identification of these curves for goods consumed by both parent and child is complicated. To make things easier, we shall consider subsidizing goods which are exclusively consumed by the child. This is a desirable situation since the subsidy will necessarily have a positive targeting effect (at least if the exclusive goods are normal). Thus, if good  $k$  is specific to children, the effect of income on demand can be written as:

$$\frac{\partial x_k(\mathbf{p}, Y)}{\partial Y} = \frac{\partial x_k^c(\mathbf{p}, \phi_c)}{\partial \phi_c} \frac{\partial \phi}{\partial Y} \text{ and thus: } \frac{\partial x_k^c(\mathbf{p}, \phi_c)}{\partial \phi_c} = \frac{\partial x_k(\mathbf{p}, Y)}{\partial Y} \Big/ \frac{\partial \phi}{\partial Y}. \quad (20)$$

This preliminary information is useful. Indeed, let us assume that goods  $j$  and  $k$  are exclusively consumed by the child. Then, if we substitute the value (20) for the slope in the marginal impact (19), we obtain the following rule-of-thumb.

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<sup>11</sup>Alternatively, we can suppose that the derivative of the demands for the taxed goods with respect to the price of good  $k$  is equal to zero.



**The Income Elasticity Rule:** *A small subsidy, starting from the no-subsidy situation, will be more effective on good  $k$  than on good  $j$  if and only if*

$$\frac{Y}{x_k} \frac{\partial x_k(\mathbf{p}, Y)}{\partial Y} > \frac{Y}{x_j} \frac{\partial x_j(\mathbf{p}, Y)}{\partial Y},$$

*i.e., the income elasticity of good  $k$  is greater than that of good  $j$ .*

The social planner is thus able to select empirically the ‘child-specific’ good for which the subsidy will have the largest effect on child welfare. The intuition is simple. If the income elasticity of the subsidized good is close to zero, the subsidy will not generate ‘good’ distortions and its impact will simply be comparable to that of a lump sum transfer. On the contrary, if the income elasticity is positive and large, the subsidy will generate favorable distortions and induce the adult to purchase a larger quantity of the subsidized good.

#### 4.4 A Comparison with Lump Sum Transfers

We now suppose that the social planner has the possibility to use lump-sum transfers, such as child benefits, as an additional instrument. The main feature of such transfers is that they are not associated with dead weight loss. We thus question whether the increment in the price subsidy is dominated by a similar increment in a lump-sum transfer, when the social objective is to improve child welfare. To examine this issue, we suppose that  $dY = dT > 0$  where  $T$  is the cash transfer. This way, the marginal impact of the transfer on the child’s welfare is equal to:

$$dV = \frac{\partial \phi}{\partial Y} \cdot dT. \tag{21}$$

The effectiveness of the lump-sum transfer is thus reduced by the fact that the derivative of the sharing rule is less than one. Then, we can establish the difference between the welfare gain of the subsidy and that of the cash transfer for a comparable marginal increase in public budget:

$$\Delta = \frac{\partial V}{\partial B} - \frac{\partial V}{\partial T}.$$

If this expression is positive, a fiscal policy that combines a subsidy placed on good  $k$  financed by lump-sum taxation can be implemented to improve child welfare. To examine that, we use expressions (18) and (21) and show that the marginal impact of the subsidy is larger than that of the cash transfer if

$$\frac{\partial \phi}{\partial Y} \frac{\partial x_k(\mathbf{p}, Y)}{\partial p_k} s_k + R_k \geq 0. \tag{22}$$

In this expression, the first term represents the tax leakage of the subsidy (i.e., the difference between the effect of a marginal increase in the subsidy on the household real income,  $x_k$ , and its effect on the budget of the social planner,  $x_k - s_k \partial x_k(\mathbf{p}, Y) / \partial p_k$ ) multiplied by the derivative of the sharing rule, i.e., the proportion of the tax leakage supported by the child. This is not surprising because, as is well-known, the welfare cost of a fiscal reform that modifies marginal tax rates and returns the money to the household as a cash transfer is equal to the tax leakage (Allgood and Snow, 1998). The first term is, in principle, negative but it is counteracted by the second term: the targeting effect. As seen before, the sign of the targeting effect depends on the difference between the child's and the adult's Engel curves. However, it is always positive when we consider child-specific goods. Interestingly, in the no-subsidy situation, the first term vanishes so that the marginal increase in the subsidy has purely a targeting effect. The main conclusion is that a subsidy placed on well-chosen goods (that is, characterized by large targeting effect) has the potential to dominate cash transfers.<sup>12</sup>

Another important message from equation (22) is that there is no opportunity for intra-household targeting through the channel of the price structure if all the individual demands possess linear Engel curves with common slopes across household members. In this case, the effect of a subsidy would be, at best, equivalent to that of a cash transfer. This is quite natural. Indeed Christiansen (1983) demonstrates that, if Engel curves are linear with a common slope, the ratio of both members' marginal utility of money is independent of prices. This is also reminiscent of a result by Deaton (1979) which determines under which conditions a system of differential taxes can be optimal to attain redistributive objectives. The intuition behind this result is that the preferences obey the Gorman polar form (Gorman, 1953) required for exact aggregation of commodity demands. If such aggregation is possible, then we cannot use variations in prices to distinguish among individual for purposes of redistribution: a cash transfer exhausts our capacity in this regard.

Finally, the introduction of a subsidy will be more favorable to children than that of a cash transfer up to the point where expression (22) is equal to zero, which

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<sup>12</sup>Note, however, that a positive labeling effect of the child benefit would play in favor of this instrument. A simple way to model this effect in our framework consists in writing the weight of the child as a function of the transfers, i.e.  $\rho = \rho(T)$ , with  $\partial \rho / \partial T > 0$ . In this case, it can be shown that the condition (22) is modified by the addition of a negative term which translates the fact that child benefits are disproportionately spent more on child goods than other incomes.

defines an upper threshold  $s_k^*$  for the subsidy:

$$\frac{s_k^*}{p_k} = - \left( \frac{\partial \phi}{\partial Y} \right)^{-1} \left( \frac{p_k}{x_k} \frac{\partial x_k(\mathbf{p}, Y)}{\partial p_k} \right)^{-1} \frac{R_k}{x_k}. \quad (23)$$

The subsidy will be more effective than the transfer as long as  $s_k < s_k^*$ . Therefore, the optimal subsidy rate on good  $k$  is inversely related to its own price elasticity (the efficiency motive, i.e., a typical Ramsey principle) and positively related to the targeting effect divided by  $x_k$  (the redistributive motive). If the social planner assigns a budget  $B$  to improve child welfare, the optimal policy mix thus consists in setting the subsidy on good  $k$  to  $s_k^*$  and distributing the rest of the public budget,  $B - s_k^* x_k$ , as child benefit (or, of course, placing a subsidy on other goods).

## 4.5 Paternalism and (de)merit Goods

One of the major justifications for the interference of the social planner with the household allocation process can be found in the existence of merit or demerit goods (according to Musgrave's original terminology).<sup>13</sup> In a certain sense, the fact that the child's welfare may be deemed a merit good already gives a good reason for the form of public intervention that is examined in the previous sections. Nevertheless, the social planner may go one step further and judge that the preferences used by the adult to determine the child's needs are a 'faulty' representation of the child's well-being. To examine this form of paternalism, we then follow and generalize Besley's (1988) approach to (de)merit goods.<sup>14</sup> That is to say, we suppose that the social planner values the child's consumption differently from the adult and treats the child as having utility defined by:

$$\bar{u}^c(\mathbf{x}^c) = u^c(\bar{\mathbf{x}}^c)$$

with  $\bar{\mathbf{x}}^c = \boldsymbol{\delta} \odot \mathbf{x}^c$  where  $\boldsymbol{\delta} = (\delta_1, \dots, \delta_n)'$  is a vector of positive constants and  $\odot$  is the Hadamard product (i.e., the element-by-element product). If we suppose that all the  $\delta$ 's are equal to one except that of good  $k$  — in other words, governments do respect the choices that the adult make for all the goods except one —, we can classify good  $k$  as a merit good if  $\delta_k > 1$  and a demerit good if  $\delta_k < 1$ .

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<sup>13</sup>In its most general definition, the notion of (de)merit goods is sufficiently vague for our purpose. In what follows, the merit can be the result of externalities in consumption, lack of information, community values and so on. See Musgrave (1987) for a definition of merit goods.

<sup>14</sup>This formulation may have some counter-intuitive implications that are not examined here. Schroyen (2005) suggests an alternative approach but the latter is a little more complicated.

To measure the impact of subsidies, we must compute the child's indirect utility function that takes into account the fact that the adult's decisions are not optimal from the social planner's viewpoint. To do that, we write:

$$\bar{v}^c(\mathbf{p}, \phi_c) = \bar{u}^c(\mathbf{x}^c(\mathbf{p}, \phi_c)).$$

This is not a traditional indirect utility function because the demands for goods are not optimal from the social planner's perspective. In particular, as is demonstrated in appendix B, the Roy's identity does not hold and

$$\frac{\partial \bar{v}^c / \partial p_k}{\partial \bar{v}^c / \partial \phi_c} = - \left( x_k^c + \delta_k \sum_{j=1}^N p_j \bar{\sigma}_{jk} \right), \quad (24)$$

where

$$\bar{\sigma}_{jk} = \frac{\partial \bar{x}_c^j(\bar{\mathbf{p}}, \bar{\phi}_c)}{\partial \bar{p}_k} + x_k^c \frac{\partial \bar{x}_c^j(\bar{\mathbf{p}}, \bar{\phi}_c)}{\partial \bar{\phi}_c},$$

with  $\bar{\mathbf{p}} = \boldsymbol{\delta} \odot \mathbf{p}$  and  $\bar{\phi}_c = \phi_c + \sum_{j=1}^n (\delta_j - 1) p_j x_j^c(\mathbf{p}, \phi_c)$ , is a substitution effect evaluated with the social planner's preferences. In other words, the ratio of the derivatives of the indirect utility function does not coincide with the quantity of the good consumed because of a term which is equal to a weighted sum of substitution effects computed with the social planner's preferences. To interpret this expression, let us note that  $\delta_k \sum_{j=1}^N p_j \delta_j \bar{\sigma}_{jk} = 0$  from the properties of compensated demands, so that expression (24) can be written as:

$$\frac{\partial \bar{v}^c / \partial p_k}{\partial \bar{v}^c / \partial \phi_c} = - \left( x_k + \delta_k \sum_{j=1}^N p_j (1 - \delta_j) \bar{\sigma}_{jk} \right).$$

Hence, the Roy's identity holds if all the  $\delta$ 's are equal to one. Using these results and equation (15), the Hicksian variation associated with the subsidy rise becomes:

$$dV = \left[ x_k \frac{\partial \phi}{\partial Y} + (R_k + P_k) \right] \cdot ds_k,$$

where

$$P_k = \delta_k \sum_{j=1}^N p_j (1 - \delta_j) \bar{\sigma}_{jk}$$

is, by comparison with the case without (de)merit goods, an additional term which represents the *paternalistic effect* of the subsidy. To interpret this expression, let

us suppose that all the  $\delta$ 's are equal to one except that of good  $k$ . The paternalistic effect becomes:

$$P_k = \delta_k p_k (1 - \delta_k) \bar{\sigma}_{kk}.$$

This term is positive – and reinforces the targeting effect – if good  $k$  is a merit good, and negative if good  $k$  is a demerit good. Moreover, its amplitude depends on the size of the own substitution effect (computed with the utility function of the social planner). Now, we may suppose that all the  $\delta$ 's are equal to one except that of some good  $j$  (different from good  $k$ ). The paternalistic effect becomes:

$$P_k = \delta_k p_j (1 - \delta_j) \bar{\sigma}_{jk}.$$

The sign of this term depends on whether goods  $k$  and  $j$  are substitutes or complements. In particular, if goods  $k$  and  $j$  are substitutes, the paternalistic effect is negative for a merit good and positive for a demerit good. On the contrary, if goods  $k$  and  $j$  are complements, the paternalistic effect is positive for a merit good and negative for a demerit good.

One important conclusion at this stage is that the generalization of the theory to (de)merit goods is straightforward: almost all the results remain valid except that the traditional targeting effect must be supplemented by a paternalistic effect. Hence, to simplify notations, we simply ignore this extension in the remainder.

## 5 Targeting Child Poverty

### 5.1 The Definition of Child Poverty

If we now consider the issue of poverty, subsidies may not be as desirable as other instruments. In effect, the cash transfer is identical for all households while the gain due to a subsidy depends on the consumption level of that good. If the good is normal, the subsidy will benefit more to rich households and miss its target. This simple idea is formally presented by Besley and Kanbur (1988, 1993). However, when tackling child poverty, results may differ to the extent that subsidies on certain goods can have redistributive intra-household effect in favor of children. This question – whether child subsidies are more efficient to reduce child poverty than cash transfers – is examined here.

First of all, we specify what we mean by child poverty. Let us assume that households differ only with respect to the income level  $Y$  and denote  $f(Y)$  the

density function of household income in the population. We posit a poverty line  $z$  so that children with  $\phi(\mathbf{p}, Y) \leq z$  are classified as being in poverty. Since the function  $\phi$  is monotonically increasing in  $Y$ , there exists a value  $Z_c$  representing the level of household income at the child poverty line and implicitly defined by  $z = \phi(\mathbf{p}, Z_c)$ . The proportion of poor children is given by:

$$H = \int_0^{Z_c} f(Y) \cdot dY.$$

We then need a (child) poverty index which aggregates information on units below the poverty line. In what follows, we shall use the income gap measure of poverty, which is defined as:

$$P = \int_0^{Z_c} \left( \frac{z - \phi(\mathbf{p}, Y)}{z} \right) f(Y) \cdot dY.$$

For our present concerns, this approach is very simple and convenient, even if insensitive to the distribution of income among poor individuals. Further extensions could look at the results when using alternative measures of poverty.

The important point to be made here is that measures of child poverty usually assume that children in poor households (e.g., households with income below 50% of the median) are children in poverty. Whether this is the case or not depends on how income is shared within the household. Originally, in our framework, we need not to assume equal sharing and focus on resources actually accruing to children to define child poverty. This way, the level of household income  $Z_c$ , defining the limit of child poverty, does not necessarily give a poverty line for the household as a whole or for the adult.

In the following, we assume that the government targets redistributive policies at households with income below  $Z_a$ . In other words, only the  $Z_a$ -population will benefit from the subsidy or the cash transfer. In practice, the choice of the means-test level  $Z_a$  will depend on the information available on household incomes and children costs. We shall consider two polar cases in the sequel: (i) the government is able to identify and target households containing poor children as previously defined, i.e.,  $Z_a = Z_c$ ; (ii) income test is not possible or not desirable and both cash transfers and price subsidies are universal, i.e.,  $Z_a$  corresponds to the highest income in the population. Notice that our problem is monotonous. If  $Z_a < Z_c$ , then  $\phi(\mathbf{p}, Z_a) < z$ , i.e., the ‘richest’ among the poor children will not be targeted. Inversely, if  $Z_a > Z_c$ , the poorest among non-poor children will be targeted.

## 5.2 The Marginal Impact of Subsidies and Transfers

First, the budgetary cost of a subsidy on good  $k$  is simply:

$$B = \int_0^{Z_a} s_k x_k(\mathbf{p}, Y) f(Y) \cdot dY,$$

so that

$$\begin{aligned} \frac{\partial B}{\partial s_k} &= \int_0^{Z_a} \left( x_k(\mathbf{p}, Y) - s_k \frac{\partial x_k(\mathbf{p}, Y)}{\partial p_k} \right) f(Y) \cdot dY \\ &= E_a(x_k) - s_k E_a \left( \frac{\partial x_k}{\partial p_k} \right), \end{aligned} \quad (25)$$

where

$$\begin{aligned} E_a(x_k) &= \int_0^{Z_a} x_k(\mathbf{p}, Y) f(Y) \cdot dY, \\ E_a \left( \frac{\partial x_k}{\partial p_k} \right) &= \int_0^{Z_a} \frac{\partial x_k(\mathbf{p}, Y)}{\partial p_k} f(Y) \cdot dY \end{aligned}$$

are the demand for good  $k$  and its derivative averaged over the  $Z_a$ -population. We then investigate the effect on the child poverty measure of a marginal increment in the budget due to a subsidy on good  $k$ . That is,

$$dP = -\frac{1}{z} \left( \int_0^{Z_c} \frac{\partial V}{\partial B} \cdot f(Y) \cdot dY \right) \cdot dB,$$

or, using the values for  $\partial V/\partial B$ ,

$$\frac{\partial P}{\partial B} = -\frac{H}{z} \times \left[ E_c \left( x_k \frac{\partial \phi}{\partial Y} \right) + E_c(R_k) \right] \times \left[ E_a(x_k) - s_k E_a \left( \frac{\partial x_k}{\partial p_k} \right) \right]^{-1}, \quad (26)$$

where

$$\begin{aligned} E_c \left( x_k \frac{\partial \phi}{\partial Y} \right) &= \frac{1}{H} \int_0^{Z_c} x_k(\mathbf{p}, Y) \frac{\partial \phi}{\partial Y} f(Y) \cdot dY, \\ E_c(R_k) &= \frac{1}{H} \int_0^{Z_c} R_k f(Y) \cdot dY \end{aligned}$$

are the income effect and the targeting effect of the subsidy, averaged over the population of households with a child in poverty. The interpretation of this expression is analogous to that of expression (18). In particular, the subsidy will decrease child poverty if the average targeting effect is positive. However, the cost of the policy is evaluated over the  $Z_a$ -population.

For the sake of comparison, we also measure the marginal impact of a lump-sum transfer. That is,

$$\frac{\partial P}{\partial T} = -\frac{H}{z} E_c \left( \frac{\partial \phi}{\partial Y} \right), \quad (27)$$

where

$$E_c \left( \frac{\partial \phi}{\partial Y} \right) = \frac{1}{H} \int_0^{Z_c} \frac{\partial \phi}{\partial Y} f(Y) \cdot dY.$$

The comparison of the marginal impact of the subsidy and the marginal impact of the transfer is given by:

$$\Delta = \frac{\partial P}{\partial B} - \frac{\partial P}{\partial T}.$$

This expression will be positive if, as easily shown, the following condition is satisfied:

$$s_k E_c \left( \frac{\partial \phi}{\partial Y} \right) E_a \left( \frac{\partial x_k}{\partial p_k} \right) + E_c(R_k) + \left[ E_c \left( x_k \frac{\partial \phi}{\partial Y} \right) - E_a(x_k) E_c \left( \frac{\partial \phi}{\partial Y} \right) \right] > 0. \quad (28)$$

The first two terms are close to those in expression (22) while the last term resembles that in Besley and Kanbur (1988). The first term, corresponding to the tax leakage of the price distortion, is negative but may be set arbitrarily small. The second term is always positive for (normal) child-specific goods. The last term, in square brackets, will generally be negative if there is no means-test. It will be all the smaller as we move from universal to means-tested instruments. To show this, let us assume that  $\partial\phi/\partial Y$  is independent of  $x_k$  and then write the last term as:

$$E_c \left( \frac{\partial \phi}{\partial Y} \right) \times [E_c(x_k) - E_a(x_k)].$$

If both instruments are universal, i.e.,  $E_a$  is the average over the whole population, this expression is certainly negative since the mean consumption in families with poor children is less than the mean consumption in the population. In this case, the targeting effect of price subsidies must be strong for condition (28) to be respected. On the other hand, the means-test of redistributive policies, as often implemented in developed countries, may considerably reduce the size of the third term. In the extreme case where the means-test allows a perfect targeting at poor children, i.e., if  $Z_a = Z_c$ , this last term is null and the price subsidy is unambiguously preferred.<sup>15</sup>

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<sup>15</sup>This conclusion is valid only if  $\partial\phi/\partial Y$  is independent of  $x_k$ . However, there are reasons to believe that  $\partial\phi/\partial Y$  is negatively correlated to  $x_k$ . In that case, the term in square brackets in expression (28) will be negative even for  $Z_a = Z_c$ .



### 5.3 Example: Transfers versus Subsidies

We suppose that means-test is not possible and extend the preceding example with utility functions of the CARA form. The individual demands are linear in  $\phi_g$ , i.e.,  $x_k^g = a_g \phi_g$ , where  $a_g = -((\partial \alpha_g / \partial p_k) / \alpha_g)$ , and the sharing rule is an affine function of  $Y$ , i.e.,  $\phi = \eta_1 + \eta_2 Y$  so that  $z = \eta_1 + \eta_2 Z_c$ . Suppose that the targeting effect is positive for good  $k$ , that is,  $a_c > a_a$ . We then assume that household incomes are uniformly distributed between zero and an upper bound,  $\bar{Y}$ . In that case, the proportion of households with a child in poverty is denoted by  $H = Z_c / \bar{Y}$  and the average demand for good  $k$  is simply equal to

$$\begin{aligned} E(x_k) &= \frac{1}{\bar{Y}} \int_0^{\bar{Y}} [(a_c - a_a) \eta_1 + (a_a(1 - \eta_2) + a_c \eta_2) Y] \cdot dY \\ &= A + BE(Y), \quad \text{with } E(Y) = Y/2 \end{aligned}$$

where  $A = (a_c - a_a) \eta_1 > 0$  and  $B = (a_a(1 - \eta_2) + a_c \eta_2)$  are the parameters of the household demand for good  $k$ .

We shall now compute the marginal impacts of the two policies at the no-subsidy situation. Using expressions (26) and (27), we obtain the marginal impact of the subsidy at  $s_k = 0$ :

$$\frac{\partial P}{\partial B} = -\frac{1}{z} \times H \times \left( A \eta_2 - \frac{B}{2} \eta_1 + \frac{A}{\theta \eta_1} + \frac{B}{2} z \right) \times [A + BE(Y)]^{-1},$$

and the marginal impact of the transfer:

$$\frac{\partial P}{\partial T} = -\frac{1}{z} \times H \times \eta_2.$$

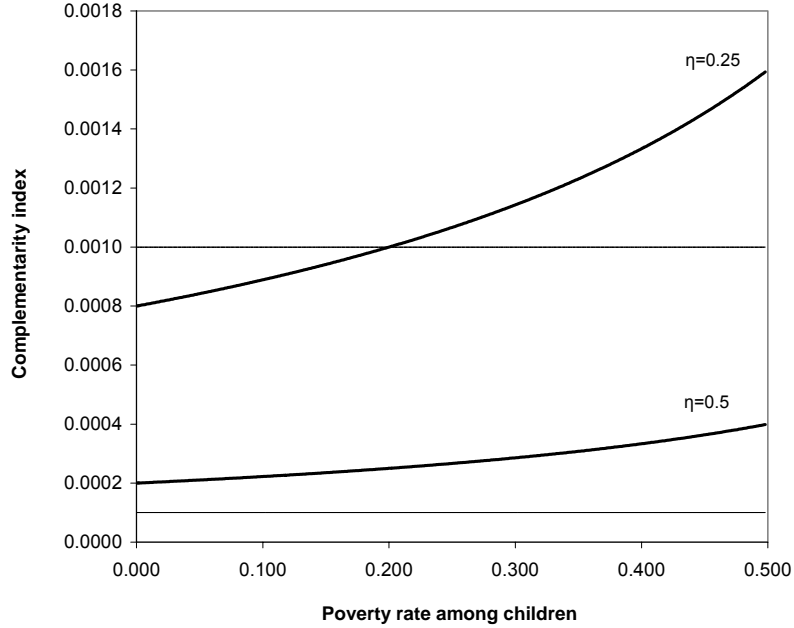
Taking the difference between these two expressions and simplifying, we demonstrate that (from the no-subsidy situation) the subsidy is more efficient than the transfer if and only if the following condition is satisfied:

$$\theta E(Y) < \frac{A}{B \eta_1 \eta_2 (1 - H)}.$$

In particular, the subsidy is especially desirable when the complementarity index (multiplied by average income as a normalization) is small and the poverty rate is large. If good  $k$  is exclusively consumed by the child, this formula simplifies to:

$$\theta E(Y) < \frac{1}{\eta_2^2 (1 - H)}. \quad (29)$$

In this case, the condition does not depend on the parameters of the demand. To illustrate the relative importance of these variables, we shall suppose that  $E(Y) =$



*Dashed lines represent reasonable bounds of the complementarity index ( $10E-4$  and  $10E-3$  respectively). For two different levels of child poverty  $\eta$ , black lines represent limits below which price subsidies are preferred to cash transfers.*

Figure 2: Dominance of Price Subsidy over Cash Transfer in Function of the Levels of Child Poverty and Complementarity Index.

$\pounds 20,000$  and sketch the relation between  $H$  and  $\theta$  as given by inequality (29). In Figure 2, this relation is represented by the upper (lower) line for  $\eta_2 = 0.25$  ( $\eta_2 = 0.50$ ). Dotted horizontal lines depict  $\theta = 10^{-3}$  and  $\theta = 10^{-4}$ , which are, as previously seen, realistic upper and lower bounds for  $\theta$ . If the fraction of  $Y$  given to the child is relatively small ( $\eta_2 = 0.25$ ), the subsidy is more efficient than transfers – true in the area below the upper line – even for a large complementarity index and a small poverty rate. If the child allocation is relatively large ( $\eta_2 = 0.50$ ), the subsidy is more efficient than transfers only if the complementarity index is very small ( $\theta \approx 0.0002$ ).

## 6 Conclusion

Using a general representation of households with children, we have (i) broken down the total effect of price subsidies on child welfare into various components (an income effect, a targeting effect and, possibly, a paternalistic effect); (ii) extracted the set of goods to subsidize in order to yield the largest gain in child

welfare; (iii) characterized the conditions under which a subsidy dominates child benefits in increasing child welfare; (iv) defined the optimal level of price subsidies and the optimal policy mix when both subsidies and direct transfers are allowed. Importantly, the effectiveness of a subsidy (or a tax) as a targeting device depends on the responsiveness of individual consumptions to variations of incomes. In addition, we have extended these results to the problem of poverty alleviation. In particular, the reduction in child poverty may be larger using well-chosen subsidies rather than cash transfers if child poverty is high and the complementarity between the parent's and the child's shares is small.

We believe that the suggested framework is an original attempt to characterize policies aimed to target at certain individuals within the household. With the suggested model, it becomes possible to assess the relative cost efficiency of most policy instruments used to alleviate child poverty. Naturally, future work should overcome some of the primary limitations of this contribution. First, the production side has been ignored in our partial equilibrium analysis. If the supply of subsidized goods is very rigid, its price will increase as the subsidy is introduced and exchanged quantities will not change, canceling distortions but also the targeting effect. Second, our analysis has considered only private goods, while the level of public consumption achieved by the household can be crucial for the welfare of children. Measures of material deprivation often include public durable goods. Nonetheless, it is possible to extend the present model to public goods, as done in the collective model literature. Third, households differ only with the level of income while introducing heterogeneity with respect to other characteristics (household size, the degree of parent's altruism, etc.) would be a difficult but important extension.

Our concluding words concern the empirical implementation of the theoretical tools developed in this paper using real data. The components of the structural model that are retrieved by simple estimations on families with children are sufficient to compute optimal subsidy rates on child-specific goods. In the less restrictive case where all types of goods are to be subsidized, the targeting effect of a subsidy must be recovered empirically. To achieve this, the easiest way consists in employing a Rothbarth-like method (Gronau, 1991), which allows the econometrician to recover the share of income accruing to the child, provided that at least one good is not consumed by the child. Then, the effect of prices on the sharing rule can be broken down into an income effect and a targeting effect. The identification of the targeting effect will allow us to extract the set of goods for which the subsidy will be the most effective. This is the objective of future research.

# Appendix

## A. The Interpretation of the Complementarity Index

If we write the index maximized by the benevolent parent as:  $U^a = v^a(\mathbf{p}, \phi_a) + \rho v_c(\mathbf{p}, \phi_c)$ ; then we compute the marginal rate of substitution between the share of the adult and that of the child as follows:

$$\left. \frac{\partial \phi_c}{\partial \phi_a} \right|_{dU^a=0} = -\frac{\partial v^a / \partial \phi_a}{\rho \partial v^c / \partial \phi_c} = -\frac{\lambda_a}{\rho \lambda_c}$$

A measure of the convexity of the indifference curve of the benevolent parent with respect to  $\phi_a$  and  $\phi_c$  is simply given by:

$$\left. \frac{\partial^2 \phi_c}{\partial \phi_a^2} \right|_{dU^a=0} = -\frac{\lambda'_a}{\rho \lambda_c} - \frac{\lambda'_c \lambda_a^2}{\rho^2 \lambda_c^3}$$

and recalling that  $\lambda_a / \lambda_c = \rho$ :

$$\left. \frac{\partial^2 \phi_c}{\partial \phi_a^2} \right|_{dU^a=0} = -\left( \frac{\lambda'_a}{\lambda_a} + \frac{\lambda'_c}{\lambda_c} \right) = \theta.$$

Then, the term  $\theta$  can also be seen as the derivative of the parent's marginal rate of substitution between  $\phi$  and  $(Y - \phi)$  with respect to the relative implicit prices of child and adult allocations.

## B. The Paternalistic Indirect Utility

The basic point is that the solution of the first order conditions for the maximization of the social planner's representation of the child's welfare is equal to that of the adult's representation for a convenient choice of shadow prices and shadow income. Indeed, from the definition of the utility function of the social planner, we have:

$$\frac{\partial \bar{u}^c(\mathbf{x}^c(\mathbf{p}, \phi_c))}{\partial x_j^c} = \lambda \bar{p}_j,$$

where  $\bar{p}_j = \delta_j p_j$  is the shadow price of good  $j$ . The corresponding shadow income can be written as:

$$\bar{\phi}_c = \phi_c + \sum_{j=1}^n (\delta_j - 1) p_j x_j^c(\mathbf{p}, \phi_c). \quad (30)$$

Hence, the adult behaves as if she maximized the social planner's representation of the child's utility function, though without perceiving the true system of prices and the true sharing rule, that is,

$$\mathbf{x}^c(\mathbf{p}, \phi_c) = \bar{\mathbf{x}}^c(\bar{\mathbf{p}}, \bar{\phi}_c). \quad (31)$$

If we differentiate this expression with respect to  $\phi_c$  and use the definition of the shadow income (30), we can show that the Engel curve slopes associated to these functions are related by an index number correction, that is,

$$\frac{\partial x_i^c(\mathbf{p}, \phi_c)}{\partial \phi_c} = \frac{\partial \bar{x}_c^i(\bar{\mathbf{p}}, \bar{\phi}_c)}{\partial \bar{\phi}_c} \left( \sum_{j=1}^n \bar{p}_j \frac{\partial x_j^c(\mathbf{p}, \phi_c)}{\partial \phi_c} \right), \quad (32)$$

where the term in parentheses on the right-hand-side represents a money metric measure of the variation in the child's welfare, as perceived by the social planner, that results from an increase in the child's share. Similarly, if we differentiate expression (31) with respect to  $p_j$ , we obtain:

$$\frac{\partial x_i^c(\mathbf{p}, \phi_c)}{\partial p_j} = \frac{\partial \bar{x}_c^i(\bar{\mathbf{p}}, \bar{\phi}_c)}{\partial \bar{p}_j} \delta_j + \frac{\partial \bar{x}_c^i(\bar{\mathbf{p}}, \bar{\phi}_c)}{\partial \bar{\phi}_c} \left( \delta_j x_j^c + \sum_{k=1}^n \delta_k p_k \frac{\partial x_k^c(\mathbf{p}, \phi_c)}{\partial p_j} \right). \quad (33)$$

If we use the relation between the slopes of the Engel curves (32) and the Slutsky equation, with the following definitions:

$$\sigma_{ij} = \frac{\partial x_i^c(\mathbf{p}, \phi_c)}{\partial p_j} + x_j^c \frac{\partial x_i^c(\mathbf{p}, \phi_c)}{\partial \phi_c}, \quad \bar{\sigma}_{ij} = \frac{\partial \bar{x}_c^i(\bar{\mathbf{p}}, \bar{\phi}_c)}{\partial \bar{p}_j} + x_j^c \frac{\partial \bar{x}_c^i(\bar{\mathbf{p}}, \bar{\phi}_c)}{\partial \bar{\phi}_c},$$

we can write expression (33) as:

$$\sigma_{ij} \sum_{k=1}^n \bar{p}_k \frac{\partial x_k^c(\mathbf{p}, \phi_c)}{\partial \phi_c} = \delta_j \bar{\sigma}_{ij} \sum_{k=1}^n \bar{p}_k \frac{\partial x_k^c(\mathbf{p}, \phi_c)}{\partial \phi_c} + \frac{\partial x_i^c(\mathbf{p}, \phi_c)}{\partial \phi_c} \sum_{k=1}^n \bar{p}_k \sigma_{kj}.$$

Multiplying both members by  $p_k$ , summing over each  $k$  and using the Cournot and Engel aggregation conditions give:

$$\sum_{k=1}^n \bar{p}_k \sigma_{kj} = \delta_j \left( \sum_{k=1}^n p_k \bar{\sigma}_{kj} \right) \left( \sum_{k=1}^n \bar{p}_k \frac{\partial x_k^c(\mathbf{p}, \phi_c)}{\partial \phi_c} \right)$$

This relation establishes a link between the substitution effects associated to  $\mathbf{x}^c(\mathbf{p}, \phi_c)$  and  $\bar{\mathbf{x}}^c(\bar{\mathbf{p}}, \bar{\phi}_c)$  respectively. This expression as well as expression (32) above will be used to compute the Roy Identity for the paternalistic indirect utility function. First, the derivative of the indirect utility function with respect to  $p_k$  is equal to:

$$\frac{\partial \bar{v}^c}{\partial p_j} = \sum_{k=1}^n \frac{\partial \bar{u}^c}{\partial x_k^c} \frac{\partial x_k^c(\mathbf{p}, \phi_c)}{\partial p_j} = \lambda \sum_{k=1}^n \bar{p}_k \frac{\partial x_k^c(\mathbf{p}, \phi_c)}{\partial p_j},$$

and, similarly, the derivative with respect to  $\phi_c$  is equal to:

$$\frac{\partial \bar{v}^c}{\partial \phi_c} = \sum_{k=1}^n \frac{\partial \bar{u}^c}{\partial x_k^c} \frac{\partial x_k^c(\mathbf{p}, \phi_c)}{\partial \phi_c} = \lambda \sum_{k=1}^n \bar{p}_k \frac{\partial x_k^c(\mathbf{p}, \phi_c)}{\partial \phi_c}.$$

Thus, if we assume that  $\partial \bar{v}^c / \partial \phi_c \neq 0$ , we obtain:

$$\frac{\partial \bar{v}^c / \partial p_j}{\partial \bar{v}^c / \partial \phi} = \frac{\sum_{k=1}^n \bar{p}_k (\partial x_k^c(\mathbf{p}, \phi_c) / \partial p_j)}{\sum_{k=1}^n \bar{p}_k (\partial x_k^c(\mathbf{p}, \phi_c) / \partial \phi_c)}.$$

The Roy's identity does not apply here. If we use the Slutsky equation and expressions (32) and (33) above, we obtain formula (24) in the main text.

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