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Swedish Family Policy, Fertility and Female Wages

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Abstract

Recent demographic literature shows in Swedish micro-level data a positive effect of female wage income or female education on fertility. The literature explains this finding with Swedish family policies of high subsidies for bought-in child care and generous parental leave benefits that are calculated on the basis of a woman's prior wage income. Both policies would cause the substitution effect from an increase in female wages on fertility to be dominated by its income effect. This paper shows within an economic model that there are offsetting effects from Swedish family policy that cause the reduction in the magnitude of the substitution effect of female wages to be most likely rather small.

Keywords: Fertility; family policy; gender equality.

JEL-classification: H31; H53; J13; J18.

1 Introduction

Since the 1960s the fertility rate (TFR) declined in OECD countries enormously and threatens the future sustainability of the public pension system. At the same time the female labour force participation rate (FLP) rose in OECD countries. Galor and Weil (1996) present a general equilibrium model in which an endogenously rising relative wage of women leads simultaneously

to a decline in the TFR and a rise in the FLP. However, surprisingly since the late 1980s the OECD countries with the highest TFRs are also the OECD countries with the highest FLPs. Among others, Esping-Anderson (1999), Ahn and Mira (2002), Rindfuss et al. (2003), and Apps and Rees (2004) have shown that the cross-country correlation between the TFR and the FLP turned from a negative value before the late 1980s to a positive value thereafter. To explain this reversal, Apps and Rees (2004) introduce to the aforementioned model of Galor and Weil subsidies for bought-in child care, cash payments per child, and joint taxation of family income or taxation of each individual's income. They show that countries with subsidies for bought-in child care rather than cash payments per child and individual rather than joint taxation are likely to have both, a higher TFR and a higher FLP.^{1,2}

In Apps and Rees (2004) public policies only have a direct effect on fertility. The authors still maintain the common assumption in economics that the female wage has a negative effect on fertility. Recently, demographers went further than Apps and Rees. Various recent studies by demographers show in Swedish micro-level data that female wage income or female education surprisingly have a positive effect on fertility, in particular on second and third order births.³ The demographic literature explains this finding with Swedish family policies of high subsidies for bought-in child care and generous parental leave benefits that are calculated on the basis of a woman's prior wage income (henceforth income-replacement based parental leave ben-

¹See Kögel (2006) for empirical evidence that cross-country differences in use of bought-in child care contribute to the positive cross-country correlation between the TFR and the FLP across Western European countries.

²Martinez and Iza (2004) show model-theoretically that a positive association between the TFR and the FLP can also be produced with a rising relative wage of skilled labour, because bought-in child care is intensively produced with unskilled female labour. However, while a rising relative wage of skilled labour can be observed in the US and the UK, the Western European countries with the highest TFRs and the highest FLPs, namely Nordic countries and France, do not have a rising relative wage of skilled labour. In addition, Da Rocha and Fuster (2006) show model-theoretically that cross-country differences in unemployment rates can also produce a positive association between the TFR and the FLP across OECD countries (see Ahn and Mira, 2002, Adsera, 2005, and Kögel, 2006, for empirical evidence).

³The earliest studies that found a positive effect of female wage income in Sweden were Andersson (2000) and Hoem (2000). The positive effect is shown to persist after controlling for the male partners wage income in Duvander and Andersson (2003) and Andersson et al. (2005). A positive effect of female education was found in Hoem and Hoem (1989), Hoem (1996), Berinde (1999), and Olah (2003).

efits). It is argued that both policies would cause the substitution effect from an increase in female wages on fertility to be dominated by its income effect. The logic behind this explanation follows a model of Ermisch (1989), who shows that the possibility of bought-in child care reduces the effect of female wages on fertility. He shows that women with high wage income can afford more bought-in child care and that this reduces the magnitude of the substitution effect for these women.⁴ The demographic literature argues that Swedish family policy would, similarly to the presence of child care in Ermisch's model, reduce the magnitude of the substitution effect in Sweden. The present study examines whether this presumption can be confirmed in an economic model similarly to the models of Ermisch and Apps and Rees.

The empirical result of a positive effect of female wage income or female education has recently also been found in Norwegian and Finish micro-level data.⁵ Norway and Finland have both similar generous income-replacement parental-leave systems as Sweden (see Bruning and Plantenga, 1999). However, while the governments in both countries provide more extensive child care subsidies than other industrialised countries, the child care system is not as generous as in Sweden (see Björklund, 2006, p. 8). In addition, Finland and recently also Norway introduced also child home care allowances for families that decide to rear their children at home after a shorter parental leave instead of to use public day care places. This policy was not implemented in Sweden, because in Sweden it is believed that a child home care allowances could trap women permanently out of the labour force (see Hoem, 2005, p. 570). Because of these differences in family policy, one would, contrary to the empirical findings in the literature, expect somewhat weaker evidence for a positive effect of female wage income or female education on fertility in Norway and Finland than in Sweden. The positive effect from female wage income or female education on fertility has also been found in French, British and West German micro-level data.⁶ This is very surprisingly, as

⁴Ermisch (1989) shows also empirical support for this result in British micro-level data.

⁵Evidence for a positive effect of female education on third order births has been found in Norwegian micro-level data by Kravdal (1992). In Finish micro-level data evidence for a positive effect of female wage income on first order births has been found by Vikat (2004).

⁶Köppen (2004) finds a significant and positive effect of female education on second order births in French micro-level data even after controlling for the male partners characteristics. In contrast, after controlling for the male partners education the effect of female education was insignificant and positive in West German micro-level data. The latter result for West Germany was first found in Kreyenfeld (2001). Kreyenfeld and Zabel (2005) find after controlling for the male partners education, the female employment status, and

these countries' family policies differ substantial from Swedish family policy, even more than those in other Nordic countries than Sweden. Hence, the latter empirical results could be interpreted as evidence for an alternative explanation given by Kravdal (2001), who argues that the positive effect of female education on third order births represents a selection effect, as well educated women who already have two children are a select group with high preference for children. Kravdal finds evidence for his argument in Norwegian micro-level data by showing that the effect of female education on third order births becomes negative and significant, once he estimates the transitions to first, second, and third child simultaneously and adds a common unobserved heterogeneity factor (which is supposed to capture the selection effect).^{7,8}

This paper shows within an economic model similarly to the models of Apps and Rees (2004) and Ermisch (1989) that there are offsetting effects from Swedish family policy that cause the reduction of the substitution effect from an increase in female wages on fertility to be most likely rather small. It is shown that child care subsidies only unambiguously reduce the magnitude of the substitution effect at the micro-level, if bought-in child care and domestic child care are *strong* substitutes. In contrast, income-replacement based parental leave benefits only unambiguously reduce the magnitude of the substitution effect, if bought-in child care and domestic child care are *weak* substitutes. At the macro-level the extent of substitutability between bought-in child care and domestic child care is irrelevant and child care subsidies and income-replacement based parental leave benefits reduce both unambiguously the magnitude of the substitution effect. However, for each

female wage income a significant and positive effect of female education on second order births in West German micro-level data. With the same control variables the authors find an insignificant and positive effect of female education on second order births in British micro-level data.

⁷Kreyenfeld (2001) shows the same result for West German micro-level data, using the same estimation method as Kravdal.

⁸Another problem of the demographic literature is the fact that the underlying economic models predict an effect from the *hourly* female wage rate instead of from the *annual* female wage income, which the demographic literature uses because of unavailability of better micro-level data. Using data of hourly female wage rates, Heckman and Walker (1990) find a negative and significant effect of female wages on fertility in Swedish micro-level data. However, Tasiran (1995, 2002) and Walker (2002) disagree on whether or not the significance of female wage rates is sensitive to Heckman and Walker's approximation of micro-level wage data with macro-level wage data.

family policy the reduction in the magnitude of the substitution effect is at the macro-level always smaller than at the micro-level, if the substitutability between bought-in child care and domestic child care is such that the effect at the micro-level is unambiguous. In addition, the magnitude of the substitution effect itself is at the macro-level larger than at the micro level. The bottom line of this is that Swedish public policy probably has a positive direct effect on the TFR and the FLP, as shown model-theoretically by Apps and Rees (2004). However, demographers most likely went too far in arguing that Swedish family policy also reversed the sign of the effect of female wages on fertility from a negative to a positive value.

The model in the next section is static, similarly to the models of Apps and Rees (2004) and Ermisch (1989). Hence, the model does not capture an effect of the Swedish parental leave benefits system that Andersson (2005) argues to be relevant and important. He stresses that due to the fact that parental leave benefits are calculated on the basis of a woman's prior wage income, the Swedish parental leave system gives women an incentive to wait with childbearing until they are established on the labour market with a decent level of income. Only this would make them eligible for high parental leave benefits. He argues this incentive would explain the finding of a positive effect of female wage income on fertility. The fact that the next section's model abstracts from this effect can be justified with the following argument: The incentive effect stressed by Andersson does not imply that Swedish women choose a high pay occupation, only in order to receive high parental leave benefits. Hence, it does not imply that high wage-type of women have more children than low wage-type of women nor that an increase in the aggregate female wage would cause an increased aggregate quantity of fertility. Instead it only implies, as argued by Björklund (2006), that Swedish women might *postpone* childbearing until they are established on the labour market. However, evidently postponement of childbearing did not reduce the Swedish aggregate quantity of fertility, as Swedish women successfully "recuperated" with increased fertility at higher age for fertility forgone at earlier age (cf. Lesthaeghe and Moors, 2000).⁹ For this reason, a dynamic model with the

⁹Postponement of childbearing did however reduce the TFR temporarily, because it led to a "tempo effect" that distorted downward the TFR as a measure of aggregate quantity of fertility (see Bongaarts and Feeney, 1988). Nevertheless, this distortion will only have been temporarily (see Sobotka, 2004) and, as is well known, even the downward distorted Swedish TFR was in the 1990s high relative to the downward distorted TFR of other Western European countries. In addition, the Swedish average TFR between 1995-

possibility to examine changes in age of childbearing as, e.g., the model by Walker (1995), while richer, would not improve the understanding of the effect of Swedish policy on the quantity of fertility of high wage-type of women in comparison to low wage-type of women nor its influence on the effect of an increase in the aggregate female wage on aggregate quantity of fertility. To make his model tractable, Walker assumes in his dynamic model fixed-coefficient technologies in the “production” of children to eliminate many substitution possibilities. However, these substitution possibilities will turn out to drive the results for the next section’s model. For this reason, the next section’s model abstracts from dynamics of childbearing age in order to examine the effect of various substitution possibilities.

2 The Model

In the following model each household consists of a man and a women. Each man supplies inelastically one unit time to the labour market, while each women allocates one unit time between labour market participation and provision of domestic child care during parental leave. Home-centered women, who provide domestic child care outside parental leave, are for simplicity ignored. This seems not to be a problematic assumption, as in 1990 the labour force participation rate of Swedish women of age 25-44 was about 90 % (see Apps and Rees, 2004, Table 1). In the macroeconomy there is a single consumption good. Following Galor and Weil (1986) and Apps and Rees (2004) and without any influence on the qualitative model results, I assume the household utility function to be a Cobb-Douglas function as shown in (1.1) in Table 1 (see the notations of the variables below the table). I also follow these authors in abstracting from quality of children. All equations in the model (except if indicated otherwise) can either refer to an individual household at the micro-level, where a household index is omitted for simplicity, or to a representative household at the macro-level. In case of a macro-level interpretation, the number of households is normalized to one.

In the first-stage-optimisation problem each household maximises (1.1) subject to the first-stage-budget constraint (1.2) in Table 1. The left hand side of (1.2) represents each household’s full-income, that is, the income that

2000 adjusted for this tempo distortion with a method of Bongaarts and Feeney (1988) was higher than the TFR between 1995-2000 of most other Western European countries adjusted for this tempo distortion with to the same method (cf. Sobotka, 2004).

Table 1: Model assumptions

Household utility function	$U = \gamma \ln n + (1 - \gamma) \ln c,$	(1.1)
First-stage-budget constraint	$w_m + w_f - T = p_n n + c,$	(1.2)
Child production function	$n = \left(x_z^{\frac{\theta-1}{\theta}} + x_c^{\frac{\theta-1}{\theta}} \right)^{\frac{\theta}{\theta-1}}, \theta > 0,$	(1.3)
Second-stage-budget constraint	$p_n n = p_{x_z} x_z + x_c,$	(1.4)
Child care production function	$x_z = \left(z_f^{\frac{\varepsilon-1}{\varepsilon}} + s^{\frac{\varepsilon-1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon-1}}, \varepsilon > 0,$	(1.5)
Third-stage-budget constraint	$p_{x_z} x_z = w_f (1 - \rho) z_f + p_s s,$	(1.6)
$p_s = (1 - \sigma) K \Rightarrow \frac{\partial p_s}{\partial w_f} \frac{w_f}{p_s} = 0,$	at the micro-level,	(1.7)
$p_s = (1 - \sigma) \delta w_f \Rightarrow \frac{\partial p_s}{\partial w_f} \frac{w_f}{p_s} = 1,$	at the macro-level,	(1.8)

Notation: U_t :household utility, n :number of children, c :household consumption, γ : constant parameter, w_m :male wage, w_f :female wage, T :lump-sum tax, p_n :price index of children, x_z :composite of child care, x_c :quantity of the consumption good used in the production of children, θ :elasticity of substitution between the composite of child care and the consumption good in the production of children, p_{x_z} :price index of child care, z_f :quantity of domestic child care, s :quantity of bought-in child care, ε : elasticity of substitution between bought-in child care and domestic child care, ρ :income-replacement rate of parental leave benefits p_s : price of bought-in child care, σ : child care subsidy, K :a constant, δ :female labour unit requirement in production of bought-in child care.

each couple would receive, if it supplied all its time endowments to the labour market. The price of the consumption good is normalized to one. The first-stage-optimisation problem gives rise to the demand of children as shown in (2.1) in Table 2. It should be noted that it is for simplicity assumed that child care subsidies and parental leave benefits are financed with a lump-sum tax T . This allows to abstract from feedback effects on fertility from wage income taxation to finance family policy. Apps and Rees (2004) show that a negative effect on fertility from wage income taxation to finance cash payments per child does not dominate the effects from the cash payments per child itself, if the elasticity of domestic child care with respect to the wage income tax rate to finance the cash payments is relatively small. The latter is in Sweden fulfilled because the share of expenditures for family cash benefits and family services, such as child care subsidies, in total governments expenditures is even in Sweden relatively small.¹⁰

¹⁰In Sweden the share of expenditures for family benefits in GDP in 1995 was 3.85%

Table 2: Results from household optimisation problems

Demand for children	$n = p_n^{-1} \gamma (w_m + w_f - T),$	(2.1)
Price index of children	$p_n = (p_{x_z}^{1-\theta} + 1)^{\frac{1}{1-\theta}},$	(2.2)
Budget share of child care	$\frac{p_{x_z} x_z}{p_n n} = \frac{p_{x_z}^{1-\theta}}{p_{x_z}^{1-\theta} + 1},$	(2.3)
Price index of child care	$p_{x_z} = \{ [w_f (1 - \rho)]^{1-\varepsilon} + [p_S]^{1-\varepsilon} \}^{\frac{1}{1-\varepsilon}},$	(2.4)
Budget share of domestic child care	$\frac{w_f (1-\rho) z_f}{p_{x_z} x_z} = \frac{[w_f (1-\rho)]^{1-\varepsilon}}{[w_f (1-\rho)]^{1-\varepsilon} + [p_S]^{1-\varepsilon}}.$	(2.5)
Budget share of bought-in child care	$\frac{p_S s}{p_{x_z} x_z} = \frac{[p_S]^{1-\varepsilon}}{[w_f (1-\rho)]^{1-\varepsilon} + [p_S]^{1-\varepsilon}}.$	(2.6)

Following Ermisch (1989) children are “produced” by combining input of a composite of child care and input of the consumption good. In order to derive closed form solutions, the “children production function” is assumed to be a CES function. In the second-stage-optimisation problem each household maximises (1.3) subject to the second-stage-budget constraint (1.4) in Table 1. Table 2 shows the resulting price index of children (2.2) and the resulting share of total child care cost in total expenditures for children (2.3). The appendix contains a derivation of (2.2) and (2.3).¹¹ For the “children production function” the following undoubtedly realistic assumption is made:

Assumption 1: $\theta < 1$ (i.e. child care and the consumption good are weak substitutes in the production of children).

Following Apps and Rees and Ermisch, child care is produced by combining domestic child care with bought-in child care. In order to derive closed form solutions, also the “child care production function” is assumed to be a CES function. For simplicity it is abstracted from discrete choice of female labour market participation. In the third-stage-optimisation problem each household maximises (1.5) subject to the third-stage-budget constraint (1.6)

- 2.13 % for family cash benefits, such as parental leave benefits, and 1.72 % for family services, such as child care subsidies - (data source: Country report for Sweden in "International Reform Monitor" in Bertelsmann Foundation, 2006). In the same year, Sweden's share of total government expenditures in GDP was 67.7 % (data source: "Economic Freedom of the World: 1997 Annual report" in Fraser Institute, 1997). Hence, in Sweden in 1995 the share of expenditures for family policy in total governments expenditures was with 5.69 % relatively small.

¹¹If we had assumed the consumption good price to equal $p_c \neq 1$, then we would have had $p_n = (p_{x_z}^{1-\theta} + p_c^{1-\theta})^{\frac{1}{1-\theta}}$ instead of (2.2).

in Table 1. Table 2 shows the resulting price index of the composite of child care (2.4) and the resulting budget share of domestic child care in total child care cost (2.5), respectively, the resulting budget share of bought-in child care in total child care cost (2.6). The derivation of (2.4)-(2.6) is similar to the derivation of (2.2) and (2.3), which - as was already mentioned - is shown in the appendix. In Sweden parents are entitled to 360 days per child of income-replacement based parental leave benefits. Of these 360 days one parent, mostly the mother, is entitled to 330 days at most, while 30 days are reserved for the other parent if used. Parents are additionally entitled to 90 days parental leave with at fixed rate of 60 SEK (about 6.7 EUR) per day. Swedish mothers who were entitled to parental leave in 1993-1998 took on average slightly more than 40 weeks parental leave with a single peaked distribution over all women of the chosen duration of parental leave (Swedish fathers took on average about 4 weeks parentel leave during this time period). By far most women did not take more than the maximum of 330 days, for which they were entitled to income-replacement based parental leave benefits.¹² For this reason, in the third-stage-budget constraint (1.6) in Table 1, the possibility to take parental leave after 330 days is for simplicity ignored. Instead, it is assumed that income-replacement based parental leave benefits reduce for all women the opportunity cost from foregone female wage income by the rate ρ .¹³

Finally, in Table 1 eq. (1.7), respectively, eq. (1.8) show the determinants of the price of bought-in child care and an elasticity of the change of the price of bought-in child care from an increase in the female wage at the micro-level, respectively, at the macro-level. Obviously, in both cases the price of bought-in child care is decreasing in the child care subsidy. Also crucial for the results of the present study, (1.7) shows that the price of bought-in child care is at the micro-level given for each woman, implying that a rise of a woman's wage has no effect on the price of bought-in childcare. As a consequence, women with different wages pay the same price of bought-in child care and

¹²The source of the mentioned institutional details of the Swedish parental leave system is Pylkkänen and Smith (2003).

¹³After 1980 in Sweden ρ had a value of 90 % (cf. Gustafsson and Stafford, 1995, p. 168). In the 1990s it has been reduced to its current value of 80 %, while it was in a temporary interim period 75 % (cf. Andersson et al., 2004, p. 407). Hoem and Hoem (1996, 1999) and Andersson (1999) argue that the reduction of ρ and simultaneous reductions in the levels of child care allowances were responsible for some of a decline of Swedens TFR in the 1990s.

the higher the wage of a woman, the more bought-in child care the woman can afford.¹⁴ In contrast, (1.8) shows that at the macro-level an increase in the female wage increases the price for bought-in child care. Without any influence on the qualitative model results, following Martinez and Iza (2004), it is for simplicity assumed that female labour is the only input into the production of bought-in child care. For this reason, an increase in the aggregate female wage leads to an increase in the price for bought-in child care by the same proportion. This implies that at the macro-level bought-in child care does not become more affordable, as the aggregate female wage increases. Note also, that assuming government investment in availability of affordable child care instead of child care subsidies would give the same qualitative model results.

3 Results

This section examines the interaction effects between Swedish family policy and the effect of female wages on fertility. For this reason, it is first necessary to derive a mathematical expression for the effect of female wages on fertility. From (2.1) in Table 2 one can calculate the elasticity $(\partial n / \partial w_f) (w_f / n)$ as

$$\frac{\partial n}{\partial w_f} \frac{w_f}{n} = \frac{w_f}{w_m + w_f - T} - \frac{\partial p_n}{\partial w_f} \frac{w_f}{p_n}, \quad (1)$$

where the first term on the right hand side of (1) is the income effect from a rise in the female wage, while the second term on the right hand side is its substitution effect. From (2.2) and use of (2.3) in Table 2 one can calculate the substitution effect $(\partial p_n / \partial w_f) (w_f / p_n)$ as

$$\frac{\partial p_n}{\partial w_f} \frac{w_f}{p_n} = \left(\frac{p_{x_z} x_z}{p_n n} \right) \frac{\partial p_{x_z}}{\partial w_f} \frac{w_f}{p_{x_z}}. \quad (2)$$

¹⁴In reality, in Sweden the lowest income families pay child care fees of only 3-4 % of the total cost of child care, while families at the highest income levels pay fees of up to 40 % of the total cost (cf. Gustafsson and Stafford, 1995, p. 168). Following Apps and Rees, this feature is for simplicity ignored in the model, as it would only strengthen the model result of a weak reduction of the magnitude of the substitution effect from Swedish family policy. In addition, for a child to get a child care place in Sweden each parent must at least participate 20 hours per week in the labour market or spend this time studying (cf. Gustafsson and Stafford, 1995, p. 167). In the model home-centered women are ignored. Nevertheless, this policy might to a slight extent offset the effect from lower child care fees for lower income families.

From (2.4) and use of (2.5), and (2.6) in Table 2 one can calculate the elasticity $(\partial p_{x_z}/\partial w_f)(w_f/p_{x_z})$ as:

$$\frac{\partial p_{x_z}}{\partial w_f} \frac{w_f}{p_{x_z}} = \frac{w_f(1-\rho)z_f}{p_{x_z}x_z} + \left(\frac{p_s s}{p_{x_z}x_z}\right) \frac{\partial p_s}{\partial w_f} \frac{w_f}{p_s}. \quad (3)$$

Combining (1)-(3) yields

$$\frac{\partial n}{\partial w_f} \frac{w_f}{n} = \frac{w_f}{w_m + w_f - T} - \left(\frac{p_{x_z}x_z}{p_n n}\right) \left[\frac{w_f(1-\rho)z_f}{p_{x_z}x_z} + \left(\frac{p_s s}{p_{x_z}x_z}\right) \frac{\partial p_s}{\partial w_f} \frac{w_f}{p_s} \right]. \quad (4)$$

Finally, using in (4), (1.7), and (1.8) in Table 1 gives

$$\frac{\partial n}{\partial w_f} \frac{w_f}{n} = \frac{w_f}{w_m + w_f - T} - \left(\frac{p_{x_z}x_z}{p_n n}\right) \left(\frac{w_f(1-\rho)z_f}{p_{x_z}x_z}\right), \text{ at the micro-level,} \quad (5)$$

$$\frac{\partial n}{\partial w_f} \frac{w_f}{n} = \frac{w_f}{w_m + w_f - T} - \left(\frac{p_{x_z}x_z}{p_n n}\right), \text{ at the macro-level.} \quad (6)$$

Eq. (5) shows that, at the micro-level, the magnitude of the substitution effect of an increase in the female wage on fertility (henceforth the magnitude of the substitution effect) equals the product of the share of total child care cost in total expenditures for children and the budget share of domestic child care in total child care cost. Eq. (6) shows that, at the macro-level, the magnitude of the substitution effect equals only the share of total child care cost in total expenditures for children. Hence, it is independent of the budget share of domestic child care in total child care cost. This is due to the fact that provision of bought-in child care requires input of female labour. As a consequence, an increase in the aggregate female wage increases not only the opportunity cost of domestic child care, but also the price of bought-in child care.¹⁵ As a consequence, at the macro-level the magnitude of the substitution effect depends on the sum of the budget share of domestic child

¹⁵Ermisch (2003, Ch. 6) also argues in a discussion of the model of Ermisch (1989) that, at the macro-level over time, an increase in the female wage increases the price of bought-in child care and hence does not make bought-in child care relatively more affordable than domestic child care. It should be noted, however, that this holds not only at the macro-level *over time*, but also at the macro-level *across countries*.

care in total child care cost and the budget share of bought-in child care in total child care cost, which of course equals one. Since the budget share of domestic child care in total child care cost is smaller than one, this implies:

Proposition 1. *The magnitude of the substitution effect of an increase in the female wage on fertility is at the macro-level larger than at the micro level. Hence, at the macro-level a positive effect of the female wage on fertility is less likely than at the micro-level.*

Next, it is examined whether or not a child care subsidy reduces the magnitude of the substitution effect. If so, then this would make it more likely that there is a positive sign of the expressions on the right hand sides of (5) and (6). This would contribute to a theoretical explanation of the empirical finding of a positive effect of female wages on fertility in Swedish micro-level data. For the absolute value of the substitution effect in (5), $|SE|$, one can calculate upon use of (2.3), (2.5), and (2.6) in Table 2

$$\begin{aligned} \frac{\partial |SE|}{\partial \sigma} \frac{\sigma}{|SE|} &= (1 - \theta) \left(\frac{x_c}{p_n n} \right) \frac{\partial p_{x_z}}{\partial \sigma} \frac{\sigma}{p_{x_z}} \\ &\quad - (1 - \varepsilon) \left(\frac{p_s s}{p_{x_z} x_z} \right) \frac{\partial p_s}{\partial \sigma} \frac{\sigma}{p_s}, \text{ at the micro-level.} \end{aligned} \quad (7)$$

From (2.4) and use of (2.6) in Table 2 follows

$$\frac{\partial p_{x_z}}{\partial \sigma} \frac{\sigma}{p_{x_z}} = \left(\frac{p_s s}{p_{x_z} x_z} \right) \frac{\partial p_s}{\partial \sigma} \frac{\sigma}{p_s}, \quad (8)$$

while from (1.7) in Table 1 follows

$$\frac{\partial p_s}{\partial \sigma} \frac{\sigma}{p_s} = - \left(\frac{\sigma}{1 - \sigma} \right). \quad (9)$$

Combining (7)-(9) gives

$$\begin{aligned} \frac{\partial |SE|}{\partial \sigma} \frac{\sigma}{|SE|} &= -(1 - \theta) \left(\frac{x_c}{p_n n} \right) \left(\frac{\sigma}{1 - \sigma} \right) \\ &\quad + (1 - \varepsilon) \left(\frac{p_s s}{p_{x_z} x_z} \right) \left(\frac{\sigma}{1 - \sigma} \right), \text{ at the micro-level.} \end{aligned} \quad (10)$$

Since according to Assumption 1, $\theta < 1$, the right hand side of (10) is unambiguously negative if $\varepsilon \geq 1$. However, the sign of the right hand side is ambiguous if $\varepsilon < 1$. This gives rise to the following proposition:

Proposition 2. *Provided fulfillment of Assumption 1, at the micro-level, a child care subsidy unambiguously reduces the magnitude of the substitution effect if $\varepsilon \geq 1$ (i.e. if bought-in child care and domestic child care are strong substitutes). It has an ambiguous effect on the magnitude of the substitution effect if $\varepsilon < 1$ (i.e. if bought-in child care and domestic child care are weak substitutes).*

For the absolute value of the substitution effect in (6), one can calculate upon use of (2.3) in Table 2

$$\frac{\partial |SE|}{\partial \sigma} \frac{\sigma}{|SE|} = (1 - \theta) \left(\frac{x_c}{p_n n} \right) \frac{\partial p_{x_z}}{\partial \sigma} \frac{\sigma}{p_{x_z}}, \text{ at the macro-level.} \quad (11)$$

Combining (11) with (8) and (9) yields

$$\frac{\partial |SE|}{\partial \sigma} \frac{\sigma}{|SE|} = - (1 - \theta) \left(\frac{x_c}{p_n n} \right) \left(\frac{\sigma}{1 - \sigma} \right), \text{ at the macro-level.} \quad (12)$$

Since the right hand side of (12) is unambiguously negative for $\theta < 1$, this and a comparison of (12) with (10) gives the following proposition:

Proposition 3. *Provided fulfillment of Assumption 1, at the macro-level, a child care subsidy unambiguously reduces the magnitude of the substitution effect. However, the reduction is at the macro-level smaller than at the micro-level if $\varepsilon \geq 1$ (i.e. if a child care subsidy unambiguously reduces the magnitude of the substitution effect at the micro-level).*

Next, it is examined whether or not income-replacement based parental leave benefits reduce the magnitude of the substitution effect. Again, this affects the likelihood of a positive sign of the expressions on the right hand sides of (5) and (6). Again, this could contribute to a theoretical explanation of the empirical finding of a positive effect of female wages on fertility in Swedish micro-level data. For the absolute value of the substitution effect in (5), one can calculate again upon use of (2.3), (2.5), and (2.6) in Table 2

$$\begin{aligned} \frac{\partial |SE|}{\partial \rho} \frac{\rho}{|SE|} &= (1 - \theta) \left(\frac{x_c}{p_n n} \right) \frac{\partial p_{x_z}}{\partial \rho} \frac{\rho}{p_{x_z}} \\ &\quad - (1 - \varepsilon) \left(\frac{p_s s}{p_{x_z} x_z} \right) \left(\frac{\rho}{1 - \rho} \right), \text{ at the micro-level.} \end{aligned} \quad (13)$$

From (2.4) and use of (2.5) in Table 2 follows

$$\frac{\partial p_{x_z}}{\partial \rho} \frac{\rho}{p_{x_z}} = - \left(\frac{w_f (1 - \rho) z_f}{p_{x_z} x_z} \right) \left(\frac{\rho}{1 - \rho} \right). \quad (14)$$

Substituting (14) in (13) gives

$$\begin{aligned} \frac{\partial |SE|}{\partial \rho} \frac{\rho}{|SE|} &= - (1 - \theta) \left(\frac{x_c}{p_n n} \right) \left(\frac{w_f (1 - \rho) z_f}{p_{x_z} x_z} \right) \left(\frac{\rho}{1 - \rho} \right) \\ &\quad - (1 - \varepsilon) \left(\frac{p_s s}{p_{x_z} x_z} \right) \left(\frac{\rho}{1 - \rho} \right), \text{ at the micro-level.} \end{aligned} \quad (15)$$

The right hand side of (15) is only unambiguously negative if $\varepsilon \leq 1$. This gives rise to the Proposition 4.

Proposition 4. *Provided fulfillment of Assumption 1, at the micro-level, income-replacement based parental leave benefits have an ambiguous effect on the magnitude of the substitution effect if $\varepsilon > 1$ (i.e. if bought-in child care and domestic child care are strong substitutes). They unambiguously reduce the magnitude of the substitution effect if $\varepsilon \leq 1$ (i.e. if bought-in child care and domestic child care are weak substitutes).*

For the absolute value of the substitution effect in (6), one can calculate again upon use of (2.3) in Table 2

$$\frac{\partial |SE|}{\partial \rho} \frac{\rho}{|SE|} = (1 - \theta) \left(\frac{x_c}{p_n n} \right) \frac{\partial p_{x_z}}{\partial \rho} \frac{\rho}{p_{x_z}}, \text{ at the macro-level.} \quad (16)$$

Substituting (14) in (16) yields

$$\frac{\partial |SE|}{\partial \rho} \frac{\rho}{|SE|} = - (1 - \theta) \left(\frac{x_c}{p_n n} \right) \left(\frac{w_f (1 - \rho) z_f}{p_{x_z} x_z} \right) \left(\frac{\rho}{1 - \rho} \right), \text{ at the macro-level.} \quad (17)$$

Since the right hand side of (17) is unambiguously negative, this and a comparison of (17) with (15) gives the last proposition of this study as follows:

Proposition 5. *Provided fulfillment of Assumption 1, at the macro-level, income-replacement based parental leave benefits unambiguously reduces the magnitude of the substitution effect. However, the reduction is at the macro-level smaller than at the micro-level if $\varepsilon \leq 1$ (i.e. if income-replacement based parental leave benefits unambiguously reduce the magnitude of the substitution effect at the micro-level).*

The bottom line of Propositions 2 and 4 is that, at the micro-level, the reduction of the magnitude of the substitution effect from Swedish family policy is overall most likely rather small. On the one hand, if bought-in child care and domestic child care are strong substitutes, then a child care subsidy reduces unambiguously the magnitude of the substitution effect. However, in this case income-replacement based parental leave benefits have an ambiguous effect on the magnitude of the substitution effect. On the other hand, if bought-in child care and domestic child care are weak substitutes, then income-replacement based parental leave benefits unambiguously reduce the magnitude of the substitution effect. However, in this case a child care subsidy has an ambiguous effect on the magnitude of the substitution effect. As a consequence, it seems, at the micro-level, unlikely that the recent empirical finding in the demographic literature of a positive effect of female wages on fertility is “real” rather than due to some empirical problems (e.g., due to the aforementioned selection effect, as argued by Kravdal, 2001). The bottom line of Propositions 3 and 5 is that, at the macro-level, Swedish family policy unambiguously reduces the magnitude of the substitution effect. However, for each of the two family policies the effect at the macro-level is smaller than at the micro level, if the substitutability between bought-in child care and domestic child care is such that the effect at the micro-level is unambiguous. Since in addition, according to Proposition 1, the magnitude of the substitution effect is at the macro-level larger than at the micro level, it seems also at the macro-level unlikely that in Sweden an increase in the female wage has a positive effect on fertility.

4 Summary

Recent demographic literature shows in Swedish micro-level data a positive effect of female wage income or female education on fertility. The literature explains this finding with Swedish family policies of high subsidies for bought-in child care and generous parental leave benefits that are calculated on the basis of a woman's prior wage income. Both policies would cause the substitution effect from an increase in female wages on fertility to be dominated by its income effect. This paper shows within an economic model that there are offsetting effects from Swedish family policy that cause the reduction of the substitution effect from an increase in female wages on fertility to be most likely rather small.

It is shown that child care subsidies only unambiguously reduce the magnitude of the substitution effect at the micro-level, if bought-in child care and domestic child care are *strong* substitutes. In contrast, parental leave benefits that are calculated on the basis of a woman's prior wage income only unambiguously reduce the magnitude of the substitution effect, if bought-in child care and domestic child care are *weak* substitutes. This is caused by the fact that the magnitude of the substitution effect depends positively on the budget share of domestic child care in total child care cost. Further, child care subsidies make bought-in child care more affordable relative to domestic child care. In contrast, parental leave benefits that are calculated on the basis of a woman's prior wage income make domestic child care more affordable relative to bought-in child care. Hence, the budget share of domestic child care in total child care cost is influenced from a change of the price of bought-in child care relative to the opportunity cost of domestic child care. Whether it rises or falls depends on the substitutability between bought-in child care and domestic child care. Since therefore only one of the two Swedish family policies can unambiguously reduce the magnitude of the substitution effect, it seems rather unlikely that, at the micro-level, in Sweden the effect from an increase in female wages on fertility is positive.

At the macro-level the substitutability between bought-in child care and domestic child care is irrelevant and child care subsidies and parental leave benefits both unambiguously reduce the substitution effect. However, for each family policy the effect at the macro-level is smaller than at the micro-level, if the substitutability between bought-in child care and domestic child care is such that the effect at the micro-level is unambiguous. The reason for this is the facts that provision of bought-in child care requires input of

female labour. Therefore, an increase in the aggregate female wage increases not only the opportunity cost of domestic child care, but also the price of bought-in child care. As a consequence, at the macro-level the magnitude of the substitution effect depends on the sum of the budget share of domestic child care in total child care cost and the budget share of bought-in child care in total child care cost, which of course equals one. Therefore, at the macro-level the magnitude of the substitution effect is independent of the price of bought-in child care relative to the opportunity cost of domestic child care. In contrast, at the micro-level the magnitude of the substitution effect depends only on the budget share of domestic child care in total child care cost, because at the micro-level the price of bought in child care is given for each woman. For this reason, at the macro-level the magnitude of the substitution effect does dependent on the price of bought-in child care relative to the opportunity cost of domestic child care. In addition, the fact that at the macro-level the magnitude of the substitution effect depends on the sum of the budget shares of domestic child care and bought-in child care in total child care cost, while at the micro-level it depends only on the budget share of domestic child care in total child care cost, implies that the magnitude of the substitution effect itself is at the macro-level larger than at the micro level. As a consequence, it seems also at the macro-level unlikely that in Sweden an increase in the female wage has a positive effect on fertility.

The present study does not deny that Swedish family policy probably has a positive direct effect on the TFR and the FLP, as shown model-theoretically by Apps and Rees (2004). However, it is argued that demographers most likely went too far in arguing that Swedish family policy also reversed the sign of the effect from female wages on fertility from a negative to a positive value.

Appendix: Derivation of (2.2) and (2.3) in Table 2

Maximisation of (1.3) in Table 1 $n = \left(x_z^{\frac{\theta-1}{\theta}} + x_c^{\frac{\theta-1}{\theta}} \right)^{\frac{\theta}{\theta-1}}$ subject to the constraint (1.4) in Table 1 $p_n n = p_{x_z} x_z + x_c$ yields

$$x_z = p_{x_z}^{-\theta} x_c \wedge x_c = p_{x_z}^{\theta} x_z \quad (18)$$

Combining the first, respectively, the second equation in (18) with the budget constraint (1.4) in Table 1 gives

$$x_c = \left(\frac{1}{p_{x_z}^{1-\theta} + 1} \right) p_n n, \quad (19)$$

$$x_z = \left(\frac{p_{x_z}^{-\theta}}{p_{x_z}^{1-\theta} + 1} \right) p_n n. \quad (20)$$

Multiplying both sides of (20) with p_{x_z} yields (2.3) in Table 2. Substituting (19) and (20) in (1.3) in Table 1 and rearranging gives rise to (2.3) in Table 2.

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