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INVESTING IN THE YOUNGEST: THE OPTIMAL CHILD CARE POLICY

by Francesca Carta*

Abstract

The aim of the paper is to characterize the optimal child care policies (subsidies and state provision), assuming that child care provision affects the child's future abilities. Public intervention is needed since two sources of economic inefficiency are contemporaneously influential: parents do not properly account for the impact of child care on future generations (human capital externalities) and income tax is distortive, hence labour supply is suboptimal. In an optimal income tax model, altruistic parents provide child care either by providing care at home or by paying for it on the market. If the government is able to observe the amount of domestic care provided by parents, it is optimal to subsidize provision of paid child care if only to correct the human capital externality. If, conversely, it is not possible to observe the amount of domestic care, market-provided child care is subsidized, including for redistributive reasons. In fact, an efficiency case for higher child care subsidies to lower income earners arises. State provision of child care may be desirable when market care purchases cannot be observed at the household level.

JEL Classification: H21, H23, H53, J13, J22, J24.
Keywords: optimal taxation, household production, child care, intergenerational transfers, warm-glow altruism.

Contents

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1 Introduction[1]

In recent decades, child care services have become a matter of serious public concern. As measures for reconciling work and family life, these services may in fact foster labour market participation, gender equality and fertility rates[2]. For example, at the EU level, at the Barcelona Summit in 2002 two targets[3] in terms of child care provision were fixed: by 2010, child care provision should have covered at least 90% of children between 3 years old and the mandatory school age and at least 33% of children under 3 years of age.

Child care services have to be seen also from a social pedagogical perspective. Recent studies stress the importance of childhood as a crucial phase of the human capital accumulation process (see Cunha et al. (2006) and Cunha and Heckman (2010) for a review). Child care, similarly to education, contributes to child development and socioeconomic integration. While it is commonly accepted that education has to be provided outside home[4], it is not the same for child care. Decisions related to child care depend on the general view about the best care provider and the optimal age at which the child should begin to socialize with peers[5]. This feature may contribute to explain why public investment in child care is lower than in the subsequent education levels (see Figure 1).

In order to have positive effects on labour supply, the use of child care services should replace domestic care. If this replacement is detrimental to child's development, policy objectives on labour supply and human capital are not compatible. The impact of different types of care on children's cognitive and non-cognitive development is analyzed in empirical papers such as Ruhm (2004)[6], and more recently Bernal and Keane (2006). Even if results are still mixed and non-conclusive, it seems that substituting parental (especially maternal) time with other types of care has a negative impact on children's achievement. Indeed, this general finding masks important differences across types of child care used, child age and mother's education. Children born in disadvantaged families benefit from external care. This result is less clear for children of educated parents.

The aim of this paper is to study the optimal child care policy combining labour supply and human capital considerations. Public intervention is needed in a second best framework,

[1]I am indebted to Helmuth Cremer and Jean Marie Lozachmeur for supervising this research. A previous version of the paper was presented at the conference "Women and the Italian Economy" organized by the Bank of Italy, held in Rome on March 7th, 2012. The views expressed therein are those of the author and do not necessarily reflect those of the Bank of Italy. I thank Roberta Zizza, and workshop and conference participants at the Bank of Italy, the Second Lisbon Research Workshop on Economics, Statistics and Econometrics of Education for useful comments. All the remaining errors are mine.

[2]By lowering the cost of childbearing in terms of labour market and career opportunities, child care services may also provide an important answer to declining fertility rates.

[3]The importance of these targets has been reaffirmed in the employment guidelines 2008 - 2010 adopted by the EU Council.

[4]Parents do not have appropriate skills and there are benefits associated to common education (Myles, 1995).

[5]They are affected by cultural determinants, and explain the variety of policy solutions adopted in national child care systems.

[6]It provides also a survey of previous contributions to this topic.

where two sources of inefficiency are considered. First, parents invest in children's human capital for some altruistic reasons and they do not take into account the human capital technology. Second, the government faces informational limits regarding individuals' abilities and time allocation.

National childcare systems are organized on three care providers: the family, the market and the Government. The Government can intervene in child care directly, by taxing or subsidizing parental care or purchased care, by providing public child care; indirectly, acting on the income distribution through income taxation. The availability of specific policy tools is constrained by the observability limits the Government faces.

The paper adopts an overlapping generation model, in which an individual lives for two periods: childhood, in which she does not take any decision, and adulthood, in which she gives birth to a child and takes all decisions. Each generation consists of two types of individuals, with low and high ability. Individuals differ in their ability at work and in producing child care, but both abilities reflect past investment in human capital and they are positively correlated. Individuals work, consume and provide care to children, by producing it or buying it on the market. Domestic care is produced by using time and depends on the parent's productivity. Parents are interested in the total amount of care children receive, since it determines their future type and income[7] (family altruism). Public policy can affect the relative size of each type and the distribution of disposable income, and may correct for the optimal child care provision. However, there are some informational limits. Individual abilities and time allocation between domestic and labor work are not observable.

Within such a setting, we derive the optimal tax structure and study the case for public child care provision. Anticipating the results, optimal tax formulas dramatically change according to the informational assumptions introduced. When domestic production is observable, standard results from the optimal taxation theory apply. The external care tax is not used for redistribution, it is corrective for the human capital externality (Pigouvian term) and the inclusion of altruism in the social welfare function (merit good term). These two terms have opposite sign: the first calls for a subsidy, the second for a tax. The result of "no distortions at the top", typical of the optimal taxation literature, is obtained, and redistribution is performed by distorting the low type's time allocation, through income and domestic care taxation. When domestic care is not observable, all tax formulas take into account the impact that variations in income and external care may have on the demand of domestic care, and indirectly on human capital. Redistribution is now performed also through the external care tax, since a direct tool on domestic care is no longer available. Conditions under which public child care is welfare improving are provided.

Finally, this paper relates to the debate about female employment. In fact, for the traditional role they play in domestic works and caring responsibilities, women are the agents of the model. The arrival of children creates a very large demand for their care, which decreases when the child is at schooling age. Data show that the arrival of a child causes a dramatic drop in the female participation rate, which is, instead, converging to the male

[7] A standard approach of taking into account children is the joy of giving formulation in which only the gift matters (Andreoni, 1990).

one when women are single or married without children. On the intensive margin, mothers work significantly less than single women (Apps and Rees, 2009). There are some economic advantages from a larger participation of women to the labor market and the economic literature started to investigate policy solutions to promote it. However, a main concern arises: who will take care of children when the mother is at work? If non maternal care is detrimental for child's development, in the long run this negative effect could offset the potential benefits associated to higher female labour supply. This paper tries to incorporate the potential effects of child care provision on children's human capital in the analysis of the optimal income taxation.

The rest of the paper is organized as follows. Section 2 reviews the related literature. In Section 3, the laissez-faire and the first-best solutions, then their decentralization, are studied. In Section 4, the second-best policy is analyzed. The optimal (incentive compatible) allocation and its implementation are determined under two different informational assumptions. In Section 5, the case for public provision of child care is studied. Section 6 provides some insights for future analysis and concludes.

2 Related literature

Child care intervention may consist in subsidies to families, cash transfers, or direct public provision, in-kind transfer. Optimality of these measures have been studied as ways to improve the efficiency of the tax system. In case of perfect information, all first best optima would be attainable through differential lump-sum taxes and there would be no role for commodity taxation or in-kind transfers. A basic tenet of the optimal tax literature in Mirrlees' framework is that the tax authority does not typically have information on taxpayers' types, but that the taxpayers' incomes are publicly observable. This rules out the availability of differential lump sum taxes but differential tax treatment of incomes is possible. As a consequence, available taxation is distortionary and the economy is in a second best. Commodity taxation and in-kind transfers may be Pareto-improving.

Cash transfers are generally considered welfare superior than in-kind transfers because they do not constrain individual consumption. Cremer and Gahvari (1997) show that the usefulness of in-kind transfers crucially depend on the information available to the government. In case of observability of incomes and personal purchases of commodities, in-kind transfers are not useful. Pareto efficient allocations can be implemented through a combination of a general income tax and commodity taxes[8] (Stiglitz, 1982; **?**). When personal commodity purchases are not observable, commodity taxation is constrained to be linear. In this context, the authors prove that uniform public provision of goods complementary to labour is welfare improving, since it allows more redistribution, limited by self-selection. Examples of these goods might be day care, basic health care and rights to a minimum old

[8]If preferences are weakly separable between labour supply and produced goods, incentive compatible allocations can be implemented through a general income tax alone. Commodity taxes are not needed. This is the famous Atkinson-Stiglitz result (Atkinson and Stiglitz, 1976).

age pension. We run a similar analysis for child care, which differs from market consumption goods for two peculiar features: it can be produced domestically and it is an investment good in children's human capital.

Cremer and Pestieau (2006) analyze optimal educational policies according to the information available to the Government. Investment in human capital is only expenditure on education. The novelty of this paper is to extend Cremer and Pestieau (2006)'s framework by allowing parents to domestically produce child care, which can be supplemented by care bought on the market. The standard work-versus-leisure model is abandoned to include household production, and we try to deal with the related observability problem. The unobservability of household production makes self-selection by the Government more difficult to attain. In addiction to unobservable labour supply, domestic production is an other moral hazard variable. Differently from Mirrlees' framework, the mimicker can enjoy more leisure and consume more care. The presence of household production breaks the positive relationship commonly assumed between utility and income.

This paper relates also to the debate about optimal taxation in presence of household production. First, the Atkinson-Stiglitz result (Atkinson and Stiglitz, 1976), which does not give any role to commodity taxation, no longer applies: the presence of household production destroys the equivalence between non-market hours and leisure (Anderberg and Balestrino (2000); Kleven (2004)). If non-market hours differently from leisure are used to produced consumption goods, weak separability between leisure and consumed good does not hold. Commodity taxation may be optimal. Second, neglecting human capital considerations, our results are in line with the general prescription of taxing at a lower rate market goods which are substitutes of home goods (Sandmo (1990); Kleven et al. (2000)). In the model optimal tax formulas may differ from this general prescription because they include the correction for human capital externality.

A research question close to ours is posed by Casarico et al. (2011). They analyze the optimal tax policy and the optimal quality of day care services when parental allocation of time affects in a type-specific way the probability that a child grows up as a high-market-ability adult. Even if the aim is similar, the adopted modelling strategy is rather different. In their paper there is not domestic production since parent's time directly enters in the human capital technology. The inclusion of a domestic production side allows to deal with the problem of its unobservability and the lack of a tax instrument directly addressed to it, in line with the previous literature. In the optimal tax rate formulas for income and external care, the induced distortions on domestic care have to be taken into account. Another difference regards the set of policy instruments available. We study the case also for in-kind transfers; instead they endogenize the quality of day care services. However, general results seem to move to the same conclusion. All optimal tax rates have to incorporate type-specific Pigouvian terms which correct for the intergenerational externality in human capital accumulation.

3 The model

Consider an overlapping generation model. An individual lives for two periods: childhood, in which she does not take any decision, and adulthood, in which she gives birth to a child and takes all decisions. Each agent has one child, and the population remains constant over time. Individuals differ in their productivity on the labor market and in producing domestic child care. Both productivities reflect past investments in human capital. A high ability individual is the able type both on the labor market and in domestic production. In child care production, being a high ability type means producing child care of higher quality (she is more able in transmitting skills). Individuals draw utility from consumption, leisure and care provided to children (warm-glow preferences). Child care can be domestically provided or bought on the market. Child care provision affects children's human capital. More precisely, the amount of child care provided increases the probability that their children will have high productivity in the future.

3.1 The household's problem

All individuals have the same strictly quasi-concave utility:

$$U\left(c^i, y^i, l^i\right) = u\left(c^i\right) + g\left(y^i\right) + v\left(l^i\right) \tag{1}$$

where c^i is consumption, y^i child care provided to children, and l^i leisure.

Child care can be domestically produced, in quantity d^i, or bought on the market, in quantity x^i. The efficiency of household tasks is represented by a production function, $d^i = \theta^i f\left(h^i\right)$, linking the amount of child care produced to the time spent on household work. This production function is increasing and concave; $f' > 0$ and $f'' < 0$. Consumed child care is the following:

$$y^i = \theta^i f\left(h^i\right) + x^i \tag{2}$$

where θ^i is the domestic productivity parameter, h^i is the number of hours devoted to domestic production and x^i is the investment in private child care[9]. Individuals differ in domestic productivity, $\theta^2 > \theta^1$. Type 1 (2) is the low (high) ability type. The domestic productivity parameter can be interpreted as the quality of child care.

Each agent owns 1 unit of time, which can be devoted to paid working time L^i, household working time h^i, and leisure l^i. Hence, the time constraint is $1 = L^i + h^i + l^i$.

Individuals differ also in labour market productivity, $w^2 > w^1$. Both domestic and labour market productivity reflects the results of past investment in child care and education. A high educated parent (type 2) is more productive in the labor market but also more able in transmitting skills to the child. Thus, in the population there exist only two types of individuals, high (2) and low (1) ability types.

The Government does not observe productivities, but it observes the relative number of type 1 and 2 individuals, respectively, π^2 and π^1. The distribution of types is known.

[9] The investment in private child care reflects the number of hours spent in daycare services, their quality and the type of activities carried out at school.

π^2 is the probability of being a high type. In this model this probability is not exogenous but endogenous, since it depends on the amount of child care received by parents. The distribution of abilities of generation t depends on the child care provided by generation $t-1$:

$$\pi_t^2 = \pi_{t-1}^2 K\left(y_{t-1}^2\right) + \pi_{t-1}^1 K\left(y_{t-1}^1\right) \tag{3}$$

where $K(y)$ is the production technology of human capital, which produces the probability of a child being of high ability type. Children of high-ability parents of generation $t-1$ have a probability $K\left(y_{t-1}^2\right)$ of being of high ability. $K\left(y_{t-1}^1\right)$ is instead the probability of being high type of children born in low-ability households. π_t^2 is the probability of a child of generation t being of high ability.

3.2 First Best

Under full information, the Government maximizes the discounted sum of adjusted utilities with a discount factor $\gamma < 1$. The parameter α is used to allow for alternative treatments of the altruistic utility term $g(y)$, $0 \leq \alpha \leq 1$. When $\alpha = 0$, the Government does not include the joy of giving in its welfare function. When $\alpha = 1$, the Government's objective function is purely utilitarian and includes the joy of giving[10].

The Government solves the following problem:

$$\max_{c_t^i, x_t^i, L_t^i, h_t^i, \pi_t^H} \sum_{t=0}^{\infty} \gamma^t \left[\sum_{i=1,2} \pi_t^i \left(u\left(c_t^i\right) + \alpha g\left(\theta^i f\left(h_t^i\right) + x_t^i\right) + v\left(1 - L_t^i - h_t^i\right)\right)\right]$$

subject to the resource constraint:

$$\sum_{i=1,2} \pi_t^i \left(w^i L_t^i - x_t^i - c_t^i\right) = 0$$

and the human capital technology:

$$\pi_{t+1}^2 = \sum_{i=1,2} \pi_t^i K\left(\theta^i f\left(h_t^i\right) + x_t^i\right).$$

The Lagrangian associated to the maximization problem is:

$$L = \sum_{t=0}^{\infty} \gamma^t \left\{ \sum_{i=1,2} \pi^i \left(u\left(c^i\right) + \alpha g\left(\theta^i f\left(h_t^i\right) + x_t^i\right) + v\left(1 - L_t^i - h_t^i\right)\right) \right. \tag{4}$$

$$\left. + \mu_t \sum_{i=1,2} \pi_t^i \left(w^i L_t^i - x_t^i - c_t^i\right) - \eta_t \left(\pi_{t+1}^2 - \sum_{i=1,2} \pi_t^i K\left(\theta^i f\left(h_t^i\right) + x_t^i\right)\right)\right\} \tag{5}$$

[10] There is not a general consensus about the inclusion of the warm-glow component in the social welfare function. Several authors, like Hammond (1987), Harsanyi (1995) and Diamond (2006), argue that the inclusion of private redistributive motives involves double counting, since the consumption by others is already included in the social welfare function. Differently, Kaplow (1998) treats gifts and warm-glow as in the realm of social welfare maximization. Thus, he argues that those who are loved more by others are also loved more by the Government.

where μ_t and η_t are the multipliers respectively associated to the resource constraint and the human capital technology.

The first order conditions are the following (computed at the steady state):

$$c^i : u'\left(c^i\right) - \mu = 0 \tag{6}$$

$$x^i : \alpha g'\left(y^i\right) + \eta K'\left(y^i\right) - \mu = 0 \tag{7}$$

$$h^i : v'\left(l^i\right) - \theta^i f'\left(h^i\right)\left(\alpha g'\left(y^i\right) + \eta K'\left(y^i\right)\right) = 0 \tag{8}$$

$$L^i : v'\left(l^i\right) - \mu w^i = 0 \tag{9}$$

$$\pi^2 : v\left(l^2\right) - v\left(l^1\right) + \mu\left(w^2 L^2 - w^1 L^1 - \left(x^2 - x^1\right)\right) - \gamma^{-1}\eta = 0. \tag{10}$$

By concavity of the objective function, for all the variables an interior solution is assumed. Rearranging:

$$c^2 = c^1;\ y^2 = y^1$$

$$f'\left(h^i\right) = \frac{w^i}{\theta^i}$$

$$v'\left(l^i\right) = w^i u'\left(c\right)$$

$$\eta = \gamma\left[\mu\left(w^2 L^1 - w^1 L^1 - \left(x^2 - x^1\right)\right) + \left(v\left(l^2\right) - v\left(l^1\right)\right)\right].$$

Consumption and total child care provided are type-independent. Type 2 individuals consume less leisure than individuals of type 1; they devote, in total, more time to non-leisure activities. This, in turn, means that as long as leisure is a normal good, the more able individual is actually worse off at the utilitarian solution. The high ability individuals would prefer the allocation of the low ability individuals.

3.3 Laissez Faire and Decentralization

In a decentralized economy, the tax function $T\left(I^i,\, d^i,\, x^i\right)$ is levied on individuals and depends on observable variables, where $I^i = w^i L^i$ is individual i's gross income. T_j is the first derivative of the tax function with respect to the variable j. The marginal consumer price of external child care x^i is equal to $p = 1 + T_x$. Depending on the informational assumptions introduced in the following, the tax function will have different structure.

The individual i maximizes (1), subject to (2) and the following constraints[11]:

$$1 = L^i + h^i + l^i$$
$$c^i + x^i = w^i L^i - T\left(w^i L^i,\, d^i,\, x^i\right).$$

The corresponding first-order conditions are:

$$x^i : g'\left(y^i\right) = u'\left(c^i\right)\left(1 + T_x^i\right) \tag{11}$$
$$h^i : v'\left(l^i\right) = \theta^i f'\left(h^i\right)\left(g'\left(y^i\right) - T_d^i u'\left(c^i\right)\right) \tag{12}$$
$$L^i : v'\left(l^i\right) = u'\left(c^i\right) w^i \left(1 - T_I^i\right). \tag{13}$$

Rearranging I get:

$$f'\left(h^i\right) = \frac{w^i\left(1 - T_I^i\right)}{\theta^i\left(1 + T_x^i - T_d^i\right)}. \tag{14}$$

In a pure laissez faire economy, there is no Government's intervention and $T_j^i = 0$ for $j = I,\, d,\, x$, and $p = 1$. Income, consumption and child care levels differ between types. This does not yield the first best optimum and there are two sources of sub-optimality. The first is of distributional nature. By using a utilitarian social welfare function, first best requires equalization of incomes, consumption and total child care levels. Under full information, decentralization is attainable by using lump sum taxes ($T_I = 0$, $T_d = 0$).

The second problem regards the individual's choice of child care provision. y^i is not determined according to the appropriate trade-off (comparing conditions (7), combined with (6), and (11)). Individuals do not internalize the impact of child care on human capital of the next generation. They provide child care for joy of giving. The decentralization of the first best for y^i follows from (6), (7) and (11):

$$1 + T_x^i = p = \frac{g'\left(y^i\right)}{u'\left(c^i\right)} = \frac{g'\left(y^i\right)}{\alpha g'\left(y^i\right) + \eta K'\left(y^i\right)} = \left[\alpha + \eta\frac{K'\left(y^i\right)}{g'\left(y^i\right)}\right]^{-1} \tag{15}$$

or equivalently:

$$T_x^i = \frac{1-\alpha}{\mu} g'\left(y^i\right) - \frac{\eta}{\mu} K'\left(y^i\right). \tag{16}$$

Since in the first best $y^2 = y^1$, the decentralizing T_x is type-independent.

The decentralizing marginal price of external child care is equal to the ratio between private benefits of child care provision (warm-glow component) and social benefits (part of

[11] In absence of taxation, the above constraints can be written as follows:

$$c^i + py^i + w^i l^i = w^i + \left[p\theta^i f\left(h^i\right) - w^i h^i\right].$$

The consumer's total income (right hand side of the equation) is equal to the sum of potential income (when the endowment of time is entirely devoted to labor) and the "profit" derived from household production. Total income is then used for consumption of goods, childcare and leisure. Since household production only enters in the consumer's program through the expression of profit, optimal h^{i*} is that which maximizes the value of this profit, hence $f'\left(h^{i*}\right) = w^i / \left(\theta^i p\right)$.

warm-glow component considered in the social welfare function plus social value of investing in human capital), (15). The social value of y^i for the next generation is equal to η (the shadow price of π^2) times $K'(y^i)$, the induced increase in π^H for an unitary increase of y^i. This term represents the human capital externality: individuals invest in child care provision for joy of giving, not for its social value. In fact, the human capital aspect of child care provision is neglected in the individual problem. This should call for a lower tax or a subsidy. α measures the weight assigned by the social planner to the altruistic component of preferences. According to the value of α, a subsidy or a tax on private care can be obtained. In (16), if $\alpha = 1$, $T_x < 0$: external child care is subsidized. In this case, the optimal subsidy is only determined by the externality component. It is a Pigouvian subsidy. Instead, if $\alpha = 0$, T_x can be even a tax. Neglecting the externality term, y, and thus x, can be taxed at no welfare cost, since they do not directly appear in the social welfare function. In case of $\alpha = 0$, $T_x < 0$ if $g'(y^i) < \eta K'(y^i)$: the marginal private benefit from child care is lower than its social value. In general, when $\alpha < 1$, the optimal tax/subsidy on private child care is determined by two conflicting terms. On one hand, by putting less weight on the warm-glow component, the Government has "paternalistic" preferences, and tends to tax x^i. On the other hand, individuals provide child care for joy of giving, neglecting its social value for the next generation. It calls for a corrective Pigouvian subsidy.

FOCs can be re-written in terms of marginal rates of substitution, given that h^{i*} is chosen according to (14)[12]:

$$\mathrm{MRS}^i_{c,x} = \frac{g'(y)}{u'(c)} = 1 + T^i_x \tag{17}$$

$$\mathrm{MRS}^i_{c,L} = \frac{v'(l)}{u'(c)} = w^i\left(1 - T^i_I\right) \tag{18}$$

$$\mathrm{MRS}^i_{x,L} = \frac{v'(l)}{g'(y)} = w^i \frac{(1 - T^i_I)}{1 + T_x} \tag{19}$$

$$. \tag{20}$$

4 Second Best Taxation

The Government does not observe individual productivities, w^i and θ^i, and allocation of time, h^i and L^i, but it does observe before tax earnings $I^i_t = w^i L^i_t$. As for $d^i_t = \theta^i f(h^i_t)$, it can be observed individually or not observed at all[13]. In the former case, a nonlinear tax

[12] The problem is written as the domestic production department is separated from consumption and labour decisions. In fact, the optimal value of time spent in child care depends only on the productivity parameters and marginal tax rates, and it does not involve any substitution between consumption or labour. They are determined in a second step, according to FOCs.

[13] Recently, several institutions (mostly in OECD countries) started providing statistics on the use of time at the aggregate level, for broad categories. However, such statistics are based on self-reporting and not properly reliable for taxation. Moreover, the aggregate value of household production is difficult to measure by the tax administration. For such reasons, we assume extreme observability conditions.

instrument is available. In the latter, domestic care cannot be taxed. The Government might or not observe x_t^i. If it is observable at individual level, then a nonlinear tax is available. Otherwise, if observable at aggregate and anonymous level, a linear tax is applied. Total child care provision is observed only when domestic care is observable. Two cases will be analyzed[14]:

- Both d_t^i and x_t^i are individually observable.
- x_t^i is observable at individual level, d_t^i is not observed.

For the following analysis, we rewrite the problem in terms of observable variables, and we define $h = z(d/\theta)$, where $z(\cdot)$ is the inverse function of $f(\cdot)$. By using the properties of the inverse function, the function $z(\cdot)$ satisfies: $z'(\cdot), z''(\cdot) > 0$. Optimal d^{i*} is chosen according to:

$$z'\left(\frac{d}{\theta}\right) = \frac{\theta}{w} \frac{1 + T_x - T_d}{1 - T_I}. \tag{21}$$

Preliminarily, it is important to establish some important properties of individual i's utility function in terms of observable variables. First, in the spaces (c, I) and (x, I) the more productive individual has a flatter indifference curve. In fact, in absence of taxation:

$$\mathrm{MRS}_{c,I}^i = \frac{v'(l)}{w^i u'(c)} = \mathrm{MRS}_{x,I}^i = \frac{v'(l)}{w^i g'(y)} = 1.$$

If leisure is a normal good, given the same bundle (c, I) or (x, I), labour will be lower for the more productive individual, and the marginal rates of substitution are smaller. The well-known single crossing condition holds in both spaces (c, I) and (x, I).

The same is valid in the spaces (c, d) and (x, d). The more productive type in child care activities has flatter indifference curves:

$$\mathrm{MRS}_{c,d}^i = \frac{v'(l)\, z'\left(\frac{d}{\theta^i}\right)}{\theta^i u'(c)} = \mathrm{MRS}_{x,d}^i = \frac{v'(l)\, z'\left(\frac{d}{\theta^i}\right)}{\theta^i g'(y)} = 1.$$

Given the same bundle (c, d) or (x, d), effort in home production will be lower for the more productive individual, with smaller marginal rates of substitution. Also in the spaces (c, d) and (x, d) the single crossing condition holds.

Second, in the space (c, x) indifference curves of the two types are the same.

Third, in the space (I, d) the marginal rate of substitution is:

$$\mathrm{MRS}_{I,d}^i = \frac{z'\left(\frac{d}{\theta^i}\right) w^i}{\theta^i} = 1.$$

The slope of the indifference curves depends on the relative differences in labour and domestic productivities. For example, we assume the production function $z(\cdot)$ is isoelastic, $z(d/\theta) = k(d/\theta)^\sigma$, with $\sigma \leq 1$. Then, type 2 has a flatter indifference curve than type 1 in the space (I, d) if $w^2/w^1 < (\theta^2/\theta^1)^\sigma$. It means that, given the same bundle (I, d), type 2 will exert less effort in domestic activities than in the labour market with respect to type 1. The contrary happens if $w^2/w^1 > (\theta^2/\theta^1)^\sigma$.

[14] For completeness, the case for x_t^i observable only at the aggregate level is reported in appendix D. The focus is on the observability of domestic care.

4.1 Nonlinear taxation of private and domestic child care

The Government observes both d_t^i and x_t^i, and thus it controls (I^i, d^i, x^i, c^i). It offers two contracts (I^2, d^2, x^2, c^2) and (I^1, d^1, x^1, c^1) such that solves (4), in the first best section, under the incentive compatibility constraint:

$$u\left(c_t^2\right) + g\left(y_t^2\right) + v\left(1 - \frac{I_t^2}{w^2} - z\left(\frac{d_t^2}{\theta^2}\right)\right) \geq u\left(c_t^1\right) + g\left(y_t^1\right) + v\left(1 - \frac{I_t^1}{w^2} - z\left(\frac{d_t^1}{\theta^2}\right)\right)$$

and λ_t is the associated multiplier. In designing the optimal tax policy, the Government wants to avoid mimicking behavior by the high-productivity type to pay less taxes. Since individual productivities are not observable, high productivity individuals can pretend to be of low type, in order to enjoy more leisure or domestic time and pay less taxes.

The first-order conditions of the Government's problem are provided in appendix A.

Combining (43) and (45) (or (44) and (46)) yields:

$$\frac{g'\left(y^i\right)}{u'\left(c^i\right)} = 1 + \frac{1-\alpha}{\mu} g'\left(y^i\right) - \frac{\eta}{\mu} K'\left(y^i\right) \tag{22}$$

where $i = 1, 2$. This expression represents the marginal rate of substitution between consumption and external care in the second best allocation. It is marginally upward or downward distorted with respect to the first best, according to which component prevails. By using (17) and (22) the individual i's marginal (positive or negative) tax on external child care is computed:

$$T_x^i = \frac{1-\alpha}{\mu} g'\left(y^i\right) - \frac{\eta}{\mu} K'\left(y^i\right). \tag{23}$$

This expression is equivalent to (16), which gives the first best decentralizing price. The only difference is that now the optimal tax/subsidy is differentiated across types, since y^i's are not equalized at the second best solution. The commodity tax does not play any role for redistribution and is used for the corrective purpose described before. The non redistributive role of the commodity tax comes from the fact given the same before tax income and domestic care, individuals make the same decisions regarding consumption and external care. The commodity tax does not have any screening properties. This is the Atkinson-Stiglitz result (Atkinson and Stiglitz, 1976) in this particular context, and it crucially depends on the observability of household production, as we can see in the next Subsection.

Proposition 1 *External care may be upward (in case of a subsidy) or downward (in case of a tax) distorted, according to (23). It is set to correct the human capital externality.*

For individuals of type 2, from (43) and (47), I get $\text{MRS}_{cL}^2 = w^2$, which, along with (18), implies $T_I^2 = 0$: at the margin there is no tax on individual 2's labour supply.

As for domestic care, using (45), (47) and (49) yields:

$$z'\left(\frac{d^2}{\theta^2}\right) = \frac{\theta^2}{w^2}. \tag{24}$$

At the margin, optimal domestic care is not distorted. It implies $T_d^2 = T_x^2$. The marginal tax on domestic care is equal to that of external care, in order to avoid distortions in time allocation. Human capital correction occurs only through external care.

Proposition 2 *When domestic and external care are observable at the individual level, the second best solution implies no distortions in time allocation for individuals of type 2.*

For type 1 individuals, combining (44) and (48) yields:

$$\mathrm{MRS}_{c,L}^1 = \frac{v'(l^1)}{u'(c^1)} = \frac{1 - \frac{\lambda}{\pi^1}}{1 - \frac{\lambda}{\pi^1}\frac{w^1}{w^2}\frac{\mathrm{MRS}_{c,L}^{21}}{\mathrm{MRS}_{c,L}^1}} w^1, \tag{25}$$

where $\mathrm{MRS}_{c,L}^{21}$ is the mimicker's marginal rate of substitution and l^{21} is leisure consumed by type 2 when accepts the bundle offered to type 1; $\mathrm{MRS}_{c,L}^{21} < \mathrm{MRS}_{c,L}^1$, since $l^{21} > l^1$ and thus $\mathrm{MRS}_{c,L}^1 < w^1$. There is a marginal downward distortion in the labor supply of type 1 individuals. This implies a positive marginal tax rate on gross income:

$$T_I^1 = \frac{\lambda}{\mu\pi^1}\left(\frac{v'(l^1)}{w^1} - \frac{v'(l^{21})}{w^2}\right) > 0. \tag{26}$$

Finally, domestic care for type 1 is determined according to[15]:

$$z'\left(\frac{d^1}{\theta^1}\right) = \frac{\theta^1}{w^1}\left[\frac{1 - \frac{\lambda}{\pi^1}\frac{w^1}{w^2}\frac{v'\left(l^{21}\right)}{v'(l^1)}}{1 - \frac{\lambda}{\pi^1}\frac{\theta^1}{\theta^2}\frac{z'(d^1/\theta^2)}{z'(d^1/\theta^1)}\frac{v'(l^{21})}{v'(l^1)}}\right]. \tag{27}$$

Domestic care for type 1 may be marginally upward or downward distorted, depending on parameter values. More specifically, the following proposition is valid.

Proposition 3 *When domestic and external care are observable at the individual level, the second best solution implies distortions in time allocation for individuals of type 1. Labour supply is marginally downward distorted. As for domestic care (and, as a consequence, time devoted to it), it is distorted according to:*

$$\frac{w^1}{w^2} \lesseqqgtr \frac{\theta^1}{\theta^2}\frac{z'\left(\frac{d^1}{\theta^2}\right)}{z'\left(\frac{d^1}{\theta^1}\right)} \Leftrightarrow z'\left(\frac{d^1}{\theta^1}\right) \gtreqqless \frac{\theta^1}{w^1}. \tag{28}$$

If $z(d/\theta)$ is isoelastic, (28) becomes:

$$\frac{w^1}{w^2} \lesseqqgtr \left(\frac{\theta^1}{\theta^2}\right)^{\sigma} \Leftrightarrow z'\left(\frac{d^1}{\theta^1}\right) \gtreqqless \frac{\theta^1}{w^1}. \tag{29}$$

[15]This expression is obtained combining (46), (48) and (50).

Human capital correction occurs through the marginal taxation of external care. Redistribution acts through the income and domestic care tax. In order to avoid mimicking behavior, the Government is distorting the choices of the mimicked type. Domestic care is upward distorted with respect to income when the relative ratio of market productivities is lower than the ratio of marginal products of domestic activity. It is downward distorted when the contrary is verified. This is consequence of the property of the indifference curves in the space (I, d). Domestic care is distorted with respect to income in the direction which hits more the mimicker than the mimicked, and it depends on the assumptions on labour and domestic productivities.

I finally have $c^2 > c^1$; $y^2 > y^1$. In the first-best allocation, it was optimal to equalize child care provision across types, and the child's probability of being type 2 was independent of parent's type and income. In second best, to disincentivize mimicking behaviour, type 2 has to be "rewarded" of the greater effort, with more consumption and child care provision than type 1. It introduces inequality in the probability of becoming a highly productive type, depending on family's origins.

4.2 Nonlinear taxation of private child care

In this case the Government observes only bought child care at the individual level. Domestic child care is neither observable at individual and aggregate level. Thus, it cannot be subject to taxation, $T\left(w^i L^i, x^i\right)$. Income and private care continue to be taxed non linearly. The Government controls I^i, R^i (after tax income), and its allocation between c^i and x^i. Total and domestic child care provision are not observable and directly controlled.

Given any contract (I^i, x^i, c^i), the individual i's demand for domestic care is determined by solving:

$$\max_{d^i} g\left(d^i + x^i\right) + v\left(1 - \frac{I^i}{w^i} + z\left(\frac{d^i}{\theta^i}\right)\right). \tag{30}$$

The first-order condition is given by

$$g'\left(y^i\right) - \frac{v'\left(l^i\right)}{\theta^i} z'\left(\frac{d^i}{\theta^i}\right) = 0. \tag{31}$$

The following lemmas, proved in appendix B, will be useful to study the second best solution.

Lemma 1 *For any given contract (I, x, c), the following inequality holds:*

$$d^1\left(I, x, c\right) < d^{21}\left(I, x, c\right).$$

This lemma claims that at any given contract (all observable variables are set at the same level), type 2 individuals consume/produce more domestic care than type 1 individuals. The mimicker will have a relative abundance of non-market hours and will therefore be more prone to produce more domestic care than the mimicked type. In absence of domestic care, given the same contract, type 2 and 1 have the same spending allocation, and type 2 enjoys more leisure. Here, they still have the same spending allocation, but now type 2 not only can enjoy more leisure, but can also consume more domestic care (and, as a consequence, more total child care). Domestic care is used as a non-observable variable to adjust utility. It makes more difficult for the Government to induce self-selection. Now, when 2 mimics 1, she no longer has to match the same child care provision of the mimicked type. Only the spending pattern has to be the same. It will make more difficult for the tax authority to satisfy the incentive compatibility constraint.

Lemma 2 $\frac{\partial d}{\partial I} < 0$ *and* $\frac{\partial d}{\partial x} < 0$.

This second lemma shows the comparative statics properties of problem (30). Both external care and income has a negative impact on domestic care. Larger external care replaces domestic care. Higher income reduces domestic care since it decreases available time to domestic activity. They are substitute activities.

The tax authority problem is the following:

$$
\begin{aligned}
L_2 = & \sum_{t=0}^{\infty} \gamma^t \Bigg\{ \sum_{i=1,2} \pi_t^i \left(u\left(c_t^i\right) + V_t^i + (\alpha - 1)\, g\left(d_t^{i*} + x_t^i\right)\right) \\
& + \mu_t \sum_{i=1,2} \pi_t^i \left(I_t^i - x_t^i - c_t^i\right) - \eta_t \left(\pi_{t+1}^H - \sum_{i=1,2} \pi_t^i K\left(d_t^{i*} + x_t^i\right)\right) \\
& + \lambda_t \left(u\left(c_t^2\right) + V_t^2 - u\left(c_t^1\right) - V_t^{21}\right) \Bigg\},
\end{aligned}
$$

where $V^i = V^i\left(I^i, x^i; w^i, \theta^i\right)$ is individual i's indirect utility function. $V^{21} = V^2\left(I^1,\, x^1;\, \theta^2,\, w^2\right)$ is the indirect utility function of type 2 when mimics type 1.

FOCs are provided in appendix C. Rearranging them in the steady state, the second best allocation is characterized.

Combining (56) and (58) yields:

$$
\mathrm{MRS}_{c,x}^2 = 1 + \left(1 + d_x^{2*}\right)\left(\frac{1-\alpha}{\mu} g'\left(y^2\right) - \frac{\eta}{\mu} K'\left(y^2\right)\right). \tag{32}
$$

As before, it is different from the first best in order to correct for human capital. The optimal tax/subsidy on private child care for type 2 is:

$$
T_x^2 = \left(1 + d_x^{2*}\right)\left(\frac{1-\alpha}{\mu} g'\left(y^2\right) - \frac{\eta}{\mu} K'\left(y^2\right)\right). \tag{33}
$$

The optimal tax on external child care is not used for redistributive scope, but it differs from (16) and (23) because it incorporates the negative/replacement effect that private care has on domestic care (stated in Lemma 2). The term in brackets has the same interpretation as in previous cases. It drives the sign of the optimal tax/subsidy on private care, since $|d_x^i| < 1$[16]. If the net term is negative and calls for a subsidy, in setting the optimal tax rate the Government considers the substitution effect external care has on domestic care. With

[16]It results from (55) in appendix B, thus $1 + d_x^i$ is always positive.

respect to before, this substitution effect reduces the marginal subsidy. Similar considerations hold in case of a tax.

Combining (56) and (61) yields:

$$\mathrm{MRS}^2_{c,L} = w^2 \left[1 - d_I^{2*} \left(\frac{1-\alpha}{\mu} g'\left(y^2\right) - \frac{\eta}{\mu} K'\left(y^2\right)\right)\right]. \tag{34}$$

This expression together with (18) and Lemma 2 implies a marginal downward or upward distortion of labour supply relative to consumption, according to the sign of the human capital correction term. Consider the case in which the net term is negative (and calls for a subsidy of child care). External care is subsidized (according to (33)) and it has a substitution effect on domestic care. In order to countervail this negative effect, that may reduce the total amount of care provided, labour supply is marginally downward distorted, and it has a positive effect on domestic care, through $d_I^{2*} < 0$. In case of a marginal tax on child care, private care is taxed and labour supply is marginally subsidized. The marginal income tax for type-2 individuals is:

$$T_I^2 = d_I^{2*} \left(\frac{1-\alpha}{\mu} g'\left(y^2\right) - \frac{\eta}{\mu} K'\left(y^2\right)\right). \tag{35}$$

External care and income tax interplay in correcting human capital externality and they have opposite sign.

Proposition 4 *When domestic care is not observable at all and private care is observable at individual level, the second best solution implies distortions in time and spending allocations for individuals of type 2. They may be upward or downward distorted, according to the needed correction for human capital. Marginal taxes/subsidies are not redistributive.*

Domestic care is a moral hazard variable which contributes to the child's human capital. When it is necessary to correct for human capital accumulation through external care, the Government has to consider the impact that it may have on domestic care. Income taxation has the purpose to indirectly control for it. Distortions of Type 2 allocation do not have a redistributive purpose, but they are driven by efficiency reasons. When correction of human capital is not needed, no distortions occur and we go back again to the result of "no distortions at the top".

Using (57) and (59), we get:

$$\mathrm{MRS}^1_{c,x} = \frac{1 - \frac{\lambda}{\pi^1}}{1 - \frac{\lambda}{\pi^1} \frac{\mathrm{MRS}^{21}_{c,x}}{\mathrm{MRS}^1_{c,x}}} \left[1 + \left(1 + d_x^{1*}\right) \left(\frac{1-\alpha}{\mu} g'\left(y^1\right) - \frac{\eta}{\mu} K'\left(y^1\right)\right)\right]. \tag{36}$$

The term in square brackets has the same interpretation as (32), but it is multiplied by the ratio in (36), which is lower than 1, since $\mathrm{MRS}^{21}_{c,x} < \mathrm{MRS}^1_{c,x}$, by Lemma 1. This ratio represents the redistributive distortion: it induces a marginal distortion in favor of x, making it less expensive relative to consumption. The rationale behind this result is the following.

Providing a subsidy on private care is disincentivizing for the mimicker. By accepting the bundle $(I^1,\, x^1)$, the mimicker can raise her utility by consuming more domestic care, at place of private care. But it is not profitable if private care is subsidized and provided at already large amount. It discourages mimicking behaviour, since domestic care cannot be used to adjust utility. The corresponding marginal tax is the following:

$$T_x^1 = \left(1 + d_x^{1*}\right)\left[\frac{1-\alpha}{\mu} g'\left(y^1\right) - \frac{\eta}{\mu} K'\left(y^1\right)\right] + \frac{\lambda}{\mu \pi^1}\left(g'\left(y^{21}\right) - g'\left(y^1\right)\right) \tag{37}$$

where the second term is negative by Lemma 1, driving the result toward a subsidy. The first term is in common with (33).

Finally, putting together (57) and (62):

$$\mathrm{MRS}_{c,L}^1 = w^1 \frac{1 - \frac{\lambda}{\pi^1}}{1 - \frac{\lambda}{\pi^1}\frac{w^1}{w^2}\frac{\mathrm{MRS}_{c,L}^{21}}{\mathrm{MRS}_{c,L}^1}}\left(1 - d_I^{1*}\left(\frac{1-\alpha}{\mu} g'\left(y^1\right) - \frac{\eta}{\mu} K'\left(y^1\right)\right)\right). \tag{38}$$

It has a similar interpretation as (36). The term in brackets is in common with (34). The ratio is the redistributive distortion. Since $d^1(I,x,c) < d^{21}(I,x,c)$, it is possible to have type-1 consuming more leisure than the mimicker, since the mimicker may use additional free time to produce domestic care. The ratio in this case is greater than 1, implying an upward distortion in labour supply. It is clear looking at the marginal income tax for low type individuals:

$$T_I^1 = d_I^{1*}\left[\frac{1-\alpha}{\mu} g'\left(y^1\right) - \frac{\eta}{\mu} K'\left(y^1\right)\right] + \frac{\lambda}{\mu \pi^1}\left(\frac{v'\left(l^1\right)}{w^1} - \frac{v'\left(l^{21}\right)}{w^2}\right). \tag{39}$$

Differently than in (26), the second term is not necessarily positive.

External and income tax for type-1 individuals may have the same sign, due to redistributive considerations.

Proposition 5 *When domestic care is not observable at all and private care is observable at individual level, the second best solution implies distortions in time and spending allocations for individuals of type 1. Distortions are both corrective for human capital and redistributive. With respect to Subsection 4.1, redistributive directions may differ.*

5 Additional tool: public child care

Another instrument of public intervention is now considered: public provision of external care. Now we examine if this additional instrument can be useful in the analysis. The answer depends on the information structure. When external child care is observable, non-linear taxes/subsidies are feasible and there is no room for further welfare improvements through public provision (for a detailed discussion see Cremer and Gahvari (1997)). Moreover, even if domestic care is not observable, it is not a good candidate for uniform public provision, since $d^{21} > \min[d^1; d^2]$: through forced consumption of domestic care, mimicking behaviour cannot be prevented[17] (Cremer and Gahvari, 1997). Any Pareto efficient self selection allocation is readily implementable through the tax and subsidy system. When external care is individually observable, there is no role for in-kind transfers.

When only anonymous transactions are observable, in-kind transfers cannot be ruled out.

Public provision can potentially be uniform or non uniform. The case of uniform provision will be considered, which is the simplest form, under the benchmark scenario represented in appendix D.

The uniform provision case is closely inspired to Cremer and Gahvari (1997), who show that under a condition on potential consumption levels of the different types and the mimicker, uniform public provision is welfare improving, since it can relax an otherwise binding incentive constraint. In this context, the condition is:

$$x^2\left(I^1, R^1, p\right) = x^{21} < \min\left[x^1\left(I^1, R^1, p\right), x^2\left(I^2, R^2, p\right)\right]. \tag{40}$$

This condition states that the potential consumption of external care by the mimicker has to be smaller than the actual consumption levels of both types of individuals. From appendix D, $x^{21} < x^1$ holds. Condition (40) becomes:

$$x^2\left(I^1, R^1, p\right) = x^{21} < x^2\left(I^2, R^2, p\right). \tag{41}$$

Individual 2's consumption of external care must be smaller when she mimics 1 than when she chooses her consumption bundle. Assuming that $(I^2, R^2) > (I^1, R^1)$, the mimicker works less and has a lower disposable income than individual 2. In appendix D it is shown that external care is an increasing function of before and after-tax incomes, given the other parameters. Thus, $x^{21} < x^2$. Moreover, public provision has to be lower or equal than the optimal amount of external care form Government's point of view, considering the human capital externality and altruism. Otherwise public provision is inefficient.

Proposition 6 *When purchases of external care are observable as anonymous transactions only, when the second best allocation satisfies $x^{21} < x^2$, a public provision of external care at level*

$$e = min\left[x^1\left(I^1, R^1, p\right), x^2\left(I^2, R^2, p\right)\right] - \epsilon \tag{42}$$

with $\epsilon > 0$ and sufficiently small to ensure $e > x^{21}$ along with a suitable adjustment in the tax policy, is welfare improving.

Satisfying (42), public provision does not modify actual consumption levels of type 1 and 2. However, it relaxes the otherwise binding incentive constraint because it imposes a higher than desired level of external care on the mimicker. With the incentive constraint no longer binding, it is then possible to adjust the tax policy to bring about an increase in welfare. Some additional redistribution can be achieved, moving closer to the first-best solution.

[17]This result goes against policies aimed at financing domestic care, such as parental leaves.

6 Conclusion

In this paper, the design of child care policy, when child care provision determines the probability that a child is high ability type, has been studied. Parents can provide two types of care to their children: domestic care, by investing time, or private care, bought on the market. In doing so, parents are motivated by warm-glow altruism and they do not internalize the human capital technology which associates child care provision to the child's probability of being high type. The warm-glow term does not account for the effect of child care on the next generation human capital, and hence the externality problem. In choosing the optimal allocation that maximizes aggregate welfare, the Government faces another problem: how to deal with the altruistic component in the social welfare function. In the economic literature, there are different theoretical views about the best way to deal with it. The first best solution is decentralized by using a marginal tax on external care, which corrects for the externality and altruism problem. These two external effects work in opposite directions. The presence of the human capital externality calls for a subsidy. Correcting for altruism involves a paternalistic role of the Government, maximizing preferences that differ from individual ones for the warm-glow component. This correction calls for a tax.

However, the Government chooses optimal allocations in a second best framework, since it is not informed about individual productivities and allocation of time. It can only observe aggregate income and the product of domestic activity, without distinguishing the individual's ability type. Moreover, the set of public tools available for implementing incentive compatible allocations is restricted by informational assumptions on domestic and private care.

When both domestic and external care are observable at individual level, standard results of the optimal taxation literature apply. Domestic and market labor decisions are not distorted for the high type. For the low type, labor supply and domestic time are distorted to disincentivize the mimicking behavior by the high type. Redistribution occurs through the nonlinear income and domestic care tax. The marginal tax on external care is not desirable for redistributive reasons but for correcting the externality and altruism problem as before.

If domestic care is not observable, all tax formulas contain the corrective component for the human capital externality and the inclusion of altruism in social welfare. Domestic care cannot be directly controlled and, in choosing the optimal allocations, the Government has to consider the indirect effects on the demand of domestic care, which affects the next generation's human capital. The external care, differently as before, is used for redistributive purposes.

Public child care may be desirable in a second-best setting. It may ease the incentive compability constraint, leaving more space for redistribution. We expect that public child care may complete crowd out some type of care for some individuals.

This paper differs from contributions on education policies since it includes a domestic sector and studies how labor and housework decisions interact. We deal with child care, which differs from other household goods for its impact on children's human capital. There are few contributions on this topic, since only recently the economic literature has devoted attention to child care as human capital investment. This paper is an attempt to incorporate the potential effects of child care provision on children's human capital in the analysis of the optimal child care policy mix.

Possible extensions of the analysis are the following.

The human capital technology assumed in the model implies, given the same level of child care provision, equality of opportunities in becoming high productive for advantaged and disadvantaged children. The family background matters in child care production but it does not directly affect the probability of being high skill. However, it is reasonable to think that being born from a high-productivity parent gives more chances of becoming high type[18]. The motivating research question can be analyzed with this new human capital technology and allowing for the Government to have different objective functions. For example, the case of a Government interested in promoting social mobility or reducing inequality can be studied.

Another extension may consist in allowing different impact on the probability of being high type according to the type of care. The perfect substitution hypothesis between types of care is removed.

[18] For genetics and social considerations.

Figures

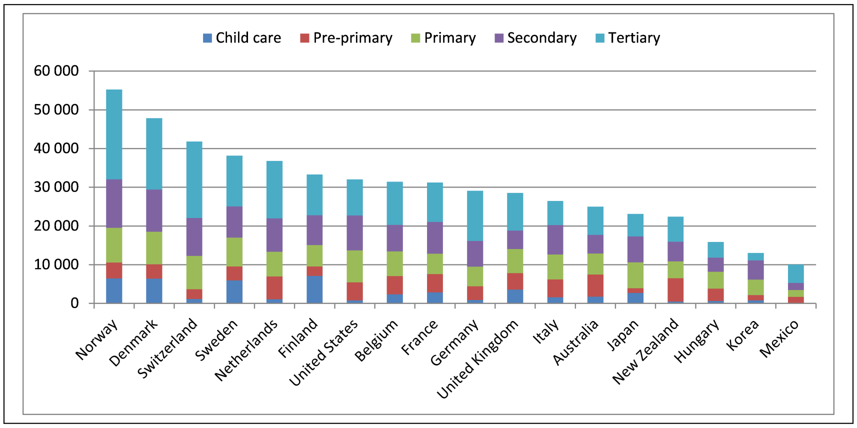

Figure 1: Public expenditure on pre-school programs and education per child/student US$PPP, 2005 (OECD, 2011)

Appendices

A Nonlinear taxation of private and domestic care, first-order conditions

$$\pi^2\mu = u'\left(c^2\right)\left(\pi^2+\lambda\right) \tag{43}$$

$$\pi^1\mu = u'\left(c^1\right)\left(\pi^1-\lambda\right) \tag{44}$$

$$\pi^2\mu = g'\left(y^2\right)\left(\alpha\pi^2+\lambda\right)+\eta\pi^2 K'\left(y^2\right) \tag{45}$$

$$\pi^1\mu = g'\left(y^1\right)\left(\alpha\pi^1-\lambda\right)+\eta\pi^1 K'\left(y^1\right) \tag{46}$$

$$\pi^2\mu = \left(\frac{\pi^2+\lambda}{w^2}\right)v'\left(l^2\right) \tag{47}$$

$$\pi^1\mu = \frac{\pi^1}{w^1}v'\left(l^1\right)-\frac{\lambda}{w^2}v'\left(l^{21}\right) \tag{48}$$

$$g'\left(y^2\right)\left(\alpha\pi^2+\lambda\right)+\eta\pi^2 K'\left(y^2\right) = \frac{\pi^2+\lambda}{\theta^2}v'\left(l^2\right)z'\left(\frac{d^2}{\theta^2}\right) \tag{49}$$

$$g'\left(y^1\right)\left(\alpha\pi^1-\lambda\right)+\eta\pi^1 K'\left(y^1\right) = \frac{\pi^1}{\theta^1}v'\left(l^1\right)z'\left(\frac{d^1}{\theta^1}\right)-\frac{\lambda}{\theta^2}v'\left(l^{21}\right)z'\left(\frac{d^1}{\theta^2}\right). \tag{50}$$

l^{21} is leisure consumed by type 2 when accepts the bundle offered to type 1.

B Proof of Lemmas 1 and 2

FOC (31) can be rewritten as:

$$g'(d+x) - \frac{1}{\theta} v' \left(1 - \frac{I}{w} - z'\left(\frac{d}{\theta}\right)\right) = 0, \tag{51}$$

where subscripts have been deleted.

This equation defines $d^i(I^i, x^i) = d(w^i, \theta^i; I, x)$ with derivatives[19]:

$$\frac{\partial d}{\partial w} = \frac{\frac{v''(l)}{w^2\theta} I z'\left(\frac{d}{\theta}\right)}{\triangle} > 0, \tag{52}$$

$$\frac{\partial d}{\partial \theta} = -\frac{\frac{v'(l)}{\theta^2} z'\left(\frac{d}{\theta}\right) - \frac{v''(l)}{\theta^3} d z'\left(\frac{d}{\theta}\right) + \frac{v'(l)}{\theta^3} d z''\left(\frac{d}{\theta}\right)}{\triangle} > 0, \tag{53}$$

$$\frac{\partial d}{\partial I} = -\frac{\frac{v''(l)}{w\theta} z'\left(\frac{d}{\theta}\right)}{\triangle} < 0, \tag{54}$$

$$\frac{\partial d}{\partial x} = -\frac{g''(y)}{\triangle} < 0, \tag{55}$$

where $\triangle = g''(y) + v''(l)\frac{1}{\theta^2}\left(z'\left(\frac{d}{\theta}\right)\right)^2 - v'(l)\frac{1}{\theta} z''\left(\frac{d}{\theta}\right) < 0$ is the second order derivative of the left hand side of (51) with respect to d. Lemma 1 follows from (52) and (53), Lemma 2 from (54) and (55).

C Nonlinear taxation of private child care, first-order conditions

$$\pi^2\mu = u'\left(c^2\right)\left(\pi^2 + \lambda\right) \tag{56}$$

$$\pi^1\mu = u'\left(c^1\right)\left(\pi^1 - \lambda\right) \tag{57}$$

$$\pi^2\mu = \left(\pi^2 + \lambda\right) g'\left(y^2\right) + \pi^2\left(d_x^{2*} + 1\right)\left[(\alpha - 1) g'\left(y^2\right) + \eta K'\left(y^2\right)\right] \tag{58}$$

$$\pi^1\mu = \left(\pi^1 - \lambda\right) g'\left(y^1\right) + \pi^1\left(d_x^{1*} + 1\right)\left[(\alpha - 1) g'\left(y^1\right) + \eta K'\left(y^1\right)\right] \tag{59}$$

$$+ \lambda\left(g'\left(y^1\right) - g'\left(y^{21}\right)\right) \tag{60}$$

$$\pi^2\mu = \left(\frac{\pi^2 + \lambda}{w^2}\right) v'\left(l^2\right) + \pi^2 d_I^{2*}\left[(1 - \alpha) g'\left(y^2\right) - \eta K'\left(y^2\right)\right] \tag{61}$$

$$\pi^1\mu = \left(\frac{\pi^1 - \lambda}{w^1}\right) v'\left(l^1\right) + \lambda\left(\frac{v'\left(l^1\right)}{w^1} - \frac{v'\left(l^{21}\right)}{w^2}\right) \tag{62}$$

$$+ \pi^1 d_I^{1*}\left[(1 - \alpha) g'\left(y^1\right) - \eta K'\left(y^1\right)\right]. \tag{63}$$

[19] By totally differentiating (51).

D Linear taxation of private child care

The Government observes bought child care only at the aggregate and anonymous level. A linear tax function is applied and all consumers pay the same price p_t. Income is still taxed non linearly. Now the Government controls I_t^i, R_t^i, the price p_t. When 2 mimics 1, she no longer has to match the same child care provision and spending pattern of the mimicked type.

In this case, given any contract (I^i, R^i, p), an individual of type i solves:

$$\max_{d^i} u\left(R^i - px^i\right) + g\left(d^i + x^i\right) + v\left(1 - \frac{I^i}{w^i} + z\left(\frac{d^i}{\theta^i}\right)\right). \tag{64}$$

The first-order conditions are given by:

$$-pu'\left(c^i\right) + g'\left(y^i\right) = 0 \tag{65}$$

$$g'\left(y^i\right) - \frac{v'\left(l^i\right)}{\theta^i} z'\left(\frac{d^i}{\theta^i}\right) = 0. \tag{66}$$

The solutions of this problem allow to define the "conditional" demand functions for consumption, $c^{i*} = c^i\left(I^i, R^i, p\right)$, external care, $x^{i*} = x^i\left(I^i, R^i, p\right)$ and domestic care, $d^{i*} = d^i\left(I^i, R^i, p\right)$. They are type-specific.

Similarly to appendix B, for any given contract (I, R, p), the following inequalities hold:

$$\begin{aligned} d^1(I,x,c) &< d^{21}(I,x,c) \\ c^1(I,x,c) &< c^{21}(I,x,c) \\ x^1(I,x,c) &> x^{21}(I,x,c). \end{aligned}$$

At any given contract (I, R, p), type 2 individuals have more consumption and domestic care than type 1 individuals, and less external care. The mimicker will have a relative abundance of non-market hours and will therefore be less (more) prone to demand external (domestic) care than the mimicked type. Given the same after tax income, buying less external care the mimicker can consume more. For the Government, inducing self-selection is even more difficult than before, sine the mimicker has no longer to satisfy neither the spending pattern of the mimicked.

Moreover, the comparative statistics of the problem (64), respectively for domestic and private care, are:

$$\begin{aligned} \frac{\partial d}{\partial I} &< 0 \qquad \frac{\partial x}{\partial I} > 0 \\ \frac{\partial d}{\partial R} &< 0 \qquad \frac{\partial x}{\partial R} > 0 \\ \frac{\partial d}{\partial p} &> 0 \qquad \frac{\partial x}{\partial p} < 0. \end{aligned}$$

Pareto-efficient allocations can be described as follows. Maximize:

$$\sum_{t=0}^{\infty} \gamma^t \left\{ \sum_{i=1,2} \pi_t^i \left[V^i + (\alpha - 1) g\left(y^i\right) \right] \right\}$$

with respect to I^i, R^I and p, for $i = 1, 2$. Subject to the resource constraint:

$$\sum_{i=1,2} \pi_t^i \left(I_t^i - R_t^i + (p_t - 1) x^{i*} \right) = 0$$

the usual human capital technology, and the self selection constraint:

$$V^2 \geq V^{21}$$

where $V^{21} = V^2 \left(I^1, R^1, p; \theta^2, w^2\right)$ is the indirect utility of type 2 when chooses the bundle offered for the low type.

The associated FOCs are:

$$\begin{aligned}
\left(\pi^2 + \lambda\right) V_R^2 + \mu\pi^2 \left(-1 + \tau x_R^{2*}\right) + \pi^2 y_R^{2*} \left[(\alpha - 1) g'\left(y^2\right) + \eta K'\left(y^2\right) \right] &= 0 \\
\pi^1 V_R^1 - \lambda V_R^{21} + \mu\pi^1 \left(-1 + \tau x_R^{1*}\right) + \pi^1 y_R^{1*} \left[(\alpha - 1) g'\left(y^1\right) + \eta K'\left(y^1\right) \right] &= 0 \\
\left(\pi^2 + \lambda\right) V_I^2 + \mu\pi^2 \left(1 + \tau x_I^{2*}\right) + \pi^2 y_I^{2*} \left[(\alpha - 1) g'\left(y^2\right) + \eta K'\left(y^2\right) \right] &= 0 \\
\pi^1 V_I^1 - \lambda V_I^{21} + \mu\pi^1 \left(1 + \tau x_I^{1*}\right) + \pi^1 y_I^{1*} \left[(\alpha - 1) g'\left(y^1\right) + \eta K'\left(y^1\right) \right] &= 0
\end{aligned}$$

$$\begin{aligned}
\sum_{i=1,2} \pi^i \left\{ V_p^i + y_p^{i*} \left[(\alpha - 1) g'\left(y^i\right) + \eta K'\left(y^i\right) \right] \right\} + \\
\lambda \left(V_p^2 - V_p^{21}\right) + \mu \sum_{i=1,2} \pi^i \left(x^{i*} + \tau x_p^{i*}\right) &= 0
\end{aligned}$$

where $y_j^{i*} = d_j^{i*} + x_j^{i*}$, $j = R, p, I$ and $i = 1, 2$.

By taking $\sum_i \frac{\partial L_3}{\partial R^i} x^{i*} + \frac{\partial L_3}{\partial p}$, we get[20]:

$$T_x = \frac{\lambda u'\left(c^{21}\right)\left(x^{21*} - x^{1*}\right) - \sum_i \pi^i \frac{\partial \widetilde{y}^{i*}}{\partial p} \left[(1 - \alpha) g'\left(y^i\right) + \eta K'\left(y^i\right) \right]}{-\mu \sum_i \pi^i \frac{\partial \widetilde{x}^{i*}}{\partial p}} \tag{67}$$

where $\widetilde{y}$ and $\widetilde{x}$ denote the Hicksian demand function of total and private child care. $T_x = p - 1$.

The right-hand side of (67) consists of three different terms. First, the denominator, which is positive, reflects the distortions created by the tax on private child care; it catches the substitution effect. It represents the marginal dead-weight loss associated with the distortion of private care price. The first term of the numerator is proportional to the difference between the mimicker's demand of private care and that of the mimicked. This

[20]The Slutsky decomposition and Roy's identity are used.

is negative by the inequality previously established, and it drives the result to a subsidy. The second term of the numerator is already familiar: it has the same components of (16) (and (23)) but averaged over the two types of individuals and the derivative of compensated demand of child care. As in previous sections, the externality term pushes for a subsidy and the possibility of laundering out pushes for a tax on x.

Denoting

$$\delta^i = \pi^i \frac{\partial \widetilde{d}^{i*}}{\partial p} \Big/ \sum_i \pi^i \frac{\partial \widetilde{d}^{i*}}{\partial p}$$

$$\chi^i = \pi^i \frac{\partial \widetilde{x}^{i*}}{\partial p} \Big/ \sum_i \pi^i \frac{\partial \widetilde{x}^{i*}}{\partial p}$$

(67) can be written as:

$$T_x = \frac{\lambda u'\left(c^{21}\right)\left(x^{21*} - x^{1*}\right)}{-\mu \sum_i \pi^i \frac{\partial \widetilde{x}^{i*}}{\partial p}} + \frac{\sum_i \left(\delta^i + \chi^i\right)\left[(1-\alpha)\, g'\left(y^i\right) + \eta K'\left(y^i\right)\right]}{\mu}. \tag{68}$$

The first term is standard in the literature about the desirability of commodity taxation and it calls for a subsidy. The second term relates to the correction of human capital, which may turn the subsidy into a tax.

As for the optimal marginal taxes on income, their formulas are more complicated than (35) and (39), but their intuition is similar: both the marginal income taxes incorporate the corrective term for human capital.

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