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

It is interesting to note that 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 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 argues repeatedly from Heckman (1974) on that increased access to subsidized child care raises labor supply of mothers (eg Lefebrve 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) where 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 themselves for their children. 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 overshooting level, a justification of no-use subsidies arise, where we determine optimal levels. Finally, parents may 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 analogous 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), stressing 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). 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 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 diractions for futher research.

2. Basic Model

Consider differentiated households. Each household has exogenous income $Y \geq 0$, comprising all sorts of capital income and typically the net wage of the primary earner inelastically working 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, being 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

$$c = Y + (1-t)wl - pl. \tag{1}$$

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

$$U = \alpha \ln c + \beta \, lnz \tag{2}$$

with $\alpha, \beta > 0$.

The Lagrangean is

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

The first-order condition is

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

Since boundary solutions may occur, we have to distinguish some 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 an opportunity cost exceeding 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 $Y > 0$. Figures 1-4 illustrate how labor supply (and demand for external child care) changes with varying income and wage. Reducing labor supply as a consequence of 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.

Insert Figures 1-4 about here

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

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

which increases in w and decreases in Y.

At the upper boundary, solving for π yields

$$\pi|_{l=1} = \frac{q\left[\beta Y + (\alpha+\beta)[(1-t)w-p]\right]}{\beta[Y+(1-t)w-p]} \qquad (7)$$

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

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

Considering heterogeneity in the wage of the secondary earner and household child care productivity, there will be three areas. If productivity in child care π is high and at the same time wage w is low, as depicted in area A in Figure 5, the secondary earner's labor supply of the household will be zero ($l=0$), spending the full time to take care for the child. By contrast, if productivity in child care is low in combination with a high wage rate in the labor market, full time work ($l=1$) is chosen and child care is bought in the market at the maximum extent (area C in Figure 5). Finally, interior solutions are possible (area B). 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 the determining first-best allocation where any revenue requirement related to the household under consideration can be met by a lump-sum tax T. Consider the interesting case $w > p$ and $q < \pi$. Any efficient allocation solves

$$\max_{l} U\left(Y - T + wl - pl, ql + \pi(1 - l)\right) \qquad (8)$$

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 $l = 1$.

Insert Figure 5 about here

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, let the tax revenue requirement be already met by taxation of primary earners, and use a specification without further redistribution across households. Thus, the government budget equation related to the household is

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

where σ_i denotes the rate of subsidization for external care granted to household i and T_i is a household specific lump-sum tax (or transfer if $T_i < 0$) which is determined as residual. 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

$$\max_{l} U\left(Y - T + (1 - t)wl - (1 - \sigma)pl, ql + \pi(1 - l)\right) \qquad (10)$$

which yields in case of an interior solution

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

thus

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

which coincides with the efficient solution iff

$$\frac{U_c}{U_z}=\frac{\pi-q}{w-p} \tag{13}$$

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 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:

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

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

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.

4. Distortion through the child care subsidy

If the child care subsidy σp is set at a level being "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

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

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

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

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

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

which 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 some very small marginal cost 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:

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

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

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

being equivalent to

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

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

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

Notice that for any fixed γ the child care subsidy is declining in the wage surplus rate $-p$. The higher is the wage surplus rate $(w - p)$, the higher is labor supply and thus the purchase of external day care. Since the quality of external care is lower 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 effective wage $(w - p)$ the optimal subsidy is declining in the measure of incompleteness γ.

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

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

Proposition 3 shows that there is again no need to employ a no-use subsidy. If the gross wage of the secondary earner exceeds the price of purchasing care in the market, the optimal subsidy per unit is reduced proportional to the difference between the gross wage of the secondary earner and price of market care. As expected, the reduction increases 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. 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 decentralized 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

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

Accordingly, the budget constraint of the household is

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

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

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

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

The resulting indirect utilities are

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

with full time parental care,

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

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

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

$$+\beta ln\left[\left[\frac{\alpha}{(\alpha+\beta)}\frac{\pi}{\left(\pi - q_j\right)} - \frac{\beta}{(\alpha+\beta)}\frac{Y}{\left[(1-t)w - p_j\right]}\right]q_j\right.$$

$$\left.\left[+1 - \frac{\alpha}{(\alpha+\beta)}\frac{\pi}{\left(\pi - q_j\right)} + \frac{\beta}{(\alpha+\beta)}\frac{Y}{\left[(1-t)w - p_j\right]}\right]\pi\right]$$

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, it is no longer obvious that labor supply varies in a monotonous fashion with income. 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 1 by parental care. The opposite happens for further increasing income when parental care is gradually replaced by luxury external care 2, as depicted in Figure 6

Insert Figure 6 about here

Labor supply will generally not be continuous in income or the wage at points in which a switch of types of external care occur. Since at unchanged labor supply the household would experience an upward jump in the quality index and a downward jump in consumption, the jumps tend to be mitigated by increasing labor supply then.

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

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

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 $c = Y + (1-t)w - p_1,\ z = q_i$ In order to ensure that higher external care qualities are not simply dominated by lower external care qualities, we need to assume that household types exist displaying $\frac{dz_{i+1}}{dc} < \frac{dz_i}{dc}$ given $(1-t)w - p_{i+1} > 0$, implying $\frac{q_i - \pi}{(1-t)w - p_i} < \frac{q_{i+1} - \pi}{(1-t)w - p_{i+1}}$. Lemma 3 summarizes properties of switching points.

Lemma 3. (i) *Any parameter set making the household indifferent between the optimal alternative involving quality* i *at quantity* $q_i \geq 0$ *and the optimal alternative involving quality* $i+1$ *at quantity* $q_{i+1} > 0$ *with* $(c_i, z_i) \neq (c_{i+1}, z_{i+1})$ *and* $(1-t)w - p_{i+1} > 0$ *generates* $z_{i+1} > z_i$ *and* $c_{i+1} < c_{i.}$ (ii) *At any such switching point labor supply is at the maximum with the higher quality choice,* $l_{i+1} = 1$.

Proof.

(i) Should the slope of the budget constraint (33) determining $z(c)$ be nonnegative – due to $(1-t)w > p_i$ in combination with $q_i \geq \pi$, labor supply will be at the maximum $l_i = 1$. In that event, we obtain $z_{i+1} > z_i$ and $l_{i+1} \geq l_i$. Indifference at the switching point then obviously requires $c_{i+1} < c_{i.}$ Thus the claims hold if the higher quality alternative satisfies $(1-t)w > p_i$ in combination with $q_i \geq \pi$.

(ii) Let the slope of the budget constraint (33) determining $z(c)$ be negative for the two external quality alternatives under consideration – due to $(1-t)w > p_i$ in combination with $q_i < \pi$. Switching zo the higher quality makes sense only if the absolute slope of the budget constraint $z(c)$ is smaller with the higher quality alternative. Any switching point is then associated with maximum labor supply at the higher quality alternative $l_{i+1} = 1$. Otherwise, utility with using the higher quality alternative could be raised by increasing labor supply (see Figure 7). Suppose $c_{i+1} > c_i$ and $z_{i+1} < z_i$ at some switching point. Then reducing labor supply slightly with the higher quality increases utility contradicting the assumption of a switching point.) ∎

Insert Figure 7 about here

Notice that it is conceivable to arrive at a reduction of labor supply should we have $(1-t)w - p_{i+1} < 0 < (1-t)w - p_i$ in combination with $q_{i+1} > q_i > \pi$. In that event, we have an upward sloping budget constraint with quality i, inducing $l_i = 1$, and a downward sloping budget constraint with quality i+1. While indifference between external technologies will again imply $z_{i+1} > z_i$ and $c_{i+1} < c_{i.}$, this could go along with less than full time labor supply $l_{i+1} < 1$.

Moreover, the budget constraint (33) indicates that when varying only the wage w or the productivity of parental care π, there might exist a type for whom the slope of (33) does not change when replacing the lower quality alternative by the higher quality alternative. If for that type the optimal combination involving the lower quality (c_i, z_i) is still feasible with the higher quality, it will be chosen, $(c_{i+1}, z_{i+1}) = (c_i, z_i)$ associated with an increase in labor supply so as to fully compensate for the higher price of external care $l_{i+1} > l_i$. Should in that situation the original choice be no longer feasible due to the smaller budget set, the lower quality is preferred to the higher quality.

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 menue involving external care of quality i and external care of quality i+1,*

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

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:*

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

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

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

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

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

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

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 requires $c_{i+1} < c_i$ 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 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

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

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

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

which is equivalent to

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

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:

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

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

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

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 $c_1 = Y - T + (1-t)wl - (1-\sigma_1)p_1 l$ 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. The government maximizes a Benthamite welfare function subject to the government budget constraint:

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

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

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

$$-\lambda\beta p_1\left[\int l_1 + \sigma_1 \int \frac{\partial l_1}{\partial \sigma_1}\right] + \frac{\partial \beta}{\partial \sigma_1}\left[V_1 - V_x + \lambda[t \int w\,(l_1 - l_x) - l_1\sigma_1 p_1 + b]\right]$$

$$= \beta \int U_c p_1 l_1 + \beta\lambda t \int w \frac{\partial l_1}{\partial \sigma_1} - \lambda\beta p_1\left[\int l_1 + \sigma_1 \int \frac{\partial l_1}{\partial \sigma_1}\right] + \lambda \frac{\partial \beta}{\partial \sigma_1}[t \int w\,(l_1 - l_x) - l_1\sigma_1 p_1 + b] = 0$$

$$\frac{\partial W}{\partial b} = (1-\beta)\int U_c + (1-\beta)\int \{U_c[(1-t)w - p_x] + U_z(q_x - \pi)\}\frac{\partial l_x}{\partial b} + (1-\beta)\lambda t \int w \frac{\partial l_x}{\partial b} \quad (41)$$

$$-\lambda(1-\beta) - \frac{\partial \beta}{\partial b}\left[V_1 - V_x - \lambda\left[t \int w\,(l_1 - l_x) - l_1\sigma_1 p_1 + b\right]\right]$$

$$= (1-\beta)[\int U_c - \lambda] + (1-\beta)\lambda t \int w \frac{\partial l_x}{\partial b} - \frac{\partial \beta}{\partial b}\left[\lambda[t \int w\,(l_1 - l_x) - l_1\sigma_1 p_1 + b]\right] = 0.$$

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 $\beta \int U_c p_1 l_1$. 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 $\lambda\beta p_1 \int l_1$ (ii) changes in the demand by users, expressed through $\lambda\beta p_1 \sigma_1 \int \frac{\partial l_1}{\partial \sigma_1}$, (iii) revenue changes according to labor supply reactions of users, given by $\beta\lambda t \int w \frac{\partial l_1}{\partial \sigma_1}$, and (iv) changes in the number of users. New users forgo the no-use subsidy, given by $\frac{\partial \beta}{\partial \sigma_1}\lambda[-l_1\sigma_1 p_1 + b]$ 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. The first-order condition for optimal no-use subsidy can be interpreted accordingly.

Solving both equations for the joint term $\lambda[t \int w\,(l_1 - l_x) - l_1 p_1 \sigma_1 + b]$ yields

$$\beta \frac{p_1\{\int U_c l_1 - \lambda \int l_1\} + \lambda[t \int w - \sigma_1 p_1]\frac{\partial l_1}{\partial \sigma_1}}{\frac{\partial \beta}{\partial \sigma_1}} = (1-\beta)\frac{\int U_c - \lambda + \lambda t \int w \frac{\partial l_x}{\partial b}}{\frac{\partial \beta}{\partial b}} \quad (42)$$

Comparing marginal utilities of consumption to marginal welfare from an increase in the public budget as in $\int U_c - \lambda$ indicates a redistributive motive, where $\lambda > 0$ is marginal welfare from increasing the government budget. Depending on whether users are on average richer in terms of consumption, the Benthamite planner is willing to support the poorer group. As $\frac{\partial \beta}{\partial \sigma_1} > 0 > \frac{\partial \beta}{\partial b}$, the signs of the numerators will coincide only if the fiscal impact of switching marginal individuals is zero, $t \int w\,(l_1 - l_x) - l_1\sigma_1 p_1 + b = 0$. Finally, the Benthamite social planner cares about fiscal impacts through labor supply and demand for standard child care responses of non-switchers. According to Lemma 1, we will have

$\frac{\partial l_1}{\partial \sigma_1} > 0 > \frac{\partial l_x}{\partial b}$. While the child care subsidy reduces the price of standard child care, increasing demand, a higher no-use subsidy constitutes an increase in exogenous income, which will reduce demand for external care should parental care be superior in terms of quality.

While it is difficult to characterize the optimal solution in general, some conclusions can be drawn from inspecting the first-order conditions above. Recalling the individualized first-best scheme of subsidies described in Proposition 5, it is useful to consider a candidate solution without no-use subsidy, $b = 0$, in combination with setting the subsidy for standard external care so as to neutralize wage taxation of secondary earners for average users of child care, such that $\sigma_1 p_1 = t \int w$. From our previous considerations, households with (i) low wage rates of secondary earners and (ii) high levels of exogenous income or income of primary earners are particular likely to choose a child care menue without including standard external child care. Thus, determining the signs of terms referring to the redistributive motive of the government is an empirical matter. For the sake of focusing on allocative arguments, we ignore these redistribution terms. At the candidate solution, the term $\lambda[t \int w - \sigma_1 p_1] \frac{\partial l_1}{\partial \sigma_1}$ vanishes, expressing that labor supply responses of existing users of standard child care are neutral for the government budget. At the same time, introducing a no use-subsidy tends to increase the deficit of the government via the labor supply reduction of non-switchers as expressed by $\lambda t \int w \frac{\partial l_x}{\partial b} < 0$. However, switching individuals no longer using standard external child care contribute to a budget surplus since we typically have $t \int w \,(l_1 - l_x) - l_1 p_1 \sigma_1 < 0$. The government saves the external care subsidy while it loses only part of the tax revenue collected from secondary earners given the plausible $l_1 > l_x > 0$. Should the positive impact from switchers no longer using standard external care outweigh the negative impact of non-users reducing their labor supply we will have $\frac{\partial W}{\partial b} > 0$ at $b = 0$. Consider at the other extreme a no-use subsidy set at the level of the standard care subsidy for marginal users, $b = l_1 \sigma_1 p_1$. In that event, there is no impact of switching on government expenditure, while tax revenue tends to be higher when people use standard external care, $t \int w \,(l_1 - l_x) > 0$. Hence labor supply responses of both non-switchers and switchers have a negative impact on the government budget generating $\frac{\partial W}{\partial b} < 0$ at $b = l_1 \sigma_1 p_1$. As a consequence, no-use subsidies will be positive, while falling short of subsidies for users of standard external care at the margin.

Turning to the level of user subsidies, and recalling that no-use subsidies will never exceed user subsidies, consider the absence of subsidies $b = \sigma_1 = 0$. In that event, introducing small user subsidies have a positive impact on the public budget both though an increase in labor supply of users, represented by $\lambda[t \int w] \frac{\partial l_1}{\partial \sigma_1} > 0$ and an increase of labor supply of households being induced to switch to the group of users (from $t \int w \,(l_1 - l_x) > 0$). Thus, we will have a positive user subsidy in the optimum because $\frac{\partial W}{\partial \sigma_1} > 0$ at $\sigma_1 = 0$. When the user subsidy is set at $\sigma_1 p_1 = t \int w$, such that labor supply responses of users do not matter for the government budget deficit, the decisive consideration comes from the fiscal impact of switchers driven into using standard child care, as expressed by the term $t \int w \,(l_1 - l_x) - l_1 \sigma_1 p_1 + b = 0$. Should switchers finance exactly their subsidies for using standard care, it matters whether tax payments of secondary earners from non-using households exceed or fall short of the aggregate no use subsidy. In the absence of the no use subsidy we would have $\frac{\partial W}{\partial \sigma_1} < 0$ at $\sigma_1 p_1 = t \int w$ in combination with $b = 0$.

These considerations are summarized in the following conjecture.

Conjecture. *If the policy space consists of $\sigma_1 p_1$, a price subsidy for external quality 1, and a lump-sum no use subsidy b, the optimum displays* $0 < b < \sigma_1 p_1 < tw_{max}$.

The argument can be sketched as follows. (i) According to Proposition 1, an overall optimal subsidization policy would require individualized price subsidies increasing in the wage and decreasing in the price of external care, leaving parental care unsubsidized. (ii) If the price subsidy σ_1 cannot be differentiated according to wage, it will reflect the optimal level for some medium type. This subsidy is then too low for high wage types and already overshooting for low wage types. (iii) If the price subsidy σ_1 could be differentiated, the no-use subsidy will be strictly positive because optimal subsidies for non-standard types of external care are positive, while a marginal subsidy for parental care is neutral for welfare. At the same time, absolute levels of optimal external care subsidies tend to be equal, while the optimum level of the parental care subsidy is zero. As the optimal level of the no-use subsidy reflects a compromise, it will be smaller than the (average) absolute price subsidy for standard external care. (iv) This reasoning has to be adapted in the case where the price subsidy cannot be differentiated, where the sign of the impact of having a uniform price subsidy on the optimal level of the no-use subsidy is uncertain.

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 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 fall short of the marginal wage tax. While the argument that no-use subsidies are part of the optimal scheme due to avoid distortions away from parental care seems doubtful or even wrong, they 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. 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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Table of Figures

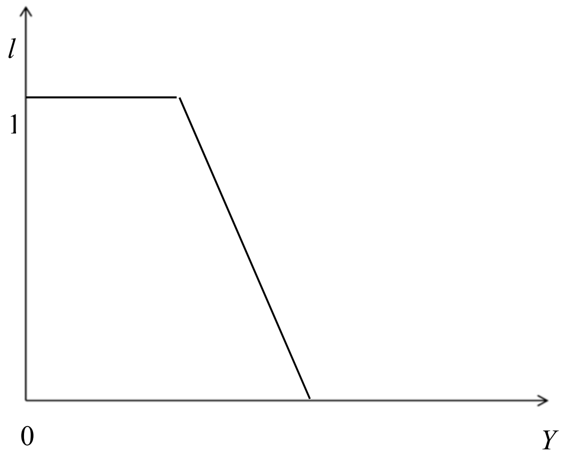

Fig. 1. Variation in income, wage high enough, π > q

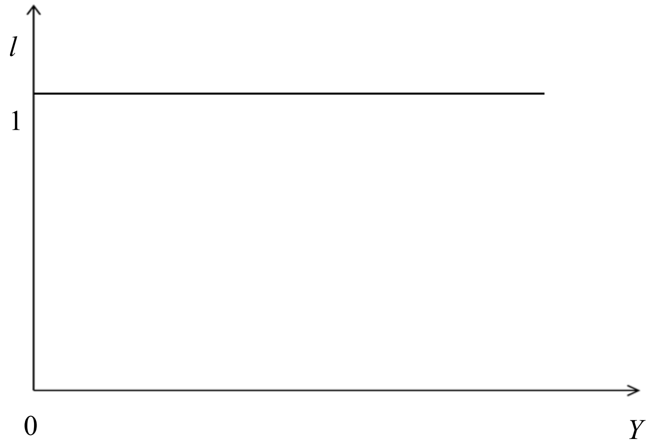

Fig. 1. Variation in income, wage high enough, q > π

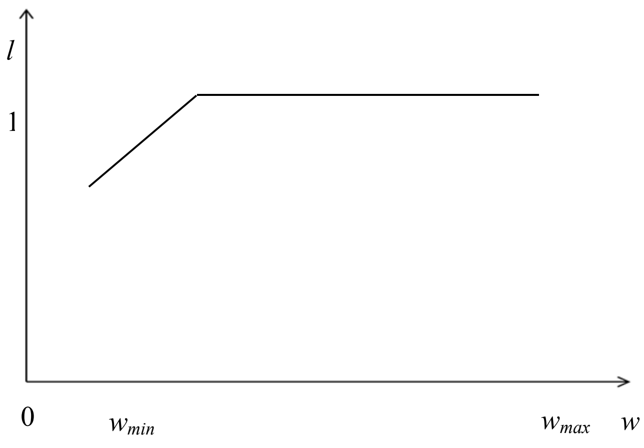

Fig. 3. Variation in wage, middle income, q > π

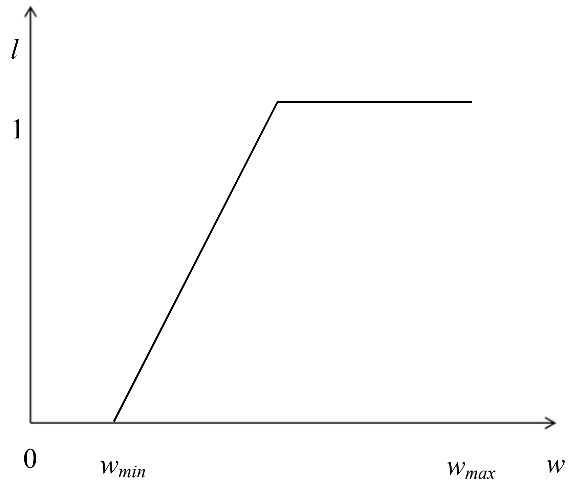

Fig. 4. Variation in wage, middle income, $\pi > q$

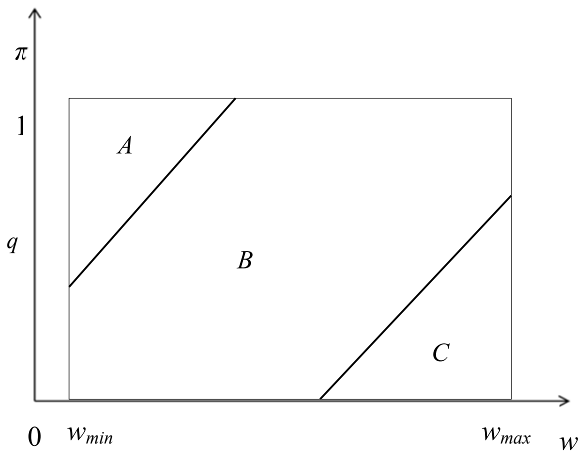

Fig. 5. Boundary and interior solutions

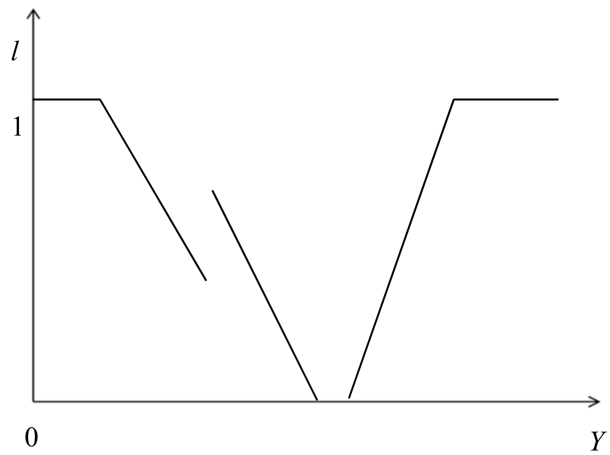

Fig. 6. Variation in income, differentiated quality, $q_2 > \pi > q_1 > q_0$, $p_2 > (1\text{-t})\, w > p_1$

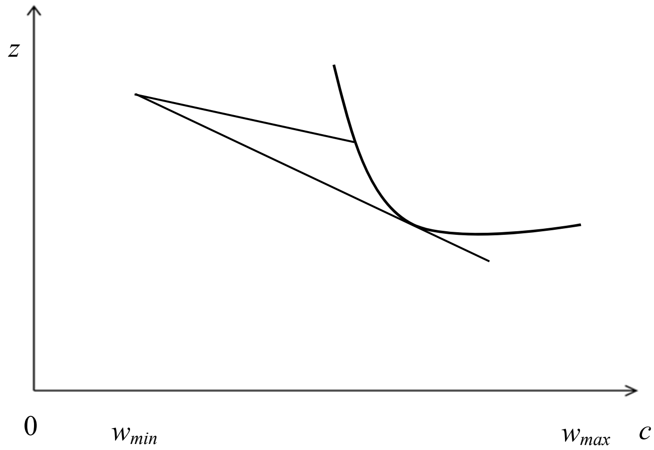

Fig. 7. Switching points, $q_i < \pi$, $(1\text{-}t)w > p_i$