

Economics

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--Manuscript Draft--

Manuscript Number:	ECONJOURNAL-D-21-00077
Full Title:	Subsidising childcare versus grandmothers' time: which policy is more effective?
Article Type:	Research Article
Keywords:	Female employment, Fertility, Childcare subsidies, Grandmother childcare, Childcare costs
Manuscript Region of Origin:	SPAIN
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Manuscript Classifications:	10.3: Labor Economics Policies; 10.4.4: Fertility • Family Planning • Child Care • Children • Youth; 10.5.3: Time Allocation and Labor Supply

Subsidising childcare versus grandmothers' time: which policy is more effective?*

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June 10, 2021

Abstract

This paper quantifies the relative effectiveness of childcare subsidies and subsidies on grandmothers' time on married mothers' employment and fertility rates, paying special attention to heterogeneous effects. A heterogeneous agent model, populated by married households that take decisions relating to labour supply and fertility, and the Spanish economy are used as a benchmark for calibration. The results indicate that childcare subsidies conditional on employment are more effective than subsidies on grandmother's time to foster the participation of married mothers in the labour force. However, they induce women to work fewer hours, unless after-school hours are also subsidised. This overtime subsidy is also necessary for the fertility rate to increase, but it implies a significant adjustment in tax rates to maintain the same fiscal balance. If the aim is simply to raise the employment rate of mothers of children aged 2 years or younger, then subsidising childcare costs only is more effective because the fiscal effort is lower. Regarding the heterogeneous effects, in all the policies studied, the growth in female employment is mainly accounted for by the behaviour of women without tertiary education while that of fertility is accounted for by women with tertiary education. Considerations related to the progressivity of these policies would also seem to favour childcare subsidies versus subsidies on grandmothers' time.

Keywords: Female employment, Fertility, Childcare subsidies, Grandmother childcare, Childcare costs.

JEL-Code: J13, J18, J22.

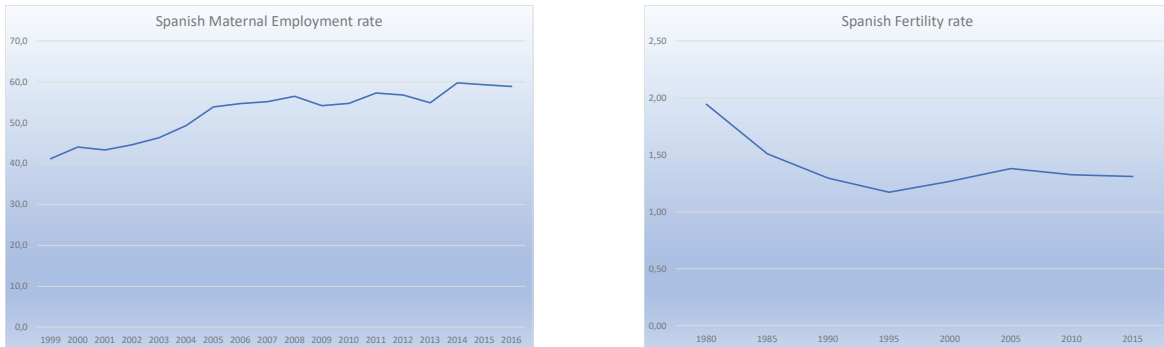
*This work was supported by the Spanish Ministry of Science and Innovation, research project ECO2017-86780-R. Declaration of interest: none.

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1 Introduction

Over the last few decades, the participation of married women in the labour force has increased substantially, while fertility rates have simultaneously dropped. Some countries, such as France and Northern European countries, have succeeded in stabilising fertility rates so they remain close to replacement rates. Southern European countries, however, are characterised by expensive childcare coupled with limited government subsidies and represent the primary cause of the trend in falling fertility.¹ Where childcare is expensive, families often turn to grandmothers to pick up the slack. This pattern might come to an end, however, due to the progressive rise in the retirement age (see Bratti et al., 2018). An increase in the provision of public childcare could partially offset the likely negative effects of the reduced availability of grandmother’s childcare on female employment and fertility. This naturally leads us to the following question: how does subsidising childcare compare to subsidising grandmothers’ time? While the effects of childcare subsidies on female employment and fertility have been extensively surveyed -see, for instance, Del Boca and Vuri (2005) and Gauthier (2007)-, the so called “granny leave” policy has received little attention in the literature (Cardia and Ng (2003) and Collins and Carlson (1998)).

Figure 1: Spanish employment rates of partnered mothers aged 15- 64 years with at least one child (left) Spanish total fertility rate (right). Sources: OECD Family Data base and INE Data.



To answer this question, I use a heterogeneous agent model, populated by married households, that take decisions relating to labour supply and fertility, and the Spanish economy as a benchmark for calibration. Spain is an interesting country in the context of the present study for the reasons I describe next. First, formal childcare for children aged 2 years or younger is very expensive. According to Borra (2010), the cost of childcare for a two-year-old represents 30% of the average wage. Second, grandmother-provided childcare is fairly common. In Spain, 15% of children aged 2 years or younger are regularly cared for by their grandmothers (see, for instance, Table 3 in the Calibration section). Third, the rate of fertility and mother’s participation in the labour force are among the lowest in Europe. It is true that maternal employment rates for women with young children have substantially risen from 41.2% in 1999 to 58.9% in 2016, partly due to changes in

¹See, for instance, the evolution of the Spanish maternal employment rate according to the OECD Family Data Base and the Spanish fertility rate according to the Spanish Statistical Office (INE) Database in Figure 1.

the tax treatment of families and in family oriented policies.² They are still, however, below the European average. For its part, the total fertility rate, which was 1.33 in 2018, is actually the lowest (see OECD Family Database). Fourth, Spain lags behind OECD countries in terms of coverage and generosity of its family policies. According to the OECD, in 2018 the total length of paid maternity and parental leave in Spain was 16 weeks, well below OECD average (55.2 weeks). Public social expenditure on families was only 1.4% of GDP, also far below the OECD average (2.4%). And fifth, the fact that Spain is characterised by low geographical mobility,³ strong family ties and a society still deeply rooted in the traditional “breadwinner” model makes the granny leave policy particularly attractive.

A version of the model described in García-Morán and Kuehn (2017) was used for the computations. In the economy model, married women, who, together with their spouses, have differing educational attainment levels, take decisions relating to labour supply and fertility. Mothers of children aged 5 years or younger need childcare in order to work. Childcare arrangements can be either formal or informal (i.e. provided by grandmothers). Child quality is affected by the time mothers spend taking care of them, and by the time children spend in childcare facilities and/or with grandmothers. The decision on how much time to allocate to the labour market will be basically driven by the opportunity costs (in terms of forgone wages), how much weight a mother attributes to the importance of spending time with her child, the availability of grandmothers, and the price of formal childcare. Government policy may affect those decisions through changes in income taxes, family benefits, childcare subsidies and by subsidizing grandmothers’ childcare.

The key contribution of this paper is to offer a first approximation in terms of fiscal cost/elasticity to quantifying the relative effectiveness of childcare subsidies and subsidies on grandmothers’ time on married mothers’ employment and fertility rates, paying special attention to heterogenous effects. A policy is said to be more effective than another one when the rise in the variable of interest is greater for each additional point increase in taxes. The calculation is thorough in that it adjusts income taxes so that policies are neutral in terms of government savings. The present study sheds light on the debate over the type of family policies needed to promote a simultaneous increase in female employment and fertility rates in a context of declining ratios of economically active individuals, very low fertility rates and unsustainable social security systems. Another contribution is the integration into the framework developed by García-Morán and Kuehn (2017) of the Spanish institutional details needed to address these issues, such as the progressive tax system, child allowances, cash benefits for working mothers of young children, childcare costs, income-related subsidies for kindergarten expenses, and subsidised public education for children aged 3 to 5 years.

The study led to several interesting findings. Childcare subsidies conditional on employment are more effective than subsidising grandmothers’ time to foster the participation of married mothers in the labour force. However, they induce women to work fewer hours, unless after-school hours are also subsidised. This “double subsidy” is also necessary for the fertility rate to increase, but it implies a significant adjustment in tax rates to maintain the same fiscal balance. If the aim is simply to raise the employment rate of mothers of children aged 2 years or younger, then subsidising childcare costs only is more effective because the fiscal effort is lower. Regarding the heterogeneous effects, in all cases, the rise in female employment is mainly accounted for by the behaviour of women

²Osuna (2018) shows that changes in tax rates and in the education distribution are the main factors behind the increase in married women employment during the late nineties, while changes in childcare costs and earning profiles are the main reasons for subsequent growth in the 2000s.

³According to Fernández and Tobío (2005), in Spain 77% of working mothers live in the same town as their mothers.

without tertiary education, while that of fertility is accounted for by the behaviour of women with tertiary education. This outcome is not new. What is interesting is the fact that considerations related to the progressivity of these policies would also seem to favour childcare subsidies versus subsidies on grandmothers' time.

Related literature. There is a substantial body of empirical literature on the effects of formal versus informal childcare arrangements on female employment and fertility. Most studies stress the positive effects of affordable and available formal childcare. For instance, Apps and Rees (2004) attribute a weaker negative relationship between rising female labour supply and decreasing fertility to the availability of cheap and good quality care possibilities outside the home. Del Boca et al. (2009) states that the provision of childcare is highly influential, especially for the employment rate of less educated women and the fertility rate of college women. Haan and Whrolich (2011) showed that increasing childcare subsidies conditional on employment significantly increases female participation rates but, on average, does not affect fertility. On the other hand, Aassve et al. (2012), Aparicio-Fenoll and Vidal-Fernández (2015) as well as Zamarro (2011) have emphasised the positive aspects of grandmother-provided childcare on female employment and fertility. Aassve et al. (2012) show that the availability of grandmother has a notable effect on individual decisions on whether to have children, especially in Southern Europe where public childcare is limited. Zamarro (2011) also finds that in countries where childcare is more costly, grandmothers are more likely to provide care. Aparicio-Fenoll and Vidal-Fernández (2015) show that daughters are more likely to have children but less likely to work when grandmothers participate in the labour market, thus providing less childcare.

Regarding the theoretical literature, there is a recent paper by Guner et al. (2020) very closely related to this study. Using an heterogenous agent model the authors study the macroeconomic effects of child-related transfers on female labour supply and welfare. They also find that childcare subsidies conditional on employment have large effects for married mothers labour supply, especially for low educated women, but they do not study the effects on fertility. Concerning the two types of childcare studied in the present study, only a few papers have incorporated them into a single framework to study both female labour force participation and fertility. For instance, Cardia and Ng (2003), using a general equilibrium model, found that subsidising grandparents' time is more effective than providing childcare subsidies. Bick (2016), using a life cycle model, where individuals take decisions concerning formal and informal childcare, concluded that subsidies have a very low impact on female labour force participation and no effect on fertility. García-Morán and Kuehn (2017), based on a model of residence choice, fertility decisions and female labour market participation, studied the effects of grandparent-provided childcare on female labour market outcomes and geographical mobility. None of these works propose to examine the quantitative implications of childcare subsidies and subsidies on grandmothers' time for female employment and fertility based on a model with a rich institutional structure regarding family policies, including the necessary fiscal adjustments and paying special attention to heterogenous effects. The present study attempts to fill this gap.

The rest of this paper is structured as follows: the model is presented in Section 2; the calibration of the baseline model economy is explained in Section 3; in Section 4, the results of the policy experiments are described; Section 5 is devoted to perform some robustness exercises. Finally, conclusions are presented in Section 6.

2 The Model

Let us consider an economy populated by a continuum of married households of mass one.⁴ We assume that people live for two three-year periods, corresponding to the first six years of a child's life. This time-span was selected as it corresponds to that of a mother's most relevant childcare decisions. In fact, most differences in a mother's decisions concerning labour force participation and childcare arrangements during early childhood take place around the age of three. Each member of the household is characterised by a given productivity (education) type. These productivity types determine wage rates in the labour market. At the beginning of the first period a woman of type i is matched with a man of type j . Women differ across two dimensions: their own type and their spouse's type. Wages in a couple, (w_i, w_j) , are a function of two components: the labour market productivity of their members (w_i^*, w_j^*) , which are fixed numbers determined by their educational type, and an independent draw (ϵ_w, ϵ_m) from a distribution $D(\mu_\epsilon, \sigma_\epsilon)$, whose purpose it to generate some heterogeneity. Thus, wages are given by the product of these two components, $w_i = w_i^* \epsilon_w$ and $w_j = w_j^* \epsilon_w$.

In the first period, women take a fertility decision: whether to have a child $k = 1$ or not $k = 0$. In each period every individual is endowed with one unit of productive time. For simplicity, men are assumed to be the primary earners and, therefore, work all their disposable time. Women without a child also work all their disposable time since they only take issues of consumption into account. Mothers consider not only consumption, but also their child quality, q . They need to decide how much time they spend working, l , and how much time they spend taking care of her child, t_m , with $l + t_m = 1$.

In order to provide labour, working mothers need to make childcare arrangements, since the time the mother is at work is assumed to be equal to the time spent on childcare ($l = t_c$). Childcare arrangements can be either formal or informal (provided by grandmothers). Here, the quality of the time spent in childcare facilities, ϕ_f , or with grandmothers, ϕ_g , is assumed to be the same.⁵ The child quality, q , is a weighted sum of the time a mother spends with her child, t_m , and the time her child spends in childcare arrangements: $q = \phi_m t_m + \phi_c l$, where $\phi_c = \{\phi_f, \phi_g\}$ and the parameter ϕ_m measures the relative importance of maternal time versus other childcare arrangements.⁶

Childcare costs depend on the age of the child. Attending a childcare center for a child aged 2 years or younger is optional. If the child attends a childcare center, the household may be entitled to a subsidy, θ_y , that depends on household income, y . The subsidy covers both the price for regular hours, p_1^r , and extended hours, p_1^e . In period 2, it is assumed that all children aged 3 to 5 go to regular childcare at a nursery school and, therefore spend t_2^r hours at the childcare facility, independent of mothers labor force participation.⁷ The price for regular school hours is given by p_2^r per unit of time. Some children may need to attend an extended learning center (after school hours), in which case women pay an extra amount, p_2^e , for those hours that exceed the regular schedule.

⁴The marriage market is not modelled. Husband's income is exogenously assigned to each women.

⁵While formal and informal childcare might be very different, there is no conclusive evidence of whether one of them is of higher quality than the other. Gregg et al. (2005) conclude that the predominant use of informal care provided by relatives leads to children's poorer cognitive development. Hansen and Hawkes (2009) establish that formal group care is positively associated with school readiness test scores, while grandparent-provided childcare is positively associated with vocabulary test scores and behavioral scores.

⁶According to Sommacal and Casarico (2012) recent research shows that the substitution of maternal time with other child care sources produces negative effects on children skills (see Baker et al. (2005) and Bernal et al. (2010)).

⁷This is based on the fact that enrollment rates for children aged 3 to 5 years are close to 100% in Spain.

Regarding informal childcare, mothers are here assumed to have access to free childcare by grandmothers with probability g_1 in the first period. With probability $(1 - g_1)$ mothers need to pay for childcare if they wish to work. In the second period, with probability g_2 , those who had access to grandmother-provided childcare in the first period continue to do so.⁸ Grannies who care for their grandchildren may be entitled to a government subsidy, gr_{sub} , based on their daughter's hourly wage and their daughter's working hours for which they need childcare.

The utility function of a woman, who values consumption, c , and the quality of her child, q , is given by

$$U(c, q, k) = \frac{c^{1-\sigma}}{1-\sigma} + (\sigma^q q^\alpha - \sigma^k)k$$

where σ is the curvature parameter in the consumption function, α is the curvature parameter in the child quality production function, σ^q is the weight of child quality, and σ^k measures the fixed utility cost per child, which capture difficulties in reconciling work and family.

As far as government policy is concerned, the government needs to raise revenue through income taxes, $\tau(i, j, y, k, t)$, which are progressively introduced to finance cash family benefits, T , childcare subsidies, θ_y , subsidies on grandmothers' time, gr_{sub} , and to provide public childcare, p_1^g and p_2^g . Working women with a child aged 2 years or younger are entitled to family benefits in cash. Families are also entitled to tax allowances based on the age of the child.

2.1 Value Functions

The model is solved backwards. Therefore, I first present the value functions for women in the second period.

Value function in the second period for childless women

Utility for childless women in the second period is given by $V^2(w_i, w_j) = \frac{c^{1-\sigma}}{1-\sigma}$, subject to the budget constraint $c = (1 - \tau^f)w_i + (1 - \tau^m)w_j$, where τ^m and τ^f stand for tax rates for males and females, respectively.

Value functions in the second period for mothers

A mother in period 2 without access to grandmother-provided childcare need to purchase formal childcare at price p_2^r per unit of time. Her value function is as follows⁹

$$V_{ng}^2(w_i, w_j, k) = \max_l \left(\frac{c^{1-\sigma}}{1-\sigma} + (\sigma^q q^\alpha - \sigma^k) \right)$$

subject to the budget constraint $c = (1 - \tau^f)w_i l + (1 - \tau^m)w_j - p_2^r t_2^r - I_{\{l > t_2^r\}} p_2^e (l - t_2^r)$, and given the child quality production function $q = \phi_m - l(\phi_m - \phi_c)$. Note that $I_{\{\cdot\}}$ is an indicator function that takes value 1 if the argument is true and 0 otherwise.

⁸This assumption is made to be consistent with the evidence presented in Table 3 in the Calibration section) where grandmother's availability seems to be less relevant in period 2.

⁹Note that the subscript ng in the value function V stands for "no grandparents", meaning that they are not available.

The value function for a mother in period 2 with access to grandmother-provided childcare is given by

$$V_g^2(w_i, w_j, k) = \max_l \left(\frac{c^{1-\sigma}}{1-\sigma} + (\sigma^q q^\alpha - \sigma^k) \right)$$

subject to the budget constraint $c = (1 - \tau^f)w_i l + (1 - \tau^m)w_j$ and given the child quality production function $q = \phi_m - l(\phi_m - \phi_c)$.

Value functions in the first period for mothers

In the first period women need to decide whether to have a child or not and how much time to work. With probability g_1 women have access to free childcare provided by grandmothers.

The value function of women with access to free childcare is given by

$$V_g^1(w_i, w_j, k) = \max_{l,k} \left(\frac{c^{1-\sigma}}{1-\sigma} + (\sigma^q q^\alpha - \sigma^k)k + \beta(g_2 V_g^2 + (1 - g_2)V_{ng}^2) \right)$$

subject to the budget constraint $c = (1 - \tau^f)w_i l + (1 - \tau^m)w_j + T$ and given the child quality production function. The continuation value is equal to the discounted value in the second period where, with probability g_2 she will continue to have access to grandmother-provided childcare, and with probability $(1 - g_2)$ she will have to pay for childcare.

The value function of women without access to free childcare is given by

$$V_{ng}^1(w_i, w_j, k) = \max_{l,k} \left(\frac{c^{1-\sigma}}{1-\sigma} + (\sigma^q q^\alpha - \sigma^k)k + \beta V_{ng}^2 \right)$$

subject to the budget constraint $c = (1 - \tau^f)w_i l + (1 - \tau^m)w_j + T - (1 - \theta_y)(p_1^r l + I_{\{l > t_1^r\}} p_1^e (l - t_1^r))$ and given the child quality production function. A woman who did not have access to grandmother-provided childcare in the first period will neither have access in the second period.

Finally, the government budget constraint is given by the following expression

$$tax\ revenue = (N_g^1 + N_{ng}^1)T + N_{ng}^1 p_1^g + \Theta + gr_{sub} + N^2 p_2^g + G$$

where N_g^1 stands for the number of working mothers helped by grandmothers in period 1, N_{ng}^1 stands for the number of working mothers not helped by grandmothers in period 1, N^2 is the number of mothers in period 2, Θ is the amount of childcare subsidies paid by the government to working mothers who make use of childcare facilities in period 1, gr_{sub} is the amount of subsidies on grandmothers' time, and G is government expenditure used to finance a public good that provides no utility.¹⁰ The subsidies, Θ and gr_{sub} , paid by the government are given by the following expressions:

$$\Theta = \sum_{x=1}^{N_{ng}^1} \theta_{x,y} (p_1^r l_{x,1} + I_{\{l_{x,1} > t_1^r\}} p_1^e (l_{x,1} - t_1^r))$$

¹⁰ G is necessary because the revenue collected by taxes is higher than the Spanish expenditure on childcare. Note that the policies experiments shown in Section 4 are implemented in such a way that government savings are constant.

$$gr_{sub} = \sum_{x=1}^{N_g^1} \psi w_{x,i} l_{x,1} + \sum_{x=1}^{N_g^2} I_{\{l_{x,2} > t_2^r\}} \psi w_{x,i} (l_{x,2} - t_2^r)$$

where $w_{x,i}$ is mothers's wage, $l_{x,1}$ and $l_{x,2}$ is mother's working time in periods 1 and 2, respectively, $\theta_{x,y}$ is the value of the childcare subsidy and ψ is the value of the granny subsidy parameter. Note that childcare subsidies only apply to mothers not helped by grannies in period 1. For its part, subsidies on grandmothers' time only apply to working mothers helped by grannies. Note also that, given the assumption that all children age 3 to 5 go to regular childcare, grannies can at most care for their grandchildren after school in the second period.

3 Calibration

3.1 Data

To calibrate the main parameters of the model, data from the European Union Statistics on Income and Living Conditions (EU-SILC) was used. Year 2016 was chosen because, in that particular year, a special module on "Access to Services" with information about childcare costs was made available. The EU-SILC is an annual household survey that provides information on individual and household characteristics, such as employment, education and family status, income, and childcare use (formal and informal).

The analysis is confined to a sample of married individuals because the main focus is the labour supply of married females. In order to analyse individuals who are potentially in the labour force and need childcare, I restricted the sample to women between ages 25 and 45. Women working less than 20 hours a month were not considered as employed, given that they need little childcare. Self-employed women were also excluded because of the specificities of their work schedules. To compute the statistics related to childcare arrangements, a smaller sample of mothers with children aged 5 years or younger was considered.

The population was divided into three educational groups: people who have less than a high school degree ($<hs$), people with a high school degree (hs) and those with a college degree (col).¹¹ The matching matrix that assigns spouses to women was generated as described next. I define women of type i and spouse of type j according to their education or schooling levels s such that $i, j \in s$. Based on these three categories, one can define nine household types by the educational attainment of husbands and wives, where $\Phi(s, s)$ is a particular element of the matching matrix. Table 1 shows the distribution of married households according to the educational level in 2016 as well as female employment rates in each of these nine household types. Some degree of assortative mating can naturally be observed, and female employment increases with education levels.

Table 2 shows that mothers who are helped by grandmothers tend to be less educated. The reason may be related to their earnings and, consequently, to the affordability of formal childcare. In fact, hourly wages are higher for mothers of young children not helped by grandmothers: 13.2 versus 12.8. Concerning employment, an opposite pattern emerges: the employment rate of mothers of young children who are helped by grandmothers is higher than the employment rate of those who are not helped by them. This is true at all educational levels, but specially for the less

¹¹ Alternatively, one can refer to these three categories as low-, medium-, and high-education; or people who did not finish secondary school ($<ss$), people who completed secondary school (ss) and those with tertiary studies or university degree (ts).

Table 1: **Couples distribution and female employment**

Educational distribution				Employment rate			
Male				Male			
Female	$< hs$	hs	col	Female	$< hs$	hs	col
$< hs$	13.0	4.9	4.1	$< hs$	42.7	46.3	48.5
hs	8.0	8.2	6.3	hs	63.4	55.5	59.4
col	8.2	12.3	35.1	col	79.6	75.4	77.6

educated. The latter may reflect difficulties in finding affordable childcare when grandparents are not available.

Table 2: **Mothers of children aged 5 or less, helped or not by grannies**

	Mothers educational distribution			Mothers employment rate	
	not helped	helped by		not helped	helped by
Female	by grannies	grannies		by grannies	grannies
< <i>hs</i>	11.0	16.4		42.0	66.7
<i>hs</i>	17.5	16.4		45.9	58.3
<i>col</i>	71.5	67.2		71.7	84.6

Whether formal childcare is affordable or not, what is true is that most children attend some kind of preschool: 53.7% in the case of children aged 2 years or younger and 81% in the case of children aged 5 years or younger (see Table 3). It is interesting to note that although 99% of children aged 3 to 5 years attend a preschool facility,¹² 13% of them are also cared for by their grandmothers who, on average, spend 13.4 hours a week caring for them. This additional need of childcare is probably a consequence of long work schedules.¹³ Children aged 2 years or younger spend on average less time with their grandmothers than in formal care: 25.4 hours a week versus 29.5. The same can be said for children aged 3 to 5 years, since public preschool is universally provided.

Table 3: **Childcare arrangements and average hours**

Age of Children	cared for by grannys	informal hours	at preschool facility	formal hours
0 - 5	13.7%	19.4	80.9%	30.3
0 - 2	14.7%	25.4	53.7%	29.5
3 - 5	12.9%	13.4	99.1%	30.7

¹²The enrollment rate for children aged 3 to 5 years in Spain is 99% due to the 1990 Educational reform (Law 1/1990). This reform made public education widely available for children aged 3 years and older.

¹³Work schedules in Spain are usually split the following way: 5 working hours before lunch time, followed by 2-3 hours lunch break, and another 3 working hours in the evening.

3.2 Calibrated parameters

In this section I explain how values were assigned to the model's parameters. The policy parameters and the parameters related to childcare costs were taken directly from Spanish data. The value of the discount factor, β , was set to 0.889 so that it is consistent with a real interest rate of 4% in the reference period.¹⁴ All remaining parameters i.e. those of the utility function $(\sigma, \alpha, \sigma^q, \sigma^k)$, the probabilities of having access to free childcare (g_1, g_2) , and the parameters of the child quality production function (ϕ_m, ϕ_c) were calibrated to match model moments related to several labour market and fertility statistics for Spain. These statistics were computed using the data described previously.¹⁵ Although all these parameters were set simultaneously (by means of the method of moments) some parameters have clear counterparts in the data which I proceed to explain now.

Table 4: **Baseline Calibration**

Parameters	Description	Value
β	<i>Discount factor</i>	0.89
σ	<i>Utility curvature of consumption</i>	0.85
α	<i>Utility curvature of child quality</i>	0.82
σ^q	<i>Weight of child quality in utility</i>	1.76
σ^k	<i>Fixed utility cost of children</i>	0.49
ϕ_m	<i>Weight of mother's time for child quality</i>	0.84
g_1	<i>Probability of free care in period 1</i>	0.09
g_2	<i>Conditional probability of free care in period 2</i>	0.95
μ_ϵ	<i>Mean of the distribution of wage offers</i>	1.00
σ_ϵ	<i>Standard deviation of the distribution of wage offers</i>	0.01

The employment rate of mothers with children aged 3 to 5 years was used to match the curvature of consumption in the utility function, σ , given that their decision to participate is, to a large extent, driven by the value of consumption. The percentage of women being mothers is related to the fixed utility cost, σ^k , because this is one of the main determinants of fertility. The parameters of the child quality in the utility function: the curvature's parameter, α , the weight of child quality, σ^q , and the weight of mother's time for child quality, ϕ_m , determine labor force participation decisions, especially when children are very young. These parameters were calibrated to match statistics related to the relevance of childcare costs and mother's time for child quality: the employment rate of mothers with children aged 2 years or younger, childcare costs as a percentage of household disposable income and childcare costs as a percentage of the wage of women without tertiary education. The probabilities of women having access to grandmother-provided childcare in the first and second period, g_1 and g_2 , were set to match the percentage of working mothers using grandmother-provided childcare for children aged 2 years or younger and 3 to 5 years, respectively.

¹⁴Note that a model period corresponds to three years.

¹⁵Since $\phi_m + \phi_c = 1$, only ϕ_m is calibrated.

Wages

In the model, women’s and men’s average hourly wages were assigned according to education levels (see Table 5). The underlying distribution of wage changes was assumed to be the same for men and women, and was broken down into a grid of five different wage changes: each of the nine couples previously defined received 25 different offers. The mean distribution, μ_ϵ , was set equal to 1 to match women’s mean hourly wage rate, while the value of the standard deviation of wage offers, σ_ϵ , was set in such a way that the aggregate labour force participation of mothers of children aged 5 years or younger was close to the value in the data, i.e. 59.1%.

Table 5: **Hourly wages**

Education	women	spouses
$< hs$	9.10	9.39
hs	10.22	12.5
col	14.18	16.5

Childcare costs parameters

Information on the prices of attending a childcare facility (regular hours, extended hours and canteen service) was used to set the values of the price parameters, p_1^r and p_1^e , in period one.¹⁶ On average, the cost of attending a childcare center from 9 am to 2 pm (regular hours), including canteen service, amounted to 279 euros a month. In the case of extended hours, the cost reached 335 euros. I set $p_1^r = 1.74$ and $p_1^e = 0.35$ in the model to match these prices.¹⁷ The cost of attending a nursery school for children 3 to 5 years is heavily subsidised since public education is universally provided. There are basically two types of schools: public schools which are completely free; and subsidised private schools, that ask for an average payment of 70 euros a month. Given that public schools represent 70% of the school system, the cost for an average family amounts to 21 euros a month.¹⁸ However, there are some school services, like canteen services or after school programs that are not free, and that on average amount to 135 euros a month. I set $p_2^r = 0.13$ and $p_2^e = 0.84$ in the model to match these monetary values.

Policy parameters

In this section, I describe the parameters related to government policy. As previously stated, the income tax system is progressive. Tax rates, $\tau(i, j, y, k, t)$, were computed for every individual using the Spanish tax code. Financial support delivered through the tax system has a substantial incidence, especially for families with children under three years old. Apart from general child tax allowances (for the number of children and for new born children), Spain grants an additional tax

¹⁶See Annex III in Decreto-Ley 1/2017, de 28 de Marzo.

¹⁷To obtain the values of the model’s parameters one needs to divide annual monetary values expressed in euros by annual working hours, which amount to 1920 (48 weeks times 40 hours a week), so that all values are expressed in the same units.

¹⁸See “Datos y Cifras: curso escolar 2014-15”, Ministerio de Educación, Ciencia y Deporte (2014).

Table 6: **Childcare costs parameters**

Parameters	Description	Value
p_1^r	<i>Cost of childcare for regular hours in period 1</i>	1.74
p_1^e	<i>Cost of childcare for extended hours in period 1</i>	0.35
p_1^g	<i>Cost of childcare paid by the government in period 1</i>	0.46
p_2^r	<i>Cost of childcare for regular hours in period 2</i>	0.13
p_2^e	<i>Cost of childcare for extended hours in period 2</i>	0.84
p_2^g	<i>Cost of childcare paid by the government in period 2</i>	2.19
t_1^r	<i>Regular hours at a childcare facility in period 1</i>	0.42
t_2^r	<i>Regular hours at a nursery school in period 2</i>	0.42

allowance for each child under three. These deductions were included in the model in order to compute the relevant tax rates. The yearly income for men and women was computed first and the tax liability was also obtained using the information on the income brackets and the appropriate tax rates.¹⁹ Child allowances need to be subtracted from the tax liability in order to get individual tax rates.

Mothers with a child aged 2 years or younger attending a childcare facility may be entitled to a subsidy, θ_y , that also depends on household income. Given the heterogeneity of the systems in the Spanish regions, the Andalusian scale was chosen as an illustration of the average subsidy.²⁰ Apart from the subsidy on the final price, the government typically finances part of the real cost of providing a childcare slot in the form of a direct payment to the childcare center. On average, the market price reaches 82% of the real cost (408,3 euros). The government pays for the rest, which in the model amounts to $p_1^g = 0.46$ per childcare slot per unit of time. Concerning preschool education, families only pay 5.65% of the real cost of providing regular hours (371,7 euros) while the government pays for the rest.²¹ This implies that the government pays $p_2^g = 2.19$ per childcare slot per unit of time.

Finally, working women with a child aged 2 years or younger are entitled to a monthly cash benefit of 100 euros. This non-refundable tax credit, T , was introduced in 2003 (Law 46/2002 de 18 de Diciembre 2002) and implies a value $T = 0.625$.²²

3.3 Calibration results

Parameter values were chosen so that the model be consistent with 2016 Spanish data related to the labour market, fertility and childcare statistics. Table 7 shows that the baseline model is a suitable starting point for carrying out policy experiments because it matches real data relatively well. In addition, it is necessary to assess the model's performance in matching moments that have not been used for calibration. Table 8 shows that the model accounts reasonable well for most

¹⁹See Ley 35/2006, de 28 de noviembre de 2006 for the details of the tax system.

²⁰See Decreto 149/2009 de 12 de Mayo and Acuerdo de 7 de julio de 2009 for the details of the scale.

²¹See "Panorama de la Educación: Indicadores de la OCDE 2015", Ministerio de Educación, Cultura y Deporte (2015).

²²In Spain, financial aid to families with young children include income-related child allowances. However, the income threshold is very low, meaning that only 5% of households are eligible for this benefit compared to 73% in France or 100% in Northern Europe. This is why it is not included in the model.

of them. The model captures the fact that working mothers earn a higher wage than the female average. The average hourly wage of childless women is 11.2 euros, while that of mothers is 12.9 euros. Mothers of younger children earn on average higher hourly wages (13.2 euros), probably as a result of selection. Generally, the number of hours of childcare generated by the model are relatively close to the number of hours in the data. Table 3 showed that working mothers of younger children tend to use more hours of grandmother-provided childcare than mothers of older children. The model generates this pattern but underestimates the number of hours that children aged 3 to 5 years spend with grandmothers and overestimates the number of childcare hours of children aged 2 years or younger. The model also accounts for the fact that children aged 2 years or younger spend more time in childcare facilities (roughly 3 more hours) than with grandmothers. This is probably explained by the fact that women with tertiary education work more hours than women without tertiary education and also make less use of grandmother’s help (see Table 2).²³

Table 7: **Data and model moments: targeted**

Statistics	Data	Baseline
<i>Mean hourly wage rate of women</i>	12.5	12.7
<i>Percentage of women being mothers</i>	45.1	44.6
<i>Employment rate of mothers, children aged 0 to 2</i>	53.0	51.2
<i>Employment rate of mothers, children aged 3 to 5</i>	65.1	65.8
<i>Employment rate of mothers,, children aged 0 to 5</i>	59.1	58.5
<i>% of work-mothers using free care, children aged 0 to 2</i>	15.7	15.7
<i>% of work-mothers using free care, children aged 3 to 5</i>	11.7	11.6
<i>Child care costs as a % of average household income</i>	12.0	12.1
<i>Child care costs as a % of mother’s non-college wage</i>	23.3	21.0

Concerning distributions, the model is able to capture the qualitative patterns and, to some extent, quantitative numbers. The model replicates mother’s and working women’s distributions relatively accurately. However, it fails to quantitatively account for working mother’s distribution by education: the model overestimates the percentage of working mothers with the highest level of education, and largely underestimates the percentage of working mothers in the lowest category of education.²⁴ The model reproduces the behaviour of women with tertiary education particularly well. Both the proportion of college working mothers over college working women and the proportion of college working mothers over college mothers are very close to those observed in the data.

4 Policy experiments

Neoclassical models of female labour market supply and fertility behaviour (Becker, 1965) point to the fact that the presence of children affect labour market and household production decisions. Children raise the opportunity cost of working and lower the effective market wage through the

²³In the data low educated mothers work on average 31 hours a week while college mothers work 35.8.

²⁴This discrepancy may be due to the reduced number of educational categories but given the limited number of observations available in each group, it was not possible to disaggregate further.

Table 8: **Data and model moments: non-targeted**

Statistics	Data	Baseline
<i>Ratio of mother's working wage to women's working wage</i>	1.06	1.18
<i>Number of hours of grandparenting, children aged 0 to 2</i>	25.4	30.5
<i>Number of hours of grandparenting, children aged 3 to 5</i>	13.4	7.10
<i>Number of hours in childcare facilities, children aged 0 to 2</i>	29.5	34.2
<i>Number of hours in childcare facilities, children aged 3 to 5</i>	30.7	29.8
<i>Proportion of college working mothers / college working women</i>	46.5	40.6
<i>Proportion of college working mothers / college mothers</i>	77.8	80.6
Distributions	Data	Baseline
<i>Mother's distribution by education</i>		
<i>< hs</i>	20.3	19.7
<i>hs</i>	20.9	21.6
<i>col</i>	58.8	58.7
<i>Working mother's distribution by education</i>		
<i>< hs</i>	13.8	7.0
<i>hs</i>	16.5	12.2
<i>col</i>	69.7	80.8
<i>Working women's distribution by education</i>		
<i>< hs</i>	14.7	18.3
<i>hs</i>	18.4	18.0
<i>col</i>	67.0	63.7

cost of childcare. The theory suggests that measures to help reconcile work and family life will prove beneficial to increase female labour supply and fertility. In this section I quantify the effects of two such policies, namely childcare subsidies and subsidies on grandmothers' time, on mothers labour force participation, fertility and the extent of use of formal versus informal childcare.

4.1 Discussion

Before proceeding to the experiments it is worth exploring in more detail the main mechanisms underlying the baseline model. First, I compare the decisions to become a mother and mother's employment rates with whether women are helped by grandmothers or not. Those who are helped by grandmothers exhibit a larger fertility rate: 57.5% against 43.4% for women who are not. They also work more: the employment rate of mothers of children aged 5 years or younger who make use of grandmother's help is about 50% higher than that of women without help.

Second, female employment rates and hours worked were observed according to the husband's rising wages, and also according to women's increasing wages. Generally, the higher the husband's wage the lower the employment rates and hours worked of mothers due to an income effect. However, given the husband's wage, the higher the woman's wage, the lower the fertility rate and the more women work because of the higher opportunity cost of not working. This behavior is to a certain extent corroborated by the data (see Table 1 in Section 3.1). See also the policy functions in the Appendix.²⁵

Third, heterogeneous effects were examined. There are some differences in terms of fertility and employment across different educational categories. Low-education women married to high school or college men tend to have more children (and work less) than low-education women married to low-education men. This is in part due to a low opportunity cost of not working and to an income effect, which induces low-education women to stay at home and devote more time to care for their children as the husband's wage increases. Most low-education women either have children and work zero hours or do the opposite. Only a few, especially those with the highest wages try to reconcile work and family. This is more prevalent when grandmothers are available.

If we compare high school women married to high school men with those married to college men, the same pattern applies: as the husband's wage increases, they tend to have more children and leave the labor market, again due to an income effect. On the other hand, most high school women married to low type men have children and work part of their disposable time if they are helped by their grandmothers. Finally, college women have less children if they are not helped by grandmothers, especially those married to low-education men, because of the high opportunity cost for these types of women.

²⁵The policy function matrices show the choice of female hours worked according to the education/productivity types of both partners in both periods for women helped ($lm1 - acgx, lm2 - acgx$) and not helped ($lm1 - acngx, lm2 - acngx$) by grandmothers; and also the decision to become a mother ($kidacg = 2$) or not ($kidacg = 1$), where the endings g and ng mean with help and without grandmother's help. Rows order women's decisions according to their education (from low to high education), while columns indicate men's education. Note that for each educational level there are five productivity types, again ordered from low to high. For instance, the first five rows indicate the decisions of women with less than high school education with productivity types in increasing order; rows 6 to 10 show the decisions of women with high school education with productivity types in increasing order; while rows 11 to 15 show the decisions of women with college education with productivity types in increasing order. The same pattern applies for men, but across columns.

4.2 Childcare subsidies for children aged 2 years or younger

This experiment was motivated by the EU agreement among member states concerning the need to remove disincentives to female labour force participation and to strive to substantially raise the provision of childcare (European Council, 2002). As Haan and Wrohlich (2011) have suggested “these reforms, by providing financial incentives for women in employment with newborn children, may be the most promising means to tackle the demographic challenges of a society with low fertility rates and low female employment”. This recommendation takes on far greater significance in Southern European countries given the prevalence of grandmother’s childcare. As Méndez (2015) has pointed out, the increase in the provision of public childcare could partially offset the likely negative effects on female employment and fertility of the reduced availability of grandmothers’ childcare in Southern European countries given the narrowing of the intergenerational gap in female labour force participation.

This experiment was implemented as described next. I set a particular value for the employment rate of mothers of children aged 2 years or younger as a target and computed the change in the value of the childcare subsidy in period 1, θ_y , as well as the necessary adjustment in tax rates to make it happen. The target value is set equal to 57.3%, which is the maternal employment rate for women whose youngest child was aged 2 years or younger in 2016 in the European Union.²⁶ The corresponding childcare subsidy in period 1 turned out to be three times larger than in the baseline economy and the tax rate increase 2.5%.

Table 9 shows that the employment rate of mothers with children aged 2 years or younger grows by 6 percentage points, which implies a value of 0.15 for the elasticity with respect to childcare costs. This result is consistent with the values that have been estimated in previous literature, which for Europe range from 0.14 for UK, to 0.46 for Romania.²⁷ Fertility is not significantly affected: there are some women married to low educated men who decide to become mothers, but high educated women married to high educated men move in the opposite direction because of the tax increase, which compensates for the former increase in fertility. Mothers work on average fewer hours as a result of the income effect generated by the subsidy and also because of the tax increase, which makes the working activity less rewarding.²⁸ Composition effects are not playing a significant role. That is, the reduction in hours worked by mothers does not happen just because the mothers that enter the labour market will supply very few hours, pushing down the average hours worked of all mothers, but rather due to income effects and also because of the tax adjustment. This reduction in average hours worked decreases the number of hours that children aged 2 years or younger spend in childcare facilities by 6%. In addition, more affordable childcare implies a significant reduction in informal childcare use (12.8%).

I now look at disaggregated results according to the educational types of women to observe the model’s predictions along these lines. Table 10 shows that all types of mothers participate more in

²⁶See OECD Family Database. Year 2016 was chosen to be consistent with the EU-SILC data used in the calibration section.

²⁷For the US, Blau and Hagy (1998) estimate a value of 0.2 for the elasticity of employment with respect to the price of childcare.

²⁸As can be seen in the Appendix, the number of hours worked by mothers not helped by grandmothers in the first period (lm1-acngx) is for the most part lower, especially for women married to non-college men, due to an income effect. Some women married to low-educated men decide to become mothers and, therefore, reduce hours worked drastically, from fulltime in the baseline to part-time work. There are also some women married to non-college men, who were already mothers in the baseline, but did not work; these women now participate in the labor market, but for a low number of hours.

Table 9: **Experiments**

Subsidising childcare costs in pdo 1 (θ_y)	Baseline	$3\theta_y$	%var	$\frac{\%var}{\%tax}$
<i>Percentage of women being mothers</i>	44.6	44.4	-0.48	-0.19
<i>Employment rate of mothers, children aged 0 to 5</i>	58.5	61.4	4.78	1.91
<i>Employment rate of mothers, children aged 0 to 2</i>	51.2	57.1	10.9	4.36
<i>Employment rate of mothers, children aged 3 to 5</i>	65.8	65.7	-0.25	-0.10
<i>% of work-mothers using free care, children 0 to 2</i>	15.7	13.8	-12.8	-5.10
<i>% of work-mothers using free care, children 3 to 5</i>	11.6	11.8	1.07	0.43
<i>Ratio of mother's wage to women's wage</i>	1.18	1.15	-2.87	-1.15
<i>Hours in childcare facilities, children aged 0 to 2</i>	34.2	32.2	-6.02	-2.41
<i>Hours in childcare facilities, children aged 3 to 5</i>	29.8	29.8	-0.14	-0.06

Subsidising after school hours in pdo 2 (p_2^e, θ_y)	Baseline	$(3\theta_y, \frac{1}{2} p_2^e)$	%var	$\frac{\%var}{\%tax}$
<i>Percentage of women being mothers</i>	44.6	52.2	15.8	2.25
<i>Employment rate of mothers, children aged 0 to 5</i>	58.5	64.3	9.5	1.35
<i>Employment rate of mothers, children aged 0 to 2</i>	51.2	57.8	12.1	1.73
<i>Employment rate of mothers, children aged 3 to 5</i>	65.8	70.8	7.3	1.04
<i>% of work-mothers using free care, children 0 to 2</i>	15.7	11.6	-30.1	-4.30
<i>% of work-mothers using free care, children 3 to 5</i>	11.6	9.3	-22.8	-3.26
<i>Ratio of mother's wage to women's wage</i>	1.18	1.15	- 2.50	-0.36
<i>Hours in childcare facilities, children aged 0 to 2</i>	34.2	32.1	-6.26	-0.89
<i>Hours in childcare facilities, children aged 3 to 5</i>	29.8	30.5	2.21	0.32

Subsidising grandmothers' time (ψ, g_1)	Baseline	$4g_1$	%var	$\frac{\%var}{\%tax}$
<i>Percentage of women being mothers</i>	44.6	48.6	8.68	0.96
<i>Employment rate of mothers, children aged 0 to 5</i>	58.5	63.4	8.08	0.90
<i>Employment rate of mothers, children aged 0 to 2</i>	51.2	58.2	12.8	1.42
<i>Employment rate of mothers, children aged 3 to 5</i>	65.8	68.7	4.23	0.47
<i>% of work-mothers using free care, children 0 to 2</i>	15.7	49.5	103	11.5
<i>% of work-mothers using free care, children 3 to 5</i>	11.6	41.3	112	12.4
<i>Ratio of mother's wage to women's wage</i>	1.18	1.19	0.69	0.08
<i>Hours in childcare facilities, children aged 0 to 2</i>	34.2	34.2	-0.02	0.00
<i>Hours in childcare facilities, children aged 3 to 5</i>	29.8	29.7	-0.5	-0.06

the labor market. The growth in the proportion of working mothers over mothers is particularly significant for women in the low and medium category: 13% and 11% respectively. This explains the drop in the ratio of mother’s wage to women’s wage, which decreases by close to 3% (see Table 9). This outcome agrees with the results in the empirical literature. For instance, Del Boca et al. (2009) found that “women who have made a lesser investment in human capital are likely to be in a relatively marginal position and, therefore, be more sensitive to changes in prices and, in particular to childcare availability”. It is also consistent with the results in Guner et al. (2020), who found that “expansions of child-related transfers lead to substantial changes in female labour supply, which are largest at the bottom of the skill distribution”.

It comes as a surprise that for women with tertiary education, fertility is not positively affected. According to Del Boca et al. (2009) ‘the impact of pro-natalist social and economic policies on the fertility choices of highly educated women is likely to be large, since these policies can be viewed as decreasing the opportunity cost of child-bearing that they face’. Accordingly, one would expect an increase in the number of mothers among women with tertiary education. This occurs for some college women married to non-college men, but this effect is compensated by the decrease in fertility of some women with tertiary education married to tertiary-education men, who do not qualify for the subsidy, but are particularly affected by the tax increase. This agrees with the results of Haan and Whrolich (2011), mentioned earlier in the related literature, who also concluded that childcare subsidies do not affect fertility on average, though with heterogenous effects.

Table 10: **Distributions by education under alternative scenarios**

Statistics	Baseline	$3\theta_y$	$(3\theta_y, \frac{1}{2} p_2^e)$	$4g_1$
<i>Mother’s distribution by education</i>				
$< hs$	19.7	20.5	19.4	19.5
hs	21.6	22.0	20.5	20.9
col	58.7	57.5	60.2	59.6
<i>Working mother’s distribution by education</i>				
$< hs$	6.97	7.88	9.45	7.5
hs	12.2	13.2	13.5	12.3
col	80.8	78.9	77.0	80.1
<i>Proportion of mothers/women</i>				
$< hs$	40.2	41.5	46.2	43.3
hs	45.6	46.2	50.7	48.2
$coll$	45.9	44.8	55.1	50.9
<i>Proportion of working mothers/mothers</i>				
$< hs$	20.7	23.6	31.4	24.6
hs	33.1	37.0	42.5	37.5
$coll$	80.6	84.1	82.4	85.3

4.3 Childcare subsidies in periods 1 and 2: the “double-subsidy”

The previous experiment did not affect the employment rates of mothers of children aged 3 to 5 years because only regular hours at school were subsidised and, in period 2, education (regular

hours) is universally provided. In order to explore this possibility, an “overtime” subsidy was added, this time for the cost of after-school hours directed to mothers of children aged 3 to 5 years, p_2^e . This subsidy might be more relevant for women with tertiary education because they tend to work longer hours. The value of this additional subsidy is set so that the aggregate employment rate of mothers of children aged 2 years or younger meets the previous target. Subsidising half of after school hours, $(\frac{1}{2} p_2^e)$, in addition to the previous childcare subsidy in period 1, $(3\theta_y)$, achieves this target but requires an adjustment in tax rates of about 7%.²⁹

The effects of this “double-subsidy” are displayed in the middle panel in Table 9. The percentage of women being mothers increases substantially, from 44.6 to 52.2 percent, especially for women not helped by their grandmothers, which grows by 17.5 percent. As expected, the additional subsidy induces more women to have children, especially women with tertiary education: the proportion of mothers over women rises by 18% for college women, while for women in the low and medium category, it increases by 14% and 10.5%, respectively (see Table 10).

Regarding employment effects, the reduction in the cost of after school hours increases the employment rate of mothers of children aged 3 to 5 years by 7%, especially that of women in the low and medium category: the proportion of working mothers over mothers rises by 41% and 25% for women in the low and medium category, respectively, and by only 2% for women with tertiary education (see Table 10). This might be surprising, but it is due to the increase in the fertility rate of women with tertiary education, which compensates to some extent the growth in the labor involvement of these type of women. These effects have an impact on the distributions of women according to education levels. Table 10 shows that college mothers gain weight in the distribution of mothers, while women in the low and medium category do so in the distribution of working mothers, a finding consistent with the results by Del Boca et al. (2009) mentioned before.

Concerning childcare use, cheaper access to formal childcare reduces the percentage of working mothers using free care by 30% and 23% in periods one and two, respectively. As in the previous scenario, the number of hours spent in childcare facilities by children aged 2 years or younger decreases by 6% because women work on average fewer hours in period 1. Conversely, the number of hours spent in childcare facilities by children aged 3 to 5 years goes up, because women work on average more in period 2 given that childcare has become much cheaper. This latter fact is especially relevant for women with tertiary education who tend to work longer hours. These changes in working hours affect wages: the ratio of mother’s working wage to women’s working wage decreases by roughly 2.5%. This drop is more notable in the first period because in the second, women with tertiary education tend to work more hours and this compensates to some extent.

With regard to heterogeneous effects by education of the match pair, most women with tertiary education married to men without tertiary education, and not helped by their grandmothers, work more hours in the second period, as a result of the cheaper access to after- school care. Only those who decide to become mothers work for the minimum number of hours. High school women and women in the low category married to men in the low category show the same behavior. Conversely, low-education women married to high school or college men, and not helped by their grandmothers, are not affected by this policy. Most of them either work fulltime and decide not to have children or devote all their time to care for them. The reason is related to the low opportunity cost of not

²⁹The subsidy for after school hours paid by the government is given by the expression $\sum_{x=1}^{N_{nq}^2} I_{\{l_{x,2} > t_2^r\}} (l_{x,2} - t_2^r) \frac{p_2^e}{2}$. This term is only relevant in the case of mothers that work longer than regular hours in period 2 and that are not helped by grandparents. This term should be added to the right-hand side of the government budget constraint shown in Section 2.

participating in the market compared to the cost of childcare.

Interestingly, low-education women married to low-education men, and helped by their grandmothers, are very much affected. The reason is not linked to the policy itself but to the necessary adjustment in tax rates. Without the tax increase, these women would work longer hours. With the tax adjustment they decide to work less. These effects are relevant because they indicate that tax adjustments may have adverse effects and may have a different impact depending on the educational group, a fact that need to be taken into account.

4.4 Subsidising grandmothers' time

In some countries such as Germany and Great Britain, there have been some proposals concerning granny leaves that would allow for parental leaves to be shared with mothers. As Rupert and Zanella (2018) claim “every employed family member who is a potential source of childcare would benefit from a temporary leave for childcare duties”. The idea behind granny leaves is to encourage the use of family time in the care of children by means of subsidising grandmothers' time. This policy, by freeing up the time mothers need to care for their children and by simultaneously reducing childcare costs, could positively affect both married mothers's employment and fertility.

In the following paragraphs, I explain how subsidies on grandmothers' time are introduced in the model, and how to compute the fiscal cost associated to this policy. To keep the analysis tractable, I abstain from modelling the endogenous decision of whether to provide childcare or not from the point of view of the grandmother.³⁰ The idea is that a certain fraction of grandmothers in the economy receive a subsidy to care for their grandchildren. The amount of the subsidy is computed as the product of their daughter's hourly wage and their daughter's working hours (for which they need childcare).³¹ The value of the grandmother availability parameter is set exogenously, together with the value of the subsidy, to meet the employment targets such that this experiment is comparable to the previous ones. The exercise is done in such a way that taxes adjust to finance the granny subsidy so that the fiscal balance stays the same. Grandmother availability turns out to be four times larger than in the baseline economy ($4g_1$), tax rates 9% higher and the subsidy received by grannies a third of their daughter's wage ($\psi = 1/3$).

The bottom panel of Table 9 shows the effects of the rise in the probability of grandmother-provided childcare for mothers of children aged 2 years or younger, from 8.5% in the baseline to 34%. This policy generates a 13% increase in the employment rate of these mothers and a 4% increase in the employment rate of mothers of children aged 3 to 5 years. Fertility is also significantly affected: the percentage of mothers increases by almost 9%. Consequently, the percentage of working mothers with children aged 5 years or younger, who use grandmother-provided childcare, increases from 13% to 45%. Greater access to informal childcare allows more women to reconcile work and family. These results are consistent with the previous empirical analysis, where it was established that there is a positive association between making use of grandparents and labor force participation (see Table 2 in Section 3.1).

Having greater access to grandmother provided childcare, not only positively affects the female

³⁰The paper is not about capturing the trade-offs faced by grandmothers, but about those of the mothers. Modelling the decision of grandmothers would generate considerable technical difficulties and would not add much to the study of the effectiveness/elasticity of these policies. Of course, I am aware of this shortcoming, but I consider this contribution as a first approximation to this problem.

³¹To impute the wage I make the extreme assumption that the grandmother's level of education is the same as her daughter's based on the low degree of intergenerational mobility in education reported by the OECD (2018).

employment rate, but also the fertility rate. As in the previous experiments, the increase in the number of mothers is mostly accounted for by women with tertiary education: the proportion of mothers over women raises by 10 percent for college women, while it increases by 7 and by 5 percent for women in the low and medium category, respectively (see Table 10).

Conversely, the positive effects on employment are concentrated among women with non-tertiary education, in line with the positive association between making use of grandparents and labor force participation for low-education women showed in Table 2 in Section 3.1. The proportion of working mothers over mothers increases by 17% and 12% percent for women in the low and medium category, respectively. Concerning women with tertiary education, the rise in the proportion of working mothers over mothers is more modest for two reasons. First, as in the “double-subsidy” scenario, the rise in the fertility rate compensates to some extent the growth in labour involvement. And second, more than 80 percent of women with tertiary education were already working in the baseline. For women in the high category the availability of grandmothers is not as essential as for low-education women because they earn higher wages and, consequently, can afford paying for formal childcare. In addition they face higher opportunity costs of not working, i.e. staying at home and caring for their children is too costly in terms of forgone wages. Note that, on average, childcare hours at childcare facilities drop, especially in period 2. The reason is again linked to the growth in labour force participation of low-education women, who, on average work fewer hours.

4.5 Comparing childcare subsidies and subsidies on grandmothers’ time

If we compare the results of subsidising formal childcare and grandmothers’ time, the combination of both types of childcare subsidies, i.e. a “*double-subsidy*” turns out to be more effective than the granny subsidy in terms of mothers labour force participation and fertility.³²

For each additional point increase in taxes, the aggregate employment and fertility rates in the double-subsidy scenario increase by 1.35 and 2.25 percent against 0.9 and 0.96 percent in the granny subsidy experiment (see these elasticities in the last column in Table 9). However, both experiments require a substantial tax adjustment, 7% and 9%, respectively. If the aim is just to raise the employment rate of mothers of children aged 2 years or younger, subsidising childcare costs only in the first period is more effective because the fiscal effort is lower: for each additional point increase in taxes, the employment rate of mothers of children aged 2 years or younger goes up by 4.36 against 1.73 percent in the case of the double-subsidy experiment and 1.42 in the case of the granny subsidy experiment. The reason for this difference in terms of effectiveness is due to the higher fiscal effort that needs to be made in those scenarios to finance either half of the costs of after school hours or grandmothers’ time.

Regarding the heterogeneous effects, the subsidy experiments seem to favour the employment rate of women without tertiary education or women married to non-tertiary educated men the most. The reason is quite simple. Subsidies for childcare costs in the first period depend on family income; therefore, high income families do not qualify for them. By contrast, the greater availability of grandparents does not depend on income. These institutional differences generate variations in the distribution of working mothers by the level of education. In particular, women with tertiary education lose less weight in the distribution of working mothers in the granny subsidy scenario. For instance, the growth in the proportion of college working mothers to college mothers in the

³²The effectiveness is measured by computing the elasticity of the relevant variables to the fiscal effort measured by the necessary tax increase.

granny subsidy experiment is 5.6% against 2.2% in the double-subsidy scenario.

The results obtained in this analysis contrast to what other authors have suggested. For instance, Cardia and Ng (2003) claim that subsidising grandparents' time is the most effective childcare policy. When they compare the effects of time transfers to that of money transfers, they arrive at the conclusion that money transfers may decrease female labour supply because the income effect can compensate the substitution effect. This result stems from the fact that money transfers are not made contingent on female employment. This is not the case in the present study. It is true that average working hours decrease, but the fact that more mothers participate more than compensates. Furthermore, Cardia and Ng (2003) do not compute the fiscal cost of the policy, which, here, is found to be quite significant. Rupert and Zanella (2018) also held the opinion that childcare subsidies may not be very successful. They claim that "when grandparents are providing for a substantial portion of childcare needs, a policy expanding the public provision of childcare may affect the labour supply of young women only marginally, due to the substitution between informal and formal childcare". This does not occur here. The drop in the percentage of mothers using free care is basically driven by the fact that more women decide to work.

All in all, according to the model, subsidies on grandmothers' time do not seem to deliver better results than childcare subsidies because they are less effective/more costly. In addition, implementing a granny leave policy in the real world may be very difficult because the reasons why grandmothers do not help with their grandchildren may not be all due to the lack of monetary incentives. Rather, other caring duties (to other children, to their partner or to their own elderly relatives), their physical ability to care for a child (due to the prevalence of chronic illness or other health problems) may also play a role. Another factor that may undermine the importance of monetary incentives is social norms. Southern European grandmothers were likely helped by their own grandmothers and will then tend to feel like their duty to help with their care. How much do these factors matter versus opportunity costs is uncertain, and out of the scope of this paper, but on the future agenda. Finally, considerations related to the progressivity of these policies would also seem to favour childcare subsidies versus subsidies on grandmothers' time.

5 Robustness exercises

In this section I perform some robustness concerning the childcare policies available in the baseline model. I quantify to what extent childcare subsidies account for married mother's employment and fertility by removing them completely. I also explore the quantitative importance of the tax credit introduced in 2003 by doing a similar exercise.

5.1 No subsidy for working mothers of children aged 2 years or younger

Some authors, Bick (2016) among others, claim that the rise in maternal employment is too small to conclude that the lack of subsidised childcare accounts for the low labor force participation of mothers with children aged 2 years or younger in Germany. In this section, the childcare subsidy for working mothers of children aged 2 years or younger is removed to test this hypothesis for the case of Spain.

The upper panel in Table 11 shows that the effects are non-negligible. The employment rate of mothers of children aged 2 years or younger drops by 27 percent, while that of mothers of children 3 to 5 years is also significantly reduced (by close to 14%). Furthermore, the fact that childcare costs

have become more expensive makes the use of free care by grandmothers more prevalent, mainly in the first period: the percentage of working mothers using free care for children aged 2 years or younger rises by 10 percentage points.

Average hours worked raise considerably. This is not driven by the fact that women - not helped by grandmothers and on the verge of participation - stop working when the subsidy is removed. This is only the case for one type of match (see the appropriate policy function in the Appendix). It is mainly driven by women - not helped by grandmothers and married to non-college men - who decide not to have a child and therefore work fulltime; and by mothers (also not helped by grandmothers and married to non-college men) who work more hours in the first period as a result of the income effect generated by the elimination of the subsidy. This last behavior explains the substantial rise in the number of hours that children aged 2 years or younger spend on childcare facilities, around 7%, despite the elimination of the subsidy. Conversely, mothers married to tertiary-education men are not affected because they do not qualify for the subsidy in the baseline scenario. Regarding fertility, the percentage of women being mothers goes down substantially, particularly that of women not helped by grandmothers which drops by 25%.

These changes in employment and fertility rates are different in magnitude depending on the educational category. The most responsive groups are women married to men without tertiary education and women with tertiary education. For women married to men without tertiary education, childcare subsidies are needed to finance childcare costs and to reconcile work and family. For college women, opportunity costs play a significant role. Table 12 shows that mothers without tertiary education are the main losers in terms of employment because they are more sensitive to the price: the proportion of working mothers over mothers falls by 100% and 78% for low and medium education women, respectively; for college women it drops by only 7%. This, in turn, affects the rate of mother's wage to women's wage, which goes up by 3.4% (see Table 11), since college women gain more weight in the distribution of working mothers. On the other hand, women with tertiary education are much more affected in terms on fertility because of the higher opportunity costs of having children in terms of forgone wages: the proportion of mothers over women falls by 23% for college women, while that of non-college women falls by only 16%.

5.2 No Tax Credit for working mothers of children aged 2 years or younger

A monthly cash benefit of 100 euros for working mothers of children aged up to three was introduced in 2003 (Ley 46/2002 de 18 de Diciembre 2002). Some authors, Azmat & González (2010) and Sánchez-Mangas & Sánchez-Marcos (2008), have found evidence of positive effects of this policy on fertility and on the employment rate of mothers with small children. Table 11 shows the effects of removing this tax credit for working mothers of children aged 2 years or younger. The aggregate effects on employment are similar to the ones in the previous scenario, but lower in magnitude. The elimination of this transfer not only affects women not helped by grandmothers, as in the previous scenario, but also those helped by grandmothers because this cash benefit is linked to employment, not to childcare expenses. The only requirement for mothers of children aged 2 years or younger is to be employed. This cash transfer is not income related.

The middle panel in Table 11 shows that the employment rates of mothers in the first and second period fall significantly, 19% and 10%, respectively. Fertility is also substantially reduced, especially for mothers not helped by grandmothers, which drops by 18%. Women are affected differently depending on whether they have access to free care or not. Most women helped by grandmothers work longer hours due to the income effect generated by the elimination of the

Table 11: **Robustness**

No childcare subsidy in period 1	Baseline	$\theta_y = 0$	%var
<i>Employment rate of mothers, children aged 0 to 2</i>	51.2	39.9	-27.1
<i>Employment rate of mothers, children aged 3 to 5</i>	65.8	57.4	-13.7
<i>Ratio of mother's wage to women's wage</i>	1.18	1.22	3.43
<i>% of work-mothers using free care, children 0 to 2</i>	15.7	25.8	48.3
<i>% of work-mothers using free care, children 3 to 5</i>	11.6	16.7	35.7
<i>Hours in childcare facilities, children aged 0 to 2</i>	34.2	36.7	7.06
<i>Hours with grandmothers, children aged 0 to 2</i>	30.5	30.5	0.0
<i>Percentage of women being mothers</i>	44.6	35.8	-22.0
<i>% of women being mothers, helped by grannies</i>	57.5	57.5	0.0
<i>% of women being mothers, not helped by grannies</i>	43.4	33.8	-25.0

No tax credit in period 1	Baseline	$T = 0$	%var
<i>Employment rate of mothers, children aged 0 to 2</i>	51.2	42.5	-18.6
<i>Employment rate of mothers, children aged 3 to 5</i>	65.8	59.8	-9.58
<i>Ratio of mother's wage to women's wage</i>	1.18	1.17	-1.09
<i>% of work-mothers using free care, children 0 to 2</i>	15.7	21.2	29.6
<i>% of work-mothers using free care, children 3 to 5</i>	11.6	14.4	20.8
<i>Hours in childcare facilities, children aged 0 to 2</i>	34.2	36.7	6.87
<i>Hours with grandmothers, children aged 0 to 2</i>	30.5	32.3	5.80
<i>Percentage of women being mothers</i>	44.6	37.9	-16.2
<i>% of women being mothers, helped by grannies</i>	57.5	55.4	-3.70
<i>% of women being mothers, not helped by grannies</i>	43.4	36.3	-17.8

Table 12: **Distributions by education under alternative scenarios**

Statistics	Baseline	$\theta_y = 0$	$T = 0$
<i>Mother's distribution by education</i>			
$< hs$	19.7	21.0	21.3
hs	21.6	21.1	23.0
col	58.7	57.9	55.7
<i>Working mother's distribution by education</i>			
$< hs$	6.97	2.94	5.67
hs	12.2	6.45	11.7
col	80.8	90.6	86.6
<i>Prop. mothers/women</i>			
$< hs$	40.2	34.2	36.9
hs	45.6	35.8	41.3
$coll$	45.9	36.4	37.1
<i>Prop. work-mothers/mothers</i>			
$< hs$	20.7	6.77	13.6
hs	33.1	14.7	26.1
$coll$	80.6	75.4	75.8

transfer. This explains why the use of free care by grandmothers becomes more prevalent: the percentage of working mothers using free care grows on average by 25%. Only some women with tertiary education, married to low-education men, and who earn very high wages decide not to have children and work all their disposable time (see the relevant policy function in the Appendix). The reasons are twofold: firstly, these women have very high opportunity costs of not working; and secondly, the loss of the cash benefit matters a lot given their partner's low income. Women not helped by grandmothers also present mixed behaviors: some of them work more hours to compensate for the loss of income, but a non-negligible number, especially women with tertiary education, decide not to have a child and work fulltime. On average, the removal of the cash transfer raises the number of hours children spend with grandparents and in childcare facilities in period 1 by 6% since some mothers tend to work longer to compensate for the loss of income.

As in the previous experiment, the changes in employment and fertility rates are different in magnitude depending on the educational category. Table 12 shows that again, women without tertiary education are the main losers in terms of employment, while women with tertiary education are much more affected in terms of fertility.

6 Conclusion

The question of the most effective policies allowing parents to reconcile work and family are currently at the center of policy debates. The framework developed in this paper has allowed us to compare the effects of childcare subsidies versus subsidising grandmothers' time on female workforce participation and fertility rates. The case of Spain was chosen to illustrate these effects for several reasons. First, childcare is very expensive and grandmother-provided childcare is fairly widespread.

And second, the low fertility rates and the low degree of participation of young mothers in the labor force are a matter of concern for the sustainability of the social security system.

To address this question, a model economy populated by married households that make employment and fertility decisions has been used as a framework. The model was calibrated so as to match certain statistics related to female labor force participation of mothers with young children, fertility, the composition of formal versus informal child care and childcare costs. The study, through a series of experiments, quantified the relative effectiveness of changes in grandmother availability (by means of granny subsidies) and childcare subsidies for young mothers' rates regarding labor force participation and fertility, paying special attention to heterogeneous effects.

The work produced some interesting findings. From a policy perspective, if the objective is simply to rise the employment rate of mothers of children aged 2 years or younger, emulating the Swedish model, i.e. devoting more resources to subsidising formal childcare for children aged 2 years or younger seems the best option. And this, for several reasons. On the one hand, subsidising grandmothers' time is more expensive in terms of the fiscal adjustment and also difficult to implement. If the aim is also to reverse the decline in fertility rates, the "double-subsidy" may be worth taken into account, despite being more expensive.

Concerning heterogeneous effects, in all the experiments, the increase in labor force participation was mainly accounted for by the behavior of women without tertiary education, while that of fertility was accounted for by the behavior of women with tertiary education. In fact, childcare policies are not neutral from a distributional point of view. Less educated women are more sensitive to changes in costs than women with more education and better labor market opportunities, a finding that is consistent with economic theory and with previous empirical analysis. What's more, tax adjustments may have adverse effects, especially on couples without tertiary education, a fact that need to be taken into account. Considerations related to the progressivity of these policies would also seem to favour income-related childcare subsidies. In fact, Guner et al. (2020) have found that expanding childcare subsidies generate substantial welfare gains, which are largest for less skilled households.

One should naturally be cautious about pushing these conclusions too far. To properly evaluate the benefits and costs of subsidising grandmothers' time and childcare subsidies, apart from performing a proper welfare analysis, additional aspects should be modelled. The most obvious is grandmothers' labour supply decisions to capture the trade-offs faced by them. However, making the labour supply decision of grandmothers endogenous will be no panacea. As stated previously, the reasons why grandmothers may decide not to care for their grandchildren may not all be related to monetary incentives. Rather, other caring duties (to other children, to their partner or to their own elderly relatives), their physical ability to care for a child (due to the prevalence of chronic illness or other health problems) may also play a role. Another factor that may undermine the importance of monetary incentives is social norms. Southern European grandmothers were likely helped by their own grandmothers and will then tend to feel like their duty to help with their care. How much do these factors matter versus opportunity costs is uncertain, and out of the scope of this paper.

Moreover, suppose we overcome the previous caveat, there is still some controversy over whether mothers should rely on grandmothers to care for their children. Who should work? Factors, such as returns to experience, could tip the balance in favour of the granny leave policy because of the adverse consequences for mothers of being absent from the labour force for a long time to care for their children. This type of analysis would require introducing dynamic aspects, such as skill

depreciation, that are absent in this paper. Given that the treatment of the granny leave policy is incomplete (for all these reasons), this paper should be considered as a first approximation in terms of cost/elasticity of these policies.

Finally, further empirical research concerning the relative value of time spent in formal versus informal childcare is needed. This question is important because grandmother and formally provided childcare might not be perfect substitutes.³³ If one turns out to be better than the other, the modelling of the choice of childcare would be relevant in this context. These avenues of research are beyond the scope of this paper, though on the agenda of future analysis.

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³³See Peisner-Feinberg et al. (2001) for a discussion about the long-term influences of the quality of childcare environments on children's cognitive and social skills.

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APPENDIX: POLICY FUNCTIONS

Baseline															
lm1_acgx =	1.0000	1.0000	1.0000	0	0	0	0	0	0	0	0	0	0	0	0
	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0	0	0	0	0	0	0
	0.4500	0.4200	1.0000	1.0000	1.0000	1.0000	0	0	0	0	0	0	0	0	0
	0.5248	0.4726	0.4200	1.0000	1.0000	1.0000	1.0000	1.0000	0	1.0000	0	1.0000	0	0	0
	0.5890	0.5439	0.4960	0.4430	1.0000	0.4692	0.4200	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0	0	0	0	0	0	0
	0.5167	0.4517	0.4000	1.0000	1.0000	1.0000	1.0000	0	0	0	0	0	0	0	0
	0.5263	0.4742	0.4200	1.0000	1.0000	1.0000	1.0000	1.0000	0	1.0000	0	1.0000	0	0	0
	0.5903	0.5453	0.4975	0.4448	1.0000	0.4710	0.4200	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
	0.6507	0.6094	0.5649	0.5183	0.4675	0.5410	0.4921	0.4393	1.0000	1.0000	0.4200	1.0000	1.0000	1.0000	0
	0.5830	0.5376	0.4892	0.4350	1.0000	0.4614	0.4200	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
	0.6347	0.6020	0.5570	0.5100	0.4589	0.5329	0.4837	0.4298	1.0000	1.0000	0.4200	1.0000	1.0000	1.0000	0
	0.6976	0.6617	0.6224	0.5790	0.5310	0.6002	0.5544	0.5039	0.4491	1.0000	0.4820	0.4256	1.0000	1.0000	0
	1.0000	0.7127	0.6773	0.6399	0.5986	0.6581	0.6187	0.5755	0.5247	0.4683	0.5557	0.5022	0.4463	1.0000	1.0000
	1.0000	0.7614	0.7292	0.6951	0.6569	0.7118	0.6756	0.6353	0.5908	0.5422	0.6176	0.5714	0.5233	0.4711	0.4200
lm1_acngx =	1.0000	1.0000	1.0000	0	0	0	0	0	0	0	0	0	0	0	0
	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0	0	0	0	0	0	0
	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0	0	0	0	0
	0.5338	0.4804	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0
	0.5976	0.5516	0.5061	0	1.0000	0.4793	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
	1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0	0	0	0	0	0
	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0	0	0	0	0
	0.5354	0.4821	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0
	0.5989	0.5430	0.5075	0	1.0000	0.4810	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
	1.0000	0.6213	0.5755	0.5275	0	0.5509	0.5006	0	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
	0.5916	0.5452	0.4994	1.0000	1.0000	0.4714	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
	0.6567	0.6138	0.5675	0.5192	0	0.5427	0.4921	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
	1.0000	1.0000	0.6331	0.5394	0.5887	0.6104	0.5634	0.5117	0	1.0000	0	1.0000	1.0000	1.0000	0
	1.0000	1.0000	1.0000	0.6096	1.0000	1.0000	0.6303	0.5857	0.5342	0	0.5661	0.5110	0	1.0000	1.0000
	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.6459	0.6001	0.5501	0.6277	0.5802	0.5306	0	1.0000
lm2_acgx =	1.0000	1.0000	1.0000	0	0	0	0	0	0	0	0	0	0	0	0
	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0	0	0	0	0	0	0
	0.4934	0.4299	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0	0	0	0	0
	0.6305	0.5824	0.4510	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0
	1.0000	1.0000	0.5305	0.4754	1.0000	0.5028	0.4419	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
	0.4951	0.4317	1.0000	1.0000	0	1.0000	0	0	0	0	0	0	0	0	0
	0.5694	0.5146	0.4529	1.0000	1.0000	1.0000	1.0000	1.0000	0	1.0000	0	1.0000	0	0	0
	0.6318	0.5838	0.5320	0.4773	1.0000	0.5043	0.4438	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
	0.6902	0.6472	0.6002	0.5505	0.4955	0.5223	0.4646	1.0000	1.0000	1.0000	0.4396	1.0000	1.0000	1.0000	0
	0.6246	0.5760	0.5237	0.4670	1.0000	0.4958	0.4331	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
	0.6836	0.6399	0.5924	0.5421	0.4865	0.5667	0.5136	0.4554	1.0000	1.0000	0.4292	1.0000	1.0000	1.0000	0
	0.7331	0.6959	0.6556	0.6115	0.5608	0.6338	0.5856	0.5319	0.4726	1.0000	0.5083	0.4468	1.0000	1.0000	1.0000
	1.0000	0.7450	0.7084	0.6696	0.6264	0.6886	0.6475	0.6020	0.4995	0.4905	0.5821	0.5268	1.0000	1.0000	1.0000
	1.0000	0.7912	0.7584	0.7234	0.6841	0.7406	0.7034	0.6617	0.6153	0.5642	0.6433	0.5950	0.5442	0.4908	0.4288

4.2 Childcare subsidy for children aged 2 years or younger

[illegible][illegible][illegible]

[illegible][illegible]

[illegible]

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kidacg =
```

4.3 Double_subsidy

[illegible][illegible][illegible]

[illegible][illegible][illegible]

4.3 Double subsidy with tax adjustment

1m1_acgx =														
1.0000	1.0000	1.0000	0	0	0	0	0	0	0	0	0	0	0	0
1.0000	1.0000	1.0000	1.0000	0	0	0	0	0	0	0	0	0	0	0
0.4479	0	1.0000	1.0000	1.0000	1.0000	0	0	0	0	0	0	0	0	0
0.5224	0.4706	0.4200	1.0000	1.0000	1.0000	1.0000	0	1.0000	0	1.0000	0	0	0	0
0.5861	0.5415	0.4944	0.4421	1.0000	0.4680	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0
1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0	0	0	0	0	0
0.4495	0.4200	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0	0	0	0	0
0.5239	0.4722	0.4200	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0	0	0	0	0
0.5874	0.5429	0.4958	0.4439	1.0000	0.4697	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0
0.6473	0.6063	0.5623	0.5166	0.4669	0.5388	0.4910	0.4394	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
0.5801	0.5353	0.4875	0.4342	1.0000	0.4601	0.4200	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0
0.6403	0.5989	0.5545	0.5084	0.4585	0.5308	0.4827	0.4299	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
0.6938	0.6583	0.6193	0.5766	0.5294	0.5975	0.5524	0.5029	0.4492	1.0000	0.4814	0.4261	1.0000	1.0000	0
0.7410	0.7085	0.6734	0.6367	0.5963	0.6546	0.6160	0.5737	0.5236	0.4682	0.5541	0.5015	0.4469	1.0000	1.0000
1.0000	0.7566	0.7247	0.6910	0.6535	0.7075	0.6718	0.6322	0.5886	0.5410	0.6148	0.5696	0.5228	0.4721	0.4200

1m1_acngx =														
1.0000	1.0000	1.0000	0	0	0	0	0	0	0	0	0	0	0	0
1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0	0	0	0	0	0
0.4479	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0	0	0	0	0
0.5224	0.4706	0.4200	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0
0.5861	0.5415	0.4977	0.4452	1.0000	0.4713	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0
1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0	0	0	0	0	0
0.4495	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0	0	0	0	0
0.5239	0.4722	0.4200	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0
0.5874	0.5429	0.4991	0.4469	1.0000	0.4730	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0
0.6516	0.6102	0.5658	0.5196	0.4694	0.5421	0.4938	0.4417	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
0.5801	0.5353	0.4875	0.4372	1.0000	0.4635	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0
0.6446	0.6028	0.5580	0.5115	0.4610	0.5341	0.4855	0.4325	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
0.6977	0.6620	0.6228	0.5798	0.5322	0.6008	0.5554	0.5055	0.4578	1.0000	0.4838	1.0000	1.0000	1.0000	0
1.0000	0.7121	1.0000	0.6492	0.6074	1.0000	0.6277	0.5840	0.5333	0	0.5648	0.5105	0	1.0000	1.0000
1.0000	1.0000	1.0000	1.0000	0.6648	1.0000	1.0000	0.6429	0.5980	1.0000	0.6250	0.5784	1.0000	0	1.0000

1m2_acgx = TAX														
1.0000	1.0000	1.0000	0	0	0	0	0	0	0	0	0	0	0	0
1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0	0	0	0	0	0
0.4918	0.4286	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0	0	0	0	0
0.5662	0.5115	0.4501	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0
0.6281	0.5804	0.5292	0.4751	1.0000	0.5020	0.4420	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0
1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0	0	0	0	0	0
0.4935	0.4305	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0	0	0	0	0
0.5676	0.5132	0.4520	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0
0.6294	0.5818	0.5307	0.4770	1.0000	0.5035	0.4439	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0
0.6874	0.6446	0.5981	0.5492	0.4952	0.5731	0.5215	0.4649	1.0000	1.0000	0.4404	1.0000	1.0000	0	0
0.6222	0.5741	0.5225	0.4667	1.0000	0.4951	0.4333	1.0000	1.0000	1.0000	1.0000	0	0	0	0
0.6807	0.6374	0.5903	0.5409	0.4864	0.5650	0.5129	0.4559	1.0000	1.0000	0.4303	1.0000	1.0000	0	0
0.7298	0.6928	0.6530	0.6096	0.5596	0.6315	0.5841	0.5313	0.4730	1.0000	0.5081	0.4478	1.0000	1.0000	1.0000
0.7747	0.7413	0.7050	0.6667	0.6243	0.6854	0.6450	0.6004	0.5500	0.4908	0.5810	0.5265	0.4678	1.0000	1.0000
1.0000	0.7870	0.7544	0.7198	0.6810	0.7367	0.7000	0.6589	0.6133	0.5632	0.6408	0.5934	0.5438	0.4923	0.4312

4.4 Granny leave

[illegible][illegible][illegible]

[illegible][illegible]

4.4 Granny leave with tax adjustment

1m1_acgx =														
1.0000	1.0000	1.0000	0	0	0	0	0	0	0	0	0	0	0	0
1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0	0	0	0	0	0
0.4472	0	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0	0	0	0	0	0
0.5217	0.4700	0.4200	1.0000	1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0	0
0.5852	0.5408	0.4939	0.4419	1.0000	0.4676	0.4200	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0	0	0	0	0	0
0.4489	0.4200	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0	0	0	0	0
0.5232	0.4716	0.4200	1.0000	1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0	0
0.5865	0.5422	0.4953	0.4436	1.0000	0.4693	0.4200	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
0.6463	0.6054	0.5616	0.5161	0.4667	0.5382	0.4907	1.0000	1.0000	0.4200	1.0000	1.0000	1.0000	1.0000	0
0.5793	0.5346	0.4870	0.4339	1.0000	0.4598	0.4200	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0
0.6394	0.5980	0.5538	0.5080	0.4583	0.5303	0.4824	0.4300	1.0000	1.0000	0.4200	1.0000	1.0000	1.0000	0
0.6927	0.6573	0.6184	0.5759	0.5290	0.5967	0.5519	0.5026	0.4492	1.0000	0.4812	0.4263	1.0000	1.0000	1.0000
0.7397	0.7073	0.6723	0.6358	0.5957	0.6536	0.6152	0.5732	0.5233	0.4683	0.5537	0.5013	0.4471	1.0000	1.0000
1.0000	0.7552	0.7234	0.6898	0.6525	0.7062	0.6707	0.6313	0.5879	0.5407	0.6140	0.5691	0.5226	0.4725	0.4200

1m1_acngx =														
1.0000	1.0000	1.0000	0	0	0	0	0	0	0	0	0	0	0	0
1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0	0	0	0	0	0
1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0	0	0	0	0
0.5309	0.4780	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0
0.5940	0.5486	0.5041	0	1.0000	0.4779	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0	0	0	0	0	0
1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0	0	0	0	0
0.5324	0.4797	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0
0.5953	0.5500	0.5055	0	1.0000	0.4796	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
0.6595	0.6175	0.5723	0.5256	0	0.5483	0.4993	0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0
0.5881	0.5423	0.4941	1.0000	1.0000	0.4700	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0
0.6526	0.6101	0.5645	0.5174	0	0.5403	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
1.0000	0.6685	0.6293	0.5858	0.5376	0.6070	0.5611	0.5105	0	1.0000	0	1.0000	1.0000	1.0000	0
1.0000	1.0000	1.0000	0.6483	0.6068	1.0000	0.6270	0.5835	0.5331	0	0.5644	0.5104	0	1.0000	1.0000
1.0000	1.0000	1.0000	1.0000	0.6638	1.0000	1.0000	0.6420	0.5974	0.5487	0.6243	0.5779	0.5301	0	1.0000

1m2_acgx =														
1.0000	1.0000	1.0000	0	0	0	0	0	0	0	0	0	0	0	0
1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0	0	0	0	0	0
0.4914	0.4283	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0	0	0	0	0
0.5657	0.5111	0.4499	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0
0.6274	0.5798	0.5288	0.4750	1.0000	0.5018	0.4421	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0	0	0	0	0	0
0.4930	0.4301	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0	0	0	0	0
0.5671	0.5127	0.4517	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	1.0000	0	0	0	0
0.6287	0.5812	0.5303	0.4769	1.0000	0.5033	0.4440	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0	0
0.6866	0.6438	0.5975	0.5488	0.4951	0.5726	0.5213	0.4650	1.0000	1.0000	0.4407	1.0000	1.0000	1.0000	0
0.6216	0.5735	0.5221	0.4666	1.0000	0.4949	0.4333	1.0000	1.0000	1.0000	1.0000	1.0000	0	0	0
0.6799	0.6366	0.5897	0.5405	0.4864	0.5646	0.5127	0.4561	1.0000	1.0000	0.4307	1.0000	1.0000	1.0000	0
0.7288	0.6919	0.6523	0.6090	0.5593	0.6308	0.5836	0.5311	0.4732	1.0000	0.5080	0.4480	1.0000	1.0000	1.0000
0.7736	0.7402	0.7040	0.6659	0.6238	0.6845	0.6443	0.6000	0.5498	0.4909	0.5806	0.5264	0.4681	1.0000	1.0000
1.0000	0.7858	0.7532	0.7187	0.6801	0.7356	0.6990	0.6581	0.6128	0.5629	0.6401	0.5929	0.5437	0.4927	0.4322

[illegible][illegible]

5.1 No childcare subsidy for working mothers of children aged 2 years or younger

[illegible][illegible][illegible]

[illegible]

5.2 No tax credit for working mothers of children aged 2 years or younger

[illegible][illegible][illegible]

[illegible][illegible][illegible]