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Three family policies to reconcile fertility and labor supply

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Three family policies to reconcile fertility and labor supply

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In this model we analyze three instruments of family policies. A direct child transfer is compared with a subsidy for external child care and a parental leave payment. The latter instruments change the quantity and quality of children by affecting the secondary earner's labor supply. We distinguish between two income groups: The secondary earners' incomes in the first (second) group are higher (lower) than the fee for external child care. We find that for the first group the parental leave payments have the strongest positive impact on fertility while for the second group the subsidy for external child care dominates. Concerning the secondary earner's labor supply the subsidy for external child care has the strongest effect on both income groups. The welfare analysis shows that a reduction of child benefits or the subsidy for bought-in child care accompanied by a budget neutral increase in the parental leave payments raises (decreases) welfare for the first (second) group.

JEL: H31, H53, J13, J22
Keywords: fertility, quality of children, child care, secondary earner's labor supply, parental leave payments

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1 Introduction

There has been a steady and significant decline in birth rates in all OECD countries over the last 40 years. Despite this negative trend one can observe a large heterogeneity within the countries' fertility rates. According to OECD statistics, total fertility rates in 2009 were as low as 1.4 children per woman in Italy, Spain, Germany, and Japan. Within the high-income countries of the world, no countries are solidly above the fertility rate of 2.1 children per women that is needed to replace the population at a constant level. Some other countries like France, Sweden, the United Kingdom or the United States managed to counteract this downside trend and to reincrease their birth rates. Therefore those countries could avert an as dramatic population decrease as for example in Germany. Due to the aging process associated with this decline in fertility, the developed countries are facing significant challenges.

Important factors linked to the decline of birth rates are higher incomes, and hence higher opportunity costs of children, as well as the rise in labor-force participation of women. According to Becker (1960 and 1981) and Becker and Lewis (1973), income increases may reduce fertility if the income elasticity for the quality of children exceeds the income elasticity for the quantity of children. Willis (1973) points out that increasing female wages will increase female labor-force participation and thus have a negative impact on the demand for children because of the higher opportunity costs.
It is often argued that the expansion of the welfare state and the social security system can also be blamed for a decline in fertility rates in the developed countries and especially in Europe. In the presence of a pay-as-you-go (PAYG) pension system there is a positive externality associated with having children, the so-called intergenerational transfer effect. The fertility distortion of the PAYG pension system arises because parents only obtain a small fraction of the pension contributions of their own children. Parts of the benefits of having children are socialized whilst the cost of raising children remains private. As a result, the number of children in a decentralized economy can be expected to be suboptimal. To counter this, most developed countries have in the last decades implemented political incentives to correct this externality and to improve the income position of families.

However, increasing fertility may not be a goal of public policies in itself. A higher number of children may come at a cost in terms of consumption and income of the parents. Even for children the quality of life may decrease if policies address only the quantity of children.

Therefore the instruments of family policy have to be analyzed very carefully with respect to these effects and their implications for welfare.

This paper presents a comparison of benefit programs on welfare, fertility and investments in quality of children within a static model with endogenous fertility and labor supply of a secondary earner. We analyze the effects of changes in child benefits, in a child subsidy on bought-in child care as well as in parental leave payments.

Child benefits have been implemented in almost all OECD countries and there have been several empirical studies (e.g. Gauthier and Hatzius, 1997, Cigno et al, 2003, Laroque and Salanié, 2005) showing that there is positive impact of child benefits on the demand for children. Nevertheless countries such as Germany with very low fertility rates and relatively low female employment rates pay relatively high child benefits. Policy differences between high and low fertility countries as well as countries with high and low female employment rates can rather be found in the rates for parental leave payments, child care subsidies, and tax breaks towards families.

Both Sweden and France have achieved to keep their fertility rates relatively high and both countries have highly developed subsidized care systems. This might lead to the conclusion that investing in child care is an important political instrument to help increasing fertility rates. In the empirical literature one finds mixed evidence about the success of child care subsidies in fostering fertility. While Hank et al (2004) find positive effects of full-time subsidized child care on fertility for Germany, Haan and Wrohlich (2009) only find significant effects for highly-educated women and women who give birth for the first time.

The third policy parameter we want to analyze, the rate of parental leave payments, has especially been implemented in Sweden. Spiess and Wrohlich (2008) simulate fiscal costs and expected labor market outcomes of a parental leave benefit reform in Germany. They provide evidence that all income groups benefit and that in the second year, mothers increase their working hours and labor market participation significantly. Lalive and Zweimüller (2009) show that an extension of the Austrian parental leave period increases fertility but lengthens the time women spent at home.

In the following we provide a welfare analysis of the three policies. This enables us to calculate the distortions of the different policies and to finally rank them regarding to the utility of the parents. In the next section we introduce the model. Section 3 presents the comparative static results. In section 4, we calculate the welfare effects of substituting policies and section 5 concludes.

2 The model

For simplicity, we divide the life cycle of each person into two phases of the same duration. During the first phase, a person entirely depends on parental support, while in the second, the adult person allocates his or her time to either working and thus contributing to family income or to raising a family. For ease of exposition, we also assume that all men and women are neatly paired off into conventional families. Family decisions are assumed to be taken by the representative parents who derive utility from consumption, c, the number of children, n, and the children's quality, q, according to the additively separable utility function

$$U(c,n,q) = u(c) + u(n) + u(q). \tag{1}$$

We assume the utility function to be continuous, strictly concave, and strictly increasing in all arguments. The quality per child, q, can be understood as a good produced domestically by the parents who use as inputs time, f, spent with the child and a child-specific consumption good, z, bought on the market. The price on the market for the child-specific consumption good is B. The domestic production function is given by

$$q = q(f,z) \tag{2}$$

and increases monotonically in both arguments.

For simplicity, we assume that only the secondary earner spends time with the children. Time spend with the child can be divided into the secondary earners' own time, h, and the time the child spends at child care, g

$$f = h + \rho g \tag{3}$$

The market price for child care, g, is denoted by π.

The secondary earner allocates her time to working which yields wage at the rate w and to leisure time. We assume that child rearing is the only domestic time requiring parental time so that she spends her leisure time completely with the children. Through the endogeneity of n, the secondary earner's labor supply is also endogenous. If she has n children her parental time equals hn. The rest of the total time is working time and given by $L = 1 - hn$, her gross income therefore equals wL. The primary earner allocates all her time to working and her gross salary is Y.

The family's budget constraint is given by

$$(1-t)(Y+w_iL)+\alpha n+\gamma w(1-t)hn=c+Bzn+(1-\beta)\pi gn \tag{4}$$

where α represents a child benefit, β a subsidy for bought-in child care and γ a parental leave payment by the government. We distinguish between two groups of secondary earners: w_i with $i \in \{1,2\}$ and $w_1 > w_2$. Secondary earners carrying w_1 earn more than secondary earners being paid w_2 and have thus higher opportunity costs of raising children.

The parents choose consumption, c, the number of children, n, as well as the secondary earner's working time, L, so as to maximize their utility, $u\big(c,n,q(f,z)\big)$, by taking account of the child's quality production and their budget constraint.
The household decision problem is

$$\begin{aligned}&\max_{c,n,q} u(c,n,q)\\ &s.t.\ (1-t)(Y+w_iL)+\alpha n+\gamma w(1-t)hn=c+Bzn+(1-\beta)\pi gn\end{aligned} \tag{5}$$

The first-order conditions yield the following necessary and sufficient conditions of the concave maximization problem:

$$\frac{u_n}{u_c}=Bz+(1-\beta)\pi g+w_i(1-t)(1-\gamma)h-\alpha\equiv P_n \tag{6}$$

$$\frac{u_q}{u_c}q_h=w_i(1-t)(1-\gamma)n-\frac{(1-\beta)\pi n}{\rho}\equiv P_{q_h,i} \tag{7}$$

$$\frac{u_q}{u_c}q_z=Bn\equiv P_{q_z} \tag{8}$$

All conditions have the well-known meaning that the marginal rate of substitution between the respective decision variables have to be equal to the marginal rates of transformation at the utility maximum. A variation in any of the policy parameters may affect the price of quantity as well as quality of children. Next to costs of parental time, the upbringing of children also incurs a fixed cost per child, Bz, which covers essential child expenditure without which the child would and could not exist. The net cost of children P_n in (6) is therefore composed of the fixed cost per child plus the net cost of external child care plus the opportunity cost of forgone net wage income of the secondary earner minus the child benefits. Children are considered consumption goods with positive net costs. The marginal net price of

a child, P_n, decreases with a higher child benefit, α, as well as with a higher subsidy for child care, β, and higher parental leave payments, γ.

Since the parent's time spent with the children and the time the children spend at external child care are substitutes we only consider the effects on the parental time. The marginal net price of parental time spent with the children $P_{q_h,i}$ in (7) therefore consists of the wage loss minus the saved fee for bought-in child care. Obviously, child benefits have no effect on the price of quality while the subsidy for child care increases and the parental leave payment reduces the net price of parental time spent with the child. We will differentiate between two cases:

$$\widehat{w}_1(1-\gamma)n > \frac{(1-\beta)\pi n}{\rho} \tag{9}$$

$$\widehat{w}_2(1-\gamma)n < \frac{(1-\beta)\pi n}{\rho} \tag{10}$$

where $\widehat{w}_i$ is secondary earner i's net wage $w_i(1-t)$. The first group's income in (9) exceeds the costs for external child care and their price for parental time, $P_{q_h,1}$, spent with their children is positive whereas for the second group in (10) the price, $P_{q_h,2}$, is negative as their income is smaller than the costs for bought-in child care. The second group of secondary earners includes all low-income earners and housewives as well as all unemployed. Since this differentiation is independent of the principal earner's income the model and its implications also apply to single-parent families.

In the following, the effects of changes in h and z are abbreviated by q_h and q_z.

3 Comparative Statics: The effects of changes in the benefit system

We start by analyzing the effects of a variation in the child benefit rate. An increase in α has the following effects on the parent's consumption of c, n and q (see Appendix A):

$$\frac{\partial c}{\partial \alpha} = -s_{nc} + ni_c \tag{11}$$

$$\frac{\partial n}{\partial \alpha} = -s_{nn} + ni_n \tag{12}$$

$$q_h \frac{\partial h}{\partial \alpha} = -s_{nq_h} + ni_{q_h} \tag{13}$$

$$q_z \frac{\partial z}{\partial \alpha} = -s_{nq_z} + ni_{q_z} \tag{14}$$

where s_{nc}, s_{nn}, $s_{nq_h}$and s_{nq_g} represent the substitution effects of the marginal cost of quantity on the demand for consumption, number of children and the quality of children, respectively. The income effects, i_c, i_n, i_{q_h} and i_{q_z}, are positive in the case of an increase of the child benefit. Since s_{nn} in (12) is negative, the total effect of an increase in child benefits on the number of children is certainly positive. Therefore additional child benefit payments encourage fertility as they reduce the cost of children.

Regarding parental and child-specific consumption the substitution effects s_{nc} in (11) and s_{nq_z} in (14) are positive. With increasing costs of quantity of children parents invest more in consumption than in the number children and the overall negative substitution effects might even exceed the positive income effect of the child benefit.

Concerning the parental time spent with the children at home we have to distinguish between the two income groups. While the substitution effect s_{nq_h} in (13) is negative for families carrying w_1 it is positive for families with lower secondary wages w_2. This imposes that the total effect of an increase in child benefits on the time the secondary earner spends with the children is definitely positive for parents with $P_{q_h,1} > 0$ while the impact on the secondary earner's parental time of parents with $P_{q_h,2} < 0$ depends on the size of the income effect. As child benefits have no direct effect on the quality of children, the ratio of quality and quantity will in any case fall since the relative price of quality to quantity rises with α. This can be illustrated by a comparison of the net price of children with respect to the number of children in (6) and to the quality of children in (7) and (8). The price for quality of children is not affected by changes in the rate of the child benefit. Therefore an increase in child benefits will always have only a remote effect on the quality of children.

The effects of an increase of the subsidy for bought-in child care affect both the quantity of children and the quality of children. The analytical results are as follows (see Appendix A)

$$\frac{\partial c}{\partial \beta} = -\pi g s_{nc} + \pi n s_{q_h c} + \pi g n i_c \tag{15}$$

$$\frac{\partial n}{\partial \beta} = -\pi g s_{nn} + \pi n s_{q_h n} + \pi g n i_n \tag{16}$$

$$q_h \frac{\partial h}{\partial \beta} = -\pi g s_{n q_h} + \pi n s_{q_h q_h} + \pi g n i_{q_h} \tag{17}$$

$$q_z \frac{\partial z}{\partial \beta} = -\pi g s_{n q_z} + \pi n s_{q_h q_z} + \pi g n i_{q_z} \tag{18}$$

where $s_{q_h c}$, $s_{q_h n}$, $s_{q_h q_h}$ and $s_{q_h q_z}$ are the substitution effects of the marginal costs of bought-in child care on the demand for the specific consumption good. The income effects are positive in the case of an increase of β.

Regarding the quantity of children in (16), the total effect is positive in the case of the second group of secondary earners as $s_{nn} < 0$ and $s_{q_h n} > 0$. If the government increases its subsidies for external child care, parents will have more children, as the price for children decreases and they can both spend more time working and thereby increase the family income. In the case of the first group of secondary earners with w_1 the effect might also be positive even though the substitution effect $s_{q_h n}$ is negative. The strong substitution effect s_{nn} and the income effect will probably offset this negative impact. This demonstrates that families with $P_{q_h,1} > 0$ react less to an increase in the subsidy for external child-care than parents with $P_{q_h,2} < 0$ with respect to the number of children.

Concerning the parental time h spend with the children in (17) an increase of the subsidy on external child care is likely to have a negative effect for both income groups. In the case of the first group both substitution effects $s_{n q_h}$ and $s_{q_h q_h}$ are negative while for the second group $s_{n q_h}$ is positive. The more the government subsidizes child care, the more parents will take advantage of the external child care and the share of external child care in total time spent with the children increases disproportionately. Families whose secondary earner's income is smaller than the fee for external child care will take even more advantage of this subsidy as it decreases the ratio of income and cost of bought-in child care.

Parental consumption in (15) is likely to increase for both income groups. The additional family income due to the increased use of external child care will also be spent on the parent's own consumption if $s_{nc} > 0$ is offset by the positive substitution effect $s_{q_h c}$ and income effect i_c. The total effect on child-specific consumption in (18) depends on the secondary earner's

income: in the case of the first group the effect is - depending on the size of the income effect - likely to be positive as $s_{nq_z} > 0$ and $s_{q_h q_z} > 0$ while the effect for the second group is rather negative as $s_{q_h q_z} < 0$.

The effects of an increase of the parental leave payment are given by (see Appendix A)

$$\frac{\partial c}{\partial \gamma} = -\hat{w}_i h s_{nc} - \hat{w}_i n s_{q_h c} + \hat{w}_i h n i_c \tag{19}$$

$$\frac{\partial n}{\partial \gamma} = -\hat{w}_i h s_{nn} - \hat{w}_i n s_{q_h n} + \hat{w}_i h n i_n \tag{20}$$

$$q_h \frac{\partial h}{\partial \gamma} = -\hat{w}_i h s_{n q_h} - \hat{w}_i n s_{q_h q_h} + \hat{w}_i h n i_{q_h} \tag{21}$$

$$q_z \frac{\partial z}{\partial \gamma} = -\hat{w}_i h s_{n q_z} - \hat{w}_i n s_{q_h q_z} + \hat{w}_i h n i_{q_z} \tag{22}$$

where $\hat{w}_i$ denotes the net wage of family i. As before the income effects are positive in the case of an increase of γ. The impact of an increase of the family splitting factor thus depends on the substitution effects of the marginal costs of parental child care on the demand for c, n and q.

Regarding parental consumption in (19) both substitution effects are positive and the total effect is thus likely to be negative depending on the size of the income effect i_c.

The total effect of an increase of the family splitting factor on the quantity of children in (20) is positive for the first group of secondary earners with $P_{q_h,1} > 0$. In the case of the second group the substitution effect $s_{q_h n}$ is again positive. Nevertheless the overall negative effect of $s_{q_h n}$ is probably offset by the strong positive effects of s_{nn} and i_n. Therefore we can assume that an increase in the family splitting factor increases the number of children for both income groups. The same applies for the secondary earner's parental time in (21). The total effect of an increase of the parental leave rate is definitely positive for the secondary earner of the first group. Secondary earners whose income is larger than the costs for external child care will take advantage of the increased rate of parental leave payments and stay at home with their children. As a matter of course this policy parameter therefore has a negative impact on the secondary earner's labor supply. In the case of the second group of secondary earners the positive substitution effect s_{nq_h} is likely to be offset by the other effects and the increase of the parental leave rate will also have a positive effect on the parental time h spent with the child.

The total effect on child-specific consumption in (22) depends again on the income group: while for the first group both $s_{nq_z} < 0$ and $s_{q_h q_z} < 0$, for the second group only $s_{q_h q_z} < 0$. The total effect of γ on z therefore depends on the size of the income effect but in contrast to the effect of β the effect is more likely to be positive for secondary earners of group two with $P_{q_h,2} < 0$.

For the welfare analysis in the next section it is useful to compare the effectiveness of the policy instruments in raising the number of children and increasing the secondary earner's labor supply. We consider a budget neutral substitution of two instruments in order to determine the size of the effect. The government's budget is given by:

$$t(Y + wL) = \alpha n + \beta \pi g n + \gamma \hat{w}_i h n \tag{23}$$

Looking at first at an exchange of child benefits and subsidies for bought-in child care the budget keeps constant if $d\alpha = -\pi g d\beta$. Taking account of equations (12) and (16) an increase of the subsidy β and a reduction of the child benefit α so as to keep the budget constant have the following effect on the number of children:

$$dn|_{d\alpha = -\pi g d\beta} = \frac{\partial n}{\partial \beta} d\beta + \frac{\partial n}{\partial \alpha} d\alpha = \pi n s_{q_h n} \lesseqgtr 0 \tag{24}$$

If we consider a group one secondary earner carrying $w_1 > w_2$ the subsidy for child care has a weaker effect on fertility than child benefits as $s_{q_h n} < 0$. On the contrary, the exchange has a positive effect of group two's fertility since in this case the effect of β on the quantity of children exceeds the effect of α.

In case of the secondary earner's parental time, the effect of a budget neutral increase of β in (17) falls short of the effect of α in (13):

$$dh|_{d\alpha = -\pi g d\beta} = \frac{\partial q_h}{\partial \beta} d\beta + \frac{\partial q_h}{\partial \alpha} d\alpha = \pi n s_{q_h q_h} < 0 \tag{26}$$

given that the substitution effect $s_{q_h q_h}$ is negative. Increasing the child benefit leads to an increase in the secondary earner's parental time which is equivalent to a decrease in her employment rate. The impact of an increase of the subsidy for bought-in child care on the other hand has exactly the opposite effect and thus leads to an increase in the secondary earner's employment rate as the children spend more time at child care.

The same policy exchange leads to more parental consumption. This positive effect on parental consumption can be explained by the fact that a larger subsidy for child care leads to an increased labor supply und thus increases family income. Regarding child-specific consumption the effect of this policy exchange is positive in the case of the first group of secondary earners with $P_{q_h,1} > 0$ and negative for the second group with $P_{q_h,2} < 0$.

Comparing child benefits and the rate of parental leave payments a budget neutral substitution requires $d\alpha = -\hat{w}_i h d\gamma$. Taking account of (12) and (20) the effect of increasing the parental leave payments depends also on the income group

$$dn|_{d\alpha=-\hat{w}_i h d\gamma} = \frac{\partial n}{\partial \gamma} d\gamma + \frac{\partial n}{\partial \alpha} d\alpha = -\hat{w} n s_{q_h n} \gtrless 0 \tag{25}$$

While the effect is positive for the first group of secondary earners, the rate of parental leave payments has a weaker effect on fertility than child benefits for the second group.
In contrast to the results of a budget-neutral exchange of α and β, the impact of an increase in γ by $d\alpha = -\hat{w}_i h d\gamma$ in (21) exceeds the effect of α in (13)

$$dh|_{d\alpha=-\hat{w}_i h d\gamma} = \frac{\partial q_h}{\partial \gamma} d\gamma + \frac{\partial q_h}{\partial \alpha} d\alpha = -\hat{w}_i n s_{q_h q_h} > 0 \tag{27}$$

An increase of the parental lead rate on the expense of the child benefits has thus a positive impact on parental time but decreases therefore the secondary earner's employment rate.
The same policy change leads in contrast to the results of a budget neutral increase of β to less parental consumption. This reduction in parental consumption can be explained by the increased parental child care time and thus reduced family income. The effect of the policy exchange with respect to child-specific consumption is negative in the case of the first group of secondary earners with $P_{q_h,1} > 0$ and positive for the second group with $P_{q_h,2} < 0$.

4 Welfare Analysis

For the welfare analysis we consider a budget neutral substitution of two instruments in order to determine the size of the effect.

Assuming that the government wants to maximize the household's indirect utility function V, the maximization problem can be written as

$$\max_{\alpha,\beta,\gamma} V(\alpha,\beta,\gamma) = u(c,n,q) + \mu[t(Y+wL) - \alpha n - \beta\pi g n - \gamma\hat{w}hn] \tag{28}$$

taking into account the government's budget constraint in (23).

The total derivative of $V(\alpha,\beta,\gamma)$ is given by:

$$\begin{aligned} dV = &\left(\frac{\partial u}{\partial c}\frac{\partial c}{\partial \alpha} + \frac{\partial u}{\partial n}\frac{\partial n}{\partial \alpha} + \frac{\partial u}{\partial q_h}\frac{\partial q_h}{\partial \alpha} + \frac{\partial u}{\partial q_g}\frac{\partial q_g}{\partial \alpha} - \mu n\right) d\alpha \\ &+ \left(\frac{\partial u}{\partial c}\frac{\partial c}{\partial \beta} + \frac{\partial u}{\partial n}\frac{\partial n}{\partial \beta} + \frac{\partial u}{\partial q_h}\frac{\partial q_h}{\partial \beta} + \frac{\partial u}{\partial q_g}\frac{\partial q_g}{\partial \beta} - \mu\pi g n\right) d\beta \\ &+ \left(\frac{\partial u}{\partial c}\frac{\partial c}{\partial \gamma} + \frac{\partial u}{\partial n}\frac{\partial n}{\partial \gamma} + \frac{\partial u}{\partial q_h}\frac{\partial q_h}{\partial \gamma} + \frac{\partial u}{\partial q_g}\frac{\partial q_g}{\partial \gamma} + \mu\hat{w}hn\right) d\gamma = 0 \end{aligned} \tag{29}$$

At first we keep the parental leave rate γ constant and consider a budget neutral substitution of child benefits α and subsidies for external child care β. Taking account of equations (11) to (14) and (15) to (18) an increase in β accompanied by a reduction in α keeps the government's budget constant if $d\alpha = -\pi g d\beta$ (see Appendix B):

$$dV|_{d\alpha=-\pi g d\beta} = \lambda\pi n\left[s_{q_h c} + P_n s_{q_h n} + P_{q_h,i} s_{q_h q_h} + P_{q_z} s_{q_h q_z}\right] = \phi\pi n P_{q_h,i} \tag{30}$$

Assuming $\phi < 0$, this policy exchange leads to a decrease of welfare for the first group with $P_{q_h,1} > 0$ and an increase of welfare for the second group with $P_{q_h,2} < 0$. The size of this effect in (30) depends on the price for external child care and the number of children which influences the significance of a subsidy for bought-in child care.

Keeping β constant a budget neutral substitution of child benefits and the rate of parental leave payments requires $d\alpha = -\hat{w}_i h d\gamma$. Taking account of equations (11) to (14) and (19) to (22) an increase of γ and a reduction of α has the following effect on the parents' welfare (see Appendix B):

$$dV|_{d\alpha=-\hat{w}_i h d\gamma} = -\lambda\hat{w}_i n\left[s_{q_h c} + P_n s_{q_h n} + P_{q_h,i} s_{q_h q_h} + P_{q_z} s_{q_h q_z}\right] = -\phi\hat{w}_i n P_{q_h,i} \tag{31}$$

The size of this effect depends on the wage rate. For a group one family the welfare effect in (31) is positive and also large as the secondary earner carries a large wage. On the contrary, the welfare effect of this policy change is negative for families with $P_{q_h,2} < 0$, but since the secondary earner carries only a small wage its negative impact is not as large as the positive impact on the first group.

Keeping α constant an increase of a subsidy for child care accompanied by a decrease of the rate of parental leave payments is budget neutral if $d\gamma = -\frac{\pi g}{\hat{w}_i h} d\beta$. Substituting γ for β has the following effect on the parent's welfare (see Appendix B):

$$dV|_{d\gamma=-\frac{\pi g}{\hat{w}_i h}d\beta} = \lambda\pi n\left(\frac{g}{h}+1\right)\left[s_{q_h c} + P_n s_{q_h n} + P_{q_h,i} s_{q_h q_h} + P_{q_z} s_{q_h q_z}\right] = \\ = \phi\pi n\left(\frac{g}{h}+1\right) P_{q_h,i} \tag{32}$$

The budget neutral increase of the subsidy for child care in (32) has a negative effect on the parent's welfare in case of the first group with $P_{q_h,1} > 0$. The size of this effect depends on the market price for external child care, the number of children, and on the ratio of bought-in to parental care. Considering the second group with $P_{q_h,2} < 0$, the welfare effect of the policy exchange is positive. Families with secondary earners carrying smaller wage rates therefore benefit from the increase of β at the cost of a decrease in γ.

On the contrary, an increase of the rate of parental leave payments accompanied by a decrease of a subsidy for child care is budget neutral if $d\beta = -\frac{\hat{w}_i h}{\pi g} d\gamma$. Substituting β for γ has the following effect on the parent's welfare (see Appendix B):

$$dV|_{d\beta=-\frac{\hat{w}_i h}{\pi g}d\gamma} = -\lambda\hat{w}_i n\left(\frac{h}{g}+1\right)\left[s_{q_h c} + P_n s_{q_h n} + P_{q_h,i} s_{q_h q_h} + P_{q_z} s_{q_h q_z}\right] = \\ = -\phi\hat{w}_i n\left(\frac{h}{g}+1\right) P_{q_h,i} \tag{33}$$

The budget neutral increase of the parental leave rate payments in (33) has a positive effect on the parent's welfare in case of the first group with $P_{q_h,1} > 0$. Families with secondary earners carrying larger wage rates benefit from the increase of γ. The size of this effect depends on the market price for external child care, the number of children, and on the ratio of parental to

bought-in care. The larger the share of parental care the stronger the impact of the policy change becomes. Considering the second group with $P_{q_h,2} < 0$, the welfare effect of the increase of γ is negative.

Combining these results one can conclude that for the first group of families with $P_{q_h,1} > 0$ the rate of parental leave payments has the largest impact on the parents' welfare while a subsidy on for external child care has the lowest impact. The effect of γ only falls short of the effects of α and β with respect to parental and child-specific consumption.
On the contrary, the effects are just the other way around for the second group of families with $P_{q_h,2} < 0$: in this case child care subsidies have the strongest impact and the rate of parental leave payments has the lowest impact on welfare. The effect of β only falls short of the effects of α and γ with respect to the second earner's parental time and child-specific consumption.

5 Conclusion

Summarizing our comparative static results and our results of the welfare analysis leads to the conclusion that the effects on fertility and parental welfare depend on the secondary earner's income. Parental leave payments have the strongest effect on both fertility and parental welfare in the case of secondary earners who can afford the fee for external child care. Regarding secondary earners whose income does not cover the fee for bought-in child care on the other hand, the model demonstrates that a subsidy for external child care has the strongest effect while parental leave payments have the weakest effect.

The analysis has shown that a budget neutral increase of the parental leave payments accompanied by a decrease of the child benefits as well as a decrease of the subsidy for external child care distorts the quantity of children upwards for the first group of secondary earners. For this income group a budget neutral exchange of the child benefits and the subsidy for external child care has also a positive effect on the number of children. We can therefore conclude that for the first group of secondary earners parental leave payments have the strongest impact on fertility while the subsidy for external child care has the lowest impact.

Concerning the second group of secondary earner a budget neutral increase of the subsidy for external child care accompanied by a decrease of the child benefits as well as a decrease of the rate of parental leave payments distorts the number of children upwards. Looking at a budget neutral exchange of the child benefits and the parental leave payments one can see that the distortion through the child benefits is also positive. This leads to the conclusion that child care subsidies have the strongest impact on fertility while the rate of parental leave payments has the lowest impact for this income group.

In the case of the secondary earner's labor supply parental leave payments have the lowest impact as a budget neutral substitution of parental leave payments and either of the other two instruments leads to an upward distortion of the secondary earner's parental time. By contrast, a budget neutral increase of both child benefits and the subsidy for bought-in child care distorts the secondary earner's employment rate upwards. Comparing those two instruments we find that the subsidy for external child care has the strongest effect on the secondary earner's labor supply for both income groups. A budget neutral increase of the subsidy for bought-in child care therefore has both a positive effect on fertility and labor supply for secondary earners whose income is smaller than the fee for external child care.

Appendix:

A: Derivation of the comparative statics results

Differentiation of the first-order conditions of individual utility maximization (6)-(8) yields:

$$\begin{pmatrix} u_{cc} & 0 & 0 & 0 & -1 \\ 0 & u_{nn} & -\lambda\left[\widehat{w}_i(1-\gamma)-\frac{(1-\beta)\pi}{\rho}\right] & -\lambda B & -P_n \\ 0 & -\lambda\left[\widehat{w}_i(1-\gamma)-\frac{(1-\beta)\pi}{\rho}\right] & u_{q_hq_h} & 0 & -P_{q_h} \\ 0 & -\lambda B & 0 & u_{q_zq_z} & -P_{q_z} \\ -1 & -P_n & -P_{q_h} & -P_{q_z} & 0 \end{pmatrix} \begin{pmatrix} dc \\ dn \\ dq_h \\ dq_z \\ d\lambda \end{pmatrix}$$

$$= \begin{pmatrix} 0 & 0 & 0 \\ -\lambda & -\lambda\pi g & -\lambda\widehat{w}h \\ 0 & \lambda\pi n & -\lambda\widehat{w}n \\ 0 & 0 & 0 \\ -n & -\pi gn & -\widehat{w}hn \end{pmatrix} \begin{pmatrix} d\alpha \\ d\beta \\ d\gamma \end{pmatrix}$$

where the determinant of the matrix on the left-hand side is denoted by D.

The Cramer rule yields the following derivatives:

$$dc = \left(-\lambda\frac{D_{21}}{D} - n\frac{D_{51}}{D}\right)d\alpha + \left(-\lambda\pi g\frac{D_{21}}{D} + \lambda\pi n\frac{D_{31}}{D} - \pi gn\frac{D_{51}}{D}\right)d\beta + \left\{-\lambda\widehat{w}h\frac{D_{21}}{D} - \lambda\widehat{w}n\frac{D_{31}}{D} - \widehat{w}hn\frac{D_{51}}{D}\right\}d\gamma$$

$$dn = \left(-\lambda\frac{D_{22}}{D} - n\frac{D_{52}}{D}\right)d\alpha + \left(-\lambda\pi g\frac{D_{22}}{D} + \lambda\pi n\frac{D_{32}}{D} - \pi gn\frac{D_{52}}{D}\right)d\beta + \left\{-\lambda\widehat{w}h\frac{D_{22}}{D} - \lambda\widehat{w}n\frac{D_{32}}{D} - \widehat{w}hn\frac{D_{52}}{D}\right\}d\gamma$$

$$dq_h = \left(-\lambda\frac{D_{23}}{D} - n\frac{D_{53}}{D}\right)d\alpha + \left(-\lambda\pi g\frac{D_{23}}{D} + \lambda\pi n\frac{D_{33}}{D} - \pi gn\frac{D_{53}}{D}\right)d\beta + \left\{-\lambda\widehat{w}h\frac{D_{23}}{D} - \lambda\widehat{w}n\frac{D_{33}}{D} - \widehat{w}hn\frac{D_{53}}{D}\right\}d\gamma$$

$$dq_z = \left(-\lambda\frac{D_{24}}{D} - n\frac{D_{54}}{D}\right)d\alpha + \left(-\lambda\pi g\frac{D_{24}}{D} + \lambda\pi n\frac{D_{34}}{D} - \pi gn\frac{D_{54}}{D}\right)d\beta + \left\{-\lambda\widehat{w}h\frac{D_{24}}{D} - \lambda\widehat{w}n\frac{D_{34}}{D} - \widehat{w}hn\frac{D_{54}}{D}\right\}d\gamma$$

With abbreviations for the substitution and income effects as follows:

$$s_{nc} \equiv \lambda\frac{D_{21}}{D},\ s_{nn} \equiv \lambda\frac{D_{22}}{D},\ s_{nq_h} \equiv \lambda\frac{D_{23}}{D},\ s_{nq_z} \equiv \lambda\frac{D_{24}}{D},$$

$$s_{q_hc} \equiv \lambda\frac{D_{31}}{D},\ s_{q_hn} \equiv \lambda\frac{D_{32}}{D}\ ,\ s_{q_hq_h} \equiv \lambda\frac{D_{33}}{D},\ s_{q_hq_z} \equiv \lambda\frac{D_{34}}{D},$$

$$i_c \equiv -\frac{D_{51}}{D},\ i_n \equiv -\frac{D_{52}}{D}\ ,\ i_{q_h} \equiv -\frac{D_{53}}{D},\ i_{q_z} \equiv -\frac{D_{54}}{D}.$$

the comparative static results in (16) – (27) follow.

B: Derivation of welfare effects

Using

$$\frac{2u_c}{D}\left[u_{q_zq_z}P_n\left(\frac{u_c}{n}-u_{cc}P_n\right)-u_{cc}u_{nn}{P_{q_z}}^2+{P_{q_z}}^2\frac{u_c}{n}\left(\frac{u_c}{n}-2u_{cc}P_n\right)\right] \equiv \phi < 0$$

the welfare effects in (30) – (33) follow:

$$\begin{aligned} dV|_{d\alpha=-\pi g d\beta} &= \lambda\pi n\left[s_{q_hc}+P_n s_{q_hn}+P_{q_h,i}s_{q_hq_h}+P_{q_z}s_{q_hq_z}\right] \\ &= \frac{2u_c\pi n}{D}P_{q_h,i}\left[u_{q_zq_z}P_n\left(\frac{u_c}{n}-u_{cc}P_n\right)-u_{cc}u_{nn}{P_{q_z}}^2+{P_{q_z}}^2\frac{u_c}{n}\left(\frac{u_c}{n}-2u_{cc}P_n\right)\right] \\ &= \phi\pi n P_{q_h,i} \end{aligned}$$

$$\begin{aligned} dV|_{d\alpha=-\widehat{w}_i h d\gamma} &= -\lambda\widehat{w}_i n\left[s_{q_hc}+P_n s_{q_hn}+P_{q_h,i}s_{q_hq_h}+P_{q_z}s_{q_hq_z}\right] \\ &= -\frac{2u_c\widehat{w}_i n}{D}P_{q_h,i}\left[u_{q_zq_z}P_n\left(\frac{u_c}{n}-u_{cc}P_n\right)-u_{cc}u_{nn}{P_{q_z}}^2\right. \\ &\left.+{P_{q_z}}^2\frac{u_c}{n}\left(\frac{u_c}{n}-2u_{cc}P_n\right)\right] = -\phi\widehat{w}_i n P_{q_h,i} \end{aligned}$$

$$\begin{aligned} dV|_{d\gamma=-\frac{\pi g}{\widehat{w}_i h}d\beta} &= \lambda\pi n\left(\frac{g}{h}+1\right)\left[s_{q_hc}+P_n s_{q_hn}+P_{q_h,i}s_{q_hq_h}+P_{q_z}s_{q_hq_z}\right] = \\ &\frac{2u_c\pi n}{D}\left(\frac{g}{h}+1\right)P_{q_h,i}\left[u_{q_zq_z}P_n\left(\frac{u_c}{n}-u_{cc}P_n\right)-u_{cc}u_{nn}{P_{q_z}}^2+\right. \\ &\left.{P_{q_z}}^2\frac{u_c}{n}\left(\frac{u_c}{n}-2u_{cc}P_n\right)\right] = \phi\pi n\left(\frac{g}{h}+1\right)P_{q_h,i} \end{aligned}$$

$$\begin{aligned} dV|_{d\beta=-\frac{\widehat{w}_i h}{\pi g}d\gamma} &= -\lambda\widehat{w}_i n\left(\frac{h}{g}+1\right)\left[s_{q_hc}+P_n s_{q_hn}+P_{q_h,i}s_{q_hq_h}+P_{q_z}s_{q_hq_z}\right] \\ &= -\frac{2u_c\widehat{w}_i n}{D}\left(\frac{h}{g}+1\right)P_{q_h,i}\left[u_{q_zq_z}P_n\left(\frac{u_c}{n}-u_{cc}P_n\right)-u_{cc}u_{nn}{P_{q_z}}^2\right. \\ &\left.+{P_{q_z}}^2\frac{u_c}{n}\left(\frac{u_c}{n}-2u_{cc}P_n\right)\right] = -\phi\widehat{w}_i n\left(\frac{h}{g}+1\right)P_{q_h,i} \end{aligned}$$

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