Comparing the effectiveness of fiscal stimuli for working parents

Henk-Wim de Boer[*], Egbert L.W. Jongen[†], Jan Kabatek[‡]

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Preliminary and unfinished work – do not quote

Abstract

We estimate a structural model for household labour supply and childcare use. Using the estimated structural parameters we simulate the effect of changes in childcare subsidies and in-work tax credits. We consider the effect on labour participation, the income distribution and government finances. External validation of the structural model comes from a comparison of a simulation of the policy reforms in our data period with the estimates from a difference-in-differences analysis on the same reforms. Childcare subsidies and in-work tax credits are about equally effective in stimulating labour supply of working parents, but the ex-post budgetary costs of childcare subsidies are high. Both policies are more effective than a general in-work tax credit for all workers.

JEL classification codes: C25, C52, H31, J22

Keywords: Discrete choice models, household labour supply, latent classes, childcare subsidies, in-work tax credits

[*]VU University Amsterdam / CPB Netherlands Bureau for Economic Policy Analysis. P.O. Box 80510, 2508 GM The Hague. Email: H.W.de.Boer@cpb.nl Phone: +31-70-3386152. Corresponding author. We have benefitted from comments and suggestions by Hans Bloemen, Arthur van Soest and seminar participants at CPB Netherlands Bureau for Economic Policy Analysis. Remaining errors are our own. We are grateful to the Ministry of Social Affairs and Employment for co-financing the construction of the dataset by Statistics Netherlands.

[†]CPB Netherlands Bureau for Economic Policy Analysis. Email: E.L.W.Jongen@cpb.nl

[‡]Tilburg University and Netspar. Email: j.kabatek@uvt.nl

1 Introduction

Many countries want to increase the labour participation of women to reduce the gender gap in participation rates and to improve the sustainability of public finances. The participation rates of men and women start to diverge after children are born. Two key fiscal instruments that are used to stimulate the labour participation of especially mothers with young children are childcare subsidies and in-work tax credits. A substantial number of countries/states have expanded childcare subsidies and public pre-kindergarten programs over the past two decades[1], and/or have introduced or intensified tax credits for working parents.[2] However, what is the most effective way to stimulate the labour participation of young mothers remains rather unclear. Estimates of the labour supply effect of childcare subsidies range from basically no effect to large effects.[3] Studies on in-work tax credits typically find sizeable positive employment effects[4], but no comparison is made with the effectiveness of related fiscal policies.

In this paper we study the effectiveness of the two key fiscal policies targeted at working women, childcare subsidies and in-work tax credits, and also compare their effectiveness relative to a more general in-work tax credit for all workers. We first estimate a structural model for the simultaneous choice of household labour supply and formal childcare use. We study both couples with children and single parents. To deal with the kinks and non-convexities in the budget set (due to the tax-benefit system), we estimate a discrete choice model. We use a large administrative household panel data set on labour supply and the use of formal childcare in the Netherlands. We determine the discrete budget sets with a highly advanced tax-benefit calculator to determine net wages and childcare subsidies. The data period 2006-2009 covers a large reform of childcare subsidies and in-work tax credits for working parents. The joint reform has previously been studied by Bettendorf et al. (2012) using quasi-experimental methods (difference-in-differences), which allows for an external validation of our structural model.

Our main findings are the following. First, we find that childcare subsidies and EITCs for working parents are about equally effective in stimulating labour participation of work-

[1] Examples include Argentina, The Netherlands, Spain, Sweden, the province of Quebec in Canada, and the states of Georgia and Oklahoma in the US.

[2] Examples are the Combination Credit in the Netherlands, the Working Families' Tax Credit in the UK and the Earned Income Tax Credit in the US.

[3] E.g. Lundin et al. (2008), Fitzpatrick (2010) and Havnes and Mogstad (2011) find no effect, Bettendorf et al. (2012) find small effects, and Berlinski and Galiani (2007) and Lefebvre and Merrigan (2008) find large effects.

[4] For an overview of studies into the impact of the EITC in the US see Hotz and Scholz (2003), and for an overview of studies into the impact of the WFTC in the UK see Brewer and Browne (2006).

ing parents, when targeted at low income households. Second, both policies are more effective in stimulating labour participation than a general in-work tax credit for all workers. This is because part of the tax credit for all workers is targeted at relatively inelastic primary earners. Third, the predictions of the structural model are lower than with the quasi-experimental results (**PM**). Fourth, in-work tax credits and childcare subsidies are more effective when they are targeted at low income households, which also leads to lower income inequality. Finally, modeling unobserved heterogeneity by latent classes plays an important role in the results.

Our model builds on a large body of literature using structural models to analyze childcare subsidies and in-work tax credits. Blau and Currie (2006) review structural labour supply models with childcare. Recent applications include Kornstad and Thoresen (2007), Blundell and Shephard (2011), Gong and Breunig (2012) and Apps et al. (2012). For an analysis of changes in in-work tax credits see Brewer et al. (2006). We use a discrete choice model for household labour supply, which has become a popular way of dealing with the kinks and non-convexities in budget constraints, building on the work of e.g. Van Soest (1995), Keane and Moffitt (1998), Blundell et al. (2000) and Blundell and Shephard (2011). An important element in the empirical analysis is the role played by unobserved heterogeneity. We consider the conventional random preference specification also used in the papers cited above, and the more recent latent classes approach as outlined in Train (2008) and Pacifico (2009) and applied by Apps et al. (2012) to a model with labour supply and childcare choices. Apps et al. (2012) show that this can make quite a difference to the estimated labour supply and childcare demand elasticities. What is also of interest is that we study the effect of changes in financial incentives for working mothers in a country that has one of the highest participation rates of women in terms of persons, but with the largest share of part-time working women in the OECD.

Our paper also contributes to a small but growing number of papers that evaluate the external performance of structural models with the results from quasi-experimental studies (Todd and Wolpin, 2006; Hansen and Liu, 2011, see e.g.). Our data set contains a large reform in childcare subsidies and in-work tax credits. The effect of this joint reform is analyzed using difference-in-differences (DD) in Bettendorf et al. (2012). They consider the effect on participation and hours worked, and they decompose hours worked effect into the extensive and intensive margin effect (taking into account that new entrants may work different hours than incumbents). A simulation of the reform package with our structural model generates results lower than the findings of the DD study.

The structural model further allows us to study some effects of the Dutch reform that we could not study using DD. We can split the effect of the policy reform into the

effect due to the changes in childcare subsidies and the effect due to changes in in-work tax credits. Also, we can determine the net cost of the policy reform to the government, taking into account the knock-on effects on the budget of additional tax receipts and savings on benefits for non-employed due to higher participation. Finally, with the structural model we can simulate counterfactual policy reforms, like the announced cut in childcare subsidies in the Netherlands in the period 2011-2015.

The paper is organized as follows. Section 2 develops the structural model we use in the empirical analysis. Section 3 then considers the empirical methodology used to estimate the structural parameters, including the different specifications for unobserved heterogeneity. In Section 4 we discuss the data set used in the empirical analysis, and present some descriptive statistics. Furthermore, we consider the main aspects of the policy reforms that occurred in our data period. Section 5 presents the estimation results, and the implicit labour supply and childcare use elasticities. Section 6 gives the simulation results for the different policy reforms, and compares the simulation outcomes to the findings of the quasi-experimental study. Section 7 concludes.

2 Structural model

We use a (log) quadratic utility function since marginal utility of income may not be constant. In addition, the quadratic utility function is very flexible. The utility function is as follows:

$$\begin{aligned} U(y, h_m, h_f; \boldsymbol{X}) \quad = \quad & \beta_1 y + \beta_2(\boldsymbol{X}) h_m + \beta_3(\boldsymbol{X}) h_f + \beta_4(\boldsymbol{X}) c + \\ & \beta_5 y^2 + \beta_6 h_m^2 + \beta_7 h_f^2 + \beta_8 c^2 + \\ & \beta_9 y h_m + \beta_{10} y h_f + \beta_{11} y c + \\ & \beta_{12} h_m h_f + \beta_{13} h_m c + \beta_{14} h_f c + \\ & \beta_{15}(\boldsymbol{X}) f c_{wm} + \beta_{16}(\boldsymbol{X}) f c_{wf} + \beta_{17}(\boldsymbol{X}) f c_c \end{aligned} \tag{1}$$

The households' choice variables are leisure men (h_m), leisure women (h_f) and hours of formal childcare (c). Preferences for leisure and childcare vary over a number of characteristics X. We also include fixed costs of work (fc_{wm}, fc_{wf}), as indicator variables (0/1 for non-working/working), in order to correct for the overprediction of small part-time jobs (see Van Soest, 1995). Similarly, we include an indicator variabele for the use of childcare (fc_c), which equals 1 all the alternatives with formal childcare.

The budget constraint takes the following form:

$$y = w_i l_i - T(w_i, l_i, \mathbf{X}) - \sum_{v=1}^{V} [TC_v(\mathbf{p}, \mathbf{c}; \mathbf{X})] + S(\mathbf{p}, \mathbf{c}, y^t; \mathbf{X}) \tag{2}$$

where w is gross hourly wage, l is labour supply and $i = m, f$. $T(w_i, l_i, \mathbf{X})$ are taxes and social security contributions calculated with a tax-benefit model. $TC_v(\mathbf{p}, \mathbf{c}; \mathbf{X})$ is total cost of childcare which equals the sum over all children (V) at the childcare centres, where $\mathbf{p}$ is a vector with hourly prices of the two types of childcare (daycare and out-of-school care). Similarly, $\mathbf{c}$ is a vector with number of hours at the childcare centres. Finally, the tax-benefit model calculates childcare subsidies $S(\mathbf{p}, \mathbf{c}, y^t)$ which depend on childcare prices, the number of hours, the number of children and households' taxable income (y^t). The time constraint is as follows:

$$l_i + h_i \leq TC_i \tag{3}$$

where $TC_i = 168$ hours.

3 Econometric methodology

Our econometric specification is based on a discrete choice model which assumes that the households are choosing their preferred work and formal childcare allocations from a finite set of alternatives $j \in \{1, ..., J\}$. Each alternative represents a unique combination of work and childcare intensity levels which are available to the family members. Since both work and childcare choices are directly affecting disposable household income, we have to model incomes corresponding to each of the alternatives using household-specific wages and childcare prices. This information is however only partially observable - for workers we can use observed gross wages whereas for non-workers we have to impute their values. Similarly, for users of childcare we can use observed prices whereas for non-users of childcare, prices have to be imputed. The imputation method accounts for potential sample selection and its detailed discussion can be found in Appendices A.2 and A.3.

We assume that the utility function, apart from the deterministic part outlined in the previous section, contains also alternative-specific random terms ε_j:

$$U_j = U(y_j, h_{mj}, h_{fj}; X) + \varepsilon_j \, , \, \forall j \in 1, ..., J \tag{4}$$

The random terms are assumed to be i.i.d. across the alternatives and to follow the Type 1 extreme value distribution. This allows us to estimate the utility function within the standard multinomial logit framework using simulated maximum likelihood. By taking 10 draws (R) from the estimated wage and price distribution, we maximize the average of

the following log-likelihood:

$$\mathcal{L} = \sum_{h=1}^{H} \frac{1}{R} \sum_{r=1}^{R} \log \sum_{j=1}^{J} \left\{ \frac{\exp\left(U_{hj}^{r}(\beta)\right)}{\sum_{j'=1}^{J} \exp\left(U_{hj'}^{r}(\beta)\right)} \right\} d_{hj} \tag{5}$$

Here, h represents a household identifier and d_{ij} denotes an indicator function which attains value 1 for the observed choice and zero otherwise.

We start with a basic model with homogeneous preferences. Next, we allow for unobserved heterogeneity by using a latent classes approach.[5] Here we assume that the analyzed population can be divided into a finite set of classes $K_c, c = 1, ..., C$, with households having homogeneous preferences within each class but heterogeneous preferences across the classes. Association of individual households with specific classes is unobserved, and therefore it has to be approximated within the model. This is done by estimating household-specific probabilities of class membership $P(h \in K_c)$ under the assumption that the sum of class-membership probabilities has to equal 1 for a given household.

$$\sum_{c=1}^{C} P(h \in K_c) = 1 \,,\, \forall h \in 1, ..., H \tag{6}$$

These probabilities therefore indicate how likely members of household h are to be driven by the preferences corresponding to class c, conditional on their choices and other observable characteristics.[6]

Inclusion of the latent classes turns the original multinomial logit model into a finite mixture model with probabilities $P(h \in K_c), c = 1, ..., C$ acting as individual weights for a set of class-specific multinomial logit models with separate preference parameter vectors β_c. Resulting log-likelihood function has the following form:

$$\mathcal{L} = \sum_{h=1}^{H} \frac{1}{R} \sum_{r=1}^{R} \log \sum_{c=1}^{C} P(h \in K_c) \cdot \sum_{j=1}^{J} \left\{ \frac{\exp\left(U_{hj}^{r}(\beta_c)\right)}{\sum_{j'=1}^{J} \exp\left(U_{hj'}^{r}(\beta_c)\right)} \right\} d_{hj} \tag{7}$$

Corresponding maximization problem is difficult to solve by conventional methods based on maximum likelihood optimization. For that reason we use the EM algorithm,

[5] Discrete choice models with latent classes have been introduced by Train (2008). For a discussion of their benefits within the domain of structural labour supply modeling, see Apps et al. (2012). For an overview of their implementation and potential computational improvements, see Kabatek (2012).

[6] When averaged over all households within the sample, the class membership probabilities reflect population shares attained by individual classes.

as proposed by Train (2008). The optimal amount of latent classes, C, is selected by comparing Schwarz-Bayesian information criteria attained by models with various degrees of class-level stratification. The model which attains the lowest information criterion is considered optimal.[7]

4 Data

Section 4.1 describes the dataset and the selection criteria we used to construct our final sample. Section 4.2 gives descriptive statistics of our final sample. A description of the recent reforms of childcare subsidies and EITCs for working parents is found in section 4.3.

4.1 Administrative data set and selection criteria

We use the Labour Market Panel (in Dutch: *Arbeidsmarktpanel*) of Statistics Netherlands. The dataset combines data from municipalities (in Dutch: *Gemeentelijke Basisadministratie*) on several characteristics, from Social Statistic Panel (in Dutch: *Sociaal Statistisch Bestand*) on income sources and from Labour Force Survey (in Dutch: *Enquete Beroepsbevolking*) on education level. The unbalanced panel consists of approximately 1.2 million individuals who have been followed for the period 1999-2009. The panel is representative for the Dutch population. The dataset contains information on age, ethnicity, education, presence of children, region, labour supply, various income sources of individuals and their partners. For the period 2006-2009, we have information on the use and cost of formal childcare as well. Here, a distinction is made between daycare (children 0-3 years of age) and out-of-school care (children 4-12 years of age).

We estimate a structural model with childcare and therefore we restrict our sample to single parents, and couples, with at least one child 0-12 years of age. We exclude households with missing information on characteristics like ethnicity, age of the children, region or education. Self-employed individuals, individuals with disability benefits, or individuals with multiple sources of income (for example wages and profits) are also excluded. The reason for this is that the budget set becomes too complex. We also drop individuals with unemployment benefits since we otherwise need to identify whether these individuals are voluntarily unemployed or not. This requires a challenging modelling approach on its own, which is beyond the scope of this study. For households with time gaps, we select the longest time period.

[7] This approach is used by Train (2008), Pacifico (2012) and Apps et al. (2012).

The tax-benefit model MIMOSI[8] calculates net income for each of the alternatives. Income, wages and childcare prices are deflated to 2006 by using the consumer price index. MIMOSI calculates the corresponding childcare subsidy which depends on the type of childcare (i.e. daycare or out-of-school care), price of childcare, the number of children and the level of taxable household income. MIMOSI is a highly advanced tax-benefit model which calculates the budget constraint very accurately. The model takes social security contributions, pension contributions, taxes and several tax credits into account. In addition, MIMOSI calculates health care premiums and several means tested benefits (rent subsidies, general subsidies to families with children, childcare subsidies). In this way, MIMOSI enables us to calculate budget constraints and the effect on the government budget.

4.2 Descriptive statistics

Table 1 shows descriptive statistics of the final sample. More detailed descriptive statistics can be found in appendix A.1. Approximately 68% of single parents participate on the labour market and the average number of working hours equals 28.4 hours per week. Non-Western immigrants and lower educated individuals appear more often in the sample with single parents compared to couples. The share of households with formal childcare is similar for single parents (31%) and couples (30%). Nearly all men in couples participate (96%) and the average number of working hours is high: 38.8 hours per week. A relatively high share of women in couples participate (78%) but the average number of working hours is low: 21.9.

For single parents, we use the full sample which consists of 8,691 individuals, or 18,964 observations. The computational burden of using the full couples' sample in the estimation is too long. Therefore we select a representative subsample of 15% by using the weight factors in the sample. Consequently, the number of couples equals 3,017 which boils down to 7,845 observations.

Table 2 shows descriptive statistics of the use and price of childcare in the period 2006-2009. Here we see that the share of households using daycare increased from 31.8% in 2006 to 52.5% in 2009. The increase in out-of-school care is even larger: from 9.8% in 2006 to 22.6% in 2009. The average number of children at the childcare centres remains constant. However, the average number of hours per child increased over this period. In 2007, the average number of hours initially decreases due to a composition effect. As it turns out, the average number of hours of entrants is lower thereby pulling down the total average

[8]CPB, 2008, MIMOSI Microsimulatiemodel voor belastingen, sociale zekerheid, loonkosten en koopkracht, CPB document no 161 (only available in Dutch).

Table 1: Descriptive statistics sample

	Single parents		Couples men		Couples women	
	0-3 yrs	4-11 yrs	0-3 yrs	4-11 yrs	0-3 yrs	4-11 yrs
Age	33.8	40.2	36.8	43.3	34.1	40.8
	(6.1)	(5.9)	(4.9)	(5.1)	(4.4)	(4.6)
Hourly wage	15.6	16.2	20.2	22.2	16.3	16.1
	(7.3)	(8.0)	(10.0)	(11.2)	(6.3)	(7.6)
Hours worked per week	28.8	28.5	38.7	38.7	23.0	21.2
	(8.5)	(8.4)	(5.2)	(5.5)	(8.2)	(8.5)
Participation rate	0.57	0.70	0.96	0.95	0.82	0.75
Ethnicity						
Native	0.54	0.65	0.84	0.86	0.84	0.84
Western immigrant	0.11	0.11	0.08	0.07	0.09	0.09
Non-western immigrant	0.35	0.23	0.08	0.07	0.07	0.08
Education						
Lower educated	0.42	0.35	0.19	0.21	0.14	0.22
Middle educated	0.38	0.43	0.44	0.44	0.46	0.51
Higher educated	0.20	0.22	0.38	0.35	0.40	0.26
Region						
Urban area	0.41	0.32	0.16	0.16	0.16	0.16
Non-urban area	0.59	0.68	0.84	0.84	0.84	0.84
Childcare						
Childcare	0.51	0.27	0.50	0.13	0.50	0.13
No childcare	0.49	0.73	0.50	0.87	0.50	0.87
Number of observations	4,171	14,793	4,170	5,013	4,170	5,013
Number of households	2,464	7,088	1,997	2,231	1,997	2,231

number of hours. Finally, real hourly prices of daycare increase whereas real hourly prices of out-of-school care remain constant. We assume that hourly childcare prices are the same for all children within the households.

We distinguish 6 labour supply options at the individual level and 4 child care options at the household level. Labour supply options are discretized in days (0-5) where each day equals 8 hours. For childcare, we allow for 0, 1, 2 and 3 or more days. We distinguish

Table 2: Use of childcare 2006-2009

	Daycare				Out-of-school care			
	2006	*2007*	*2008*	*2009*	*2006*	*2007*	*2008*	*2009*
Share households	31.5	41.4	48.8	51.8	10.0	14.9	19.8	22.4
Average number of children	1.3	1.3	1.3	1.3	1.4	1.4	1.5	1.5
	(0.5)	(0.5)	(0.5)	(0.5)	(0.6)	(0.6)	(0.6)	(0.6)
Average number of hours per child	19.5	18.7	19.5	20.0	9.6	8.7	9.4	9.9
	(9.3)	(10.4)	(10.3)	(10.4)	(6.4)	(6.3)	(6.8)	(7.6)

between the two types of childcare where one day at a daycare centre equals 10 hours, whereas out-of-school care only takes 5 hours for one day. Figures A.1-A.4 in appendix A.1 show that we observe spikes at these hours. Single parents choose from a discrete choice set $h \in \{h_j, j = 1, ...J\}$ with $J = 6 * 4 = 24$. For couples, the number of alternatives $J = 6 * 4 * 4 = 144$.

4.3 Reform of childcare subsidies and EITCs for working parents

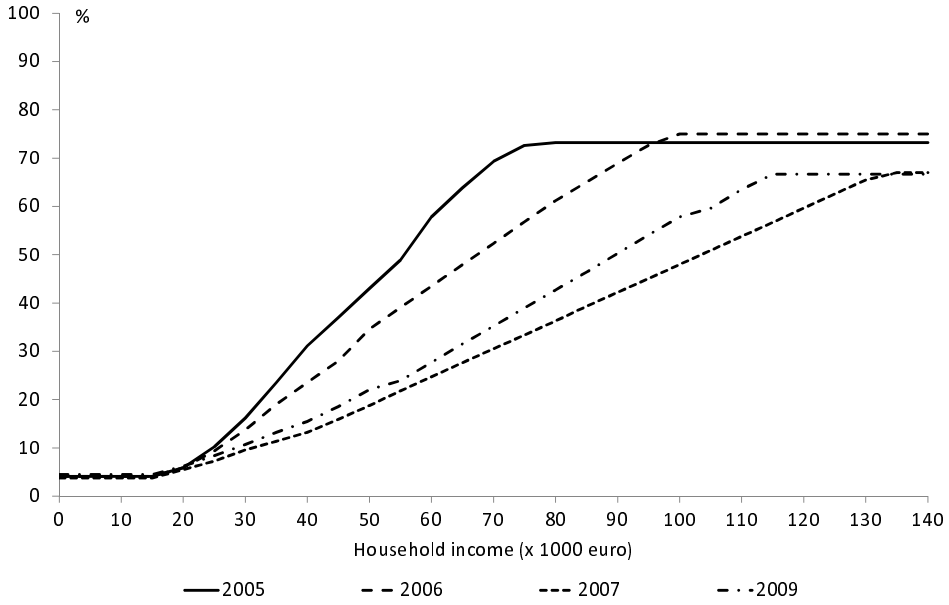
One of the interesting features of our data set is that during our data period there was a large reform in childcare subsidies and EITCs for working parents. This gives us large exogenous variation in household budget sets. Below we outline the key features of the reform.

The childcare reform started with the introduction of the Law on Childcare (*Wet kinderopvang*) in 2005. Before the introduction of the Law on Childcare, centre based childcare was subsidized at different rates. Places subsidized directly by employers and local governments (76% of places[9]) had lower effective parental fees than so-called 'unsubsidized' places (24% of places), the costs of which were partly tax deductible for parents. The introduction of the *Wet kinderopvang* in 2005 unified the subsidies for childcare places. From 2005 onwards, all formal places qualified for the same subsidy from the central government. This increased the subsidy somewhat for parents with children going to an unsubsidized place before 2005. With the introduction of the *Wet kinderopvang* so-called guestparent care also became eligible for the subsidy. This is small scale care at the home of the guestparent or the children. But the unification of the subsidies and the extension to guestparent care had only a minor effect on public spending on formal childcare. Indeed, presumably because the subsidy was actually reduced somewhat for the highest incomes[10],

[9] Source: Statistics Netherlands.

[10] See Plantenga et al. (2005).

Figure 1: Parental contribution rate for the first child



Source: own calculations using publicly available subsidy tables.

public spending actually fell slightly from 2004 to 2005 (see Ministry of Finance, 2010).

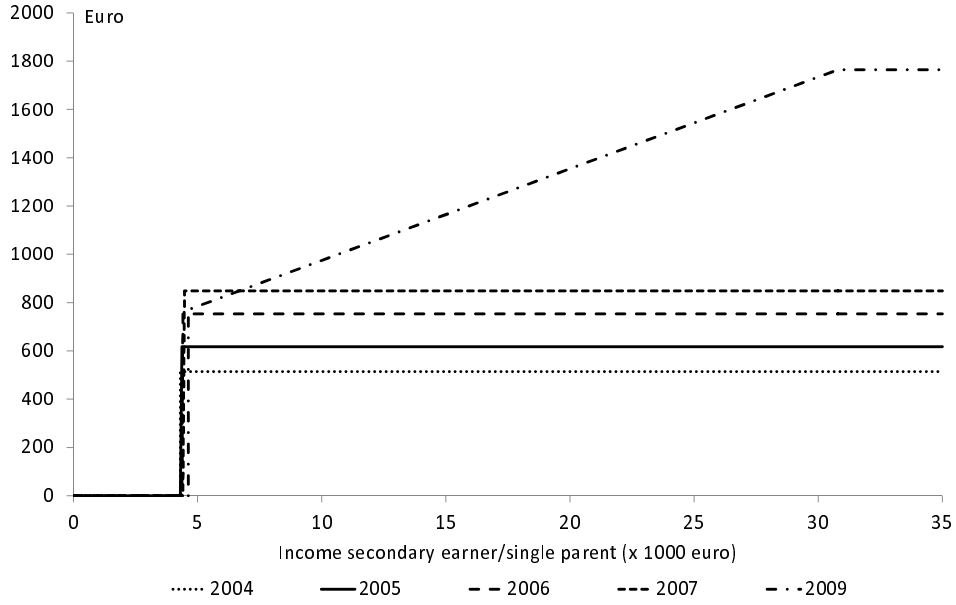
More important were the changes that followed in 2006 and 2007. In these years the subsidy rate was increased drastically, in 2007 in particular. Figure 1 shows the changes in the parental contribution rate for the 'first child'.[11] First, note that the parental fee depends on the income of the household. In all years, households with the lowest income receive the highest subsidy (up to 96% of the full price). For the lowest income households the subsidy rate hardly changed. For the middle income households the subsidy rate went up by 20 to 40%-points, whereas the increase in the subsidy for the highest income households was somewhat smaller than for middle income households. On average, the parental cost share in the full price dropped from 37% in 2005 to 18% in 2007.[12,13] Next to the drop in parental fees, from 2007 onwards schools were obliged to act as an intermediary for parents and childcare institutions to arrange out-of-school care. In 2008 there were virtually no changes in childcare subsidies, but then 2009 witnessed a partial reversal of

[11]The Tax Office defines the first child as the child for which the parents have the highest childcare expenditures.

[12]Source: Tax Office data provided by the Ministry of Social Affairs and Employment (personal communication).

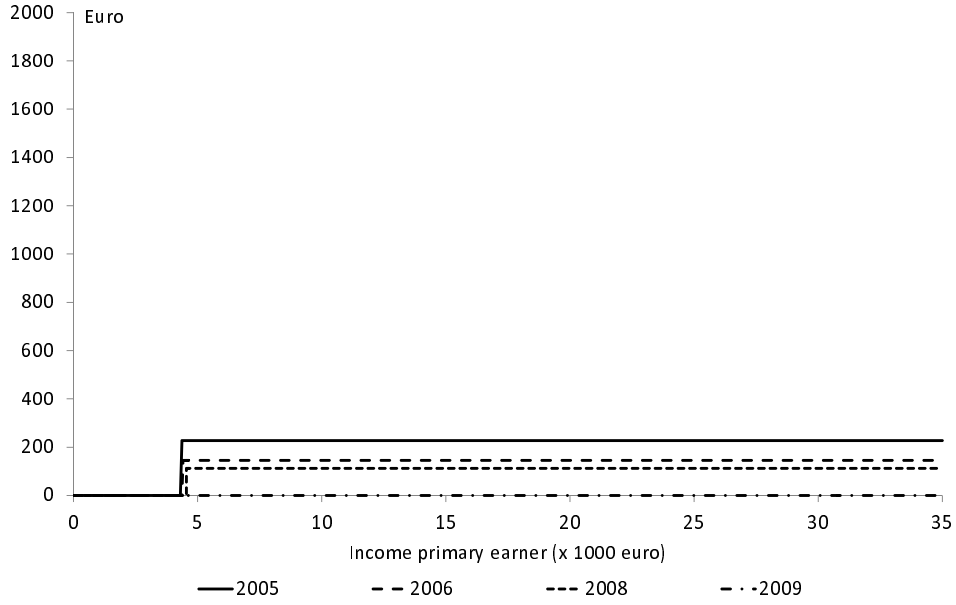
[13]Despite the steep increase in the subsidy rate, the average prices of formal childcare places grew more or less in line with the CPI, see Section 4.2

Figure 2: EITC secondary earners with children and single parents



Source: Tax Office.

Figure 3: EITC primary earners with children



Source: Tax Office.

the policy change, as parental fees were raised somewhat.

Over the same period there were also some changes in EITCs for parents with a youngest child up to 12 years old, the so-called *Combinatiekorting* (Combination credit) and the *Inkomensafhankelijke combinatiekorting* (Income dependent combination credit).[14] Figure 2 shows the change in the sum of the *Combinatiekorting* and *Inkomensafhankelijke combinatiekorting* for secondary earners and single parents over the period 2004–2009. Up to 2008, the credit was income independent as long as wage income exceeded a certain threshold. The sum of these two credits increased from 514 euro in 2004 to 858 euro in 2008. In 2009 the *Inkomensafhankelijke combinatiekorting* was increased for secondary earners and single parents with relatively high earnings. The maximum credit was 1,765 euro, where the maximum was reached at 30,803 euro of gross individual income (in 2009 the minimum wage of a fulltime worker was 16,776 euro).

Primary earners with children only apply for the *Combinatiekorting*, which is much smaller than the *Inkomensafhankelijke combinatiekorting*. This credit was phased out over the period 2005–2009,[15] see Figure 3. There was a reduction in 2006, and then a smaller reduction in 2008 before it was eventually abolished in 2009.

5 Estimation results

This section presents estimation results of the utility function. Subsection 1 presents results for single parents whereas subsection 2 shows the results for couples.

5.1 Single parents

5.1.1 Model without latent classes

Table 3 shows estimated preferences of the log quadratic utility function for single parents. Negative marginal utility of income in the chosen option is not consistent with optimization behaviour, but this undesirable feature is rare in our sample: only 5% of the single parents have negative marginal utility of income. The share of households with negative marginal utility of leisure is high: 67%. The interaction term of age with leisure is negative whereas the quadratic term of age with leisure is positive. Hence, younger single parents have a lower preference for leisure whereas older single parents have a higher preference for leisure. The tipping point is at an age of approximately 42 years.[16] Single parents with a

[14] Up to 2008 the *Inkomensafhankelijke combinatiekorting* was called the *Aanvullende combinatiekorting* (Additional combination credit). The name refers to the combination of work and care.

[15] The credit was left virtually unchanged from 2004 to 2005.

[16] Calculated as (1.083/2*1.376)*10+38.

young child (0-3 years of age) have a higher preference for leisure than single parents with an older child (4-11 years of age).

Marginal utility of childcare is negative for 16% of the single parents using formal childcare in our sample. All interaction terms of observable characteristics with the number of hours childcare are positive. Conditional on using formal childcare, single parents with a young child, non-native background and/or living in an urban area prefer more hours of formal childcare. All interaction terms in the fixed costs specification of labour participation are negative. Single parents with a lower education, non-native background, a young child and/or living in an urban area have higher fixed costs of participation, i.e. relative to the base group (higher educated, native background, youngest child 4-12 years of age and not living in an urban area). The intuition of the indicator variable for the use of formal childcare is similar to the fixed costs specification of work. The constant term is negative implying that there are fixed cost of childcare. The interaction terms of the indicator variable with education are negative (and significant), which represents the fact that the use of formal childcare is relatively low among single parents with a lower education. Single parents with a young child (0-3 years of age) have lower fixed costs of childcare than single parents with older children.

Figures 4 and 5 show the fit of our model. Figure 4 shows that the labour supply model predicts the labour supply distribution well. The horizontal axis shows the number of working hours whereas the vertical axis represents the share of single parents. Figure 5 shows the distribution of the use of childcare, where the number of days of childcare is located at the horizontal axis. Again, the observed and predicted distribution closely resemble each other.

Table 4 presents elasticities for single parents. Elasticities are simulated by raising gross wages and prices by 10%. Elasticities in table 4 refer to a 1% increase in wages and prices. The model produces a relatively low labour supply elasticity: 0.25. Decomposition of the wage elasticity shows that the extensive margin is important here. The increase in labour supply slightly increases the demand for childcare (0.04) in the model. Finally, the price elasticity of childcare equals -0.22. Here, an increase in the gross price of childcare by 1% does not come at the expense of lower labour supply (i.e. effect is 0 on average).

Table 3: Parameters utility function single parents

	Youngest child 0-3 yrs	Youngest child 4-12 yrs
Income	-1.363***	-4.657***
Leisure	-77.760***	-67.950***
*age	-1.518***	-0.895***
*age^2	0.945***	1.532***
Income^2	5.527***	4.494***
Leisure^2	-52.880***	-100.400***
Income*leisure	52.820***	28.870***
Income*childcare	-0.147***	-0.308***
Childcare	0.908***	-0.509***
*non-Western immigrant	0.996***	1.063***
*Western immigrant	0.419***	0.204***
*urban area	0.221***	0.269***
Childcare^2	-0.206***	-0.176***
Childcare*leisure	-3.379***	-7.103***
Fixed costs work	-3.600***	-2.892***
*education low	-0.685***	-1.243***
*education mid	0.251***	-0.250***
*non-Western immigrant	-0.708***	-1.274***
*Western immigrant	-0.442***	-0.618***
*urban area	-0.384***	-0.349***
Fixed costs childcare	-1.347***	-1.545***
*education low	-2.011***	-0.895***
*education mid	-0.648***	-0.171***
*non-Western immigrant	-1.326***	-1.172***
*Western immigrant	-0.735***	-0.603***
Individuals*alternatives	100,104	355,032
Individuals	4,171	14,793
Negative mu income	6%	5%
Negative mu leisure	100%	100%
Negative mu childcare	0%	33%

Fit labour supply

Figure 4: Youngest child 0-3 yrs

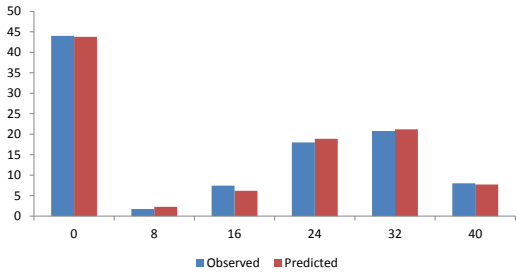
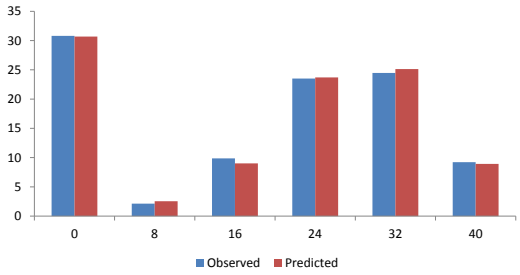


Figure 5: Youngest child 4-11 yrs



Fit use of childcare

Figure 6: Youngest child 0-3 yrs

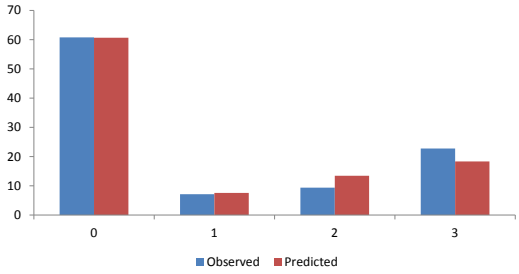


Figure 7: Youngest child 4-11 yrs

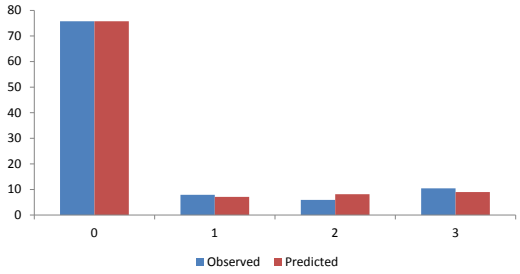


Table 4: Elasticities single parents

	Model without latent classes		**Model with latent classes**	
	child 0-3 yrs	child 4-11 yrs	child 0-3 yrs	child 4-11 yrs
Wage (+1%)				
Labour supply	0.26	0.21		
- extensive margin	0.31	0.18		
- intensive margin	-0.05	0.03		
Childcare	0.13	-0.03	**PM**	**PM**
Price childcare (+1%)				
Childcare	-0.36	-0.11		
Labour supply	-0.01	0.00		

5.1.2 Model with latent classes

The second column of table 4 contains elasticities for the model with latent classes. **PM**

5.2 Couples

5.2.1 Model without latent classes

Table 5 shows estimation results for couples. Unlike for single parents, the log quadratic utility function does not result in negative marginal utility of income for any of the households. Marginal utility of leisure increase with age for men and women.[17] Women with younger children have a higher preference for leisure than women with older children.[18] Marginal utility of childcare is negative for most households (60%) in the observed outcomes. Furthermore, the interaction term of income and childcare is positive which indicates that childcare is a normal good. Conditional on using formal childcare, households with younger children (0-3 years) and/or living in an urban area have a higher preference for childcare.

We estimate fixed costs of labour participation, interacted with observable characteristics, for men and women separately. Men and women with a non-native background have higher fixed costs of participation. The inclusion of education in the fixed costs specification leads to mixed results. Lower educated women have higher fixed costs of participation whereas lower and middle educated men have lower fixed costs of participation. This latter result is intuitively not appealing.[19] We include an indicator variable for the use of formal childcare. The constant term of this dummy is negative which means that there are fixed costs of childcare. The interaction terms with lower and middle education are negative indicating that these households use formal childcare less often than their reference category (i.e. higher education). Finally, we find significant effects for men with a non-Western background and households with a young child (0-3 years of age) and/or living in an urban area.

Figures 6 and 7 show the observed and predicted labour supply distribution for men and women, respectively. Here we see the model predict the labour supply distributions quite well. Figure 8 compares the observed and predicted distribution of the use of formal childcare. Again, the model predicts well.

Table 6 presents the corresponding elasticities for couples. Most men work fulltime and the wage elasticity for men is low (0.08). Cross elasticities show that an increase in men's wage results in a small increase in the demand for childcare (0.19) and a drop in female's labour supply by -0.12%. Wage elasticities are much higher for women: 0.39. We find that the extensive margin is more important than the intensive margin. The price elasticity of childcare is -0.53 and a price increase of childcare only results in a small decrease in

[17] The quadratic terms are not significant.

[18] The interaction term is not significant for men.

[19] A dummy for urban area is not significant in the fixed cost specification for either men or women.

female's labour supply (-0.07).

Table 5: Parameters utility function couples with youngest child 0-3 years

Income	13.650***	Fixed costs men	-10.150***
Leisure men	-62.290***	*education low	1.033***
*age	0.613***	*education mid	1.261***
*age^2	-0.666***	*non-Western immigrant	-0.669***
		*Western immigrant	-1.380***
Leisure female	-16.650***		
*age	1.764***	Fixed costs women	-2.493***
*age^2	2.149***	*education low	-0.341***
		*education mid	0.283***
Income^2	-2.091***	*non-Western immigrant	-1.289***
Income*leisure men	3.267***	*Western immigrant	-0.622***
Income*leisure women	-6.211***		
Leisure ^{2}	-97.290***	Fixed cost childcare	0.487***
Leisure women^2	-151.400***	*non-Western immigrant men	-0.350***
Leisure men*leisure women	-17.340***	*Western immigrant men	-0.252***
		*education low men	-0.370***
Childcare	-2.077***	*education mid men	-0.351***
*urban area	0.797***	*non-Western immigrant women	-1.426***
*non-Western immigrant men	-0.079***	*Western immigrant women	-0.137***
*Western immigrant men	0.325***	*education low women	-0.918***
*non-Western immigrant women	0.998***	*education mid women	-0.531***
*Western immigrant women	0.270***	*urban area	-1.206***
Childcare^2	-0.033***		
Childcare*income	0.561***		
Childcare*leisure men	0.841***		
Childcare*leisure women	-6.985***	Negative mu income	0%
		Negative mu leisure men	74%
Couples*alternatives	599,904	Negative mu leisure women	38%
Couples	4,166	Negative mu childcare	54%

Table 6: Parameters utility function couples with youngest child 4-11 years

Income	3.032***	Fixed costs men	-10.590***
Leisure men	-84.860***	*education low	0.779***
*age	1.511***	*education mid	1.147***
*age^2	1.179***	*non-Western immigrant	-1.374***
		*Western immigrant	-0.925***
Leisure female	-25.240***		
*age	0.707***	Fixed costs women	-1.610***
*age^2	1.157***	*education low	-0.574***
		*education mid	-0.241***
Income^2	0.878***	*non-Western immigrant	-0.599***
Income*leisure men	7.394***	*Western immigrant	-0.184***
Income*leisure women	1.369*		
Leisure men^2	-125.800***	Fixed cost childcare	-2.628***
Leisure women^2	-113.600***	*non-Western immigrant men	-1.392***
Leisure men*leisure women	-14.270***	*Western immigrant men	-0.963***
		*education low men	-0.116***
Childcare	-2.019***	*education mid men	-0.230***
*urban area	-0.347***	*non-Western immigrant women	0.317
*non-Western immigrant men	0.785***	*Western immigrant women	0.745***
*Western immigrant men	0.885***	*education low women	-1.090***
*non-Western immigrant women	0.213***	*education mid women	-0.340***
*Western immigrant women	-0.699***	*urban area	0.815***
Childcare^2	-0.746***		
Childcare*income	0.698***		
Childcare*leisure men	-3.428***		
Childcare*leisure women	-7.962***	Negative mu income	0%
		Negative mu leisure men	78%
Couples*alternatives	722,448	Negative mu leisure women	41%
Couples	5,017	Negative mu childcare	57%

Table 7: Elasticities couples

	Model without latent classes		**Model with latent classes**	
Wage elasticity men (+1%)	child 0-3 yrs	child 4-11 yrs	child 0-3 yrs	child 4-11 yrs
Labour supply men	0.09	0.09		
- extensive margin	0.08	0.08		
- intensive margin	0.01	0.01		
Labour supply women	-0.15	-0.11		
Childcare	0.10	0.27		
			PM	**PM**
Wage elasticity women (+1%)				
Labour supply women	0.37	0.38		
- extensive margin	0.25	0.25		
- intensive margin	0.12	0.13		
Labour supply men	-0.04	-0.03		
Childcare	0.40	0.45		
Price elasticity childcare (+1%)				
Childcare	-0.61	-0.36		
Labour supply men	0.00	0.00		
Labour supply women	-0.13	-0.02		

5.2.2 Model with latent classes

The second column of table 4 contains elasticities for the model with latent classes. **PM**

Fit labour supply women

Figure 8: Age youngest child 0-3 yrs

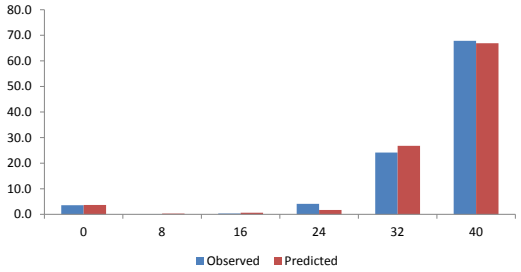
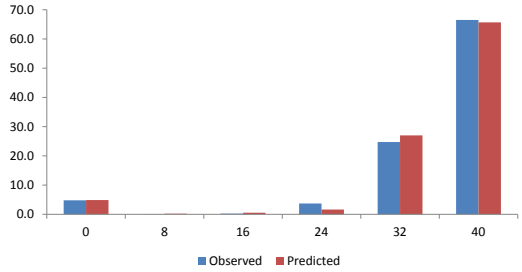


Figure 9: Age youngest child 4-11 yrs



Fit labour supply women

Figure 10: Age youngest child 0-3 yrs

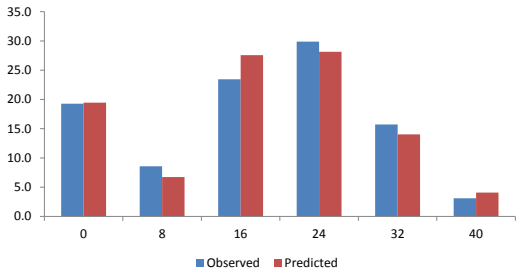
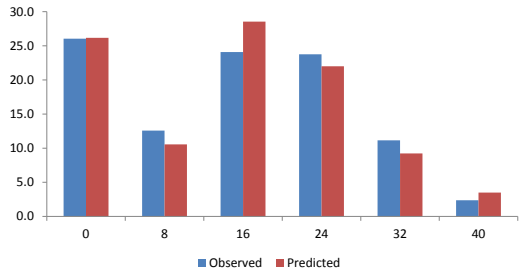


Figure 11: Age youngest child 4-11 yrs



Fit use of childcare

Figure 12: Age youngest child 0-3 yrs

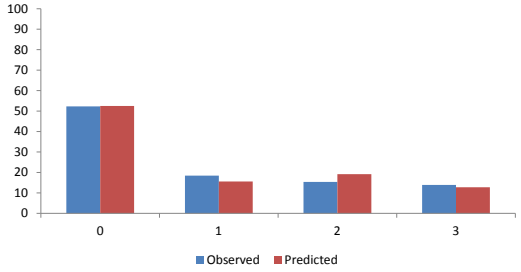
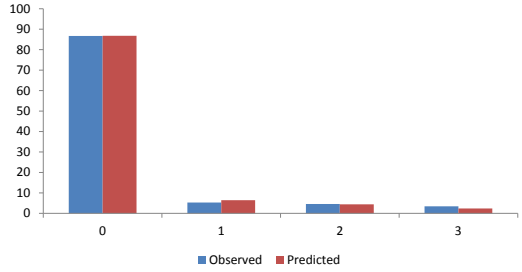


Figure 13: Age youngest child 4-11 yrs



6 Policy simulation

6.1 Effectiveness fiscal stimuli working parents

In the Netherlands, there are 3 important fiscal stimuli for working parents. First, a childcare subsidy for households with young children (0-12 years of age), who work and use formal childcare. Second, working single parents and secondary earners with young children (0-12 years of age) earn an EITC (*Inkomensafhankelijke Combinatiekorting*). Both the EITC and childcare subsidy are expected to increase labour supply of especially mothers. The EITC is targeted at a larger group since it includes single parents and couples who do not use childcare as well. Third, a general EITC for all workers (*Arbeidskorting*) with the only criteria that an individual needs to work. Hence, individuals without children and primary earners receive this EITC as well. From a policy perspective, it is interesting to simulate whether a childcare subsidy, an EITC for working parents, or general EITC for all workers is more effective in raising labour supply. Therefore, we simulate an ex-ante increase of 100 million euro in each of these options. We study the effectiveness of fiscal stimuli by increasing the budget in an income neutral way (section 6.1.1) and by targeting these scenarios at low income households (section 6.1.2).

6.1.1 No targeting of childcare subsidies and EITCs

Here, we increase the budget in an income independent way in all three scenarios. Childcare subsidies are raised by 10 percentage points, such that the increase in subsidy is the same for all households (given the same demand for childcare). Moreover, we introduce EITCs for working parents and all workers as a fixed amount: 265 and 120 euro, respectively. Figures A.5-A.10 in appendix A.4 show distribution of income effects in all three scenarios. The first column in table 7 shows labour supply effects of increasing childcare subsidies by 100 million euro. Men hardly adjust their labour supply which is consistent with having a relatively low elasticity. Not surprisingly, we see a substantial increase in labour supply for relatively elastic women in couples (1.29%). Overall, labour supply increases by 0.42% and total demand for childcare increases by approximately 8%.

The second column presents labour supply effects of increasing the EITC for working parents by 100 million euro. Labour supply effect of women in couples is smaller now: 0.72%. The total increase in labour supply equals 0.26%. The final column shows that increasing the EITC for all workers is the least effective way to increase labour supply. Total labour supply increases by only 0.08%. The reason for this is that this general EITC for all workers is less targeted, compared to for instance an EITC for secondary earners, since a large part reaches primary earners as well.

Based on this simulation, we conclude that the childcare subsidy is more effective in stimulating labour supply than an EITC for working parents. However, we need to take the ex-post budgettary costs into account and table 7 contains these knock-on effects. Simulations show that labour supply increases in all scenarios. Consequently, the government earns more income taxes but expenditures on additional tax credits and childcare subsidies also increase. In the scenario with the EITC for working parents, the government earns 6.55% back of the ex-ante increase in the budget for this EITC. A relatively high (negative) knock-on effect is found in the scenario with childcare, which is caused by the strong increase in demand for childcare. The goverment spends more money on childcare subsidies (and additional tax credits) and this effect is larger than the additional income tax revenues, thereby increasing the ex-post budgetary budget with 26 million euro. Hence, the childcare subsidy is more effective in stimulating labour supply than an EITC for working parents, but ex-post budgetary costs are high.

6.1.2 Targeting childcare subsidies and EITC

Section 4.3 showed that childcare subsidies and the EITC for working parents depend on income. The same holds for the general EITC for all workers. It is interesting from a policy's perspective to study the effectiveness of fiscal stimuli when we target them at low income households. For working parents, we introduce a maximum EITC of 520 euro. The EITC for working parents rises with 2%, starting at a personal income level of 4,000 euro until the maximum is achieved at 30,000 euro. Only working single parents and secondary earners receive this EITC. The maximum level of the general EITC for all workers is much lower: 165 euro. We keep the income thresholds the same as for the EITC for working parents, and the general EITC rises with 0.6%. Finally, we decrease the parental contribution rate of childcare with 170%.

Figures A.11-A.16 in appendix A.4 show income effects for all three scenarios. Table 8 shows that labour supply effects of EITCs are higher when target at low income households (i.e. compared with results in subsection 6.1.1). The reason for this is that the EITCs are targeted at a more elastic group. Labour supply effects of childcare subsidy and EITC for working parents are roughly the same now. Again, ex-post budgetary costs are much lower in the scenario with the EITC for working parents. In this scenario, the knock-on effect is approximately 16% and the ex-post budgetary cost is only 84 million euro in this scenario.

Table 8: Effectiveness fiscal stimuli: no targeting

	Childcare subsidy	EITC working parents	EITC all workers
Couples with children 0-3 yrs			
Labour supply men	0.10	0.06	0.01
- extensive margin	0.27	0.14	0.07
- intensive margin	-0.17	-0.08	-0.07
Labour supply women	2.49	0.74	0.23
- extensive margin	1.55	0.88	0.35
- intensive margin	0.92	-0.13	-0.12
Childcare	10.97	1.17	0.64
Couples with children 4-11 yrs			
Labour supply men	0.04	0.07	0.00
- extensive margin	0.04	0.11	0.03
- intensive margin	0.00	-0.04	-0.04
Labour supply women	0.47	0.72	0.27
- extensive margin	0.24	0.82	0.36
- intensive margin	0.22	-0.10	-0.08
Childcare	6.31	1.01	0.58
Single parents 0-3 yrs			
Labour supply	0.85	0.38	0.17
- extensive margin	1.42	1.34	0.62
- intensive margin	-0.56	-0.96	-0.44
Childcare	5.19	0.52	0.24
Single parents 4-11 yrs			
Labour supply	0.16	0.23	0.10
- extensive margin	0.12	0.56	0.26
- intensive margin	0.03	-0.33	-0.15
Childcare	2.14	-0.29	-0.13
Aggregated effect			
Labour supply	0.50	0.27	0.08
Demand childcare	9.06	0.99	0.55
Knock-on effect	-53.43	27.55	4.74
- taxes	67.65	21.19	-3.64
- childcare subsidy	-127.55	-10.26	-5.56
- indirect taxes	6.47	16.62	13.94
Productivity	121.54	59.69	12.49

Table 9: Effectiveness fiscal stimuli: targeting

	Childcare subsidy	EITC working parents	EITC all workers
Couples with children 0-3 yrs			
Labour supply men	0.14	0.05	0.04
- extensive margin	0.20	0.12	0.08
- intensive margin	-0.06	-0.07	-0.04
Labour supply women	2.32	1.27	0.27
- extensive margin	1.23	0.72	0.12
- intensive margin	1.08	0.55	0.14
Childcare	7.39	1.73	0.70
Couples with children 4-11 yrs			
Labour supply men	0.04	0.06	0.04
- extensive margin	0.03	0.10	0.06
- intensive margin	0.01	-0.04	-0.02
Labour supply women	0.48	1.11	0.26
- extensive margin	0.22	0.64	0.14
- intensive margin	0.26	0.46	0.12
Childcare	0.38	1.70	0.73
Single parents 0-3 yrs			
Labour supply	0.41	0.80	0.25
- extensive margin	0.57	1.11	0.35
- intensive margin	-0.16	-0.30	-0.10
Childcare	2.36	0.60	0.19
Single parents 4-11 yrs			
Labour supply	0.09	0.62	0.19
- extensive margin	0.06	0.60	0.18
- intensive margin	0.04	0.01	0.00
Childcare	1.14	-0.08	-0.02
Aggregated effect			
Labour supply	0.48	0.43	0.12
Demand childcare	7.53	1.53	0.63
Knock-on effect	-16.17	45.88	13.54
- taxes	73.60	40.82	4.97
- childcare subsidy	-96.87	-14.75	-5.87
- indirect taxes	7.10	19.82	14.44
Productivity	132.75	105.95	25.28

Table 10: Results reforms 2005-2009

	Reforms 2005-2009			**DD-analysis**
	Childcare	*EITC*	*Total*	*Childcare + EITC*
Couples with children				
Labour supply men	0.09	0.05	0.14	-1.0
Labour supply women	2.15	2.59	4.74	6.6
Childcare	14.56	2.90	17.47	
Single parents				
Labour supply	0.14	1.29	1.43	12.0
Childcare	1.08	0.52	1.60	
Aggregated effect				
Labour supply	0.69	0.85	1.55	
Childcare	12.75	2.61	15.36	

6.2 External validation

Our data set contains a large reform in childcare subsidies and EITCs, enabling external validation of our simulated results. We simulate both reforms separately and compare our results with the results of the DD-analysis by Bettendorf et al. (2012). They use use a DD-analysis to study the joint reform of childcare and EITCs in the period 2005-2009. Both reforms affect labour supply of working parents but it is not possible to disentangle these effects with a DD-analysis.

Table 9 shows labour supply effects of the childcare reform in the period 2005-2009. Single parents slightly increase their labour supply (0.14%) whereas the increase in demand of childcare is only 1.08%. The increase in labour supply is highest for women in couples: 2.15% and couples demand 14.56% more childcare. As described in section 4.3, the childcare reform 2005-2009 was targeted at middle and high income households. Household income of single parents is relatively low and therefore the labour supply effect is modest for single parents. The opposite holds for women in couples: they have a relatively high household income which, accompanied with a substantial increase in subsidy rates, results in a relatively strong increase in labour supply.

Labour supply effects of the increase in the EITC in the period 2006-2009 are found in the second column in table 9. In order to increase labour supply of especially working mothers, the Dutch government only targets the EITC at single parents and secondary earners as from 2009 (as described in section 4.3). Policy simulation shows that women

Table 11: Results reforms 2005-2009

	Reform childcare 2006-2009	Reform EITC 2006-2009
Couples with children 0-3 yrs		
Labour supply men	0.21	0.07
- extensive margin	0.32	0.18
- intensive margin	-0.10	-0.11
Labour supply women	3.87	2.67
- extensive margin	2.08	1.66
- intensive margin	1.76	1.00
Childcare	17.08	3.17
Couples with children 4-11 yrs		
Labour supply men	0.06	0.10
- extensive margin	0.05	0.16
- intensive margin	0.01	-0.05
Labour supply women	0.67	2.29
- extensive margin	0.33	1.45
- intensive margin	0.34	0.82
Childcare	9.48	3.04
Single parents 0-3 yrs		
Labour supply	0.41	1.41
- extensive margin	0.10	1.23
- intensive margin	0.31	0.18
Childcare	1.25	0.89
Single parents 4-11 yrs		
Labour supply	0.12	1.21
- extensive margin	0.03	0.82
- intensive margin	0.08	0.39
Childcare	1.05	0.25
Aggregated effect		
Labour supply	0.75	0.87
Demand childcare	13.29	2.81

in couples and single parents raise labour supply by 2.59% and 1.29%.

The third column in table 9 gives the combined simulated effect of both reforms. The

simulated labour supply effects for men in couples and single parents are lower than in the DD-analysis (**PM**). Simulated labour supply effects of women in couples are broadly in line with the DD-analysis.

6.3 Childcare reform 2011-2015

Recent projections show that government expenditures on childcare are expected to increase further in the period 2011-2015 (Ministry of Social Affairs and Employment, 2011) Consequently, the Dutch government decided to cut expenditures on childcare by 0.8 billion euro over the period 2011-2015. In this way, the average contribution rate of households increase from 22% in 2010 to 34% in 2015 (Ministry of Social Affairs and Employment, 2011). Approximately 0.5 billion euro of the expenditure cut on childcare is obtained by lowering childcare subsidy rates. We simulate this reduction of subsidy rates and table 10 gives the results.

For single parents, the average labour supply effect is slightly higher (in absolute value) in the reform 2011-2015 (-0.23%) compared to the earlier reform in the period 2005-2009. Women in couples, however, adjust their labour supply to a lesser extent under the second reform (-1.93% instead of 2.15%). We have two explanations for this result. First, the second reform results in a smaller change (in absolute value) in the average contribution rate of households. Second, the reform 2006-2009 was targeted at middle and high income households whereas the design of the reform 2011-2013 is more evenly spread over all households (i.e. households' contribution rates increase with the same percentage).

Table 12: Results childcare reform 2011-2015

Couples with children 0-3 yrs	
Labour supply men	-0.19
- extensive margin	-0.30
- intensive margin	0.10
Labour supply women	-3.29
- extensive margin	-1.82
- intensive margin	-1.49
Childcare	-12.89
Couples with children 4-11 yrs	
Labour supply men	-0.06
- extensive margin	-0.05
- intensive margin	-0.01
Labour supply women	-0.65
- extensive margin	-0.31
- intensive margin	-0.35
Childcare	-8.37
Single parents 0-3 yrs	
Labour supply	-0.52
- extensive margin	-1.02
- intensive margin	0.51
Childcare	-4.01
Single parents 4-11 yrs	
Labour supply	-0.13
- extensive margin	-0.09
- intensive margin	-0.03
Childcare	-1.81
Aggregated effect	
Labour supply	-0.67
Demand childcare	-10.71

7 Conclusion

Using a large administrative dataset, including data on the use of formal childcare, we estimate a structural labour supply model with childcare. The model estimates elasticities that are in line with related studies. The extensive margin is more important than the intensive margin, and married/cohabiting women's labour supply is most elastic. Our simulated results of recent reforms on childcare and EITCs for working parents are lower than results found by a DD-analysis on the same reforms. Finally, we study the effectiveness of fiscal stimuli for working parents. We conclude that hildcare subsidies and EITCs for working parents are about equally effective in stimulating labour supply when targeted at low income households. However, the scenario with higher childcare subsidies is accompanied by high ex-post budgetary costs. **PM**

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A Appendix

A.1 Descriptive statistics childcare

Table A.1 shows combinations of average number of days of childcare and the number of working days for the period 2006-2009. Columns refer to the number of working days (mothers/single fathers), whereas rows represent the average number of days child care. Here we see for instance that 3 percent of the households, in which the mother works 3 days, use 1 day of daycare in 2006. Figures A.1 and A.2 show the use of daycare in 2006 and 2009. The same information is found in figure A.3 and A.4 for out-of-school care.

Table A.2 shows descriptive statistics of prices of childcare in the period 2006-2009. Unsurprisingly, nominal prices increase over time. However, the increase in real prices for out-of-school care is very small. In addition, Table A.2 shows that prices are modestly dispersed over characteristics like education, age and ethnicity. Singles pay a higher average price for daycare compared to couples but this situation is reversed for out-of-school care. Households with higher educated women pay a slightly higher price on average.

Table A.1: Descriptive statistics: use of childcare by labour supply

Daycare 2006[a]								Out-of-school care 2006[b]							
	0	1	2	3	4	5	Total		0	1	2	3	4	5	Total
0	24.3	4.7	15.0	16.1	4.9	3.6	68.5	0	30.1	6.7	20.3	20.0	7.0	6.1	90.0
1	0.7	0.2	2.6	5.2	1.2	0.7	10.5	1	0.2	0.1	1.0	2.0	0.7	0.3	4.2
2	0.6	0.2	2.2	7.0	2.4	1.0	13.2	2	0.1	0.0	0.6	1.5	0.7	0.3	3.3
3	0.2	0.1	0.3	2.6	2.2	0.9	6.2	3	0.1	0.0	0.1	0.5	0.5	0.2	1.4
4	0.2	0.0	0.0	0.2	0.6	0.5	1.5	4	0.2	0.0	0.0	0.2	0.3	0.3	1.0
Daycare 2009								Out-of-school care 2009							
	0	1	2	3	4	5	Total		0	1	2	3	4	5	Total
0	18.6	3.1	8.9	11.3	3.7	2.7	48.2	0	24.3	5.1	16.2	19.5	6.8	5.7	77.6
1	1.3	0.7	4.2	8.3	1.9	0.8	17.1	1	0.6	0.2	2.1	4.6	1.9	0.7	10.0
2	0.6	0.3	3.5	10.2	3.8	1.8	20.2	2	0.2	0.1	1.0	3.0	1.6	0.6	6.3
3	0.5	0.0	0.5	4.8	3.5	1.7	11.0	3	0.2	0.0	0.3	1.5	0.9	0.4	3.3
4	0.5	0.1	0.1	0.5	1.4	0.9	3.5	4	0.3	0.0	0.2	0.7	0.8	0.8	2.7

[a] Daycare is discretized as follows: 0-15, 15-25, 25-35, >= 35

[b] Out-of-school care is discretized as follows: 0-7.5, 7.5-12.5, 12.5-17.5,>=17.5

Figure A.1: Daycare 2006

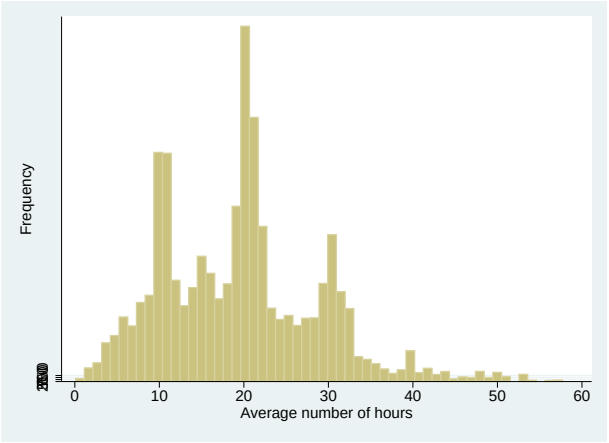


Figure A.2: Daycare 2009

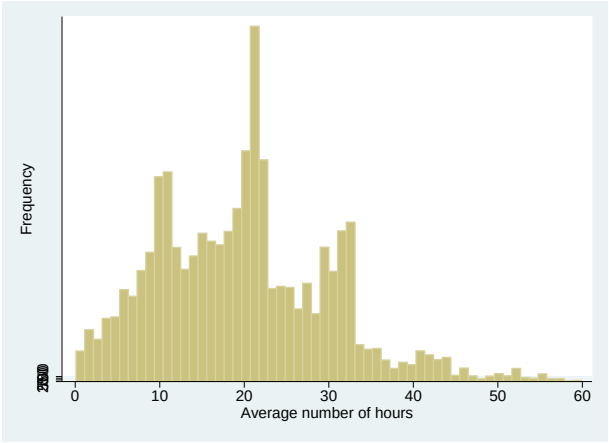


Figure A.3: Out-of-school care 2006

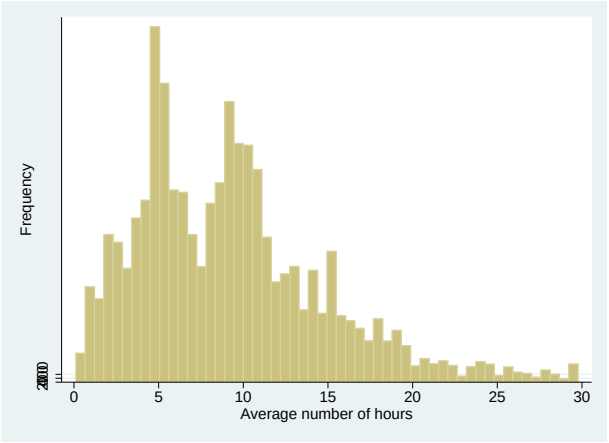


Figure A.4: Out-of-school care 2009

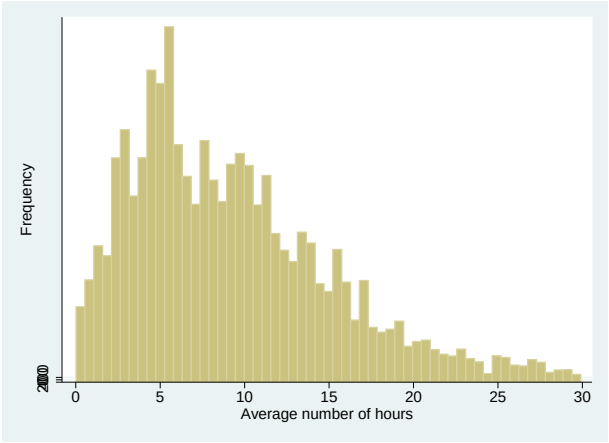


Table A.2: Descriptive statistics

	Daycare		*Out-of-school care*	
	2006	*2009*	*2006*	*2009*
Average price	5.37	5.83	5.55	5.86
	(0.45)	(0.44)	(0.58)	(0.45)
Average real price	5.36	5.52	5.55	5.56
Household composition				
Couples	5.37	5.83	5.56	5.86
	(0.44)	(0.44)	(0.57)	(0.45)
Singles	5.38	5.87	5.51	5.84
	(0.52)	(0.44)	(0.61)	(0.43)
Education				
Lower education	5.36	5.82	5.48	5.84
	(0.47)	(0.53)	(0.67)	(0.45)
Middle education	5.34	5.82	5.53	5.86
	(0.49)	(0.45)	(0.60)	(0.46)
Higher education	5.39	5.83	5.58	5.86
	(0.41)	(0.41)	(0.53)	(0.44)
Etnicity				
Authochthon	5.36	5.82	5.55	5.86
	(0.45)	(0.44)	(0.58)	(0.44)
Non Western immigrant	5.39	5.88	5.49	5.83
	(0.43)	(0.41)	(0.63)	(0.47)
Western immigrant	5.37	5.81	5.57	5.83
	(0.44)	(0.49)	(0.51)	(0.49)
Age				
Lower age	5.35	5.85	5.52	5.89
	(0.46)	(0.44)	(0.63)	(0.45)
Higher age	5.38	5.80	5.56	5.85
	(0.43)	(0.44)	(0.55)	(0.45)

A.2 Wage estimation

We only observe wages for working individuals in the sample. For non-workers we have to estimate wages. Wages are estimated separately for single men, single women, men in couples and women in couples. Here, a distinction is made between lower education (primary/elementary), medium education (intermediate vocational) and higher education (higher vocational / university). We estimate the following wage equation:

$$w_{it} = x'_{it}\beta + \eta_i + \epsilon_{it} \tag{8}$$

where w_{it} is the natural logarithm of real hourly wage, x_{it} is a vector with observable characteristics and ϵ_{it} is the error term for individual i in period t with $\epsilon_{it} \sim IID(0, \sigma^2_\epsilon)$. η_i is the individual specific effect.

First, we apply the pooled OLS estimator in which we ignore the individual specific effect η_i:

$$w_{it} = x'_{it}\beta + \mu_{it} \tag{9}$$

where $\mu_{it} = \eta_i + \epsilon_{it}$. The pooled OLS estimator is unbiased if the individual specific effect is uncorrelated with the regressors x_{it}. We use cluster robust standard errors in order to control for serial correlation of the error terms and heteroskedasticity.

Second, we estimate the Heckman two step model. The sample of non-workers may differ in an unmeasurable way from the sample of working individuals and selection bias may be present. The Heckman selection model can take this potential selection bias into account by estimating the following two equations:

$$p_{it} = x'_{it}\gamma + z'_{it}\theta + \nu_{it} \tag{10}$$

$$w_{it} = x'_{it}\beta + invmills'\lambda_{it} \ + \epsilon_{it} \tag{11}$$

The first equation estimates the probabilty of participation by a pooled probit regression. Vector z_{it} contains variables who are expected to have an effect on the probability of participation but not on wages. Hence, vector z_{it} is an exclusion restriction in order to indentify the parameters of the participation equation. The second equation is the wage equation with the inverse Mills' ratio as additional regressor:

$$invmills_{it} = \phi(p_{it})/\Phi(p_{it}) \tag{12}$$

The wage equation (4) is estimated by pooled OLS again.

Third, we estimate the two equations of the Heckman model simultaneously by maximum likelihood. In general, this method is more efficient than the two step estimator.

Fourth, we take the individual specific effect explicitly into account by estimating the following fixed effects (FE) model:

$$w_{it} = x'_{it}\beta + \eta_i + \epsilon_{it} \tag{13}$$

The fixed effects model allows for correlation between the individual specific effect η_i and the regressors x_{it}. The model is estimated by taking deviations from the mean and therefore the individual specific effect drops out. However, the same holds for time invariant regressors which obviously is an disadvantage.

Fifth, we apply the random effects (RE) estimator:

$$w_{it} = x'_{it}\beta + \eta_i + \epsilon_{it} \tag{14}$$

The random effects estimator assumes that the individual specific effect is independent of the regressors with $\eta_{it} \sim IID(0, \sigma_\eta^2)$.

Finally, we estimate a quasi fixed effects model (Mundlak, 1978):

$$w_{it} = x'_{it}\beta + \omega_i + \bar{x_i}'\pi + \epsilon_{it} \tag{15}$$

where the individual specific effect consists of a random part, ω_i with $\sim IID(0, \sigma_\omega^2)$, and a part which is allowed to be correlated with regressors $\bar{x_i}'\pi$. Here, $\bar{x_i}$ is the average of some time-varying variables such as age. A significant coefficient for π provides evidence that the individual specific effect is correlated with regressors.

Table A.3 shows estimation results of all models for higher educated women with a partner. A significant attrition indicator provides evidence that selection bias is present. The results show that attrition bias is absent. Ideally, we want to use panel data estimation techniques (FE, RE, quasi FE) which enables us to take the unobserved individual specific effect into account. We performed a Hausman test in order to test whether random effects or fixed effect is appropriate. For all groups, we reject the null hypothesis that the individual specific effect is uncorrelated with regressor and therefore we prefer fixed effects over random effects estimation. With fixed effects we lose information on time-invariant regressors and therefore we opt for the quasi fixed effects model. However, the significant inverse Mills' ratio shows that selection bias is present. Hence, we need to correct for selectivity bias in our quasi fixed effects estimation. We estimate a probit model in the first stage and derive the inverse mills' ratio for each individual i at each period t. Next, we estimate wages by quasi fixed effects and include the inverse mills' ratio in the second stage. Tables A.4 and A.5 show the results of this quasi fixed effects model, with a correction for selectivity bias, for singles and couples respectively.[20]

[20]We only present results of our preferred model for all subgroups. We did estimate all models for all subgroups and the results are available on request.

We use age splines since we expect that the relationship between wage and age is nonlinear. Tables A.4 and A.5 show that age indeed increases with age but at a diminishing rate. This is in line with other studies (for instance Vella and Verbeek, 1999). For both singles and couples we see that the age profile is steepest for higher educated individuals. We also include cohort and year dummies in the regression. Because of perfect collinearity between age, cohort and period we use transformed time dummies following Deaton and Paxson (1994). The time dummies for 2006 and 2007 depend on the dummies for later years and are calculated manually.[21]. Year dummies are significant in most specifications while the cohort variables are jointly significant for most subgroups. Real wages are lower on average for non-Western immigrants. Finally, the coefficients for the Mundlak age averages have no economic interpretation but are joinly significant in all specifications.

[21] t2006=-(d2007+d2008+d2009) and t2007=-2*d2008-3*d2009

Table A.3: Results wage estimation: higher educated women with a partner

	Pooled OLS	Heckman 1	Heckman 2	Fixed Effects	Random Effects	Quasi FE
Age effect						
18-30	0.044***	0.045***	0.044***	0.046***	0.047***	0.047***
31-40	0.024***	0.022***	0.024***	0.036***	0.034***	0.035***
41-50	0.002	0.003**	0.002*	0.023***	0.017***	0.023***
51-63	0.000	-0.014***	-0.002	0.017***	0.005***	0.013***
Cohort effect						
1980-1989	0.044***	0.096***	0.052***		0.212***	0.158***
1975-1980	0.030**	0.068***	0.036***		0.171***	0.118***
1970-1975	0.035***	0.057***	0.038***		0.116***	0.077***
1960-1965	-0.022**	-0.016*	-0.021**		-0.078***	-0.044***
1955-1960	-0.032**	-0.025*	-0.031**		-0.151***	-0.064***
<1955	-0.030**	-0.004	-0.026**		-0.181***	-0.046***
reference=1965-1970						
Year effect[a]						
2006	0.005	0.005	0.005	0.002	0.002	0.002
2007	-0.005	-0.005	-0.005	-0.002	-0.002	-0.002
2008	-0.005***	-0.004***	-0.005***	-0.003***	-0.003***	-0.003***
2009	0.005***	0.004***	0.005***	0.002***	0.003***	0.002***
Etnicitity						
Western immigrant	-0.013*	-0.080***	-0.024***		-0.032***	-0.032***
Non-western immigrant	-0.074***	-0.185***	-0.092***		-0.111***	-0.114***
reference = autochtoon						
Partner						
married	-0.039***	-0.091***	-0.047***	0.001	-0.025***	-0.025***
Mundlak age averages						
18-30						0.001
31-40						-0.004***
41-50						-0.017***
51-63						-0.019***
Inverse Mills' ratio		0.497***		-0.024	0.091***	0.098***
Constante	1.484***	1.410***	1.472***	1.219***	1.231***	1.273***
Observations	89859	89859	101083	89859	89859	89859
Number of individuals				26770	26770	26770
Attrition bias						
Attrition indicator				0.002	-0.001	0.000

[a] Deaton & Paxson transformed time dummies

Table A.4: Results wage estimation: quasi fixed effects singles

	Single men			Single women		
	Lower educ.	Middle educ.	Higher educ.	Lower educ.	Middle educ.	Higher educ.
Age effect						
18-30	0.035***	0.050***	0.073***	0.035***	0.043***	0.053***
31-40	0.016***	0.028***	0.046***	0.022***	0.027***	0.040***
41-50	0.009***	0.016***	0.027***	0.026***	0.020***	0.022***
51-63	0.008***	0.016***	0.015***	0.021***	0.021***	0.016***
Cohort effect						
1980-1989	0.056	0.152***	0.245***	0.070	0.146***	0.210***
1975-1980	-0.009	0.068**	0.100***	0.026	0.078***	0.149***
1970-1975	0.004	0.032**	0.068***	0.017	0.046***	0.080***
1960-1965	0.006	0.012	-0.034	0.019	-0.025*	-0.056***
1955-1960	0.014	0.026	-0.075**	0.011	-0.027	-0.107***
<1955	-0.007	-0.006	-0.039	-0.004	-0.020	-0.048**
reference=1965-1970						
Year effect						
2006	0.005	0.004	0.004	0.005	0.005	0.002
2007	-0.005	-0.005	-0.006	-0.008	-0.006	-0.002
2008	-0.004***	-0.002**	-0.001	0.000	-0.003***	-0.001
2009	0.005***	0.003***	0.003***	0.003**	0.004***	0.001*
Etnicitity						
Western immigrant	-0.029	0.012	0.018	-0.011	0.008	0.001
Non-western immigrant	-0.080*	-0.038	-0.135***	-0.025*	-0.020	-0.052**
reference = autochtoon						
Mundlak age averages						
18-30	0.000	0.000	0.006	-0.002	0.004	-0.001
31-40	-0.010**	-0.006*	-0.009**	-0.018***	-0.010***	-0.002
41-50	-0.007	-0.010***	-0.012***	-0.023***	-0.012***	-0.010***
51-63	-0.005	-0.010***	-0.014***	-0.015***	-0.023***	-0.019***
Inverse Mills' ratio	0.004	-0.219**	-0.177***	-0.028*	-0.097***	-0.191***
Constante	1.462***	1.058***	0.380	1.431***	1.084***	1.097***
Observations	14055	26511	19534	11947	27783	21358
Number of individuals	4691	8621	6300	3887	8936	6694

Table A.5: Results wage estimation: quasi fixed effects couples

	Couples men			Couples women		
	Lower educ.	Middle educ.	Higher educ.	Lower educ.	Middle educ.	Higher educ.
Age effect						
18-30	0.045***	0.047***	0.076***	0.037***	0.037***	0.047***
31-40	0.020***	0.029***	0.045***	0.022***	0.024***	0.035***
41-50	0.013***	0.020***	0.028***	0.024***	0.021***	0.023***
51-63	0.010***	0.008***	0.011***	0.020***	0.017***	0.013***
Cohort effect						
1980-1989	0.085***	0.147***	0.173***	0.146***	0.126***	0.158***
1975-1980	0.025	0.074***	0.129***	0.063***	0.080***	0.118***
1970-1975	0.019*	0.034***	0.093***	0.030***	0.048***	0.077***
1960-1965	0.010	-0.017***	-0.012	-0.008	-0.019***	-0.044***
1955-1960	-0.002	-0.031***	-0.043***	0.009	-0.027**	-0.064***
<1955	0.007	0.002	-0.012	0.010	-0.019*	-0.046***
reference=1965-1970						
Year effect						
2006	0.005	0.005	0.004	0.006	0.004	0.002
2007	-0.006	-0.006	-0.003	-0.007	-0.005	-0.002
2008	-0.002***	-0.003***	-0.007***	-0.004***	-0.003***	-0.003***
2009	0.004***	0.004***	0.005***	0.005***	0.004***	0.002***
Etnicitity						
Western immigrant	0.003	-0.068***	-0.055***	0.001	-0.026***	-0.032***
Non-western immigrant	-0.062***	-0.231***	-0.291***	-0.051***	-0.074***	-0.114***
reference = autochtoon						
Partner						
married	0.015***	0.017***	0.015***	-0.011**	-0.015***	-0.025***
Mundlak age averages						
18-30	-0.008*	0.000	-0.005	-0.003	-0.002	0.001
31-40	-0.006**	-0.003**	0.000	-0.012***	-0.008***	-0.004***
41-50	-0.008***	-0.007***	-0.014***	-0.022***	-0.016***	-0.017***
51-63	-0.008***	-0.015***	-0.019***	-0.018***	-0.020***	-0.019***
Inverse Mills' ratio	-0.329***	0.452***	0.674***	-0.008	0.026**	0.098***
Constante	1.446***	1.162***	0.618***	1.298***	1.430***	1.273***
Observations	88997	168316	129663	60824	146294	89859
Number of individuals	26779	49634	37742	19385	44262	26770

A.3 Childcare price estimation

For non-users of formal childcare we have to impute a price for childcare. We have information on the use of formal childcare in the Netherlands for the period 2006- 2009. Here, a distinction is made between daycare (children 0-3 years) and out-of-school care (children 4-11 years). For both types of childcare we know whether childcare is at the child care centre or by so-called guest parents. Only households with a child at the age of 0-11 years use childcare and therefore we restrict our attention to this group.

We focus on households since childcare is consumed at the household level. As it turns out, characteristics of females are more important in predicting use and price of childcare than characteristics of men. Hence, we only include females characteristics in the regressions[22]. We pool singles and couples due to the low number of observations for singles. The same models as for the wage estimation are estimated[23]. Here, the dependent variable is the natural logarithm of the hourly real price. Tables A.6 and A.7 show estimation results for daycare and out-of-school care respectively[24].

Estimation results show that year dummies are significantly increasing for day care. However, time effects are less important in the price equation for out-of-school care (as expected based on descriptive statistics in Table A.2). Households with higher educated women or younger women pay a higher price on average. An explanation might be that these households search for higher quality. We conducted a Hausman test in order to test whether fixed or random effects is appropriate. In all cases, the Hausman test rejected the null hypothesis that random effects is consistent. Hence, the Hausman test favours the fixed effects model. Finally, we estimate a quasi fixed effects model with Mundlak age averages included. The age averages are jointly significant which is another way to show that we should prefer fixed effects over random effects. For the panel data models we tested whether attrition and selection bias is present. The results show that attrition bias is absent in all regressions. The inverse mills ratios are not significant in most models. Again, we use the quasi fixed effects model in the final column to impute prices of childcare for non-users.

[22] Obviously we include males characteristics in case of single fathers.

[23] The Heckman model by maximum likelihood is dropped due to convergence problems.

[24] Including a squared term for age, age splines, ethnicity, a dummy for age of the youngest child or a dummy for multiple children, leads to insignificant effects in most specifications.

Table A.6: Results price estimation: daycare

	Pooled OLS	Heckman 1	Fixed Effects	Random Effects	Quasi FE
Year effect					
2007	0.063***	0.059***	0.034	0.044***	0.058***
2008	0.137***	0.131***	0.073	0.096***	0.123***
2009	0.170***	0.163***	0.081	0.113***	0.153***
Higher educated	0.014*	0.006		-0.001	0.000
Age	-0.003***	-0.003***	0.003	-0.004***	-0.017***
Single parent	0.054***	0.051***		0.033**	0.033**
Inverse Mills ratio		-0.018	-0.047	-0.035*	-0.032
Mundlak age average					0.014**
Constant	5.438***	5.459***	5.351***	5.544***	5.507***
Observations	35675	35675	35675	35675	35675
Individuals			14984	14984	14984
Test attrition bias					
Attrition indicator			0.001	-0.003	-0.001

Table A.7: Results price estimation: out-of-school care

	Pooled OLS	Heckman 1	Fixed Effects	Random Effects	Quasi FE
Year effect					
2007	0.002	-0.004	0.088***	-0.010**	0.015
2008	0.006	-0.006	0.169***	-0.025***	0.025
2009	0.000	-0.014	0.250***	-0.040***	0.035
Higher educated	0.027***	0.007		0.020*	0.020*
Age	-0.004***	-0.003***	-0.103***	-0.005***	-0.031***
Single parent	-0.044***	-0.056***		-0.045***	-0.047***
Inverse Mills ratio		-0.040**	0.015	-0.009	-0.008
Mundlak age average					0.026**
Constant	5.700***	5.734***	9.367***	5.790***	5.741***
Observations	28938	28938	28938	28938	28938
Individuals			12015	12015	12015
Test attrition bias					
Attrition indicator			0.006	-0.001	0.005

A.4 Effects on income inequality

Figures A.5-A.10 illustrate income effects in each of the scenarios in which we study the effectiveness of fiscal stimuli for working parents. Disposable household income is located at the horizontal axis whereas the income effect, which is defined as the percentage change in disposable income, is located on the vertical axis. We present income effects for single parents and couples separately. Figures A.5-A.10 refer to the scenarios in which we increase the budget by 100 million euro income independently.

Figures A.11-A.16 show income effects of policy scenarios when we target these scenarios more at low income households. Finally, income effects of the policy reforms in the periods 2006-2009 and 2011-2013 are found in figures A.17-A.22.

Figure A.5: Single parents

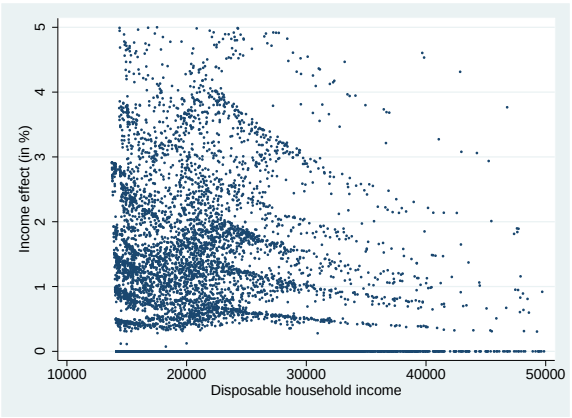
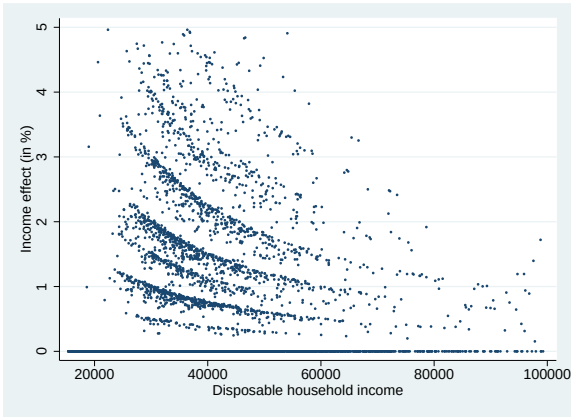


Figure A.6: Couples



Fixed EITC working parents

Figure A.7: Single parents

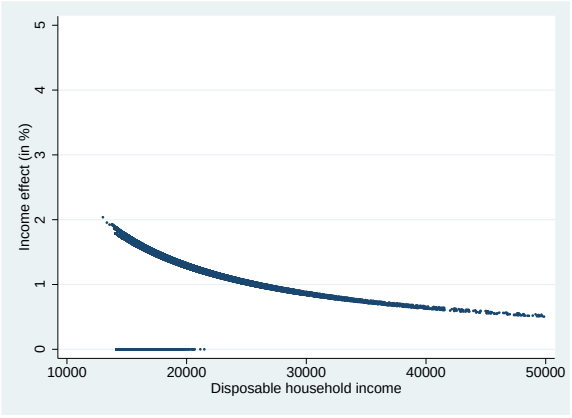
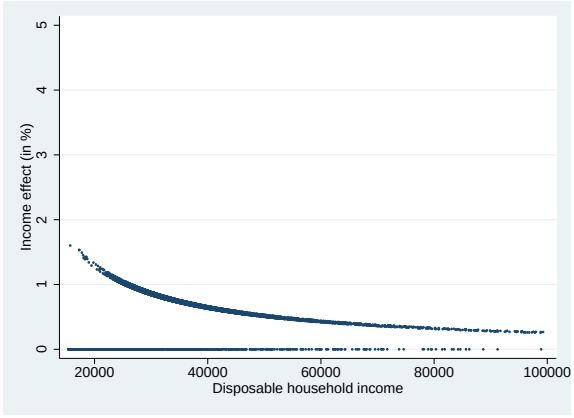


Figure A.8: Couples



Fixed EITC all workers

Figure A.9: Single parents

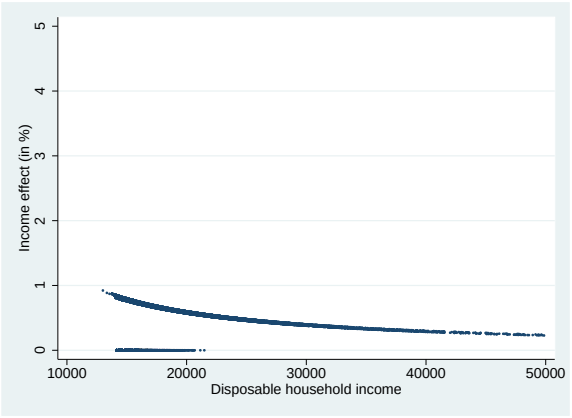
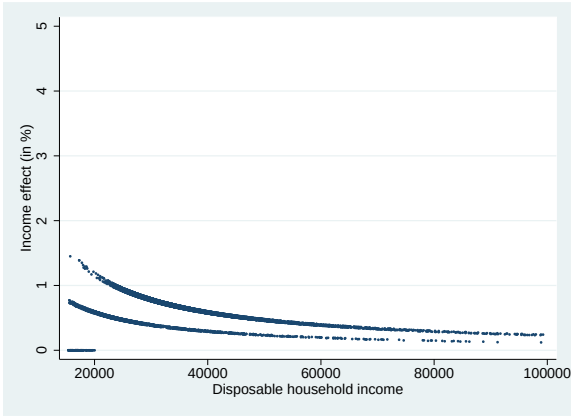


Figure A.10: Couples



Childcare

Figure A.11: Single parents

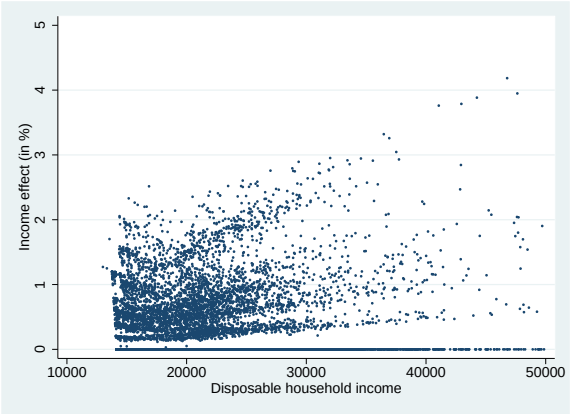
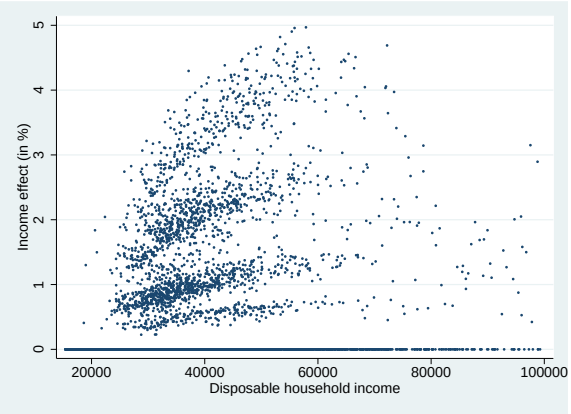


Figure A.12: Couples



EITC working parents

Figure A.13: Single parents

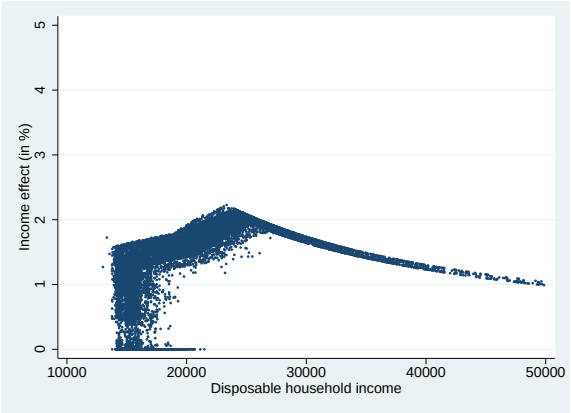
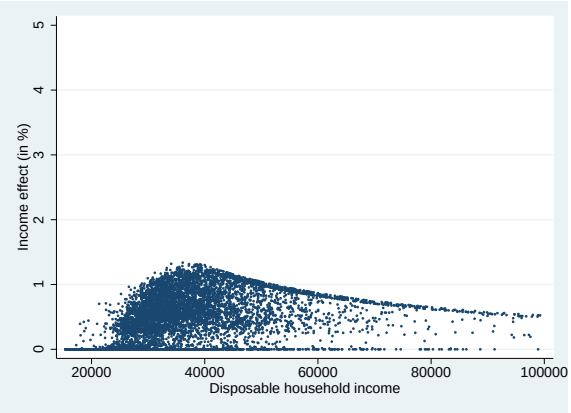


Figure A.14: Couples



EITC all workers

Figure A.15: Single parents

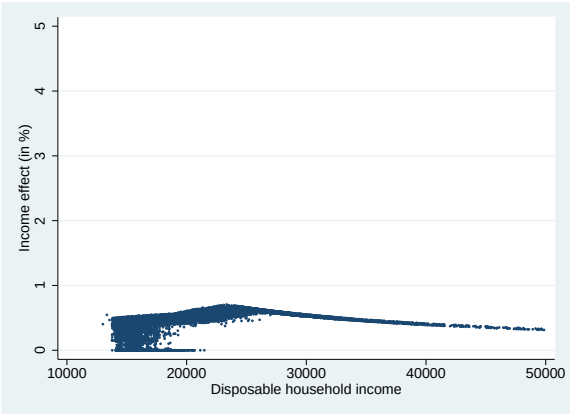
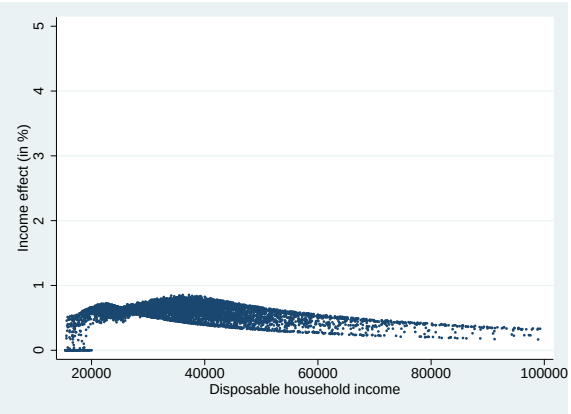


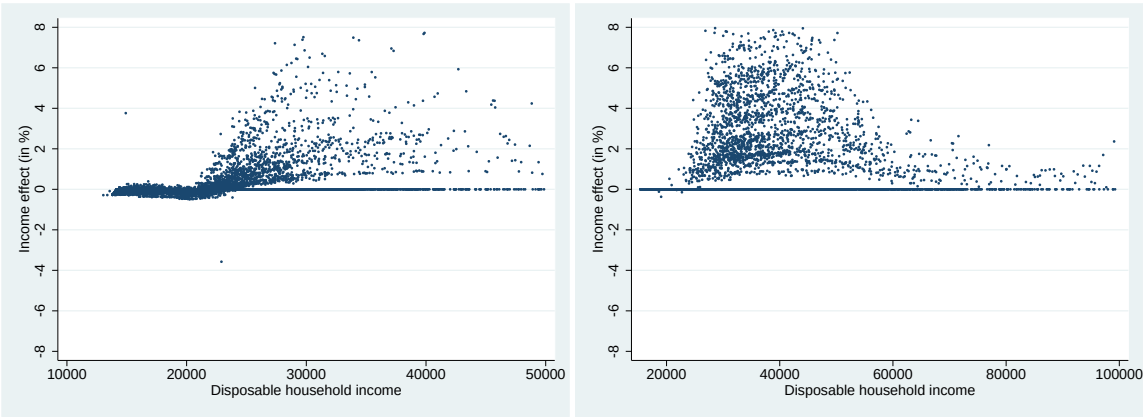
Figure A.16: Couples



Reform childcare 2006-2009

Figure A.17: Single parents

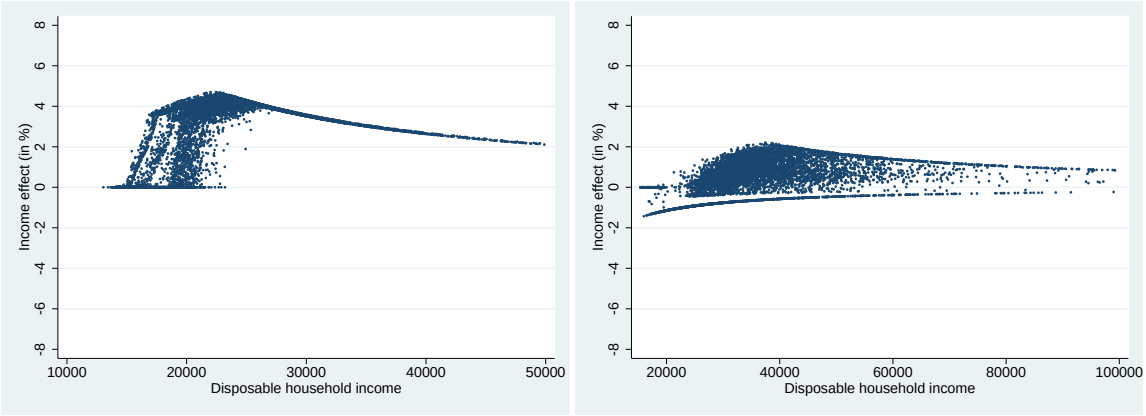
Figure A.18: Couples



Reform EITC working parents 2006-2009

Figure A.19: Single parents

Figure A.20: Couples



Reform childcare 2011-2013

Figure A.21: Single parents

Figure A.22: Couples