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Welfare Enhancing Marginal Tax Rates: The Case of Publicly Provided Day Care

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Sammanfattning

Tidigare studier har visat att offentligt tillhandahållande av en viss typ av privata varor kan underlätta omfördelning då det föreligger asymmetrisk information om individers produktivitet. I denna uppsats fokuserar vi på hur skattefinansierad barnomsorg kan underlätta inkomst-omfördelning mellan högproduktiva och lågproduktiva individer. Vi visar att en optimal icke-linjär inkomstskatt skall vara beskaffad så att individerna via marginalskatten möter samhällets produktionskostnad av att tillhandahålla barnomsorg. I denna mening är inte den offentligt tillhandahållna barnomsorgen subventionerad; istället för att individerna betalar för den via marknaden betalar de för den via skatten. Att betalningen sker via skatten och inte via marknaden är dock av fundamental betydelse för att kunna lösa upp den själv-selektionsrestriktion som följer av den asymmetriska informationen. Att betalningen sker via skatten istället för via marknaden innebär att en extra börda drabbar en högproduktiv agent som låtsas vara lågproduktiv, vilket gör imiterande mindre attraktivt. Vi visar även att offentligt tillhandahållande av en privat vara kan vara strikt förbättra för alla parter även om preferenserna för barnomsorg och arbete är heterogena.

Abstract

There is a well established case for public provision of certain private goods when the government pursues income redistribution under asymmetric information about the skill levels of the agents of the economy. This paper highlights the role of tax funding of day care for children, which is a striking example of a valid case for public provision. We demonstrate that the optimal income tax should face all agents with the (social) cost of the day care they need in order to earn further income. In this sense day care should not be subsidised. It is simply paid for via the tax bill. However, such a payment scheme, rather than a day care fee, is crucial for alleviating the self-selection constraint of the asymmetric information, non-linear income tax model, as it imposes a burden of paying for superfluous day care on a mimicking high-skilled agent. Also, deviating from conventional preference assumptions, we show that heterogeneity of preferences for work and day care does not invalidate the Pareto improving properties of this kind of public provision.

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1. Introduction

The labour force participation of females has increased dramatically in all developed countries over the last 50 years. For example, in US the labour force participation for married women with children under 6 increased from around 12% in 1950 to around 63% in 2000 (Blau and Currie 2003). In Sweden in 1950 the labour force participation was 20% for married women aged 25-29 and 15% for married women aged 30-39 (Silenstam 1970, table A:15). In year 2000 for women with children under age 7 the labour force participation was 75% for women aged 25-34 and 82% for women aged 35-44 (AKU 2000) [4]. Concurrently various forms of day care have developed. At early stages it was not uncommon that employers helped to organize day care. In the Nordic countries publicly financed and operated day care centers have over time increased in importance and are now the most common form of day care. For example, in Sweden 85% of children in ages 2-5 are in day care.[5] To a substantial part (80-85%) this child care is publicly financed. In US day care is also common. According to Blau and Currie (2003): "For good or ill, the majority of children in the U.S. and many other high-income nations are now cared for many hours per week by adults other than their parents and school teachers". Much of day care in US is privately financed and produced. However, there is an ongoing debate about the quality of private day care and a trend towards an increasing share of publicly subsidised day care. Blau and Currie state that one third of the costs of childcare for children under 6 is paid for by government subsidies.

The figures above show that day care is of great importance and, it seems, is becoming increasingly so. Given this large quantitative importance there are several questions of great interest to study. For example, how does child care, and the quality of it, affect child outcomes? There is a fairly large literature on this topic. The US literature is summarised in Blau and Currie (2003). How is the labour supply of females affected by various forms of day care? This is studied by, among others, Blau and Robins (1988), Gustafsson and Stafford (1992), Ribar (1995) and Powell (2002). Two important and interrelated questions are whether day care should be privately or publicly financed, and whether it should be privately or publicly produced. The literature on publicly provided goods as a means to promote redistribution provides a reason for publicly financed day care. Several authors have demonstrated that there is a strong case for public provision of certain private goods in an economy in which individuals have homogeneous

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[4] It is not possible to get data using the same definitions for 1950 and 2000.
[5] Calculated from tables 62 and 500 in Statistisk Årsbok 2003.

preferences but differ in skill levels.[6] What has received less interest is how the tax system and publicly provided day care interact. It is this question we will address. How should the income tax be designed? Should there be a fee for using day care or should it be financed entirely by taxes. To what extent should the households be confronted with the cost of day care? In the course of our analysis we shall provide precise answers to these questions.

The pros and cons of publicly versus privately financed day care have been a much debated issue and the development of publicly provided day care in, say, Sweden has not been unquestioned. For example, in popular debate it has been argued that taxes for low income people in Sweden are higher than in most other countries, allegedly with harmful effects. It has also been argued that low income people that do not want day care are made worse off because of the public provision they do not really want. We will study if these claims are correct.

As a vehicle for our analysis we will use the modified two-type, optimal income tax model of Stern (1982) and Stiglitz (1982) based on Mirrlees (1971). A non-linear, redistributive income tax is imposed under the asymmetric information that knowledge of who is high-skilled and who is low-skilled is private information not available to the government. The tax schedule must then be designed subject to the self-selection constraint ensuring that a high-skilled person does not select an income point intended for the low-skilled person. If the high-skilled person were to mimic, he would obtain more leisure than the low-skilled person with the same income as, being more productive, the high-skilled person could earn the same income in less time. However, if some of the transfer is given in kind, it may be of less value to the mimicker than to the genuine low-skilled type if the good being transferred is less beneficial to someone who enjoys more leisure. Shifting to a transfer in kind may therefore make mimicking less appealing, and thus alleviate the self-selection constraint and enhance welfare. Day care for children may be a striking example of a good suitable for this purpose as a person who works less will need less day care. By pretending to be low-skilled, the high-skilled person will pay the same tax as the low-skilled person, but will obtain a smaller benefit in return. Blomquist and Christiansen (1995) highlighted day care as an example of a private good that would be well suited for public provision, but details were not discussed. It turns out that there are special aspects of day care that makes a specialized study of interest.

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[6] Blackorby and Donaldson (1988), Besley and Coate (1991), Blomquist and Christiansen (1995, 1999), Boadway and Marchand (1995), and Cremer and Gahvari (1997) are a few studies showing the benefits of public provision of certain private goods.

In view of the previous assumption of homogeneous preferences and the Swedish (Scandinavian) debate it is appropriate to ask: Does heterogeneity of preferences invalidate the mechanism, implying that public provision of day care is merely of theoretical, not of practical, interest? The argument is that if the public provision level is set so as to fit the low-skill person with a high preference for the publicly provided good, the low skill person with a low preference for the good comes out worse than in a system without public provision. In this paper we take this critique seriously and investigate if a public provision scheme can be constructed so that we obtain a strict Pareto improvement when going from a pure tax/transfer system to the public provision scheme even if preferences are heterogeneous[7].

In line with the Stern-Stiglitz approach we assume that there are two skill groups, high-skilled and low-skilled individuals. The low-skilled group is assumed to consist of people with heterogeneous preferences: some with a strong preference for leisure, reflecting a strong wish to have time available to spend with the children, and some with a weak preference for leisure, reflecting that they are more inclined to pay for child care. Each agent chooses how much labour to supply and the corresponding consumption level, which depends on the tax liability[8]. A fixed number of children must be cared for either by the parents themselves or by day-care centres. We realize that parents might want to have a child in day care while going to the dentist, going shopping etc. However, as a stylized fact we think it is reasonable to assume that the need for day care equals the hours of work. Hence, in the following we assume that parents do not want to have the children at a day-care centre for more hours than they work and that the need for externally supplied day-care is equal to the number of working hours.

As in the conventional two-type model we assume that the government imposes a positive net tax on the high-skilled agent and makes a transfer to the low skilled types. The transfer may be in cash or in kind (in terms of day-care). To discuss what is the optimal tax/day care payment scheme our approach will be to assume that day-care is publicly provided free of charge in the amount each agent wants. This regime will then be used as our point of departure for further discussion below.

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[7] There is only a sparse literature on heterogeneous preferences in the context of taxes and welfare policy. For a few examples see Sandmo (1993) Tarkiainen and Tuomala (1999), Boadway et al. (2002), and Cuff (2000).
[8] We perceive each agent as a homogeneous decision maker who may be a single person or a household (couple) facing a single wage-rate and only being concerned with its aggregate leisure, consumption, etc.

The low-skill individuals have heterogeneous preferences. In some sense we would like to treat people in an "equal way" irrespective of preferences. However, it is not unambiguous how to define equal treatment operationally. One could make a case for various definitions. As we do not intend to make a contribution to the literature on horizontal equity, we have simply chosen one often used definition. The net transfers should be the same to all low-skill individuals irrespective of their preferences.[9] Hence, we will assume that for horizontal equity reasons the government would like to transfer the same total amount of resources (adding up transfers in kind and in cash) to both preference types. This means that if one type receives a smaller amount of publicly provided day care, he/she must receive a larger transfer in cash.

In section 2 of the paper we set up the model we will use. Section 3 contains a description of the optimal income tax, whereas section 4 shows how a strict Pareto improvement can be obtained by supplementing the tax solution with publicly provided day care. In section 5 we characterize the optimal tax/public provision scheme. Section 6 provides a concluding discussion.

2. The Model

Let Y^i and B^i denote the gross income and disposable (cash) income, respectively, of a person of type i. Moreover, let a low (high) skill level, reflected by a corresponding wage-rate, be denoted by w^1 (w^2). The labour supply of type i can be expressed as Y^i / w^i. Low and high-skilled types are labelled by superscripts 1 and 2, respectively, and a strong preference for leisure is indicated by a superscript s and a weak preference for leisure by a superscript w. Since the distinction applies only to low-skilled persons in our model, we note that it is sufficient to apply a single index to these agents, eg s means strong preference for leisure and (implicitly) a low skill level.

A consumer has preferences over consumption, which is equal to disposable income net of the amount spent on day-care, and leisure, which includes time spent with (and looking after) the children and other time for housework, relaxation, etc. Since every person has the same time endowment, there is a unique relationship between working time and leisure and it is a matter of convenience whether preferences are expressed as preferences for leisure or for work. We find the latter option more convenient and write the direct utility function as $u(C,h) = u(C, Z - L)$ where Z is the time endowment, L is leisure, and hours of work, h, is given by $h = Z - L$. We

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[9] This is basically the same definition of horizontal equity as used by Jordahl and Micheletto (2002) and earlier by Bossert (1995) and Allingham (1975).

denote the resource cost of day care by p per unit. In a situation without publicly provided day-care the consumption level of type i is then $C^i = B^i - pY^i / w^i$. It follows that if day-care must be purchased in the market, we can write the utility function of a type i individual as $u(B^i - pY^i / w^i, Y^i / w^i)$. Following the convention of suppressing w^i in the latter argument, we write the utility function as $U^i(B^i - pY^i / w^i, Y^i)$.

For a fixed wage rate we can depict an indifference curve in Y,B-space (omitting superscripts) as done in Diagram 1 below. An increase in Y will, for a fixed wage rate, provide a measure of increased labour supply, and the curve will tell us the corresponding increase in disposable income that is needed to compensate for the increase in labour supply taking into account both the disutility of labour and the cost of day care incurred when more labour is supplied. An s-type will obviously have an indifference curve that is steeper than that of a w-type through any given point in Y,B-space as a stronger preference for leisure means requiring a larger compensation to offset the additional disutility from working more.

If day care is publicly provided free of charge, the relevant utility function is $u(B^i, Y^i / w^i) = U^i(B^i, Y^i)$. It is still the case that the s-type has the steeper indifference curve as compared to the w-type. We assume that type *2* has the same preferences as the w-type.

We assume the standard single crossing property that for any fixed gross and net income point in *Y, B*-space the indifference curve of a low ability type of person is steeper than that of a high ability type. The difference in steepness of indifference curves between the two preference types is obvious by the assumption about preferences.

3. The Optimal Income Tax when there is No Public Provision

As a starting point we consider the income tax optimum without public provision. This optimum tax problem is, with a few qualifications, analogous to that of Stiglitz (1982) and Stern (1982). The approach is to assign to each person a bundle of gross and net income that implicitly defines the tax schedule (as for each gross income the difference between gross and net income defines the corresponding tax). An essential feature of the problem is asymmetric information between the respective tax payers and the government about the individual skill levels (wage rates). The implication is that the income points assigned to the respective agents must be chosen subject to the self-selection constraint that no agent could gain by selecting the income point intended for

some other agent – described as 'mimicking' of the other agent. The standard assumption is that the tax policy pursues redistribution from high-skilled to low-skilled to the extent that the effective constraint is to avert mimicking by the high-skilled. The efficient tax policy is the one that maximises the welfare of the low-skilled for any utility level assigned to the high-skilled and subject to the self-selection constraint and the government budget constraint. In our problem we also have to add the horizontal equity constraint that the two types of low-skilled agents receive the same transfer.
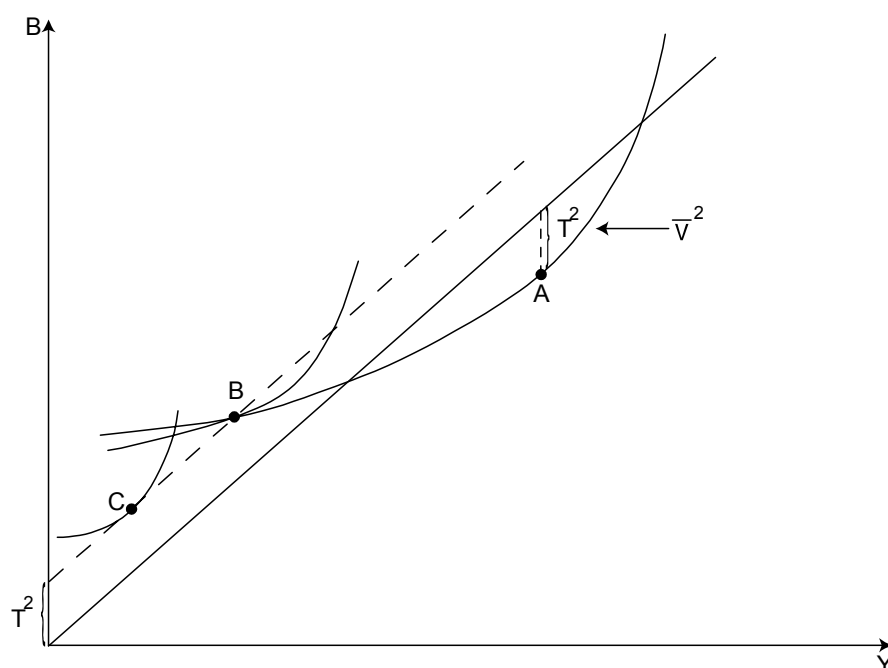

Diagram 1

We choose not to pursue the analysis of the optimum tax solution algebraically, but present it graphically using diagram 1. We start by pre-assigning some utility level to the high-skilled agent such that $U(B - pY/w, Y) = \bar{V}^2$ and draw the corresponding indifference curve in Y,B-space. In order to maximise the resources available for the low-skilled subject to this utility constraint, the tax collected from the high-skill person is maximised. Hence we assign point A to the high-skilled person. This is the point on the selected indifference curve where its slope is equal to unity, and the vertical distance from the depicted 45-degree line from the origin, which measures the income tax, is maximised. This point has the property of a zero marginal income tax

for the high-skilled type.[10] The slope of the indifference curve is $(dB/dY)_{\bar{u}} = \dfrac{(U_C p/w) - U_Y}{U_C} = 1$,

and hence $MRS_{C,Y} = \dfrac{-U_Y}{U_C} = 1 - \dfrac{p}{w} = MRT_{C,Y}$, which is the marginal rate of transformation between net consumption C and gross income Y allowing for the fact that p/w is the day care cost incurred by a person earning an additional unit of gross income.

The tax collected is denoted by T^2. This amount can be transferred to the low-skilled persons. For simplicity we normalise the size of the high-skilled group to two and assume the low skilled group is of the same size split equally between the two preference types. Imposing the condition that both receive the same net transfer, they each receive T^2. For the moment confining attention to the pure budget constraint, the feasible points would be along the dotted straight line. Ideally we would like each low-skilled type to be assigned a point of tangency between the budget line and an indifference curve, and the person with weak preferences for leisure would be assigned a point further to the north-east than the person with strong preferences for leisure. If for both persons there are such points of tangency to the left of point B we have a situation of first best. It is not of interest to study this situation any further.

The interesting cases are those in which the information constraint comes into play, and we have as a binding self-selection constraint that no low-skilled person can be assigned a point to the right of B, because then the high-skilled agent 2 would get a higher utility level by mimicking. The two interesting alternatives are *i.* the tangency points with indifference curves along the budget line occur to the right of point B for both persons or *ii.* the point of tangency for the person with weak preferences for leisure is to the right of B, and the tangency for the person with strong preference for leisure is located to the left.

In the former case there will be bunching of both low-skilled types at B. The marginal rate of substitution between B and Y denoted $MRS_{B,Y}$ (slope of the indifference curve) differs between individuals. Employing the usual measure of marginal tax rates as one minus the $MRS_{B,Y}$ (cf. footnote 9), the person with the weaker preference for leisure would face a higher marginal tax than the person with stronger preferences for leisure. Also, the consumption bundle would be less

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[10] The standard approach in the absence of day care is to equate the marginal rate of substitution to the marginal income net of tax, i.e. $-U_Y/U_B = 1 - T'(Y)$ by which the marginal tax rate is implicitly defined.

distorted for the person with strong preferences for leisure. In case *ii* there would be separate points for the two types of low-skill persons. This is the case illustrated in the diagram. The low-skilled person with a strong preference for leisure would be undistorted ($MRS_{B,Y} = 1$) and face a zero marginal tax at income point *C*. The person with a weak preference for leisure would be distorted and face a positive marginal tax at income point *B* ($MRS_{B,Y} < 1$). There would be a binding self-selection constraint in both cases, and either the consumption-leisure bundle must be distorted for both types (the former case), or the consumption-leisure bundle for the weak preference type must be distorted (the latter case).

4. A Pareto Improving Public Provision Scheme

We will next show how a strict Pareto improvement can be obtained by introducing public provision of day-care being financed by (increased) taxes. In case *i.*, when the low-skilled persons are bunched at income point *B,* the story is basically the same as it would be, had preferences been homogeneous. In the optimal tax situation the demands for day care are given by: $x^s = x^w = x^1 = Y^1/w^1$, $x^2 = Y^2/w^2$ and $x^m = Y^1/w^2$, where x^m denotes the demand of the mimicker. We cannot tell whether x^1 is smaller or larger than x^2, but we know that $x^m < x^2$ and $x^m < x^1$. We let individuals get the amount of day care they want/need and decrease the after-tax incomes by px^1 and px^2, respectively. Hence, the situation for the actual persons is unchanged. However, the mimicker is forced to pay, via taxes, for more day care than he needs and hence suffers a loss of utility, implying that the self-selection constraint will no longer bind. This means that we can change the income point for the low-skill individuals to a point where their consumption-leisure bundle is less distorted. Hence, we can improve welfare for both low skill persons without hurting the high-skill person.

The situation is slightly more complicated in case *ii.* Since the mimicker mimics the low-skill person with weak preferences for leisure the demands are given by $x^s = Y^s/w^1 < x^w = Y^w/w^1$, $x^2 = Y^2/w^2$ and $x^m = Y^w/w^2$. As above $x^m < x^2$ and $x^m < x^w$. As before, the actual persons receive free of charge the amounts of day care x^s, x^w and x^2. The after tax incomes are decreased by the amounts px^s, px^w and px^2. These changes will leave the consumption bundles, and hence utilities, of all actual persons unchanged, but the mimicker's consumption, and hence utility will decrease as he is forced to pay in the form of taxes for more

day care than he needs. Hence the self-selection constraint is no longer binding, implying that there is scope for changes in the tax system such that utility increases for at least one person without decreasing for the others. One such change would be to make the consumption-leisure point for the low-skill person with a weak preference for leisure less distorted. A technical question; could it be that the high-skill person would like to mimic the low skill person with a strong preference for leisure in the new situation where there is public provision of day care? It is easy to show that this is not the case. The income point for the low skill person with a strong preference for leisure was not attractive to mimic in the optimal tax solution. The rebundling of the after tax income, so that part of it comes in the form of publicly provided day care, makes the point even less attractive to mimic.

In our experiment we have imposed the condition that both low-skill persons should obtain the same net transfer, i.e., the sum of the cash transfer and the value of the publicly provided and received day care should be the same for the two low-skill types. The total amount transferred from the high-skill person is constant. Hence the net transfer to each one of the two low-skill types does not change. In case *ii* of the optimal tax solutions referred to on p. 7, the transfer to the person with a strong preference for leisure comes in an undistorted form in the optimal tax solution. Hence, it cannot be improved by the public provision scheme. As the experiment is set up the low skill person with a strong preference for leisure neither gains nor loses by the provision scheme. If we abandon the condition that both types should have the same net transfer, we could design a public provision scheme such that both low skill types gain. In such a scheme the low-skill type with a strong preference for leisure would be favoured in the sense that he obtains a larger net transfer than the weak preference type.

5. Characterization of the Optimal Tax-Public Provision Optimum

There can be two types of optima. One possibility is bunching of the two low-skill types. As noted above this situation is quite similar to the case with homogeneous preferences, which has been the topic of earlier studies on publicly provided private goods. We consider the non-bunching case to be the more interesting one and focus on such an optimum, i.e, an optimum where the two low-skill types are allocated different points.

To characterise the Pareto optimal policy we assume that the policy maker maximizes a weighted sum of the utilities (with weights α^s and α^w) for the low-skill groups subject to a

required minimum utility level ($\bar{U}^2$) for the high-skill group, the self selection constraint, the government budget constraint and the requirement that the net transfer to the two low skill groups be the same. (Since we have imposed the condition that both types of low-skilled persons receive the same net transfer the relative size of α^s and α^w is of no importance for the solution as long as both weights are positive.)

Given these assumptions the Lagrange function of the optimisation problem will take the form:

$$\Lambda = \alpha^s U^s(B^s, Y^s) + \alpha^w U^w(B^w, Y^w) - \lambda\left(U^2\left(B^2, Y^2\right) - \bar{U}^2\right) \tag{1}$$

$$- \beta(U^m(B^w, Y^w) - \bar{U}^2) - \sigma\left(Y^s - B^s - p\frac{Y^s}{w_1} - Y^w + B^w + p\frac{Y^w}{w_1}\right)$$

$$+ \mu\left(2(Y^2 - B^2) + (Y^w - B^w) + (Y^s - B^s) - 2p\frac{Y^2}{w^2} - p\frac{Y^w}{w^1} - p\frac{Y^s}{w^1}\right)$$

The first constraint (with Lagrange multiplier λ) is the minimum utility requirement for the high-skilled person. The second restriction (with multiplier β) is the self-selection constraint that the utility that the high-skilled person can obtain by mimicking the low-ability person (with weak preference for leisure) must not exceed the utility level actually intended for him. The equality of transfers to the low-income persons is captured by the third constraint (to which σ has been assigned). The last constraint (with shadow price μ) gives the budget constraint. (For the sake of the derivations below note that when differentiating w.r.t. B^i, the first argument of the utility function is C^i and that we always have $\partial C^i / \partial B^i = 1$ for the respective values of i.)

Standard first order conditions are derived in an appendix. Invoking those results we first obtain

$$\frac{-U_Y^2}{U_C^2} = 1 - \frac{p}{w^2} \tag{2}$$

from (a3). From (a6) we have

$$\frac{-U_Y^s}{U_C^s} = 1 - \frac{p}{w^1} \tag{3}$$

From (a14) we obtain

$$MRS^w = \rho(MRS^m - MRS^w) + 1 - \frac{p}{w^1} < 1 - \frac{p}{w^1}, \tag{4}$$

where $\rho = \beta U_C^m /(\mu + \sigma)$, $\qquad MRS = -U_Y /U_C$, and the inequality follows because $MRS^m - MRS^w < 0$, which is the standard assumption that the high-skilled type has the flatter indifference curve through any given point in *Y,B*-space.

According to conditions (2) and (3) the labour of the high-ability person, and also the labour supply of the low-skilled agent with a strong preference for leisure are undistorted. Since resources must be allocated to day-care, every hour of work inflicts a real cost of p on society, which should be reflected in the budget constraints to provide the right incentives for labour supply and making sure that $MRS = MRT$ in terms of consumption and leisure. This is exactly the contents of conditions (2) and (3). The marginal rate of substitution (MRS) between gross and net income on the left hand side expresses the compensation in terms of consumption required to offset the disutility from earning an additional unit of gross income. In other words, this is a money measure of the marginal disutility of acquiring further income. According to (2) and (3) the marginal disutility (MRS) should be equated to the extra income actually generated after deducting the cost of day care. Since the latter is a necessary social cost, the right hand side does in fact express the *net* social income generated by work effort at the margin. Thus the condition is equivalent to the first best efficiency condition, and there is no distortion. It follows from (4) that the type of person with weak preference for leisure has a marginal disutility of acquiring further income, which is less than the net social income that can actually be obtained. Hence the labour supply is distorted downwards.

It is of interest to interpret these findings further in terms of marginal tax rates. For this purpose it is helpful to distinguish between a gross and a net tax concept, where the latter is defined net of transfers to the consumers in terms of day care provision. The rationale is that a transfer can be perceived as a negative tax. We write the gross tax function as $T(Y) = Y - B(Y)$ and the tax net of the public day care provision as $\tau(Y) = Y - B(Y) - pY/w = T(Y) - pY/w$. The corresponding marginal tax rates are *T'(Y)* and $\tau'(Y)$, where $\tau'(Y) = T'(Y) - p/w$. Employing the usual measure of marginal tax rates in the Mirrlees-Stern-Stiglitz tradition we can define *T'(Y)* as $1 - MRS_{B,Y}$ and $\tau'(Y)$ as $1 - MRS_{C,Y}$. As observed from the optimality conditions (2) and (3) the marginal net tax rate is zero for these two types of agents, whereas their marginal gross tax rates become:

$$T'(Y^2) = p/w^2 \qquad (5) \qquad \text{and} \qquad T'(Y^s) = p/w^1 \qquad (6)$$

respectively. That is, the marginal income tax should not be zero but should be equal to the marginal cost of day care implied by agent *i* earning an additional unit of gross income. The implication is that these persons face the same marginal prices as in a situation with no public provision of day care. Even if true that the individual obtains day care "for free" from the public sector, it is still the case that the individual acts as if he were facing the real cost of day care provision. They simply pay for it via their taxes. Hence, for the actual person two the optimal tax/public provision scheme faces the individual with exactly the same budget constraint as in the system where day care is bought in the market and where he is relieved of a tax burden corresponding to the cost of his need for day care.

One may then ask what difference it makes whether day care is publicly or privately funded. The answer is that is makes a crucial difference with respect to mimicking. If a person of type two were to mimic, his tax payment would cover the cost of the day care of the low-skilled person, which would exceed his own need. While it is true that the tax pays for the day care that people actually need at their optimum income points, it pays for more than the day care needed by mimickers, which imposes a cost to mimicking. Note also that an individual of type two is likely to complain and argue that he would prefer a system where one does not pay for day care via the taxes. He would like a system with lower tax payments and all day care purchased in the market. The reason is that in such a system he could mimic, obtaining a tax relief exceeding his cost of day care as a mimicker. However, if the political majority are adamant to retain the previous redistribution, steps would have to be taken to prevent such behaviour, and a Pareto inferior situation would arise as compared to a regime with public provision of day care. Hence, a public provision system, improving upon the market solution, is likely to have the property that some people would like to have it differently in the hope of escaping the burden of redistribution.

The consumption-leisure bundle of the low-skilled group with weak preference must be distorted in order to prevent these agents from being mimicked. Their marginal income tax is:

$$T'(Y^w) = \rho(MRS^w - MRS^m) + p/w_1 \tag{7}$$

and the marginal tax net of the day care cost is:

$$\tau'(Y^w) = T'(Y^w) - p/w_1 = \rho(MRS^w - MRS^m) \tag{8}$$

We see that the marginal effect on total tax payments, taking account of the transfer in kind, is of the same form as the marginal income tax in the pure income tax system. However, now there is an additional term, p/w_1, in the expression for the marginal *income* tax. Also the low-skilled person with a weak preference for leisure now pays via the tax bill for the day care he obtains, and the marginal (social cost) of providing day care is reflected in the marginal income tax. Hence, for all actual persons public provision makes the cost of obtaining day care no different than if it were purchased in the market. In either case the consumers face the real cost of day care, as is socially desirable since day care is a true cost of supplying labour. The market price and the extra tax, perceived as earmarked for day care, yield the same labour market disincentives. Only if a person were to mimic, would the public scheme be different than a market system as a mimicker, via the tax system, would be forced to pay for an amount of day care equal to that demanded by the low-skill person with a weak preference for leisure, and exceeding the need of the mimicker. This is the crucial property of the public provision system as it is indeed the capability of alleviating the self-selection constraint that is the very justification for the public provision in our context.

6. Discussion and Extensions

Taking as point of departure the insight that public provision of day care can mitigate the self-selection constraint in an optimum tax model, we have shown that heterogeneity in preferences does not invalidate the usefulness of publicly provided day care in this respect. More importantly, the paper has demonstrated that the optimal tax should be designed so as to face the taxpayers with the real cost of providing day care. In that sense public provision does not imply subsidised day care. Surprisingly, although it seems straightforward once stated, this result has not been observed before. A reason why this appears as a clear-cut result in our paper is that the demand for day care is assumed to be strictly proportional to work effort and gross income.

Beyond the introduction of heterogeneous preferences, the present analysis deviates from a number of previous, related analyses in several respects. i) Previous studies have not assumed that the publicly provided good is a perfect complement with labour. ii) It has been a common assumption that there is only one public provision level. iii) It has often been assumed that the consumers may top up their consumption of the good in question in the market or even opt out to

rely solely on acquisition in the market[11]. We may note that to the extent that consumers top up or opt out the situation is similar to the one described in our model in that the agents encounter the full cost of the good under survey as reflected by market prices or taxes. An issue addressed in previous work is whether a good partially provided by the public sector should be taxed/subsidised.[12] We note that in our present model, as far as we consider the actual situation of the two types of persons, there is no separate role for a commodity tax (subsidy). As day care is a prerequisite for working the only thing that matters is the net wage obtained after tax and after paying for day care. However, with respect to the mimicking problem it makes a crucial difference whether a day care centre charges a fee, or it is paid for via the tax bill. If there is a fee, a mimicker will escape part of the fee as compared to the low-skilled person simply by demanding less day care. There is no similar escape from taxes as they are determined by income rather than working hours, and by definition the mimicker and the mimicked earn the same income. Hence we can conclude that child care should be fully tax financed, but people should still face the true marginal cost of labour market participation as reflected in the marginal income tax.

We have addressed public provision of day care, but the same kind of analysis and results may apply to other, often publicly provided, goods for which demand is labor elastic. Health care and education for one's children are examples that easily come to mind. To the extent that the marginal tax burden pays for publicly provided goods that would otherwise be purchased in the market, this part of the marginal tax is equivalent to a market price (assuming no cost difference).

In the introduction of this paper we noted that in popular debate in Sweden it has been argued that taxes, both total and marginal, for low income people are much too high, with allegedly harmful effects. We can use the analysis of this paper to comment on this. When trying to relate our results to conditions in Sweden it is a problem that we in our model just have two ability levels. It is well known that the zero marginal income tax result for the high ability type is due to the fact that there is a finite highest ability level. When there is no finite highest ability level we do not really know what the marginal income tax at the top should be.[13] It is less

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[11] See Blomquist and Christiansen (1998a).

[12] See Blomquist. and Christiansen (1998b).

[13] Diamond (1998), using strong functional form assumptions, try to characterize the marginal income tax at high skill levels when there is no upper bound for the skill level.

problematic to relate the results for a low-skill person with real data. Since there is a clear mode in the distribution of wage rates at the bottom part of the distribution we think this mode can be used as an empirical value for the low-skill wage. Using this mode, simple back of the envelope calculations indicate that for low income individuals, p/w_1 amounts to something like 30-35% if we assume one child is in day care. Hence, this part of the marginal tax can be interpreted as a payment for day care. Beyond this there is, according to formula (8), an additional term $\rho(MRS^w - MRS^m)$ reflecting the distortion that is needed to deter mimicking.

If we in this simple exercise set the wage for a high-skilled to double the wage of a low-skilled, a rough estimate of p/w^2 would be in the order 15-18%. Hence, even if we do not really know what the marginal tax net of the day care provision should be for a high skill person, we know that for high skill persons with children in public day care there should be a component of their marginal income tax reflecting the social cost of day care amounting to an order a little more than 15%.

Hence, we find that for low skill individuals with children the marginal taxes in Sweden may very well be in accordance with what optimal taxation theory prescribes, given that there is publicly financed day care. Lower marginal income tax rates would be inefficient as they would induce too large labor supply.

We realize that the following statement might be controversial. However, our analysis shows: *i.* there is a gain in efficiency if publicly financed day care replaces day care bought in the market *ii.* in an economy with publicly funded day care it is not only reasonable, it is indeed necessary for efficiency that marginal income tax rates are higher than in economies where day care is purchased in the market. Hence, it might very well be that economies with higher marginal tax rates have less severe distortions than economies with lower marginal tax rates. One cannot judge the distortions generated by a tax system in isolation, one must also consider the expenditure side.

The discussion above has (tacitly) assumed that the tax payer has a single child. If there are more children in the household the marginal cost of working longer hours is larger as there are more children to pay for in day care. This means that an even larger share of the marginal tax rate reflects a cost of day care rather than a distortion, indicating that our "back of the envelope

figures" above are on the lower side.[14] Families with children face the same tax schedules as others but receive free day care. Of course, one interpretation of this is that families with children face another tax/transfer schedule than others, but that part of the after tax income comes in kind in order to deter mimicking. This would then be an example of what Akerlof (1978) named tagging of income. If a needy group could be identified the tax breaks should be geared just to this group and not to everyone.

Appendix

Departing from the Lagrange function (1) standard first order conditions are derived.

$$\Lambda_{B^2} = -\lambda U_C^2 - 2\mu = 0, \tag{a1}$$

and

$$\Lambda_{Y^2} = -\lambda U_Y^2 + 2\mu(1 - p/w^2) = 0, \tag{a2}$$

implying that

$$\frac{-U_Y^2}{U_C^2} = 1 - \frac{p}{w^2} \tag{a3}$$

$$\Lambda_{B^s} = \alpha^s U_C^s - (\mu - \sigma) = 0 \tag{a4}$$

and

$$\Lambda_{Y^s} = \alpha^s U_Y^s + (\mu - \sigma)\left(1 - \frac{p}{w^1}\right) = 0 \tag{a5}$$

implying that

$$\frac{-U_Y^s}{U_C^s} = \frac{(\mu - \sigma)\left(1 - \frac{p}{w_1}\right)}{\mu - \sigma} = 1 - \frac{p}{w^1} \tag{a6}$$

$$\Lambda_{B^w} = \alpha^w U_C^w - \beta U_C^m - (\mu + \sigma) = 0 \tag{a7}$$

and

$$\Lambda_{Y^w} = \alpha^w U_Y^w - \beta U_Y^m + (\mu + \sigma)\left(1 - \frac{p}{w^1}\right) = 0 \tag{a8}$$

simplifying to

$$-\alpha^w U_Y^w = -\beta U_Y^m + (\mu + \sigma)\left(1 - \frac{p}{w^1}\right) \tag{a9}$$

and

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[14] With households supporting different numbers of children one might in general have different tax schedules contingent on the number of children, but we shall not pursue the more general issue of household taxation (see e.g. Cremer et al. (2003) and Schroyen (2003)).

$$\alpha^w U_C^w = \beta U_C^m + (\mu + \sigma) = 0 \tag{a10}$$

Dividing on both sides we obtain

$$\frac{-U_Y^w}{U_C^w} = \frac{-\beta U_Y^m + (\mu + \sigma)\left(1 - \dfrac{p}{w^1}\right)}{\beta U_C^m + \mu + \sigma}, \tag{a11}$$

which can be reformulated as

$$\frac{-U_Y^w}{U_C^w}(\beta U_C^m + \mu + \sigma) = -\beta U_Y^m + (\mu + \sigma)\left(1 - \frac{p}{w^1}\right). \tag{a12}$$

Straightforward manipulations yield the expression

$$\frac{-U_Y^w}{U_C^w}\left(1 + \frac{\mu + \sigma}{\beta U_C^m}\right) = \frac{-\beta U_Y^m}{\beta U_C^m} + \frac{(\mu + \sigma)\left(1 - \dfrac{p}{w_1}\right)}{\beta U_C^m} \tag{a13}$$

or equivalently

$$\frac{-U_Y^w}{U_C^w}\left(\frac{\mu + \sigma}{\beta U_C^m}\right) = \frac{-U_Y^m}{U_C^m} - \frac{-U_Y^w}{U_C^w} + \frac{(\mu + \sigma)\left(1 - \dfrac{p}{w^1}\right)}{\beta U_C^m} \tag{a14}$$

References

Akerlof, G. A. (1978). "The Economics of "Tagging" as Applied to the Optimal Income Tax, Welfare Programs, and Manpower Planning." *American Economic Review* 68, 8-19.

AKU 2000, Grundtabeller årsmedeltal 2000. Statistiska Centralbyrån.

Allingham, M. (1975). "Towards an Ability Tax", *Journal of Public Economics* 4, 361-376.

Besley, T. and S. Coate (1991). "Public Provision of Private Goods and the Redistribution of Income." *American Economic Review* 81, 979-984.

Blackorby, C. and D. Donaldson (1988). "Cash versus Kind, Self-selection and Efficient Transfers." *American Economic Review* 78, 691-700.

Blau, D. and J. Currie (2003) "Preschool, Day Care and After School Care: Who's Minding the Kids?", forthcoming in Handbook of the Economics of Education

Blau, D.M. and P.K. Robins (1988) Child-Care Costs and Family Labour supply, *Review of Economics and Statistics* 70, 374-81.

Blomquist, S. and V. Christiansen (1995). "Public Provision of Private Goods as a Redistributive Device in an Optimum Income Tax Model." *Scandinavian Journal of Economics* 97, 547-567.

Blomquist, S. and V. Christiansen (1998a). "Topping Up or Opting Out? The Optimal Design of Public Provision Schemes". *International Economic Review 39*, 399-411.

Blomquist, S. and V. Christiansen (1998b). "Price Subsidies Versus Public Provision". *International Tax and Public Finance 5*, 283-306.

Blomquist, S. and V. Christiansen (1999). "The Political Economy of Publicly Provided Private Goods." *Journal of Public Economics* 73, 31-54.

Boadway, R. and M. Marchand (1995). "The Use of Public Expenditures for Redistributive Purposes"." *Oxford Economic Papers* 47, 45-59.

Boadway, R. M. Marchand and M. Sato (1998). "Subsidies versus Public Provision of Private Goods as Instruments for Redistribution." *Scandinavian Journal of Economics* 100, 545-564.

Boadway, R., M. Marchand, P. Pestieau and M.d.m. Racionero (2002). " Optimal Redistribution with Heterogeneous Preferences for Leisure," *Journal of Public Economic Theory 4*, 475-498.

Bossert, W. (1995). "Redistribution Mechanisms Based on Individual Characteristics," *Mathematical and Social Sciences* 29, 1-17.

Cremer, H. and F. Gahvari (1997). "In-kind Transfers, Self-selection and Optimal Tax Policy." *European Economic Review* 41, 97-114.

Cremer, H., A. Dellis and P. Pestieau, (2003). "Family Size and Optimal Income Taxation." *Journal of Population Economics 16*, 37-54.

Cuff, K. (2000). "Optimality of Workfare with Heterogeneous Preferences." *Canadian Journal of Economics 33,* 149-174.

Diamond, P. (1998). "Optimal Income Taxation: An Example with a U-shaped Pattern of Optimal Marginal Tax Rates", *American Economic Review* 88, 83-95.

Epple, D. and R.E. Romano (1996). "Public Provision of Private Goods." *Journal of Political Economy* 104, 57-84.

Gouveia, M. (1997). "Majority Rule and the Public Provision of a Private Good." *Public Choice* 93, 221-244.

Gustafsson, S. and F. Stafford (1992). Child Care Subsidies and Labor Supply in Sweden, Journal of Human Resources, *Journal of Human Resources* 27, 204-30.

Jordahl, H. and L. Micheletto (2002). "Optimal Utilitarian Taxation and Horizontal Equity." Working paper 2002:19, Department of Economics, Uppsala University. Forthcoming in *Journal of Public Economic Theory*

Mirrlees, J.A. (1971). "An Exploration in the Theory of Optimum Income Taxation." *Review of Economic Studies* 38, 175-208.

Nichols, A.L. and R.J. Zeckhauser (1982). "Targeting Transfers through Restrictions on Recipients." *American Economic Review Papers and Proceedings* 72, 372-377.

Powell, L (2002). Joint Labor Supply and Childcare Choice Decisions of Married Mothers, *The Journal of Human Resources* 37, 106-128.

Ribar, D. (1995), "A Structural Model of Child Care and the Labor Supply of Married Women", *Journal of Labor Economics* 13, 558-597.

Sandmo, A. (1993), "Optimal Redistribution when Tastes Differ", *Finanz Archiv 50 (2)*, 149-163.

Schroyen, F. (2003), "Redistributive taxation and the Household: The Case of Individual Filings". *Journal of Public Economics 87*, 2527-2547

Silenstam, P. (1970). Arbetskraftsutbudets utveckling i Sverige 1870-1965. Stockholm: Almqvist and Wicksell.

Statistisk Årsbok 2003. Statistiska Centralbyrån, Stockholm.

Stern, N.H. (1982). "Optimum Income Taxation with Errors in Administration." *Journal of Public Economics* 17, 181-211.

Stiglitz, J.E. (1982). "Self-Selection and Pareto Efficient Taxation." *Journal of Public Economics* 17, 213-240.

Tarkianen, R. and M. Tuomala (1999). "Optimal Nonlinear Income Taxation with a Two-Dimensional Population; A Computational Approach." *Computational Economics 13*, 1-16.

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