

Modes of child care

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Abstract: We model choices between caring for an infant at home or through some market provision of child care. Maternal labor supply necessitates child care purchased in the market. Households are distinguished along three dimensions: (i) Exogenous income, (ii) the wage rate of the primary care giver and (iii) the quality which the primary caregiver provides for child care. The market can supply child care at varying qualities and in continuous amounts. All households value consumption and child care quality. Sources of market failure comprise taxation of labor and productivity impacts on child care not fully taken account of by parents. Optimal corrective subsidies are highly correlated with taxed paid by secondary earners. In a second-best environment, typical policies of subsidizing child care will also distort quality choices. Employing “no-use subsidies” mitigates such distortions and can also counter excessive levels of subsidies for external child care.

Keywords: child care; labor supply; subsidies; family policy

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1. Introduction

The provision and financing of child care varies substantially across countries. For example, child care facilities are often publicly provided and heavily subsidized in France and Sweden, while there is no similarly strong intervention in the child care market in the UK. These radically different approaches to child care policy in the former countries all lead to rates of formal child care of around 30-45 per cent (in 2006) of children below age 3, which lies considerably above the European average (DICE Database, 2011). Moreover, Finland, Sweden, Norway and Germany have experimented with cash for care, henceforth called no-use subsidies, where lump-sum payments are granted to parents with children at infant age who do not use public or subsidized private child care facilities. Thus, these subsidies are paid both if parents take care for their children or if unsubsidized external child care is chosen. The empirical literature from Heckman (1974) on argues repeatedly that increased access to subsidized child care raises labor supply of mothers (eg Lefebvre and Merrigan, 2008, Bauernschuster and Schlotter, 2015), while it remains unclear whether there is also a significant positive effect on fertility (Bick, 2016, Bauernschuster et al., 2016). In advanced economies, as suggested by Havnes and Mogstad (2011), analyzing the expansion of kindergarten in Norway, it may happen that public child care supply simply crowds out private alternatives with little impact on maternal labor supply.

In this paper we study household's child care choices where parental care and external care can be substituted on a continuous basis. While higher wages for secondary earners generally drive up the demand for external care, higher incomes of primary earners may work in the opposite direction. When replacing lower by higher quality of external care, this will often go along with an upward jump in household labor supply. For simplicity, we fix labor supply of the primary earner at full time – which makes sense in a cooperative household framework if the primary earner exhibits both higher wage rate in the market and lower productivity in parental child care. We abstract from issues of uncoordinated labor supply and home production decisions as being addressed by Meier and Rainer (2015); there it turns out that optimal taxation of wages will typically be gender-specific being determined both by Ramsey-type labor supply elasticity considerations and Pigouvian impacts of encouraging home production.

The main focus of our analysis lies in determining a scheme of optimal subsidies for child care. The decision between supplying labor and purchasing child care in the market on the one side and caring for the own children at home on the other side is distorted by wage taxation. As home production cannot be taxed, secondary earners with low productivities in the labor market are inclined to stay at home and care for their children themselves. We show that optimal subsidies for external care increase in the wage and the marginal tax rate of the secondary earner, and fall with a higher price of external care. This structure turns out because optimal subsidies are designed so as to perfectly offset the distortions from taxing wages of secondary earners. If subsidies for external child care are set at an excessive level, a justification of no-use subsidies arises. In that case we determine optimal levels. Finally, parents may have imperfect altruism towards their children or underestimate the impact of child care quality on their children's wellbeing and future productivity. Such a situation may be dealt with by reduced subsidies for market care or increasing no-use subsidies.

If there is quality differentiation in the market for external child care, optimal subsidies are determined perfectly analogously to the basic model, undoing also distortions of choosing between types of external care, where parental care does not receive a subsidy. Should, however, subsidies support only one

standard quality type, households will revise their decisions at the expense of both lower and higher quality alternatives. In this situation, a new justification arises for implementing no-use subsidies to reduce welfare losses.

In their comprehensive survey on the literature on the economics of child care, Blau and Currie (2006) present several justifications for government intervention, stressing positive externalities not taken into account by parents and information asymmetries, resulting in poor qualities in the child care market. This message is backed by Blau and Hagy (1998), pointing to substantial substitution effects when varying the price for some type of care in combination with low propensities to pay for quality-related attributes. In line with our findings, Baker et al. (2008), considering a day care subsidization reform in Quebec, find substantial crowding out of private day care and negative impacts of child and family wellbeing. Regarding long-term outcomes, Havnes and Mogstad (2015), studying kindergarten expansion in Norway, suggest negative impacts on children from wealthy families and positive impacts on children from a disadvantaged family background. In a similar vein, Gathmann and Sass (2012), analyzing the impacts of implementing the no-use subsidy in the German state of Thuringia, find a considerable labor supply reduction and losses in cognitive outcomes of children from poorer families.

The theoretical literature on child care subsidies is still inconclusive. Apps and Rees (2004) argue that increasing the subsidy to formal child care financed by a cut in family allowances will increase labor supply and fertility. Distortions associated with wage taxes are smaller if child care facilities are funded or subsidized through these taxes (Blomquist et al., 2010). Moreover, individual taxation tends to be superior to joint taxation in an optimal taxation framework since tax avoidance by using parental care is less pronounced (Apps and Rees, 2016). Looking at a life-cycle model with a capital income tax rate as additional policy instrument, Domeij and Klein (2013) derive a Ramsey rule, keeping the tax wedge constant over time and advocate full tax deductibility of child care expenses. Discussing family allowances, parental leave benefits and subsidies for external child care, Fenge and Stadler (2014) obtain ambiguous impacts on welfare, as any change of the composition of policy measures has asymmetric distributional implications. Kemnitz and Thum (2015) analyze changes in the balance of power of spouses, inducing inefficiently low fertility. They consider child allowances, maternal care benefits and formal child care subsidies as alternative instruments to overcome the inefficiency. Other papers investigate political economy issues. If taxes on wages are comparatively high, the childless will support substantial subsidies to day care facilities due to a higher labor supply of mothers and the resulting increase in tax revenue (Bergstrom and Blomquist, 1996). However, the calibration exercise of Guner et al. (2014) also points to a substantial fraction of losers from adopting a universal childcare program. Borck and Wrohlich (2011) consider households differentiated in income voting on the size of the public childcare systems in the spirit of Epple and Romano (1996a, b) where rich households opt out in favor of private childcare in tailored quality.

The remainder of the paper is organized as follows. Section 2 introduces the basic model with some comparative static analysis. After showing how to overcome the distortion induced by wage taxation in Section 3, Section 4 deals with justifying cash for care subsidies. Having investigated the consequences of incomplete contracts between child and parents in Section 5, Section 6 is devoted to analysing the case of a differentiated external care supply. The final Section 7 concludes and indications directions for further research.

2. Basic Model

Consider differentiated households. Each household has exogenous net income $Y \geq 0$, comprising all sorts of capital income and typically the net wage of the primary earner who supplies labor inelastically full time. Additional income can be earned at net wage $(1 - t)w$, where t is the income tax rate and $w \in [w_{min}, w_{max}]$ represents gross wage, which is equal to marginal productivity. Each household has a child of infant age. Child care is available in the market at price p and quality $q \in [0,1]$, and can be purchased on a continuous basis. Alternatively, the household can take care of the child at own quality $\pi \in [0,1]$. Households are differentiated according to their income Y , their wage rate w and their child care quality π . One time unit of child care needs to be provided, either by "leisure" $1 - l$ in the household or through buying units in the market. With total time endowment being equal to unity and c representing consumption the budget equation reads

$$c = Y + (1 - t)wl - pl. \quad (1)$$

Let the preferences of the household be given by the strictly concave utility function $U(c, z)$ where $z = ql + \pi(1 - l)$ is the productivity index of child care. To keep the model tractable we use a Cobb-Douglas specification

$$U = \alpha \ln c + \beta \ln z \quad (2)$$

with $\alpha, \beta > 0$.

The Lagrangean is

$$L = \alpha \ln[Y + (1 - t)wl - pl] + \beta \ln[ql + \pi(1 - l)] + \lambda_1 l + \lambda_2 (1 - l) \quad (3)$$

The first-order condition is

$$\frac{\partial L}{\partial l} = \frac{\alpha[(1 - t)w - p]}{Y + [(1 - t)w - p]l} + \frac{\beta(q - \pi)}{ql + \pi(1 - l)} + \lambda_1 - \lambda_2 = 0 \quad (4)$$

Since boundary solutions may occur, we have to distinguish the following cases:

i) If $(1 - t)w > p$ and $q > \pi$, that is, external care is more productive than parental care and its price falls short of the opportunity cost of parental care, we obtain $l = 1$, that is, labor supply will be full time.

ii) If $(1 - t)w < p$ and $q < \pi$, the secondary earner will specialize in child care, $l = 0$, maximizing both consumption and child quality under these parameters.

iii) If either (a) $(1 - t)w > p$ and $q < \pi$, or (b) $(1 - t)w < p$ and $q > \pi$, any type of interior or boundary solution may occur, $0 \leq l \leq 1$.

In case of an interior solution we obtain

$$l = \frac{\alpha[(1 - t)w - p]\pi - \beta(\pi - q)Y}{(\alpha + \beta)(\pi - q)[(1 - t)w - p]} \quad (5)$$

$$= \frac{\alpha}{\alpha + \beta} \frac{\pi}{\pi - q} - \frac{\beta}{\alpha + \beta} \frac{Y}{[(1 - t)w - p]}$$

Consider now $(1 - t)w > p$ and $q < \pi$, hence the opportunity cost exceeds the price of external child care in combination with technically superior parental care, which clearly constitutes a frequent case in practice.

Lemma 1: *If $(1 - t)w > p$ and $q < \pi$, and labor supply lies in the interior, labor supply increases with a lower income Y , a lower quality of parental care π , and a higher quality of external care q . If in addition exogenous income Y is positive, labor supply increases with a higher net wage $(1 - t)w$ and a lower price of external care p .*

Proof. This follows directly from (5). ■

The Lemma can be interpreted as follows. As labor supply is the mirror image of parental care, a higher income is used to increase both consumption and the child care quality index via reducing labor supply. The positive impact of the net wage is not immediate at the outset as substitution and income effect work into opposite directions. It turns out that they cancel out each other in the absence of the exogenous income, while the substitution effect dominates when $Y > 0$. Reducing labor supply as a response to a higher price of external care is again the consequence of a dominating substitution effect with $Y > 0$, where the household substitutes external care by parental care. A higher quality of external care at given price enables the household to increase both consumption and the quality index by increasing labor supply. By contrast, a higher productivity of parental care induces more parental care and a lower labor supply, associated with sacrificing some consumption.

While Lemma 1 summarizes the comparative statics properties of an interior solution, it is important to keep in mind that there are corner solutions. Various parameter value combinations provide thresholds where the corner solutions obtain. For the setting $(1 - t)w > p$ and $q < \pi$, we can deduce in Lemma 2 responses of threshold child care productivities to other parameter changes:

Lemma 2: *If $(1 - t)w > p$ and $q < \pi$, and $Y > 0$, threshold parental care productivity at the lower boundary of labor supply $\pi|_{l=0}$ increases with a higher net wage $(1 - t)w$ and decreases in Y . Threshold parental care quality at the upper boundary of labor supply $\pi|_{l=1}$ also increases with a higher*

net wage $(1 - t)w$ and falls in Y .

Proof. The boundaries can be determined by setting $l = 0$ and $l = 1$ in equation (5). At the lower boundary with specialization in home production solving for π gives

$$\pi|_{l=0} = \frac{\beta q Y}{\beta Y - \alpha[(1-t)w - p]} = \frac{q}{1 - \frac{\alpha[(1-t)w - p]}{Y}} \quad (6)$$

which increases in w and decreases in Y .

At the upper boundary, solving for π yields

$$\begin{aligned} \pi|_{l=1} &= \frac{q[\beta Y + (\alpha + \beta)[(1-t)w - p]]}{\beta[Y + (1-t)w - p]} \\ &= q + \frac{\alpha}{\beta} q \frac{1}{1 + \frac{Y}{(1-t)w - p}} \end{aligned} \quad (7)$$

which again increases in w and falls in Y . ■

Recalling from Lemma 1 that labor supply decreases in parental care productivity π , we generally have $\pi|_{l=0} > \pi|_{l=1}$. With a higher net wage of the secondary earner, the necessary level of parental care productivity to fully withdraw from the labor market will increase. Conversely, a higher exogenous income induces the secondary earner to fully specialize in household production already at a lower level of parental care productivity. An analogous reasoning applies for the level $\pi|_{l=1}$ denoting the necessary minimum level of parental care quality that induces the household to reduce labor supply below full time.

3. Distortion through tax

Since the income tax distorts decisions in favor of providing child care within the household, three types of deviations from efficient allocations occur. First, secondary earners may specialize in caring for the child at home, fully withdrawing from the labor market. Second, while still choosing an interior solution, households may reduce labor supply due to the tax. Finally, households may prefer an interior solution to working full time. The distortion can be undone by an appropriate subsidy on purchasing child care in the market.

As a benchmark, we solve for first-best allocations where any revenue requirement related to the household under consideration can be met by a lump-sum tax T . Consider the case $w > p$ and $q < \pi$. Any efficient allocation solves

$$\max_l U(Y - T + wl - pl, ql + \pi(1 - l)) \quad (8)$$

which yields

$U_c(w - p) + U_z(q - \pi) = 0$ in case of an interior solution,

$l = 0$ if $U_c(w - p) + U_z(q - \pi) \leq 0$ at $l = 0$,

$l = 1$ if $U_c(w - p) + U_z(q - \pi) \geq 0$ at $l = 1$.

Wage taxes with elastic labor supply are typically distortionary. However, this distortion can be completely undone through the judicious use of an appropriate child care subsidy. For simplicity, we take both the wage tax rate t and the tax revenue requirement referring to the household as given, using a specification without further redistribution across households. The government budget equation related to the household is

$$T_i + tw_i l_i = \sigma_i p l_i, \quad (9)$$

where σ_i denotes the rate of subsidization for external care granted to household i and T_i is a net supplementary household specific lump-sum tax (or transfer if $T_i < 0$) which is determined as residual. With $\bar{T}_i, \hat{T}_i, T_i^g$ representing the tax paid by the primary earner, the tax revenue requirement and the gross lump-sum tax, respectively, we obtain $T_i = T_i^g + \bar{T}_i - \hat{T}_i$. In the following, we will suppress the household index as long as this does not lead to confusion.

Proposition 1. *If the distortion arises through taxation of wage income, a first-best allocation can be implemented by a subsidy $\sigma p = tw$ per unit of time.*

Proof. Using a subsidy $\sigma p = tw$, the household maximizes

$$\max_l U(Y - T + (1 - t)wl - (1 - \sigma)pl, ql + \pi(1 - l)) \quad (10)$$

which yields in case of an interior solution

$$U_c((1 - t)w - (1 - \sigma)p) + U_z(q - \pi) = 0, \quad (11)$$

thus

$$\frac{U_c}{U_z} = \frac{\pi - q}{(1-t)w - (1-\sigma)p} \quad (12)$$

This coincides with the efficient solution iff

$$\frac{U_c}{U_z} = \frac{\pi - q}{w - p} \quad (13)$$

which requires $\sigma p = tw$. ■

The optimal subsidy has the striking feature that it increases with the wage rate of the secondary earner and her marginal tax rate. This contrasts with subsidization practices in many countries where subsidies are usually higher for low income households.

Moreover, the first-best subsidy rate $\sigma = tw/p$ decreases in the market price of child care. The last property is particularly interesting as a higher price will generally turn out as a consequence of a higher quality. From the optimality condition $\sigma p = tw$, the absolute amount of the subsidy per unit of time is – at given wage and marginal tax rate of the secondary earner – independent of the price p . As a consequence, making expenditure on market childcare fully deductible in wage taxation, and thus setting the subsidy rate constant, will not be optimal as it distorts choices in favor of more expensive high quality alternatives.

It should be noted that implementing a first-best allocation by employing a subsidy for market child care becomes impossible if pure leisure enters utility as an additional use of time. Denote leisure by e with a modified utility function $U(c, z, e)$ and total demand for market child care $l + e$, where parental care is provided in the remaining time $1 - l - e$. In that event, utility maximization with respect to labor supply l and leisure e yields as first-order conditions in case of an interior solution:

$$\frac{\partial U}{\partial l} = U_c[(1-t)w - p] - U_z(\pi - q) = 0 \quad (14)$$

$$\frac{\partial U}{\partial e} = -U_c p - U_z(\pi - q) + U_e = 0 \quad (15)$$

The second condition states that at the margin the direct benefit of increasing leisure U_e just offsets losses from lower consumption due to purchasing additional child care in the market $U_c p$ and utility changes from the child care quality index due to replacing parental care by external child care, $U_z(\pi - q)$. It is obvious that the leisure choice is undistorted. Thus, if leisure is the marginal use of time, the optimal subsidy on market child care is zero. Hence, should labor supply of the secondary earner be zero anyway, there is no justification for any government intervention in the child care market. By contrast, if the marginal use of time is market work, the optimal subsidy matches the marginal wage tax of the secondary earner. While a lower level of the subsidy distorts labor supply downward, any positive subsidy distorts leisure upward. At the same time, just exempting the secondary earner from wage taxation without adding a subsidy for market child care obviously induces a first-best allocation.

Another reason for considering the level of the optimal subsidy as derived in Proposition 1 as an upper limit benchmark is due to our simplifying assumption that the marginal cost of raising public funds is zero. Since this cost is generally positive if there is a necessity of using distortionary taxation, taking it into account clearly reduces the optimal subsidy.

4. Distortion through the child care subsidy

If the child care subsidy σp is set too high, it distorts the decision of the household against providing parental care. This distortion may be offset by a cash benefit b to parents per unit of time in which subsidized child care is not purchased in the market. Such a cash for care subsidy, called a “no-use subsidy” is in place in some Scandinavian countries and has also been implemented in Germany between 2013 and 2015 after fierce political debate. In our model, the full amount of b is paid when the secondary earner fully withdraws from the labor market. Otherwise, it is reduced proportionally. Proposition 2 characterizes the optimal level of the subsidy.

The modified government budget equation related to the household now reads

$$T_i + tw_i l_i = \sigma_i p l_i + b_i(1 - l_i), \quad (16)$$

Proposition 2. *If the distortion arises through a combination of taxation of wage income and child care subsidy, a first-best allocation can be implemented by paying a no-use subsidy $b = \sigma p - tw$ per unit of time.*

Proof. With this specification, the household maximizes

$$\max_l U(Y - T + [(1 - t)w - b - (1 - \sigma)p]l, ql + \pi(1 - l)) \quad (17)$$

which yields as first-order condition in case of an interior solution

$$U_c((1 - t)w - b - (1 - \sigma)p) + U_z(q - \pi) = 0, \quad (18)$$

thus

$$\frac{U_c}{U_z} = \frac{\pi - q}{(1-t)w - b - (1-\sigma)p} \quad (19)$$

This coincides with the efficient solution iff

$$\frac{U_c}{U_z} = \frac{\pi - q}{w - p} \quad (20)$$

which requires $b = \sigma p - tw$. ■

Should the subsidization rate σ for purchasing child care in the market be constant, the optimal no-use subsidy increases in the price of market care and falls both with a higher tax rate and with a higher wage of the secondary earner. These properties are generally not satisfied by real-world no-use subsidies, which are typically constant. As expected, the size of the optimal no-use subsidy b increases with the subsidization rate of market child care σ . Should the no-use subsidy be paid only if demand for external care is zero, its optimal level is presumably cut to some extent to reduce the incentive to move away from interior solutions with part-time work.

Though our first-best approach suggests equivalence of systems of subsidization involving higher or lower levels of subsidies, introducing very small marginal costs of raising public funds could decide matters in favor of the lowest level of expenditures, associated with setting the no-use subsidy to zero, as in Section 3.

5. Incomplete contracts

It may be the case that parents do not take into account the productivity impact of child care on their child in full. This can be a consequence of the impossibility of writing contracts with minors. In a complete contract world, children would most likely like to buy additional quality units of child care, but cannot.

Let the social planner's preferences be given by

$$W(c, z; \gamma) \equiv U\left(c, \frac{1}{1-\gamma}z\right) \quad (21)$$

with $0 < \gamma < 1$. This function expresses the “true” preference weights for the social welfare function which derive from the fundamental benefits a child receive from child care. In this formulation the discrepancy between the social welfare weights and the parental weights is increasing in γ . We can thus take γ as a measure of market incompleteness.

Solving the social-planner's problem results in the following first-order condition on optimal labor supply:

$$\frac{\partial W}{\partial l} = U_c(w - p) + \frac{1}{1 - \gamma} U_z(q - \pi) = 0 \quad (22)$$

Proposition 3. *If the market failure arises through a combination of taxation of wage income and underestimation of productivity impact of child care, the optimal level of the child care subsidy is given by $\sigma p = tw - \gamma(w - p)$. Should the child subsidy be chosen at a different level, the perfectly correcting no-use subsidy is $b = \gamma(w - p) + \sigma p - tw$.*

Proof. From (18) and (22), optimal corrective subsidies satisfy

$$(1 - \gamma)(w - p) = (1 - t)w - b - (1 - \sigma)p, \quad (23)$$

which is equivalent to

$$\gamma(w - p) = tw + b - \sigma p. \quad (24)$$

With $b = 0$, solving for the child care subsidy yields

$$\sigma p = tw - \gamma(w - p). \quad (25)$$

Otherwise, the related no-use subsidy to any given child care subsidy σp to satisfy (24) is

$$b = \gamma(w - p) + \sigma p - tw \quad (26) \quad \blacksquare$$

Proposition 3 shows that there is again no need to employ a no-use subsidy. Notice that for any fixed measure of market incompleteness γ the child care subsidy is declining in the “wage surplus rate” $(w - p)$. The higher is the positive wage surplus rate $(w - p)$, the higher is labor supply and thus the purchase of external day care. If the quality of external care is lower than that for own child care, any increase in the effective wage $(w - p)$ decreases child care quality, which necessitates a decrease in the optimal child care subsidy. Similarly, for any fixed positive wage surplus rate $(w - p)$ the optimal subsidy is declining in the degree of underestimation of the productivity impact of child care as measured by γ . Should underestimation be strong enough to satisfy $\gamma > tw/(w - p)$, external care is even taxed rather than subsidized. When the wage surplus rate is negative, interior solutions combine higher quality external

care with lower quality parental care. In that event, the optimal subsidy from the basic model is corrected upward.

If, for whatever reason, the child care subsidy is not set at the level given by (25), a no-use subsidy can be employed as it also directly addresses demand for market child care. For example, should the optimal child care subsidy as given by (25) be negative, the social planner's choice can be achieved also by combining $\sigma p = 0$ with a no use subsidy $b = \gamma(w - p) - tw$ according to (26).

6. Differentiation of quality

Setup. Suppose now that three sorts of child care quality are available in the market, at quality levels $q_2 > q_1 > q_0$, associated with prices $p_2 > p_1 > p_0$. The highest quality q_2 represents luxury care, like a nanny, the middle quality q_1 is some commonly available arrangement, and the lowest quality q_0 could stand for an informal supply in the neighbourhood. For simplicity, demand for different types of market child care is mutually exclusive, while each quality type can be combined with parental care on a continuous basis. Demand for quality $i \in \{0,1,2\}$ is denoted by $l_i \in \{0, l\}$. Let quality again be additive such that the resulting quality is

$$z = l_0 q_0 + l_1 q_1 + l_2 q_2 + (1 - l)\pi. \quad (27)$$

Accordingly, the budget constraint of the household is

$$Y + (1 - t)lw = p_0 l_0 + p_1 l_1 + p_2 l_2 + c \quad (28)$$

In order to avoid zero demand for dominated alternatives, we need to assume that the price per unit of quality increases in quality, $p_0/q_0 < p_1/q_1 < p_2/q_2$. Otherwise, some lower quality is at least weakly dominated. With price per unit of quality falling in quality, the household could increase both consumption and the quality index by switching from a lower to a higher quality alternative.

In case of an interior solution and external care of given quality, consumption turns out to be

$$c = \frac{\alpha}{\alpha + \beta} \left[Y + \frac{\pi}{\pi - q_i} [(1 - t)w - p_i l] \right] \quad (29)$$

while $c = Y$ if $l = 0$ and $c = Y + (1 - t)w - p_i$ if $l = 1$.

The resulting indirect utilities are

$$V_o = \alpha \ln Y + \beta \ln \pi \quad (30)$$

with full time parental care,

$$V_{1j} = \alpha \ln(Y + (1-t)w - p_j) + \beta \ln q_j \quad (31)$$

if the household works full time and purchases external care of quality $j \in \{0,1,2\}$ and

$$\begin{aligned} V_{ij} = & \alpha \ln \left(\frac{\alpha}{\alpha + \beta} \left[Y + \frac{\pi}{\pi - q_j} [(1-t)w - p_j] \right] \right) \quad (32) \\ & + \beta \ln \left[\frac{\alpha}{(\alpha + \beta)} \frac{\pi}{(\pi - q_j)} - \frac{\beta}{(\alpha + \beta)} \frac{Y}{[(1-t)w - p_j]} \right] q_j \\ & \left[+1 - \frac{\alpha}{(\alpha + \beta)} \frac{\pi}{(\pi - q_j)} + \frac{\beta}{(\alpha + \beta)} \frac{Y}{[(1-t)w - p_j]} \right] \pi \end{aligned}$$

in case of an interior solution.

While some properties of the comparative static analysis from the basic model carry over to the specification with quality differentiation, the property of labor supply varying in a monotonous fashion with income may no longer hold. Consider an example in which parental child care is more productive than standard external care, but less productive than luxury care, $q_1 < \pi < q_2$. At the same time, let luxury care be most expensive, followed by the opportunity cost of parental care, $p_1 < (1-t)w < p_2$. With increasing exogenous income Y , the household moves from lower quality alternatives to higher quality alternatives, where labor supply is reduced when gradually substituting standard external care quality 1 (middle quality) by parental care. Inspecting equation (5) shows that the opposite happens for further increases in income when parental care is gradually replaced by luxury external care quality 2. Moreover, as discussed below, labor supply will generally not be continuous in income or the wage at points in which a switch of types of external care occur.

Properties of switching points. Let us now consider points at which a household is indifferent between using quality i at quantity $l_i \geq 0$ and quality $i + 1$ at quantity $l_{i+1} > 0$. The budget constraints can be combined to express the quality index z as function of consumption c . We obtain

$$z = \pi + (q_i - \pi)l = \pi - \frac{Y(q_i - \pi)}{(1-t)w - p_i} - \frac{\pi - q_i}{(1-t)w - p_i} c, \quad (33)$$

which is linear in c . Notice that all budget restrictions varying the external care alternative of a given household share a common point without any external care $c = Y, z = \pi$. The other extreme is achieved with full time labor supply, inducing $c = Y + (1-t)w - p_i, z = q_i$. The slope of the budget line is $\frac{dz}{dc} = -\frac{\pi - q_i}{(1-t)w - p_i}$. Figure 1 displays some examples of budget lines. In a (c, z) diagram, increasing exogenous income Y moves the budget line to the right, keeping its slope unchanged. Increasing parental care productivity π moves the common point upward, keeping the full time labor supply point unchanged.

Finally, raising the secondary earner's wage w does not affect the common point and moves the full time labor point to the right.

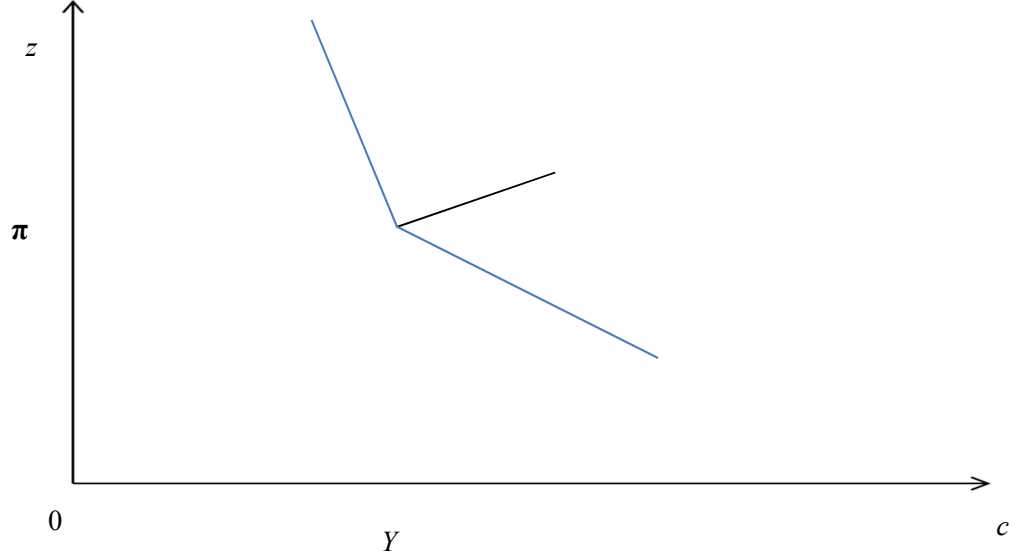


Fig. 1. Alternative budget lines

Lemma 3 summarizes properties of consumption points for switching households.

Lemma 3. *Any parameter set making the household indifferent between the optimal alternative involving quality i at quantity $l_i \geq 0$ and the optimal alternative involving quality $i + 1$ at quantity $l_{i+1} > 0$ with $(c_i, z_i) \neq (c_{i+1}, z_{i+1})$ generates $z_{i+1} > z_i$ and $c_{i+1} < c_i$.*

Proof.

- (i) Should the switch occur with identical slopes of the budget line in the (c, z) plane, the full time labor supply point associated with the lower quality is not feasible when using the higher quality due to the assumption $p_0/q_0 < p_1/q_1 < p_2/q_2$. Since the set of feasible consumption vectors is simply a proper subset with the higher quality alternative in that event, and since indifference curves are strictly convex, the respective consumption vectors must be identical, $(c_i, z_i) = (c_{i+1}, z_{i+1})$.
- (ii) If the budget set with the higher quality alternative is not a subset of the budget set with the lower quality alternative, additional consumption points must be feasible with the higher quality when the switch occurs. Otherwise the higher quality alternative is simply dominated. Should $c_{it+1} \geq c_i$, then either there exists a feasible point (c_i, z_i) that dominates the optimal (c_{i+1}, z_{i+1}) or the candidate (c_{i+1}, z_{i+1}) dominates the optimal (c_i, z_i) . As the individual is not indifferent in either of these cases, we must have $c_{it+1} < c_i$ at the switching point, which requires $z_{it+1} > z_i$ for indifference. ■

Lemma 3 shows that switching to a higher quality alternative can occur only if either the chosen consumption points coincide, $(c_i, z_i) = (c_{i+1}, z_{i+1})$, or the higher quality involves a higher child care quality index in combination with lower personal consumption.

Regarding the change in labor supply, there is no unambiguous pattern. Whenever the switch leads to the same consumption point, labor supply must be higher with the higher child care quality involved. This property holds because market quality units become more expensive and hence require a higher market income. When the switch leads to a new consumption point, it can easily be shown that the higher quality alternative will be associated with full time labor supply if $(1 - t)w - p_{i+1} > 0$, that is, if market work increases consumption even after subtracting expenses for market child care. Again, labor supply cannot decrease when moving to higher quality in the market for child care. Should, however, market work not compensate for child care costs for the switching household type, $(1 - t)w - p_{i+1} < 0$, with market care exhibiting higher quality than parental care, $q_{i+1} > \pi$, interior solutions for labor supply can be obtained. In that event, labor supply with the higher quality alternative can fall short of the level chosen when using the lower quality. This is justified by using parental care so as to increase consumption at the expense of a higher child care quality index.

Further properties and comparative statics of switching points. We can now proceed to characterize the separation of groups along the intersection loci and related comparative static results:

Proposition 4: *Consider the set of switching points $(\tilde{Y}, \tilde{w}, \tilde{\pi})$ at which a household is indifferent between the optimal menu involving external care of quality i and external care of quality $i+1$,*

$$V_i(\tilde{Y}, \tilde{w}, \tilde{\pi}, q_i, p_i) = V_{i+1}(\tilde{Y}, \tilde{w}, \tilde{\pi}, q_{i+1}, p_{i+1}). \quad (34)$$

Then households with slightly higher income or wage of the secondary earner will prefer the higher quality alternative, while households with slightly higher productivity of parental care will prefer the lower quality alternative should $l_i < 1$. Any threshold income and any threshold wage rises with a lower price of the lower quality alternative or a higher price of the higher quality alternative; any threshold parental care productivity increases with a higher price of the lower quality alternative and a decreasing price of the higher quality alternative:

$$\frac{\partial \tilde{Y}}{\partial p_i} = - \frac{\frac{\partial V_i}{\partial p_i}}{\frac{\partial V_i}{\partial Y} - \frac{\partial V_{i+1}}{\partial Y}} < 0,$$

$$\frac{\partial \tilde{Y}}{\partial p_{i+1}} = \frac{\frac{\partial V_{i+1}}{\partial p_{i+1}}}{\frac{\partial V_i}{\partial Y} - \frac{\partial V_{i+1}}{\partial Y}} > 0,$$

$$\frac{\partial \tilde{w}}{\partial p_i} = -\frac{\frac{\partial V_i}{\partial p_1}}{\frac{\partial V_i}{\partial w} - \frac{\partial V_{i+1}}{\partial w}} < 0$$

$$\frac{\partial \tilde{w}}{\partial p_{i+1}} = \frac{\frac{\partial V_{i+1}}{\partial p_{i+1}}}{\frac{\partial V_i}{\partial w} - \frac{\partial V_{i+1}}{\partial w}} > 0,$$

$$\frac{\partial \tilde{\pi}}{\partial p_i} = -\frac{\frac{\partial V_i}{\partial p_i}}{\frac{\partial V_i}{\partial \pi} - \frac{\partial V_{i+1}}{\partial \pi}} > 0,$$

$$\frac{\partial \tilde{\pi}}{\partial p_{i+1}} = \frac{\frac{\partial V_{i+1}}{\partial p_{i+1}}}{\frac{\partial V_i}{\partial \pi} - \frac{\partial V_{i+1}}{\partial \pi}} < 0,$$

since $\frac{\partial V_{i+1}}{\partial Y} > \frac{\partial V_i}{\partial Y} > 0$, $\frac{\partial V_{i+1}}{\partial w} > \frac{\partial V_i}{\partial w} > 0$, and $\frac{\partial V_i}{\partial \pi} > \frac{\partial V_{i+1}}{\partial \pi} > 0$.

Proof. Notice that each intersection point we have $c_{i+1} < c_i$ and $q_{i+1} > q_i$. Given separable utility, marginal utility of income is higher with a higher quality of external care, $\frac{\partial V_{i+1}}{\partial Y} > \frac{\partial V_i}{\partial Y}$. Marginal utility of the wage of the secondary earner is also higher with higher level of external care, $\frac{\partial V_{i+1}}{\partial w} > \frac{\partial V_i}{\partial w}$, as (i) consumption is lower and (ii) the weight attached to the wage does not fall since labor supply does not fall.

Thus, starting at an indifference point, increasing income or wage yields a preference in favor of the higher quality alternative.

Again with separable utility, marginal utility of parental care is lower with higher quality of external care, $\frac{\partial V_i}{\partial \pi} > \frac{\partial V_{i+1}}{\partial \pi}$, due to (i) higher overall care index and (ii) weakly lower weight of parental care. Thus, starting at an indifference point, increasing parental care productivity yields a preference in favor of the lower external quality alternative. Finally, due to the envelope theorem, we only need to consider direct impacts of parameter (price) changes since either $\frac{\partial V_i}{\partial l} = 0$ in case of an interior solution or $\frac{\partial l}{\partial p} = 0$ at the boundary. ■

The intersection sets divide household types such that higher income or wage types are found on the side with higher external care quality while higher parental productivity of care types will use lower external care quality. The latter is intuitive as these households tend to use external care less intensively.

Since an increase of the price of the weaker external care quality makes any combination involving that quality less attractive, threshold levels of income and wage are decreasing. At the same time, the threshold quality of parental care is increasing, including now some household types that preferred the lower quality at the original prices. The results with respect to increasing the price of the higher quality can be interpreted analogously.

Distortions. We proceed by investigating how quality decisions are distorted by considering indifference conditions. Without loss of generality, we concentrate on the decision between quality q_0 and quality q_1 without subsidies. At the upper boundary $l = 1$ a household is indifferent iff

$$\alpha \ln(Y - T + (1 - t)w - p_0) + \beta \ln q_0 = \alpha \ln(Y - T + (1 - t)w - p_1) + \beta \ln q_1 \quad (35)$$

which can be rearranged to obtain

$$\frac{\beta}{\alpha} \ln \frac{q_1}{q_0} = \ln \frac{Y - T + (1 - t)w - p_0}{Y - T + (1 - t)w - p_1}$$

Though taxation affects quality choice through inducing the purchase of lower qualities, this is no true distortion here as it would also result with a lump-sum tax.

In case of an interior solution for labor supply, the socially optimal switching point from quality q_0 to quality q_1 is characterized by

$$\alpha \ln(Y - T + (w - p_0)l(Y, w, \pi, p_0, q_0)) + \beta \ln q_0 = \alpha \ln(Y - T + (w - p_1)l(Y, w, \pi, p_1, q_1)) + \beta \ln q_1$$

which is equivalent to

$$\frac{\beta}{\alpha} \ln \frac{q_1}{q_0} = \ln \frac{Y - T + (w - p_0)l(Y, w, \pi, p_0, q_0)}{Y - T + (w - p_1)l(Y, w, \pi, p_1, q_1)} \quad (36)$$

Proposition 1 suggests that all types of external care should be subsidized, though at different rates. According to that proposition, rates should be smaller for higher qualities such that absolute subsidies per time unit stay constant. However, Proposition 1 only considers combinations of parental care with a given type of external care. When at any intersection the household replaces lower quality of external care by higher quality of external care, the amount of the subsidy shrinks (rises) if demand for external care in units of time goes down (up). It turns out that a first-best subsidy scheme can be formulated as a straightforward extension of Proposition 1.

Consider again an individualized government budget constraint, in which the wage tax rate is uniform, while lump-sum taxes and child care subsidization rate can be differentiated for each household j :

$$T_j + tw_j l_j = (\sigma_{0j} p_0 l_0 + \sigma_{1j} p_1 l_1 + \sigma_{2j} p_2 l_2) + b_j (1 - l_0 - l_1 - l_2), \quad (37)$$

Proposition 5. *If with multiple qualities the distortion arises through taxation of wage income, a first-best allocation can be implemented by a scheme of subsidies for external care, characterized by $\sigma_i p_i = tw$ per unit of time.*

Proof. Following the proof of Proposition 1, the suggested scheme of subsidies induces the first-best level of labor supply (and mix of parental and external care) for any given type of external care, thus $l(Y, (1 - t)w, \pi, (1 - \sigma_i) p_i, q_i) = l(Y, w, \pi, p_i, q_i)$. It remains to be shown that the choice of external quality type is also undistorted. Switching points will satisfy

$$\frac{\beta}{\alpha} \ln \frac{q_1}{q_0} = \ln \frac{Y - T + ((1 - t)w - (1 - \sigma_0)p_0)l(Y, (1 - t)w, \pi, (1 - \sigma_0)p_0, q_0)}{Y - T + ((1 - t)w - (1 - \sigma_1)p_1)l(Y, (1 - t)w, \pi, (1 - \sigma_1)p_1, q_1)} \quad (38)$$

which coincides with (36). ■

The optimal subsidy achieves a first-best allocation because it perfectly offsets wage taxation of the secondary earner. Instead of reducing wage taxation to zero, tax proceeds are returned in full to the taxpaying household such that the tax wedge vanishes. Due to this property of the subsidization scheme, it does not matter that labor supply can change at intersection points. Labor supply will not be distorted anyway, and the household's choice of external care is not associated with any fiscal externalities. All income effects are eliminated as each household finances its subsidy in full. Finally, as in the basic model, there is no justification for a no-use subsidy.

As already mentioned above, the result stands in contrast to policies aiming at deductibility of child care expenses in the income tax. Such a policy would be equivalent to fixing the subsidization rate, which in the light of Proposition 5 will distort external child care quality choices in favor of higher quality alternatives.

Subsidizing standard care only. An interesting issue arises from the feature of many real-world subsidies to focus exclusively on standard external care. This practice may be justified by problems of verifying child care qualities in other arrangements. Such a single-standard subsidization policy crowds out not only parental care, but also other qualities of external child care. While some poor parents will replace informal low quality care arrangements by the standard quality, some middle class households may refrain from using high quality external care. Due to this distortion of quality choice, a new justification for implementing no-use subsidies arises that holds even if the subsidy for standard quality care is not excessive as in Section 4. Tying the no-use subsidy to the condition $l_1 = 0$ can then mitigate crowding out among the different sorts of external child care.

For this analysis, a Benthamite social planner is introduced, where all households have to be treated in a uniform fashion. Consider an environment in which a price subsidy $\sigma_1 p_1$ per unit of time for standard care is paid. Those who do not use standard care receive a lump sum b . Let T be a lump-sum tax used so as to balance the budget and β the share of users of standard care. Hence, consumption of a user of standard care is $c_1 = Y - T + (1 - t)wl_1 - (1 - \sigma_1)p_1 l_1$, while consumption of a non-user is $c_x = Y - T + b + (1 - t)wl_x - p_x l_x$ with $x \in \{0, 2\}$.

Consider a continuum of households with Lebesgue measure 1. In the following, we suppress boundaries of integration for the sake of keeping the notation simple. The government maximizes a Benthamite welfare function subject to the government budget constraint:

$$\max_{\sigma_1, b} W = \int U(c, z) + \lambda [T + t \int wl - \sigma_1 p_1 \int l_1 - (1 - \beta) b] \quad (39)$$

With V_1 and V_x denoting indirect utility when using standard child care or child care of quality x , respectively, the first-order conditions are

$$\frac{\partial W}{\partial \sigma_1} = \int U_c p_1 l_1 + \int \{U_c [(1 - t)w - (1 - \sigma_1)p_1] + U_z (q_1 - \pi)\} \frac{\partial l_1}{\partial \sigma_1} + \lambda t \int w \frac{\partial l_1}{\partial \sigma_1} \quad (40)$$

$$\begin{aligned}
& -\lambda p_1 \left[\int l_1 + \sigma_1 \int \frac{\partial l_1}{\partial \sigma_1} \right] + \frac{\partial \beta}{\partial \sigma_1} [V_1 - V_x] + \lambda \int_s \{tw(l_1 - l_x) - l_1 \sigma_1 p_1 + b\} \\
& = p_1 \int (U_c - \lambda) l_1 + \lambda \int [tw - \sigma_1 p_1] \frac{\partial l_1}{\partial \sigma_1} + \lambda \int_s \{tw(l_1 - l_x) - l_1 \sigma_1 p_1 + b\} = 0,
\end{aligned}$$

$$\begin{aligned}
\frac{\partial W}{\partial b} &= \int_{1-\beta} U_c + \int \{U_c[(1-t)w - p_x] + U_z(q_x - \pi)\} \frac{\partial l_x}{\partial b} + \lambda t \int w \frac{\partial l_x}{\partial b} \quad (41) \\
& -\lambda(1-\beta) + \frac{\partial \beta}{\partial b} [V_1 - V_x] - \lambda \int_s [tw(l_1 - l_x) - l_1 \sigma_1 p_1 + b] \\
& = \left[\int_{1-\beta} U_c - \lambda(1-\beta) \right] + \lambda t \int w \frac{\partial l_x}{\partial b} - \lambda \int_s [tw(l_1 - l_x) - l_1 \sigma_1 p_1 + b] = 0,
\end{aligned}$$

where integrals with index s refer to marginal (switching) types while index $1 - \beta$ indicates the non-users of standard care.

The condition with respect to the subsidization rate σ_1 can be interpreted as follows. Increasing that rate boosts consumption of standard care users at unchanged behavior, raising welfare by $\int U_c p_1 l_1$. The labor supply response of users could have an impact on their welfare, which is however zero according to an envelope theorem argument. Either labor supply is found in the interior when $U_c[(1-t)w - (1 - \sigma_1)p_1] + U_z(q_1 - \pi) = 0$, or at the boundary, implying $\frac{\partial l_1}{\partial \sigma_1} = 0$. The budget deficit of the government changes according to (i) unchanged behavior of users of standard care, represented by $\lambda p_1 \int l_1$ (ii) changes in the demand by users, expressed through $\lambda p_1 \sigma_1 \int \frac{\partial l_1}{\partial \sigma_1}$, (iii) revenue changes according to labor supply reactions of users, given by $\lambda t \int w \frac{\partial l_x}{\partial \sigma_1}$, and (iv) changes in the number of users.

New users forgo the no-use subsidy, $\lambda \int_s \{-l_1 \sigma_1 p_1 + b\}$ and also modify their tax payments as they move from labor supply without use of standard care l_x to labor supply subject to using standard external care l_1 . Again, utility changes of new marginal users can be ignored, since they move from indirect utility without using the subsidy V_x to the same level of indirect utility with the subsidy V_1 .

Summarizing the terms in (40), (i) $p_1 \int [U_c - \lambda] l_1$ expresses redistributive concerns, (ii) $\lambda [t \int w - \sigma_1 p_1] \frac{\partial l_1}{\partial \sigma_1}$ deals with the fiscal impact of behavioral changes within the group of users of standard care where $\frac{\partial l_1}{\partial \sigma_1} > 0$, and (iii) $\lambda \int_s \{tw(l_1 - l_x) - l_1 \sigma_1 p_1 + b\}$ shows the fiscal impact of households becoming new users of standard care as $\frac{\partial \beta}{\partial \sigma_1} > 0$. In the third term, $\int tw(l_1 - l_x)$ will be positive if l_x refers mostly to households using parental care exclusively or external care of the lower quality 0, and negative should l_x be dominated by users of the higher external care quality 2.

In the first-order condition (41) on the optimal no-use subsidy, the term $\int_{1-\beta} U_c - \lambda(1 - \beta)$ again expresses redistributive concerns. Increasing this subsidy reduces the tax revenue via lower labor supply of non-users of standard care due to an income effect, mirrored by $\lambda t \int w \frac{\partial l_x}{\partial b} < 0$. Finally, some marginal households taking up the no-use subsidy forgo the user subsidy and also change their tax payments according to the adaptation of labor supply of secondary earners, adding up to $-\lambda \int_s [tw(l_1 - l_x) - l_1 \sigma_1 p_1 + b]$ noting $\frac{\partial \beta}{\partial b} < 0$.

Proposition 6 collects the findings on the structure of optimal subsidies.

Proposition 6. *If the policy set is given by a uniform price subsidy of standard care $\sigma_1 p_1$ per unit of time and a lump-sum no-use subsidy b , and if distributional impacts are ignored:*

- (i) *Any optimum with a positive no-use subsidy $b > 0$ is associated with a positive fiscal impact of households switching away from using standard care at the margin.*
- (ii) *A positive no-use subsidy will be implemented if and only if with optimized price subsidy of standard care given $b = 0$ the fiscal surplus due to households switching away from using standard care outweighs tax revenue losses due to reductions of labor supply.*
- (iii) *The uniform price subsidy $\sigma_1 p_1$ will always be positive if secondary earners of marginal households on average pay higher taxes when using standard care, $t \int_s [w(l_1 - l_x)] > 0$. With an interior solution for the no-use subsidy $b > 0$, it will fall short of the following weighted average tax paid by secondary earners of inframarginal users of standard care: $\int [tw - \sigma_1 p_1] \frac{\partial l_1}{\partial \sigma_1} > 0$. If the optimal no-use subsidy is found at the lower boundary $b = 0$, the optimal uniform price subsidy falls short of the following weighted average tax paid by secondary earners of inframarginal and marginal users of standard care: $\int [tw - \sigma_1 p_1] \frac{\partial l_1}{\partial \sigma_1} + \int_s [tw - p_1 \sigma_1] l_1 > 0$.*
- (iv) *The no-use subsidy will be smaller than the average subsidy paid to marginal users of standard care, $\int_s b < \sigma_1 p_1 \int_s l_1$, if marginal secondary earners pay higher taxes when being users of standard care, $t \int_s [w(l_1 - l_x)] > 0$.*

Proof.

- (i) If distributional impacts are ignored, the term $\int_{1-\beta} U_c - \lambda(1 - \beta)$ in (41) is arbitrarily set to zero. Since $\frac{\partial l_x}{\partial b} < 0$ by analogy to Lemma 1 and $\frac{\partial \beta}{\partial b} < 0$, equation (41) can hold with equality only if $\int_s \{tw(l_1 - l_x) - l_1 \sigma_1 p_1 + b\} < 0$.
- (ii) The no-use subsidy will be positive if and only if $\frac{\partial w}{\partial b} > 0$ at optimized price subsidy $\sigma_1 p_1$ given $b = 0$. This in turn requires $t \int w \frac{\partial l_x}{\partial b} - \int_s \{tw(l_1 - l_x) - l_1 \sigma_1 p_1\} > 0$ at optimized

- price subsidy $\sigma_1 p_1$ given $b = 0$. Since $t \int w \frac{\partial l_x}{\partial b} < 0$ and $\frac{\partial \beta}{\partial b} < 0$, the condition $-\int_s \{tw(l_1 - l_x) - l_1 \sigma_1 p_1\} > -t \int w \frac{\partial l_x}{\partial b}$ has to hold.
- (iii) The uniform price subsidy is positive as $\frac{\partial w}{\partial \sigma_1} > 0$ at $\sigma_1 = 0$ because $\lambda t \int w \frac{\partial l_1}{\partial \sigma_1} > 0$ and $\int_s \{tw(l_1 - l_x) + b\} > 0$. With $b > 0$, we obtain $\int_s \{tw(l_1 - l_x) - l_1 \sigma_1 p_1 + b\} < 0$ according to part (i). Ignoring distributional impacts in (40), setting $\int (U_c - \lambda) l_1$ arbitrarily to zero, this in turn implies $\int [tw - \sigma_1 p_1] \frac{\partial l_1}{\partial \sigma_1} > 0$. With $b = 0$, we obtain $\int [tw - \sigma_1 p_1] \frac{\partial l_1}{\partial \sigma_1} + \int_s [tw - p_1 \sigma_1] l_1 > 0$ from (40) since $-\int_s tw_x < 0$.
- (iv) In case of an interior solution, we have $\int_s \{tw(l_1 - l_x) - l_1 \sigma_1 p_1 + b\} < 0$, being equivalent to $\int_s b < \sigma_1 p_1 \int_s l_1 - t \int_s w(l_1 - l_x)$. Hence, if $t \int_s w(l_1 - l_x) > 0$, we obtain $\int_s b < \sigma_1 p_1 \int_s l_1$. ■

The message of Proposition 6 is as follows. Employing a no-use subsidy makes sense only if introducing the subsidy yields a fiscal surplus at the margin via inducing households to switch away from subsidized child care. This is however not sufficient as the income effect of the no-use subsidy reduces labor supply of recipients and hence, tax revenue. Therefore, should a no-use subsidy be implemented, we will have a positive fiscal impact of households switching away from using subsidized standard care even at the optimum. However, the presence of market care alternatives affects the optimal subsidy even if no-use subsidies remain absent. In that event, the optimal price subsidy falls short of the tax paid by an average secondary earner among users of standard care. This happens because non-using households then have an unambiguous positive impact on the government budget, which is lost when inducing these same households to become users of standard child care.

7. Concluding discussion

The messages from our analysis challenge several practices of child care policies. Optimal subsidies for external child care are generally positive and increase both in wages of secondary earners and their marginal tax rates. Given progressive wage taxes, this finding suggests to use the tax system so as to implement a basically non-redistributive scheme of subsidization in which double-earner households with high wages and high tax burden will receive high subsidies. When different types of child care quality are available in the market, higher prices will be associated with smaller subsidization rates. This is a consequence of the general property of the subsidization scheme in our benchmark scenario to fully compensate wage taxation of secondary earners through child care subsidies and thereby eliminate the distorting impact of the government. As far as the incomplete contract argument is perceived as relevant, the optimal subsidy will generally fall short of the marginal wage tax. No-use subsidies may play an important role in order to reduce distortions in quality choice if, for whatever reason, some standard versions of external child care receive preferential treatment by the government.

The model could be extended in various directions. First, it is certainly interesting to allow for leisure as an alternative use of time, which always remains untaxed. If leisure replaces market work, the distortion through wage taxation loses in weight, reducing subsidies for external child care at any given amount of market child care both in relative and absolute terms. In particular, if the secondary earner does not work, the optimal subsidy for market child care is zero. Thus, subsidizing market child care is no longer a substitute for exempting secondary earners from wage taxation. Relatedly, our analyses often allow for explicit results on optimal subsidies by arbitrarily setting the marginal cost of public funds to zero. Should these marginal costs of public funds be non-zero, the levels of optimal subsidies will be lower than stated here. Second, should the government pursue also a redistributive goal, policy changes are presumably ambiguous. While single-earner households tend to have lower incomes than double earners, the opposite may hold when comparing resulting utility levels. Finally, it is uncertain as to how prices of external care are distorted upward by wage taxation. Standard tax incidence arguments suggest that when less elastic labor supply in the external child care market meets considerable more elastic labor demand, the lion's share of the burden of wage taxation will fall on the labor supply side, implying little impact on prices. Hence, changes to the subsidies derived here may remain small.

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References

- Apps, P. and R. Rees (2004) Fertility, taxation and family policy. *Scandinavian Journal of Economics* 106, 745-763.
- Apps, P. and R. Rees (2016) Optimal taxation and the household. CESifo Working Paper No. 5845, Munich.
- Baker, M., J. Gruber and K. Milligan (2008) Universal child care, maternal labor supply and family wellbeing. *Journal of Political Economy* 116, 709-745.
- Bauernschuster, S., T. Hener and H. Rainer (2016) Children of a (policy) revolution: the introduction of universal child care and its effect on fertility. *Journal of the European Economic Association*, forthcoming.
- Bauernschuster, S. and M. Schlotter (2015) Public child care and mother's labor supply: evidence from two quasi-experiments. *Journal of Public Economics* 123, 1-16.
- Bergstrom, T. and S. Blomquist (1996) The political economy of subsidized day care. *European Journal of Political Economy* 12, 443-457.
- Bick, A. (2016) The quantitative role of child care for female labor participation and fertility. *Journal of the European Economic Association* 14, 639-668.

- Blau, D. and J. Currie (2006) Pre-school, day care, and after-school care: who's minding the kids? In E. Hanushek and F. Welch (Eds.) Handbook of the Economics of Education, vol. 2. Elsevier: Amsterdam, 1163-1278.
- Blau, D. and Hagy, A. P. (1998) The demand for quality in child care. *Journal of Political Economy* 106, 104-146.
- Blomquist, S., V. Christiansen and L. Micheletto (2010) Public provision of private goods and nondistortionary marginal tax rates. *American Economic Journal: Economic Policy* 2, 1-27.
- Borck, R. and K. Wrohlich (2011) Preferences for child care policies: theory and evidence. *European Journal of Political Economy* 27, 436-454.
- DICE Database (2011) Use of formal childcare arrangements, 0-2-year-olds, 2005-2009, Ifo Institute, Munich, online available at <http://www.cesifo-group.de/DICE/fb/9fTtHHzh>
- Domeij, D. and P. Klein (2013) Should day care be subsidized? *Review of Economic Studies* 80, 568-595.
- Epple, D. and R. Romano (1996a) Ends against the middle: determining public service provision when there are private alternatives. *Journal of Public Economics* 62, 297-325.
- Epple, D. and R. Romano (1996b) Public provision of private goods. *Journal of Political Economy* 104, 57-84.
- Fenge, R. and L. Stadler (2014) Three family policies to reconcile fertility and labor supply. CESifo Working Paper No. 4922, Munich.
- Gathmann, C. and B. Sass (2012) Taxing childcare: effects on family labor supply and children. CESifo Working Paper No. 3776, Munich.
- Guner, N., R. Kaygusuz and G. Ventura (2014) Childcare subsidies and household labor supply IZA Discussion Paper No. 8303, Bonn.
- Havnes, T. and M. Mogstad (2011) Money for nothing? Universal child care and maternal employment *Journal of Public Economics* 95, 1455-1495.
- Havnes, T. and M. Mogstad (2015) Is universal child care leveling the playing field? *Journal of Public Economics* 127, 100-114.
- Heckman, J.J. (1974). Effects on child-care programs on women's work effort. *Journal of Political Economy* 82, S136-S163.
- Kemnitz, A. and M. Thum (2015) Gender power, fertility, and family policy. *Scandinavian Journal of Economics* 117, 220-247.
- Lefebvre, P and P. Merrigan (2008) Child care policy and the labor supply of mothers with young children: a natural experiment from Canada. *Journal of Labor Economics* 26, 519-548.

Meier, V. and H. Rainer (2015) Pigou meets Ramsey: gender-based taxation with non-cooperative couples. *European Economic Review* 77, 28-46.