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7/16/08
11:30 am

Should daycare be subsidized?

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First draft: March 28, 2007
This version: February 15, 2008

Abstract

In the presence of distortionary taxes on labor, can subsidies on childcare, financed by a further increase in taxes, raise welfare by encouraging women with small children to work? We approach this question in two different ways. First we consider a set of stylized models where we prove analytically that under some conditions the Ramsey optimal policy consists in making childcare expenses tax deductible. Then we construct a calibrated stochastic dynamic life-cycle model of household decision-making designed to capture some facts about labor supply in Germany. We find that the welfare gains associated with subsidizing childcare are considerable, and that the maximum gains are realized when childcare is subsidized to an even greater extent than what tax deductibility implies.

Keywords: Female labor force participation, Germany, daycare subsidies
JEL classification: E13, J16.

* We thank David Strömberg and seminar participants at the University of British Columbia and Simon Fraser University.
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1 Introduction

Public provision of private goods and services is a significant and widespread phenomenon. Governments around the world spend large amounts on healthcare, mass transit, nursing homes, education and childcare. A large literature has emerged in order to explain this. One strand of this literature shows that public provision of private goods can be an efficient way of redistributing purchasing power across individuals in the presence of asymmetric information.[1] Another strand takes the public provision of private goods to be an inefficient policy emerging from a political process.[2] Blomquist and Christiansen (1999) combine the two approaches to show that an effient public provision of private goods can emerge from a political process, again in the presence of asymmetric information.

In this paper we consider a rather different case for subsidizing childcare (or providing it at a subsidized rate), essentially in the spirit of Ramsey (1927). The point is that labor is undersupplied in an economy where the government has an exogenous spending requirement and lump-sum taxes are ruled out; a subsidy on childcare mitigates this distortion by smoothing it across agents with different numbers of small children. We begin our paper by showing, in two stylized environments, that the optimal policy is to make childcare expenses tax deductible. In the first one, a representative agent lives for T periods and faces a deterministic profile of productivity and children. In the second, there are two heterogeneous agents who live for one period. In both environments, every hour of work requires the agent to purchase an hour of daycare per child. The intuitive reason why the optimal policy is to make childcare expenses deductible is that this policy equalizes the ratio of marginal private to marginal social returns to working; by doing this, it minimizes the total distortion.

Our smoothing argument for subsidizing childcare is, we believe, new. On the other hand, we are certainly not the first to point out that subsidies on childcare may encourage labor supply of mothers and that this may be beneficial in some sense. Heckman (1974) presents

[1] Examples include Besley and Coate (1991), Blackorby and Donaldson (1988), Bruce and Waldman (1991) and Coate (1995).

[2] Representative papers are Epple and Romano (1996), Gouveia (1997), and Slivinski (2005).

strong evidence from the United States that childcare subsidies indeed do increase female labor supply, and Gustafsson and Stafford (1992) report a similar finding for Sweden. Bergstrom and Blomquist (1996) argue in the context of a highly stylized model that the effect on labor supply may be so large that subsidizing childcare is self-financing; a similar result is found in Lundholm and Ohlsson (1998). Rosen (1997) argues that though there is a case to be made for subsidizing childcare, nevertheless the Swedish subsidy rate of 90 percent is excessive and leads to a large reduction in welfare.[3]

The fact that childcare subsidies encourage labor supply has inspired a literature using them as an important factor accounting for differences in labor supply across countries, especially the difference between Scandinavia and (the rest of) continental Europe.[4]. Moreover, the question of expanding the availability of subsidized childcare is close to the top of the political agenda in many countries, as documented in OECD (2006) and Wrohlich (2006). This motivates the second part of our paper, where we use a calibrated model to provide a quantitative assessment of the impact of providing universal accessibility of subsidized childcare in Germany.

There are strong reasons for focussing on Germany in this context. First of all, the labor supply of German mothers with small children is much lower compared to their counterparts in Scandinavia. The employment rate for Swedish mothers with children under the age of 3 is 72 percent; the corresponding number in Germany is 48 percent. Moreover, Scandinavian countries have much greater availibility of highly subsidized childcare than Germany does. The fraction of children between the ages of 0 and 3 in early childhood education and care is 66 percent in Sweden and 9 percent in Germany.[5] Wrohlich (2005) documents that there is strong excess demand for subsidized childcare in Germany; her results indicate that this excess demand amounts to more than 50 percent of all German children below the age of 3. However, Germany's policy is currently in transition; a 2004 federal law requires municipalities to provide childcare slots for children up to 3 years if both parents are working or wish to work. Our work contributes to an evaluation of this

[3] Aslaksen et al. (2000) criticize Rosen for ignoring the effects of childcare on child development.
[4] See Olovsson (2004), Rogerson (2006b), Rogerson (2006a), and Ragan (2005)
[5] See OECD (2006).

and other reforms expanding the availability of subsidized childcare.

The model that we use to evaluate different degrees of daycare subsidies has the following features. Individuals live for seven 6-year periods plus a retirement period and are either permanently single or permanently living with one other person of the opposite sex. Children arrive at random according to probabilities that are consistent with the data. Housework other than taking care of children takes a fixed amount of time depending on the size of the household, and male and female labor are perfect substitutes as far as this housework is concerned. Childcare can be contracted out at a (possibly subsidized) cost.

Our findings include the following. A 90 percent subsidy on daycare leads to a sizeable increase in the labor supply of mothers will small children. It also raises ex-ante welfare for everyone: couples, single men and, single women, whose gains correspond to an increase in consumption of 0.5, 0.4 and 1.5 percent respectively.

The childcare subsidy that maximizes the ex-ante welfare of married couples (who constitute the majority of the population) is more than 100 percent. This is of course a much higher subsidy than that implied by merely making childcare expenses tax deductible.

Why is it optimal to subsidize childcare so much and why does its raise welfare so much? In the stylized models we show that childcare deductibility is optimal when taxes are linear, utility weights are such that zero transfer payments are optimal, and there is no uncertainty. Uninsurable uncertainty does seem to play a role here in that subsidized daycare is a fairly good substitute for insurance. Without uncertainty, welfare gains go down by about a third. Other factors accounting for the apparent optimality of very high subsidies remain to be investigated.

The paper is organized as follows. Section 2 presents the stylized model and proves the optimality of childcare expense deductibility. 3.1 presents the calibrated model. Section 3.2 describes how we assign specific values to parameters. Section 3.3 describes the reforms we consider and their effects on output, labor supply and welfare. Section 4 concludes.

2 Stylized models

2.1 A T-period model with homogeneous agents

Consider a $(T+1)$-period small open economy model where the government may levy a linear tax on labor income (at rate τ_t) and pay a linear subsidy on daycare (at rate θ_t) in each period. The real cost of daycare is d per unit of time and child and η_t is the number of children in period t. Notice that for every unit of time that the agent works it needs to purchase childcare for all the children. Capital income is not taxed. The representative agent solves

$$\max \sum_{t=0}^{T} \beta^t \left[u(c_t) + v(h_t)\right] \tag{1}$$

where $u\colon \mathcal{R}_+ \to \mathcal{R}$ is a differentiable and concave function, and $v\colon \mathcal{R}_+ \to \mathcal{R}$ is a differentiable and convex function, subject to the life-time budget constraint (associated with the Lagrange multiplier λ)

$$\sum_{t=0}^{T}(1+r)^{-t}c_t + \sum_{t=0}^{T}(1+r)^{-t}(1-\theta_t)d\eta_t h_t = \sum_{t=0}^{T}(1+r)^{-t}(1-\tau_t)w_t h_t, \tag{2}$$

where c_t denotes consumption, h_t denotes hours worked, w_t denotes age-specific productivity, and r is the (exogenous) interest rate. Assume that $(w_t - d\eta_t) > 0$ for all t.

The agent's first order conditions are

$$\begin{aligned} \beta^t u_{c,t} - \lambda(1+r)^{-t} &= 0 & (3)\\ \beta^t v_{h,t} + \lambda(1+r)^{-t}\left[(1-\tau_t)w_t - (1-\theta_t)d\eta_t\right] &= 0. & (4) \end{aligned}$$

The resource constraint is

$$\sum_{t=0}^{T}(1+r)^{-t}\left[c_t + d\eta_t h_t + G\right] = \sum_{t=0}^{T}(1+r)^{-t}w_t h_t, \tag{5}$$

where G denotes government consumption.

2.1.1 Ramsey government

The Ramsey government maximizes (1) subject to (5) (associated with the Lagrange multiplier μ) and the implementability constraint (with Lagrange multiplier φ)

$$\sum_{t=0}^{T} \beta^t \left[u_{c,t} c_t + v_{h,t} h_t \right] = 0.$$

The first order conditions are

$$\begin{aligned} \beta^t u_{c,t} \left[1 + \varphi R_{c,t} \right] - \mu (1+r)^{-t} &= 0, \quad (6) \\ \beta^t v_{h,t} \left[1 + \varphi R_{h,t} \right] + \mu (1+r)^{-t} \left[w_t - d\eta_t \right] &= 0, \quad (7) \end{aligned}$$

where

$$\begin{aligned} R_c &= 1 + \frac{u_{cc} c}{u_c}, \\ R_h &= 1 + \frac{v_{hh} h}{v_h}. \end{aligned}$$

2.1.2 Ramsey policies

Divide the first order condition with respect to hours at two different ages for the household and for the Ramsey government respectively to get

$$\begin{aligned} \frac{\beta^{t-s}}{(1+r)^{-(t-s)}} \frac{v_{h,t}}{v_{h,s}} &= \frac{(1-\tau_t) w_t - (1-\theta_t) d\eta_t}{(1-\tau_s) w_s - (1-\theta_s) d\eta_s}, \quad (8) \\ \frac{\beta^{t-s}}{(1+r)^{-(t-s)}} \frac{v_{h,t}}{v_{h,s}} &= \frac{1 + \varphi R_{h,s}}{1 + \varphi R_{h,t}} \frac{w_t - d\eta_t}{w_s - d\eta_s}. \quad (9) \end{aligned}$$

Evidently the left hand sides of these equations are identical. Comparing the right hand sides, we see that if $R_{h,s} = R_{h,t}$, then the equations are satisfied if $\tau_t = \theta_t = \tau$ for all t. This establishes the following Proposition.

Proposition 1 *If $R_{h,s} = R_{h,t}$, (e.g. $v(h) = -\frac{h^{1+1/\gamma}}{1+1/\gamma}$) then the Ramsey allocations can be implemented by constant taxes and daycare expenses being deductible, i.e. $\tau_t = \theta_t = \tau$.*

An instructive way of expressing this result is that it amounts to equalizing, over the life-cycle, the consumption/leisure wedge, i.e. the ratio of marginal private to marginal social returns from working.

2.1.3 When are constant taxes optimal?

If taxes and subsidy rates are constant, i.e. $\tau_t = \tau$ and $\theta_t = \theta$, then combining (8) and (9) we have

$$\tau \gtreqless \theta \text{ if } \left(1 - \frac{1+\varphi R_{h,s}}{1+\varphi R_{h,t}}\right)(w_t - d\eta_t)(w_s - d\eta_s) \gtreqless 0 \tag{10}$$

As we have seen, this means that if $R_{h,t} = R_{h,s}$ for all t, s then $\tau = \theta$. We have also seen that in that case, constant taxes are optimal.

$$\tau \gtreqless \theta \text{ if } R_{h,t} \gtreqless R_{h,s} \tag{11}$$

for all s, t. Apparently (11) is a contradiction except in the special case where $R_{h,t}$ takes at most two distinct values. In other words, taxes should typically be age-dependent, as emphasized in a different context by Erosa and Gervais (2002).

2.1.4 In what periods should labor supply be high?

By Equation (9), we have

$$\frac{v_{h,t}}{v_{h,s}} \frac{1+\varphi R_{h,t}}{1+\varphi R_{h,s}} \gtreqless 1 \text{ iff } h_t \gtreqless h_s,$$

and hence

$$h_t \gtreqless h_s \text{ if } w_t - d\eta_t \gtreqless w_s - d\eta_s \beta^{t-s}(1+r)^{(t-s)}. \tag{12}$$

In particular, if $\beta(1+r) = 1$, then

$$h_t \gtreqless h_s \text{ if } w_t - d\eta_t \gtreqless w_s - d\eta_s \tag{13}$$

which means that the agent should work more in those periods when the pre-tax wage net of pre-subsidy daycare costs are higher.

2.1.5 A two-period model with constant taxes

Under what circumstances might optimal fiscal policy involve subsidizing daycare even more than at a level corresponding to making daycare costs tax-deductible? To investigate this question, we consider a two-period model where the representative agent has children in the first but not in the second period. Thus suppose $T = 1$, $\eta_0 > 0$, $\eta_1 = 0$ and $R_{c,t} = R_c$ (e.g. CRRA utility in consumption). Then combining equations (3), (4), (6) and (7) and setting $t = 1$, we have

$$(1-\tau) = \frac{1+\varphi R_{c,1}}{1+\varphi R_{h,1}}$$

and when $t = 0$ we get

$$\frac{(1-\tau)w_0 - (1-\theta)d\eta_0}{w_0 - d\eta_0} = \frac{1+\varphi R_{c,0}}{1+\varphi R_{h,0}}$$

which combined implies that

$$\frac{w_0}{d\eta_0} = \frac{(1-\theta) - \frac{1+\varphi R_{c,0}}{1+\varphi R_{h,0}}}{\frac{1+\varphi R_{c,1}}{1+\varphi R_{h,1}} - \frac{1+\varphi R_{c,0}}{1+\varphi R_{h,0}}}$$

and since $\dfrac{w_0}{d\eta_0} > 1$ we have that

$$(1-\theta) \gtreqless (1-\tau) \text{ if } \frac{1+\varphi R_{c,1}}{1+\varphi R_{h,1}} \gtreqless \frac{1+\varphi R_{c,0}}{1+\varphi R_{h,0}}$$

and since $R_{c,t} = R_c$ we have

$$\theta \gtreqless \tau \text{ if } R_{h,1} \gtreqless R_{h,0}$$

Now suppose R_h is a strictly increasing function of h (which is true if e.g. $v(h) = \ln(1-h)$). Then

$$\theta \gtreqless \tau \text{ if } h_1 \gtreqless h_0. \tag{14}$$

Combining (12) and (14) we have

$$\theta \gtreqless \tau \text{ if } \beta(1+r)w_1 \gtreqless w_0 - d\eta_0.$$

Proposition 2 *If (i)* $R_{c,t} = R_c$ *(e.g. CRRA), and (ii)* $\dfrac{dR_h}{dh} > 0$ *(e.g.* $v(h) = \log(1-h)$*) then* $\theta \gtreqless \tau$ *if* $\beta(1+r)w_1 \gtreqless w_0 - d\eta_0$*. Thus if* $\beta(1+r) = 1$*, then daycare should be subsidized to a greater extent than merely making it tax deductible if wages net of daycare costs are larger in the period without children.*

2.2 A static model with heterogeneous agents

Suppose that there are two agents, a and b, that differ with respect to productivity/wages and number of children; otherwise the notation is as in the previous section. Suppose, to make the problem interesting, that

$$w_a - d\eta_a \neq w_b - d\eta_b$$

and that $w_a - d\eta_a > 0$ and $w_b - d\eta_b > 0$. Suppose further that each agent receives a transfer, x and that

$$x_a + x_b = 0.$$

We need this transfer to disentangle efficiency issues from issues of distribution. The Ramsey government may want to favour one of the agents because she likes him more, and if the only way to do that is to subsidize what he consumes she may do that. This is not an interesting argument for subsidizing daycare. So we allow the government to transfer resources from one agent to the other in a lump-sum fashion and then consider what the optimal policy is when the utility weights of the government are such that it chooses to set the transfer to zero.

The Ramsey government solves

$$\max \varphi_a \left[u(c_a) + v(h_a)\right] + \varphi_b \left[u(c_b) + v(h_b)\right]$$

subject to

$$c_a + c_b = \left(w_a - d\eta_a\right) h_a + \left(w_b - d\eta_b\right) h_b$$

(with Lagrange multiplier μ) and the implementability constraints (with Lagrange multipliers λ_i)

$$u_{c,i}\left(c_i - x_i\right) + v_{h,i}h_i = 0;\ i = a, b$$

where φ_i is the weight placed on agent i, and $\varphi_a + \varphi_b = 1$. The first order conditions are

$$\begin{aligned} u_{c,i}\left[\varphi_i + \lambda_i R_{c,i}\right] - \mu &= 0,\ i = a, b & (15)\\ v_{h,i}\left[\varphi_i + \lambda_i R_{h,i}\right] + \mu\left[w_i - d\eta_i\right] &= 0,\ i = a, b & (16)\\ -\lambda_a u_{c,a} - \lambda_b u_{c,b} &= 0 & (17) \end{aligned}$$

where

$$\begin{aligned} R_c &= 1 + \frac{u_{cc}\left(c - x\right)}{u_c},\\ R_h &= 1 + \frac{v_{hh}h}{v_h}. \end{aligned}$$

Combining the first order condition with respect to consumption and transfers (15 and 17) we have

$$\frac{\varphi_a}{\lambda_a} - \frac{\varphi_b}{\lambda_b} = R_{c,a} - R_{c,b}.$$

Suppose that φ_i is such that $x_i = 0$ and that $\frac{u_{cc,a}c_a}{u_{c,a}} = \frac{u_{cc,b}c_b}{u_{c,b}}$ (e.g. $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$). Then $\varphi_i = \frac{\lambda_i}{\lambda_a + \lambda_b}$. Suppose further that $R_{h,a} = R_{h,b}$ (e.g. $v(h) = -\frac{h^{1+1/\gamma}}{1+1/\gamma}$). Divide the first order condition with respect to hours for the Ramsey government respectively and substitute in $\varphi_i = \frac{\lambda_i}{\lambda_a + \lambda_b}$ and $\frac{\lambda_a}{\lambda_b}$ from (17) we have

$$\frac{v_{h,a}}{v_{h,b}}\frac{u_{c,b}}{u_{c,a}} = \frac{w_a - d\eta_a}{w_b - d\eta_b}. \tag{18}$$

From the first order conditions with respect to hours for the two agents we may derive

$$\frac{v_{h,a}}{v_{h,b}}\frac{u_{c,b}}{u_{c,a}} = \frac{(1-\tau)w_a - (1-\theta)d\eta_a}{(1-\tau)w_b - (1-\theta)d\eta_b}. \tag{19}$$

Comparing (18) and (19) we have the following proposition.

Proposition 3 *Suppose that the weights φ_i placed on agents is such that no transfers are given, $x_i = 0$, $\frac{u_{cc,a}c_a}{u_{c,a}} = \frac{u_{cc,b}c_b}{u_{c,b}}$ (e.g. $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$) and that $R_{h,a} = R_{h,b}$ (e.g. $v(h) = -\frac{h^{1+1/\gamma}}{1+1/\gamma}$) then the Ramsey optimal allocations can be implemented by making daycare costs tax-deductible, i.e. $\tau = \theta$.*

Again, this involves equalizing "wedges"; this time, across individuals.

3 The calibrated model

3.1 Description of the model

Households live for T periods. They work in periods 0, 1, 2, ... R, where $R < T$. There are three types of households: couples, single men and single women.

3.1.1 Singles

Singles choose, at each age s, labor supply h_s and savings a_{s+1} so as to maximize

$$\mathsf{E}\left[\sum_{s=1}^{T}\beta^s u(c_s, \ell_s, \eta_s)\right]$$

subject to

$$a_{s+1} + c_s = ra_s + w_s h_s - \tau(w_s h_s) + a_s - db_s^y h_s + \zeta(\sum_{k=1}^{K} b_{k,s}) + fb_s^y,$$

$$\ell_s = h_s + n_s,$$

$$n_s = \theta^g\left(\sum_{k=1}^{K} b_{k,s}\right)$$

and $a_1 = a_{T+1} = 0$ where

$$\tau(y) = \max\{0, \rho_0(y - \rho_1)\}$$

$$u(c,\ell,\eta) = \eta^{\sigma}\frac{c^{1-\sigma}}{1-\sigma} - \psi_s^g \frac{\ell^{1+1/\varepsilon}}{1+1/\varepsilon}.$$

Here $\eta_s = \eta(b_s)$ is the number of consumption equivalents in the household, c_s is aggregate household consumption, ℓ_s is the total amount of work; h_s is market work and n_s is homework.

The state vector is $x = (s, g, e, t, b)$ where $g \in \{\text{male}, \text{female}\}$ is gender, $e \in \{\text{lo}, \text{hi}\}$ represents education, t represents labor market experience and b is a vector representing the set of children; its kth element represents the number of children of age k; $k \in \{1, 2, \ldots, K\}$. Parental leave benefit per young child is denoted by f and ζ is the child benefit per child. b^y is the number of young children, i.e. children of age 1.

Labor market experience t is a function of past hours worked; $t_s = \varphi(\ell_1, \ell_2, \ldots, \ell_{s-1})$.

The number of consumption equivalents depends on the number of children.

The probability of newborns arriving depends on three things: your age, your gender and the number of children you already have. Thus the vector b evolves according to

$$\mathsf{P}(b_{1,s+1} = j) = p^g_{s,n_s,j}$$

$$b_{i,s+1} = b_{i-1,s}$$

where s is age and $n_s = \sum_{k=1}^{K} b_{k,s}$.

The wage depends on s, e and t; it also depends on marital status, but since we are at the moment only concerned with singles, we suppress that.

$$\ln w = \gamma_0 + \gamma_1 I_{\{g=\text{male}\}} + \gamma_2 I_{\{e=\text{hi}\}} + \gamma_3 t + \gamma_4 s + \gamma_5 s^2$$

3.1.2 Couples

Couples choose female labor supply and savings so as to maximize

$$\mathsf{E}\left[\sum_{s=1}^{T} \beta^t u(c_s, \ell_s^m, \ell_s^f, \eta_s)\right]$$

subject to

$$a_{s+1}+c_s = ra_t+w_s^m\bar{h}_s+w_s^f h_s^f-\widetilde{\tau}(w_s^m\bar{h}_s+w_t^f h_s^f)+a_s-db_s^y\min\{\bar{h}_s,h_s^f\}+\zeta\left(\sum_{k=1}^{K}b_{k,s}\right)+fb_s^y,$$

where

$$\widetilde{\tau}(y)=\max\{0,\rho_0(y-2\rho_1)\}$$

$$u(c,\ell^m,\ell^f,\eta)=\eta^\sigma\frac{c^{1-\sigma}}{1-\sigma}-\psi\frac{(\ell^m)^{1+1/\varepsilon}}{1+1/\varepsilon}-\psi\frac{(\ell^f)^{1+1/\varepsilon}}{1+1/\varepsilon}$$

Total male work equals

$$\ell_s^m=\bar{h}_s+n_s^m$$

and total female work equals

$$\ell_s^f=h_s^f+n_s^f.$$

The homework constraint is

$$n_m+n_f=\theta\eta$$

For simplicity we let male labor supply at age s be exogenously given denoted by $\bar{h}_s$.

The vector b evolves according to

$$\mathsf{P}(b_{1,s+1}=j)=p_{s,n_s,j}$$

$$b_{j,s+1}=b_{j-1,s}$$

where s is age and $n_s=\sum_{k=1}^{K}b_{k,s}$.

The state vector $\widetilde{x}=(s,b,e^m,e^f,t^m,t^f)$ where e^m and e^f represents the education of the man and the woman, respectively, and t^m and t^f are vectors representing labor market experience of the man and the women, respectively.

The wage of each of the partners depends on s, e and t.

$$\ln w^g=\gamma_0+\gamma_1 I_{\{g=\text{male}\}}+\gamma_2 I_{\{e^g=\text{hi}\}}+\gamma_3 t^g+\gamma_4 s+\gamma_5 s^2+\gamma_6+\gamma_7 I_{\{g=\text{male}\}}$$

where γ_6 is the gender-independent cohabitation effect and γ_7 is the male-specific cohabitation effect.

3.2 Calibration

The period length is set to six years.

The parameters are β, d, σ, ρ_0, ρ_1, ζ, f, ε, $\widetilde{\gamma}$, the length of a working life R, the length of an adult life T, the length of childhood K, the probabilities $p^f_{s,i}$, $p^m_{s,i}$, $p_{s,i}$, the labor market experience function φ, and the functions η, θ^m, θ^f, θ and γ.

For all the German data, we use the database (G)SOEP, see `http://www.diw.de`. The birth probabilities are based on the number of young children of living in the same household as a given adult. The functions θ^m, θ^g and θ are based on the number of hours of housework per week reported in 2003 by single males, single females, cohabiting males and cohabiting females, respectively as a function of the number of children in the household. (It is noticeable that single men spend less time on housework than single women.) An adult is counted as cohabiting if (1) he or she is living in the same household as another adult, (2) he or she is one of the two eldest in the household and (3) the other person in that pair is of the opposite sex.

The parameter ε, representing the Frisch elasticity of labor supply, is set to 0.3; see MaCurdy (1981) and Domeij and Flodén (2006). The reciprocal of the intertemporal elasticity of substitution for consumption, σ, is set to 2.

The parameter β is set to 0.97^6 and the interest rate r is set so that the subjective and market discount rates are equal; $r = 1/\beta - 1$.

The labor market experience function φ is chosen so that $t_s = \ell_{s-1}$; this is motivated by the observation that hours worked further in the past (beyond six years ago) appears to have a very small impact on current wages. The vector γ is based on a regression of the log wage on time, age, marital status, education and experience. The wage is defined as the ratio of last six years' labor earnings and last six years' hours worked. Education is represented by a dummy that equals one if the person has 12 years of schooling or more. Specifically, the regression coefficients are $\gamma_1 = 0.1775$ (the male wage premium), $\gamma_2 = 0.1522$ (the education premium), $\gamma_3 = 0.7178$ (the experience

premium), $\gamma_4 = 0.065$ (the age premium), $\gamma_5 = -0.0006$ (the coefficient on age squared), $\gamma_6 = -0.0584$ (the gender-independent cohabitation effect) and, finally , $\gamma_7 = 0.0835$ (the male-specific cohabitation effect). In this version of the paper, however, we save on computational time by ignoring the effects of experience and education, setting the experience and education premiums to zero.

The tax system parameters ρ_0 and ρ_1 are set so as to match the empirical relationship between income earned and taxes paid. Specifically, $\rho_0 = 0.42$ (the marginal income tax rate) and ρ_1 (the basic deduction) is set to a number corresponding to €10000 per year.[6]

The child benefit ζ is set so as to correspond to the legally determined sum of €154 per month and child. The parental leave benefit f is set to correspond to €300 per month and child for two years.

The length of a time period is six years and people are assumed to live for $T = 10$ periods, the last three periods being spent in retirement. We think of the first period of life as age 20-25 years. Children remain children for three periods; $K = 3$, implying that "young" children are in the age range 0-5 years.

Married men's labor supply, $\bar{h}$ is set to approximate the corresponding average in GSOEP, which is about 2100 hours per year.

The parameters ψ_s, the weights on work in the utility functions of married couples, are chosen so as to match average hours worked by married women without children under six in the age ranges 20-43 and 44-61, as shown in Table 1. In order to have as many moments as targets, we only have two values for ψ_s, one for the 20-43 age range and one for the 44-61 age range. The parameters ψ_s^g are set in a similar fashion to match the corresponding facts for single men and women. The parameter d is set to match average hours among married women in the age range 20-43 with children below the age of 6. The resulting value of d corresponds to 20% of the wage of a young woman with no

[6] All €amounts are translated into model terms by using the earnings of a 22.5-year-old single woman with low education and no labor-market experience who works $\bar{h}$. In the data (from 2004) this number is estimated as €9960.

experience. It is worth noting that in the steady-state equilibrium, about 0.60 percent of GNP is spent on daycare; the corresponding number in the data is 0.58 percent.[7] Notice also that single men with children under six work more than their counterparts without small children, and that the reverse is true for single women. The model reproduces these qualitative feature even though they are not calibration targets.

Table 1: Hours per year in the last six years

	Data (2004)		Model	
Ages	20-43	44-61	20-43	44-61
Cohabiting men with children†	2109	—	2108	—
Cohabiting men without children	2107	2036	2108	2036
Single men with children*	2134	—	1720	—
Single men without children	1633	1999	1634	1998
Cohabiting women with children	770	—	769	—
Cohabiting women without children	1333	1260	1334	1262
Single women with children*	923	—	995	—
Single women without children	1304	1421	1304	1420

† A child in this context is one below the age of 6.

*Not a calibration target. *Data source: GSOEP*

3.3 Reforms

We now consider various reforms, all involving daycare subsidies at various rates. The reforms are designed in such a way that those already born at the moment of reform are not affected; they pay the taxes under the old system and get no subsidies. We adopt this

[7] Source: OECD (2006).

approach in order to avoid any issues of intergenerational redistribution. In particular, we want to avoid the result that the initial old and middle-aged lose from the reform simply because they pay for it but get nothing in return. Such a result would not be particularly interesting. We solve for the transition; this is necessary in order to check government budget balance, but in terms of allocations this transition is trivial because of the grandfather clause in our reforms.

3.3.1 Deductibility

We begin by considering a reform that makes childcare expenses tax deductible, or, equivalently, we introduce a 42 percent subsidy of childcare expenses. This reform forces the government to raise the labor tax rate, but by less than half a percentage point. GNP[8] goes up by 0.3% percent. Table 2 shows the welfare effects of the reform, organized by marital status, gender, and the number of children at age 20-25. Table 4 shows the effects on hours worked by marital status, gender and presence (or not) of small (0-6 year-old) children.

3.3.2 Subsidies at Swedish levels

We consider here a policy where 90 percent of daycare costs are covered by the government; this is the current policy in Sweden. Such a policy implies a tax increase from $\rho_0 = 0.42$ to $\rho_0 = 0.43$. The effect on GNP is to increase it by 0.7 percent.

In Table 3, we report the welfare gains exressed as equivalent percentage consumption increases for individuals and couples of age 1 (20-25 years old). We report both uncon-

[8] We use GNP rather than GDP because GDP is not defined. A further sense in which GNP our output measure is perhaps inadequate is that it doesn't include childcare in the home. However, it isn't entirely clear how to measure that. In particular, it isn't clear in the model how many hours are devoted to childcare. All we have assumed is that you have to buy one hour of childcare for every hour that the mother, or the single father works. And even if the number of hours were known, it is not clear at what price to value it. Two alternatives stand out: the (unsubsidized) price of childcare (which is common to everyone in the economy) and the wage of the (lowest-wage) parent (which is idiosyncratic), but it is not obvious which one to choose.

ditional welfare gains and welfare gains conditional on having 0, 1 or 2 children at that age. In Table 5 we report the effects on hours.

3.3.3 A range of reforms

In Figures 2-6, we plot the effects on welfare of various subsidy rates, in each case conditioning on different information. In Figure 2, the welfare measure uses the population-share-weighted sum across all three groups (married, single men, single women) of unconditionally expected utility. In 3 we still use unconditionally expected utility, but look at each group separately. What we see there is that single men would prefer (ex ante) a subsidy rate of about 60 percent, but that the other groups would prefer a subsidy rate of 100 percent (assuming that subsidy rates above 100 percent are infeasible). In the remaining Figures, we report welfare effects conditional on the number of children at age 20-25.

Table 2: Daycare deductibility, equivalent consumption increase

	Married	Single men	Single women
Unconditional	0.3%	0.3%	0.8%
0 children	0.3%	0.2%	0.5%
1 child	0.4%	1.8%	1.7%
2 children	0.2%	2.5%	1.7%

Table 3: 90 percent Daycare subsidy, equivalent consumption increase

	Married	Single men	Single women
Unconditional	0.5%	0.4%	1.5%
0 children	0.4%	0.1%	0.9%
1 child	0.7%	3.6%	3.6%
2 children	0.5%	5.2%	3.5%

Table 4: Daycare deductibility, effects on average labor supply

	Pre-reform		Post-reform	
Ages	20-43	44-61	20-43	44-61
Single men with children*	1720	—	1778	—
Single men without children	1634	1998	1631	1994
Cohabiting women with children	769	—	952	—
Cohabiting women without children	1334	1262	1316	1237
Single women with children*	995	—	1069	—
Single women without children	1304	1420	1298	1411

Table 5: 90 percent subsidy, effects on average labor supply

	Pre-reform		Post-reform	
Ages	20-43	44-61	20-43	44-61
Single men with children*	1720	—	1833	—
Single men without children	1634	1998	1628	1989
Cohabiting women with children	769	—	1162	—
Cohabiting women without children	1334	1262	1291	1204
Single women with children*	995	—	1142	—
Single women without children	1304	1420	1289	1400

4 Concluding remarks

The conclusion from this paper is that sizeable daycare subsidies are optimal in a wide class of economic environments and have substantial benefits from the point of view of an efficient trade-off between leisure and consumption. Our stylized models established a presumption that daycare should be subsidized in an environment where there is a government spending requirement and where lump-sum taxes are ruled out. The key assumptions behind this result were that every hour of work requires an hour of daycare for each small child and that agents differ with respect to productivity and/or the number of children. Under some special assumptions about preferences and the tax system, we were able to prove that the subsidy rate should equal the labor tax rate, thus equalizing the ratio of private to social returns to working across agents. An equivalent policy would be to let daycare expenses be tax deductible.

When we consider a more fully-fledged model, calibrated to capture some important facts on labor supply in Germany, we find that expanding the availability of highly subsidized childcare slots would be a good idea. Indeed, we find that it should be subsidized at an even higher level than the labor tax rate. Single women would benefit the most from such a reform, but married couples and even single men would benefit, too. Moreover, the effects on the labor supply of mothers with small children would be large, making German mothers behave more like Scandinavian ones.

In our analysis we have not considered the possible effects of daycare on child welfare and development. It is an open question whether taking these effects into account would weaken or strengthen our results. There is some evidence that daycare has a positive effect on child development and parental welfare (see OECD (2006)). If we trust this evidence, then our assessment of the benefits of daycare subsidies are conservative. On the other hand, Baker et al. (2005) find some contrary evidence from the province of Québec, so that issue remains unsettled. Either way, there is a strong efficiency case to be made for daycare subsidies that must be weighed against any other possible effects.

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Figure 1: Income earned and taxes paid, couples, 2004. Source: GSOEP.

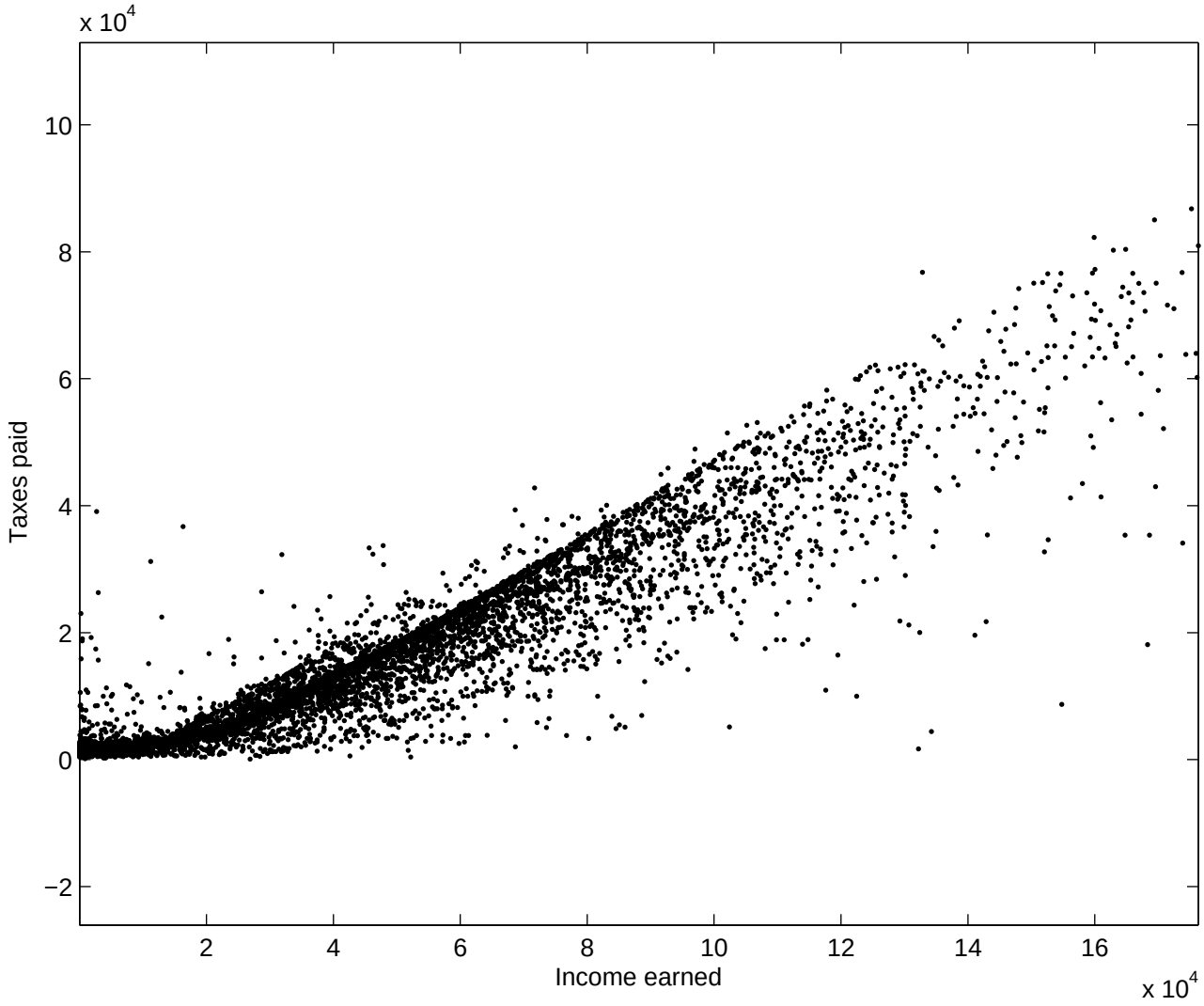

Figure 2: Ex ante welfare gains

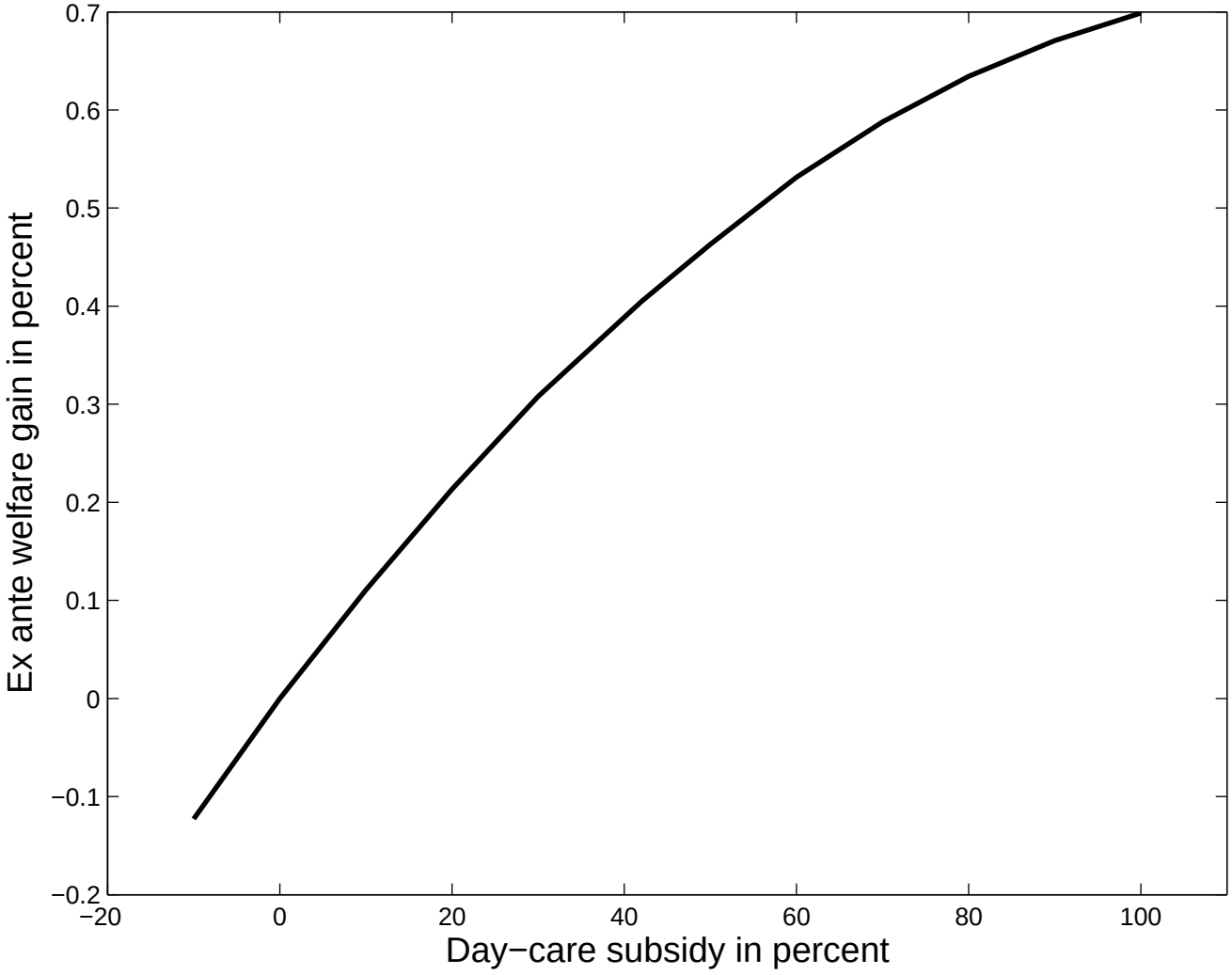

Figure 3: Average welfare gains by marital status and gender

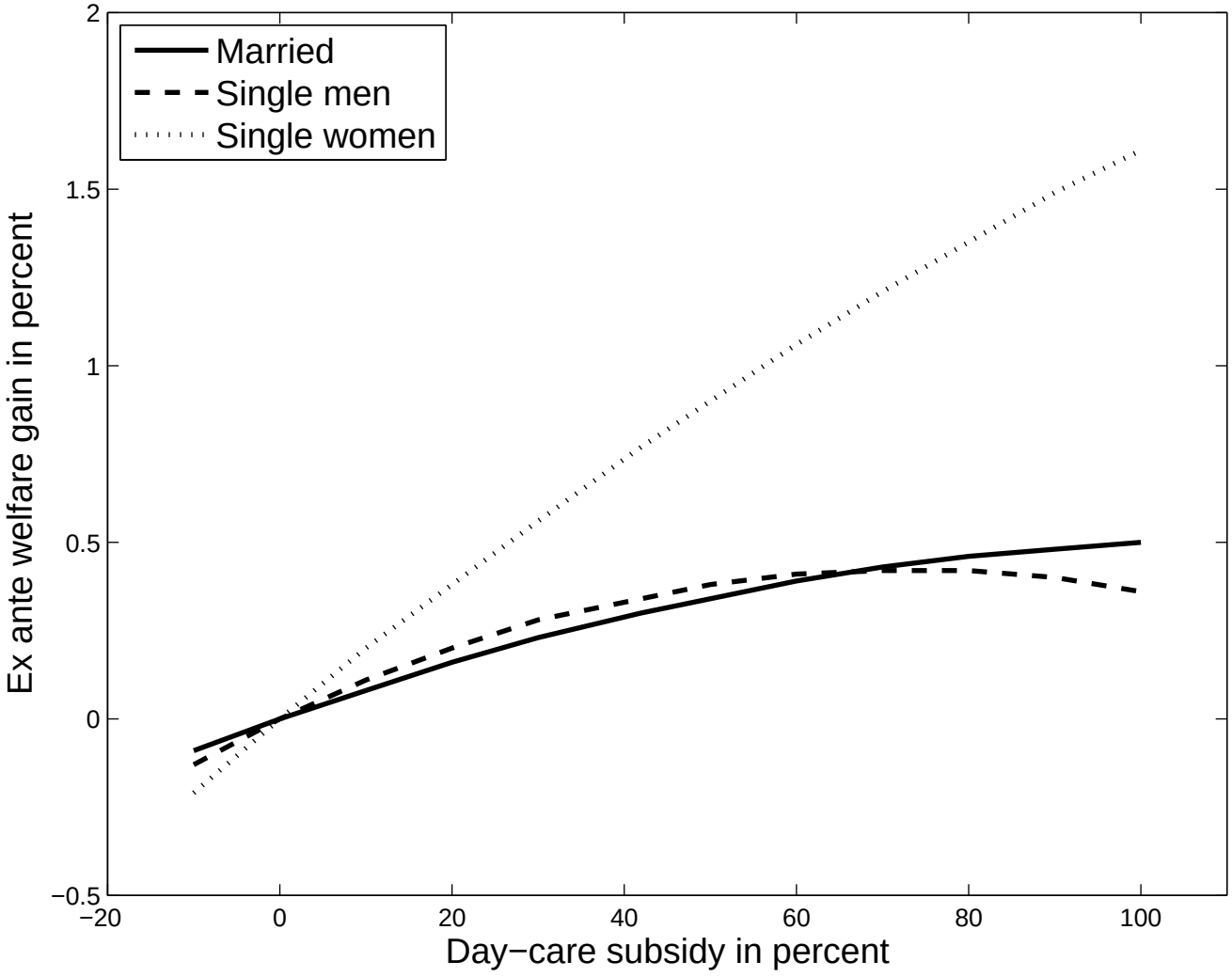

Figure 4: Average welfare gains by initial number of children: married couples

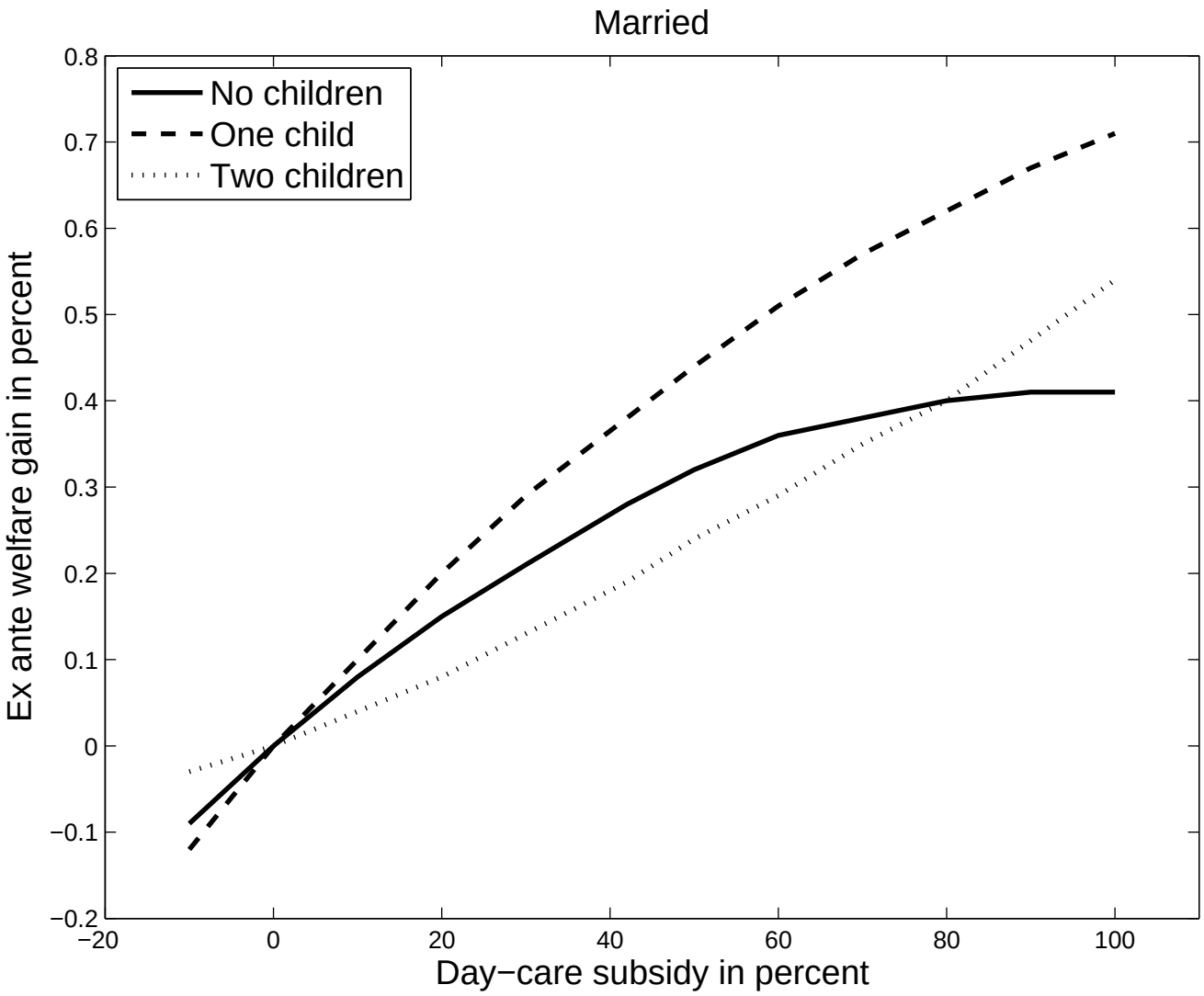

Figure 5: Average welfare gains by initial number of children: single men

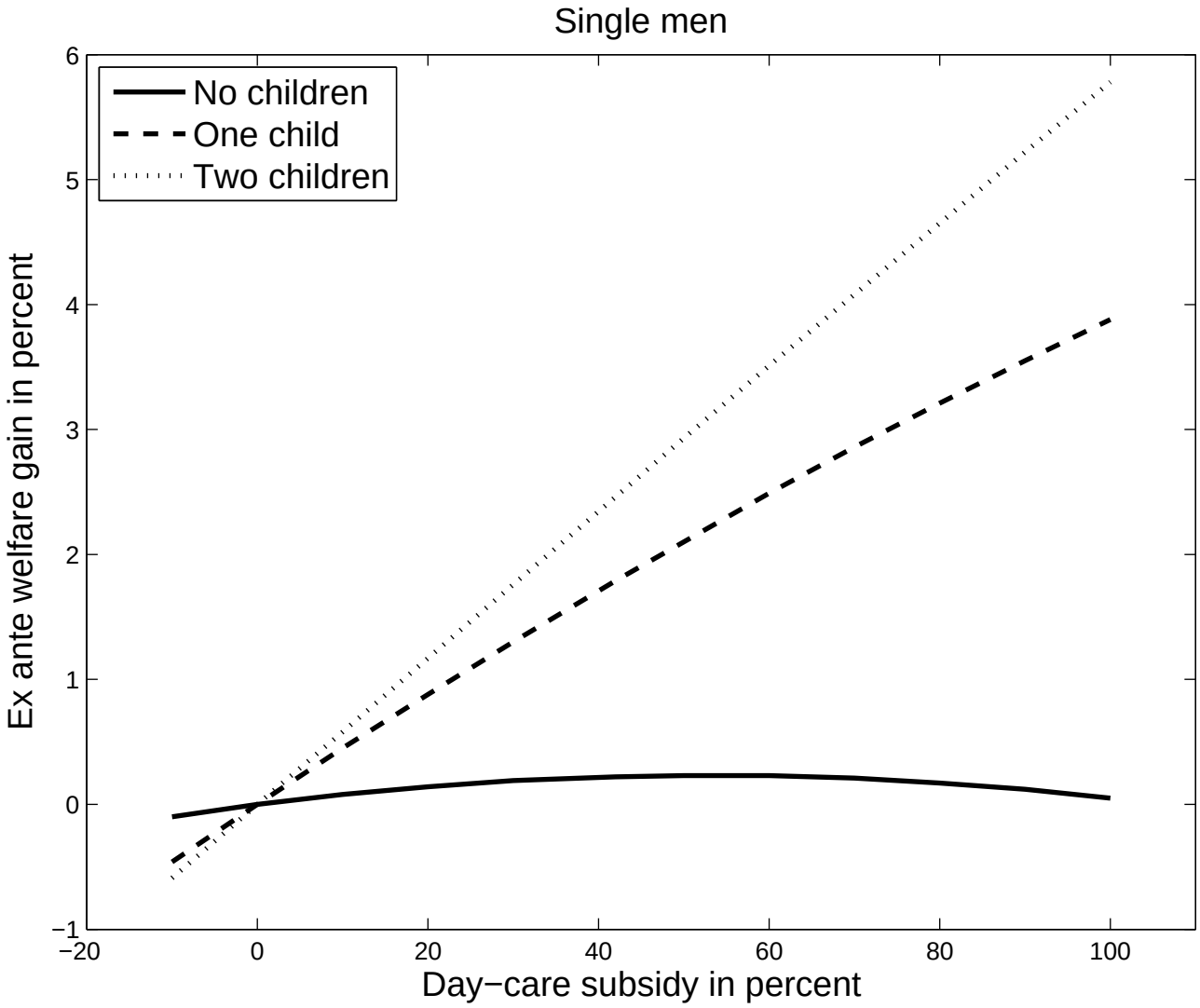

Figure 6: Average welfare gains by initial number of children: single women