CPB Netherlands Bureau for Economic Policy Analysis

CPB Discussion Paper | 361

Optimal Income Support for Lone Parents in the Netherlands:

Are We There Yet?

Henk-Wim de Boer
Egbert Jongen

Optimal Income Support for Lone Parents in the Netherlands: Are We There Yet?*

Henk-Wim de Boer† Egbert Jongen‡

September 2017

Abstract

The Netherlands witnessed major reforms in income support for lone parents over the past decade. The goals of these reforms were to improve the financial incentives to work and to simplify the system. We consider whether the new system can be considered (closer to) 'optimal'. We employ the inverse-optimal method of optimal taxation to recover the implicit social welfare weights before and after the reforms. Before the reforms, the social welfare weights are not monotonically declining in income. After the reforms, this anomaly has disappeared for the group of lone parents as a whole, but remains for the subgroup of lone parents with a youngest child 0–3 years old. An optimal tax analysis suggests that, for a wide range of redistributive preferences, subsidies for working lone parents with a low income could be increased further.

JEL codes: C63, H21, H31

Keywords: Optimal taxation, revealed social preferences, lone parents

*We are grateful to Peter Haan for the programs used in Blundell et al. (2009) and Elise Splint of the Dutch Ministry of Social Affairs and Employment for the model used to construct Figure 1. We have benefitted from comments and suggestions by Leon Bettendorf, Peter Haan, Christine Ho, Lars Kroese, Arjan Lejour, Daniël van Vuuren and seminar and conference participants at CPB Netherlands Bureau for Economic Policy Analysis, the Dutch Ministry of Social Affairs and Employment, the IMA 2017 conference in Turin and the IIPF 2017 conference in Tokyo. Remaining errors are our own. The views expressed in this paper do not necessarily reflect the position of CPB Netherlands Bureau for Economic Policy Analysis or Leiden University.

†CPB Netherlands Bureau for Economic Policy Analysis. E-mail: h.w.de.boer@cpb.nl.

‡CPB Netherlands Bureau for Economic Policy Analysis and Leiden University. Corresponding author. CPB, P.O. Box 80510, 2508 GM The Hague. Phone: +31-650746439. E-mail: e.l.w.jongen@cpb.nl.

1 Introduction

Lone parents are a group of particular interest to policymakers. The tax-benefit systems of well-developed OECD countries typically include targeted subsidies and tax credits for lone parents, and the Netherlands is no exception. However, when providing income support for lone parents the government has to strike a delicate balance between providing income support for the needy and providing sufficient incentives to work. Indeed, lone parents have been shown to be particularly responsive to changes in financial incentives (for the Netherlands see Jongen et al. 2014; Mastrogiacomo et al. 2017). The theory of optimal taxation, pioneered by Mirrlees (1971), studies the trade-off between equity and efficiency. With optimal tax theory we can derive the optimal income support system for a given set of social welfare weights, behavioural responses and ability distribution. Saez (2002) extends the optimal tax model of Mirrlees (1971) to include an extensive margin decision for labour supply and simulates optimal income support in the US for different sets of social welfare weights and behavioural responses. A number of recent papers invert the optimal tax model of Saez (2002), using the so-called inverse-optimal method of optimal taxation to reveal the implicit social welfare weights for a given system of income support (Blundell et al. 2009; Bargain and Keane 2011; Bourguignon and Spadaro 2012; Bargain et al. 2014a; Jacobs et al. 2017).[1] Anomalies in these implicit social welfare weights may indicate suboptimal elements of the system of income support and can help policymakers to optimize the system.

In this paper we study optimal income support for lone parents in the Netherlands. Over the past decade, there were major reforms in income support for lone parents in the Netherlands. The goals of these reforms were to improve the financial incentives for lone parents to work and to simplify the system of income support. However, whether these reforms moved the system closer to an optimal income support system remains largely unknown. We try to answer this question using the inverse-optimal method of optimal taxation.

Following Blundell et al. (2009), we invert the optimal tax model of Saez (2002)

[1] Studying the inverse-optimal problem has a long history in public economics, see e.g. Stern (1977), Christiansen and Jansen (1978), Ahmad and Stern (1984) and Decoster and Schokkaert (1989). However, only recently have researchers been able to use detailed micro data on incomes and corresponding tax rates to study the social welfare weights implicit in tax-benefit systems.

where lone parents can make both an extensive margin (participation) and intensive margin (hours worked per week) decision. For this model we need three inputs: i) the income (ability) distribution, ii) net taxes by income, and iii) the behavioural responses to taxes (and benefits) at the extensive and the intensive margin by income. For the income distribution we take data from the Labour Market Panel of Statistics Netherlands (2012), a large administrative dataset. To calculate the net taxes by income we use the advanced tax-benefit calculator MIMOSI (Koot et al. 2016). Finally, we determine the extensive and intensive behavioural responses to taxes by estimating a discrete-choice model for labour supply (and child care) for lone parents in the Netherlands. We consider results for the whole group of lone parents with a youngest child 0–17 years of age, and for subgroups of lone parents with a youngest child in different age groups (pre-primary school age 0–3, primary school age 4–11 and secondary school age 12–17).

Our main findings are as follows. First, the implicit social welfare weights in the initial income support system are not monotonically declining in income. Specifically, the social welfare weights are increasing from working lone parents with a low income to working lone parents with a higher income. This anomaly is present when we consider the whole group of lone parents and for all subgroups of lone parents by age of the youngest child. Furthermore, the anomaly is particularly strong for lone parents with a youngest child 0–3 years of age. Second, after the reforms, this anomaly disappears when considering the group of lone parents as a whole, and also for the subgroups of lone parents with a youngest child 4–11 and 12–17 years of age. However, for lone parents with a youngest child 0–3 years of age the anomaly is mitigated, but remains. Third, an optimal tax analysis suggests that subsidies for working lone parents with a relatively low income could be increased further. This is true for both weak and strong preferences for redistribution. Whether subsidies for non-working parents should be decreased or increased, and whether subsidies or taxes for working lone parents with a higher income should be decreased or increased, depends on whether the preferences for redistribution are weak or strong.

Our contribution to the literature is twofold. First, we use the inverse-optimal method to evaluate the success of a series of tax-benefit reforms, and show that the inverse-optimal tax method can be a powerful tool to assist policymakers in optimizing their tax-benefit system. In this paper we use the inverse-optimal tax method to evaluate the reform ex post. However, the same method could also be

used to evaluate a potential reform ex ante. Second, we extend the analysis of applied optimal taxation to lone parents in the Netherlands, building on the work for Germany and the UK in Blundell et al. (2009). Similar to Blundell et al. (2009) and some of the other applications of the inverse-optimal method (e.g. Bargain et al. 2014a; Jacobs et al. 2017), we find that welfare weights are not always monotonically declining in income, in the initial system, suggesting that welfare improving reforms are possible. Indeed, we believe the Dutch case is interesting because it shows that a series of reforms was able to 'fix' or at least mitigate the anomalies in the initial income support system.

The outline of the paper is as follows. In Section 2 we outline the inverse-optimal model. Section 3 considers the changes in income support for lone parents in the Netherlands over the past decade and gives descriptive statistics for lone parents in the Netherlands. In Section 4 we then recover the sets of implicit social welfare weights over time. Subsequently, we calculate optimal income support for sets of social welfare weights that differ in inequality aversion in Section 5. Section 6 discusses our findings and concludes. An appendix contains supplementary material.

2 The inverse-optimal model

Following Blundell et al. (2009), we invert the optimal tax model of Saez (2002). Saez (2002) follows the framework set out by Mirrlees (1971). A social planner maximizes a social welfare function, which is a weighted sum of individual utilities over income and leisure. Income is determined by ability and effort (hours worked). Individuals differ in their earnings ability, but the social planner only observes income. When the social planner redistributes income from high- to low-income earners it levies a marginal tax on both innate ability and effort. The latter creates an efficiency loss. Hence, the social planner faces a trade-off between equity and efficiency.

Saez (2002) extends the Mirrlees (1971) model by explicitly allowing for an extensive and intensive margin response to taxation, building on the work of Diamond (1980). Specifically, Saez (2002) assumes that there are $I + 1$ groups on the labour market, where I groups of individuals work and one group does not work. Gross income for each group is exogenously fixed and is higher for higher i. The solution of the optimal tax problem can be characterized by individuals choosing between option i and option $i - 1$ (intensive margin) and by choosing between option i and

option 0 (extensive margin).

The resulting optimal tax system is characterized by the following system of equations (Saez 2002). First, we have the expressions for the optimal level of taxes (which can be negative, e.g. a subsidy) in labour supply choice i relative to labour supply choice $i-1$:

$$\frac{T_i - T_{i-1}}{C_i - C_{i-1}} = \frac{1}{\zeta_i h_i} \sum_{j=i}^{J} h_j \left[1 - g_j - \eta_j \frac{T_j - T_0}{C_j - C_0} \right], \tag{1}$$

where T_i denotes taxes at choice i, C_i is net income at choice i (gross income minus taxes), ζ_i is the intensive elasticity of labour supply at i, h_i is the share of individuals that chooses discrete labour supply option i, η_j is the extensive elasticity at choice j and g_j is the social welfare weight of individuals at choice j (the social value of one more euro for individuals in option j). The intensive and extensive elasticity of labour supply are defined respectively as:

$$\zeta_i = \frac{C_i - C_{i-1}}{h_i} \frac{dh_i}{d(C_i - C_{i-1})}, \tag{2}$$

and:

$$\eta_j = \frac{C_j - C_0}{h_j} \frac{dh_j}{d(C_j - C_0)}. \tag{3}$$

Furthermore, we normalize the total number of individuals to one: $\sum_i h_i = 1$.

Next, we invert the optimality conditions to 'free' the social welfare weights (Bourguignon and Spadaro 2012). Following the numerical implementation in Blundell et al. (2009), we solve for 6 discrete labour supply choices, $i \in (0, 1, 2, 3, 4, 5)$, where option $i = 0$ is the option where the individual does not work. For the highest income group $i = I = 5$ we have a social welfare weight:

$$g_I = 1 - \zeta_I \frac{T_I - T_{I-1}}{C_I - C_{I-1}} - \eta_I \frac{T_I - T_0}{C_I - C_0}, \tag{4}$$

and for the income groups with less income but working we have:

$$g_i = 1 - \zeta_I \frac{T_i - T_{i-1}}{C_i - C_{i-1}} - \eta_i \frac{T_i - T_0}{C_i - C_0} + \frac{1}{h_i} \sum_{j=i+1}^{J} h_j \left[1 - g_j - \eta_j \frac{T_j - T_0}{C_j - C_0} \right]. \tag{5}$$

The system of equations (4) and (5) gives the solution for the work options T_1–T_5. The social welfare weight for the individuals that do not work follows from the

normalization:

$$\sum_{i=0}^{I} h_i g_i = 1, \tag{6}$$

the weighted average of the g_i's for the relevant group of lone parents equals one.[2]

The system of equations (4)-(6) give the social welfare weights implicit in the tax system, given the elasticity parameters η_i and ζ_i, and the share of individuals in each of the 6 options h_i. A complication is that these shares are endogenous to the tax-benefit system. The h_i's in the baseline correspond to averages for the period 2006–2009. Hence, there is no need to adjust the h_i's for 2006–2009. However, when calculating the social welfare weights in later years, and for the optimal tax analysis, we need to take into account that the shares respond to the changes in financial incentives. Here we follow Saez (2002) and assume that the density of options 1 to 5 (the work options) change according to the following rule:[3]

$$h_i = h_i^0 \cdot \left(\frac{C_i - C_0}{C_i^0 - C_0^0} \right)^{\eta_i}, \tag{7}$$

where the superscript 0 indicates baseline values.[4]

3 Income support and descriptive statistics for lone parents in the Netherlands

In this section we first discuss the system of income support for lone parents in the Netherlands, and the changes in this system over the period 2006–2015. Next, we consider the dataset we use for the quantitative analysis and present descriptive statistics.

[2] In the absence of income effects, the weighted average of the social welfare weights equals 1, see Saez (2002). Following Saez (2002) and Blundell et al. (2009), we ignore income effects for simplicity. Empirical studies suggest that this is a good approximation, see e.g. Bargain et al. (2014b).

[3] And the share in option 0 is the residual.

[4] Next to the shares, the elasticities could also be dependent on the tax-benefit system. We find that the elasticities after the reforms are typically somewhat higher than before the reforms.

3.1 Income support system lone parents: 2006–2015

We focus on the system of income support for lone parents in the years 2006, 2009, 2014 and 2015.[5] In the quantitative analysis, as our baseline we use the average employment rate, gross income income distribution and the intensive and extensive elasticities for the period 2006–2009, which is the period of our dataset. After considering the system in 2006 and 2009, we jump to 2014, the last year before the major reform in income support for lone parents in 2015. 2015 is the final year we consider.

Income support in 2006 Lone parents typically receive welfare benefits (*Bijstand* in Dutch) when they do not work.[6] The withdrawal rate of welfare benefits with gross labour income is 100 percent.[7] Welfare benefits for lone parents and singles without children are 70% of the so-called social minimum (0.7*14,450 = 10,116 euro in 2006). In addition, lone parents on welfare benefits receive a supplement of 20% of the social minimum (2,890 euro). Finally, lone parents on welfare benefits also receive the general child benefit (*Kinderbijslag* in Dutch), which in 2006 was 712 euro for a child of 0–5 years of age, 864 euro for a child aged 6–11 and 1,017 euro for a child aged 12–17.

Working lone parents do not receive welfare benefits or the supplement, but they do receive the general child benefit and a number of specific (non-refundable) tax credits. First, there is an income-dependent tax credit for lone parents with a youngest child of up to 18 years of age (*Kinderkorting* in Dutch), with a maximum amount of 924 euro. This tax credit is targeted at lone parents with a relatively low gross income, and is phased out to zero starting at an income of 28,521 euro at a rate of 5.75%. Second, there is a tax credit for lone parents with a youngest child up

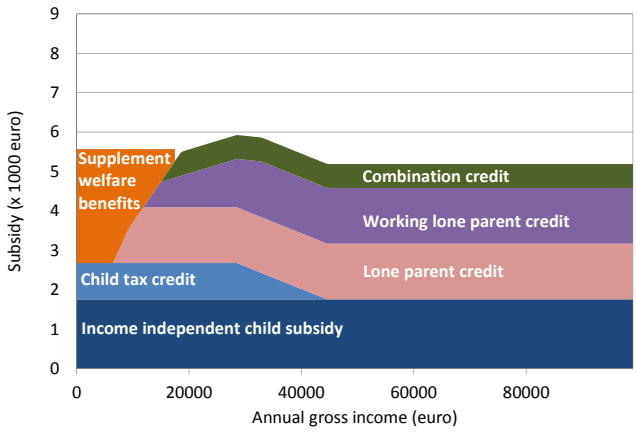
[5] A detailed overview of the parameters of the elements of the tax-benefit system over the period 2006–2015 relevant for our analysis is given in Section A in the Appendix.

[6] Lone parents receive welfare benefits if they are long-term unemployed and are not entitled to unemployment benefits.

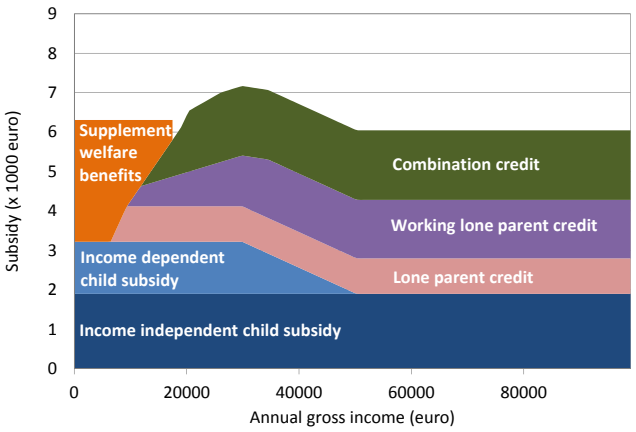
[7] Lone parents living on welfare benefits get a temporary exemption of the withdrawal of benefits of 25% of net labour income, up to a maximum of approximately 200 euro per month, for a period up to 6 months. For lone parents with a youngest child up to 12 years of age there is an additional temporary exemption, they may keep 37.5% of the net labour income up to a maximum of approximately 325 euro per month up to 30 months. In the analysis below we ignore these temporary exemptions to the withdrawal rate of benefits.

Figure 1: Targeted income support for lone parents over time

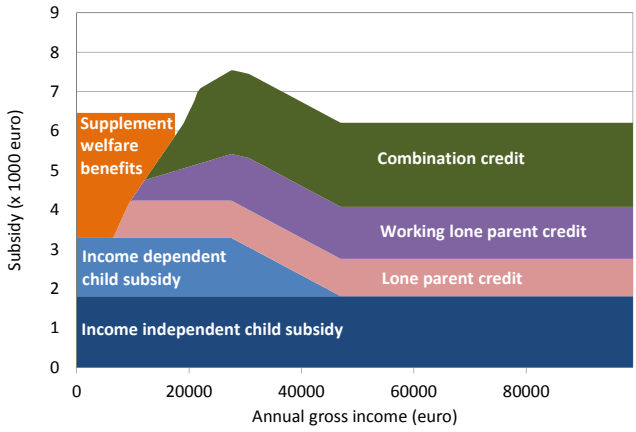
(a) 2006



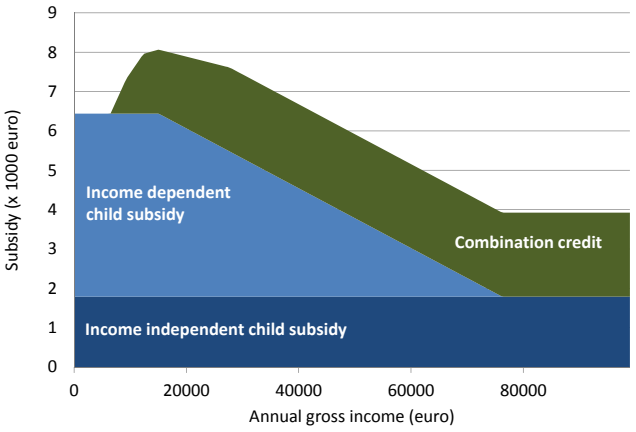
(b) 2009



(c) 2014



(d) 2015



Notes: Own calculations using the *Koopkrachtmodel* of the Dutch Ministry of Social Affairs and Employment. Targeted income support for a lone parent with two children 8 years of age.

to 18 years of age (*Alleenstaande Ouderkorting* in Dutch), which equals 1,414 euro. Third, there is a tax credit for working lone parents with a youngest child up to 16 years of age (*Aanvullende Alleenstaande Ouderkorting* in Dutch), that increases with gross income, at a phase-in rate of 4.3% until a maximum of 1,414 euro is reached. Finally, working lone parents with a youngest child up to 12 years of age also qualify for the so-called combination credit of 608 euro (*Combinatiekorting* in Dutch), which was income-independent in 2006 provided that gross labour income exceeded 4,405 euro. Figure 1(a) shows graphically the rather complicated system of income support for a lone parent with two children 8 years of age in 2006.

Income support in 2009 Moving to 2009, there were three important changes in the system of income support for lone parents over the period 2006–2009. First, the *non-refundable* income-dependent tax credit targeted at lone parents with a relatively low gross income was replaced by a *refundable* income-dependent child subsidy (*Kindgebonden Budget* in Dutch). Households with one child received a maximum amount of 1,011 euro, and households with two children received a maximum amount of 1,322 euro.[8] This child subsidy is phased out to zero at a rate of 6.5%, starting at a household income of 29,914 euro. Second, the tax credit for working lone parents with a youngest child up to 12 years of age (*Combinatiekorting*) became income-dependent, increasing in income with a phase-in rate of 3.8% until a maximum amount of 1,765 euro was reached. Finally, there was a reduction of the lone parent tax credit (*Alleenstaande Ouderkorting*) from 1,414 euro to 902 euro. Figure 1(b) shows the resulting system of income support for lone parents in 2009. Overall, income support for working lone parents increased somewhat relative to lone parents on welfare benefits compared to 2006.

Income support in 2014 Between 2009 and 2014 the elements of the system of income support lone parents did not change, though there were some changes in the parameters.[9] There was however a substantial increase in the combination credit for working lone parents with a youngest child up to 12 years of age (*Combinatiekorting*), the phase-in rate was increased to 4% and the maximum was increased to 2,133 euro.

[8] See Section A in the Appendix for the amounts for households with more children.

[9] See Section A in the Appendix.

The income support system of 2014 is illustrated in Figure 1(c). This figure shows that the financial incentives to work further improved during the period 2009–2014. In addition, next to the changes in the system of income support for lone parents, there was another change in the tax-benefit system over the period 2009–2014 that further improved the incentives to work. The earned income tax credit for all working individuals was increased, from 1,504 euro in 2009 to 2,907 euro in 2014. We should note though that not all working lone parents benefited from this increase in tax credits. Indeed, lone parents with a relatively low gross income did not have sufficient taxable income to claim (the full amount of) all the non-refundable tax credits. This can also be seen from Figure 1(c), first lone parents have to earn enough gross income to claim the lone parent tax credit, then enough gross income to claim the working lone parent tax credit and then enough gross income to claim the combination tax credit. If they then want to claim the general earned income tax credit as well, they need to have even more gross income. Next to changes in tax credits there were also some changes in child care subsidies. Specifically, between 2006 and 2009 child care subsidies became more generous, and after 2011 child care subsidies became less generous again. However, these changes mostly affected households with higher incomes. Lone parents typically earn a relatively low income for which changes were more modest. Section A in the Appendix gives the changes in child care subsidies over the period 2006–2015.[10]

Income support in 2015 2015 then witnessed a major reform in the income support system for lone parents. The two main goals of the reform were i) to further improve the financial incentives to work, and ii) to simplify the system of income support for lone parents (Ministry of Social Affairs and Employment 2012). The new system is shown graphically in Figure 1(d).

Before the reform there were six income support schemes for lone parents, after the reform there were only three. The supplement for lone parents on welfare benefits was abolished, and so were the lone parent tax credit and the working lone parent tax credit. These elements were replaced by an increase in the income-dependent child subsidy. More specifically, a supplement for lone parents was introduced in the income-dependent child subsidy to compensate them for the loss of the supplement on welfare benefits and the tax credits for lone parents. The supplement

[10] In the analysis below we take into account the use of child care and child care subsidies.

in the income-dependent child subsidy was a maximum amount of 3,050 euro in 2015. For example, for lone parents with two children, the maximum amount of the income-dependent child subsidy became 4,932 euro. In addition, the phase-out rate was reduced from 7.60% to 6.75%, though the phase-out now already started at a lower income of 19,463 euro (compared to 26,147 euro in 2014). For working lone parents with a relatively low income, this reform improved the financial incentives to work. In part, this was due to the move from the non-refundable tax credits to the refundable income-dependent child subsidy. Working lone parents were now also more likely to have enough taxable income to claim all the work-related tax credits (e.g. the combination credit and the earned income tax credit).[11]

3.2 Dataset and descriptive statistics

For the data on the gross income distribution, employment rates and household characteristics we use the Labour Market Panel (LMP) of Statistics Netherlands (2012). The LMP is a large administrative household panel data set with annual data. We use data for the period 2006–2009 (2009 is the last year in the dataset). The LMP contains a rich set of individual and household characteristics, including gender, month and year of birth, the highest completed level of education and ethnicity for all adult members of the household, the ages of the children and the area of residence. The LMP also contains administrative data on hours worked and gross income from different sources (wages, benefits etc.).

Table 1 gives descriptive statistics of the 2006–2009 sample we use in the inverse-optimal and optimal tax analyses, and in the estimation of the extensive and intensive margin elasticities.[12] We focus on lone parents with a youngest child up to and including 17 years of age, to which the reforms considered above apply. First consider the descriptive statistics for the whole group of lone parents with a child up to 17 years of age. The first row of Table 1 shows that 76% of these lone parents participate on the labour market, and the average number of hours worked (conditional on working) is 30 hours per week. Following Blundell et al. (2009) we next

[11] Note that for working lone parents with an income above approximately 50 thousand euro there was actually a drop in income support. However, the large majority of working lone parents has a gross income well below 50 thousand euro.

[12] Appendix B gives descriptive statistics for the full set of demographic characteristics in the dataset.

Table 1: Descriptive statistics lone parents: averages for 2006–2009

	Share	Employment rate (in %)	Working hours (conditional)	Low education share (in %)	Age
Youngest child 0–17		76.0	29.9	35.0	43.2
– Youngest child 0–3	10.1	55.8	28.2	41.6	33.8
– Youngest child 4–11	35.8	71.2	28.2	33.9	40.4
– Youngest child 12–17	54.1	83.0	31.0	34.4	46.9

Notes: Includes lone parents aged between 18 and 63 years of age with at least one child 0–17 years of age. We exclude lone parents who are students, self-employed or who are on disability or unemployment benefits.

distinguish between subgroups based on the age of the youngest child: pre-primary school age 0–3 (row 2), primary school age 4–11 (row 3) and secondary school age 12–17 years of age (row 4). Lone parents with a youngest child 0–3 years of age are the smallest group (10%), and the shares are much higher for lone parents with young children 4–11 (36%) and 12–17 (54%) years of age. As expected, the average age of lone parents increases with the age of the youngest child. The same holds for the participation rate and the average number of hours worked per week, despite a higher average level of education for the mothers with a child 0 to 3 years of age.

To determine the extensive and intensive labour supply elasticities, we estimate preferences over income, leisure and child care with a structural discrete-choice model (Aaberge et al. 1995; Van Soest 1995; Keane and Moffitt 1998; Bargain et al. 2014b). Discrete-choice models have the advantage of being able to take into account all the complexities in the budget set that result from the tax-benefit system (such as kinks and non-convexities). Section C in the Appendix describes the setup of our discrete-choice model, and gives the estimated parameters of the utility function and the fit of the model. The corresponding extensive and intensive elasticities are discussed below.

4 Implicit social welfare weights over time

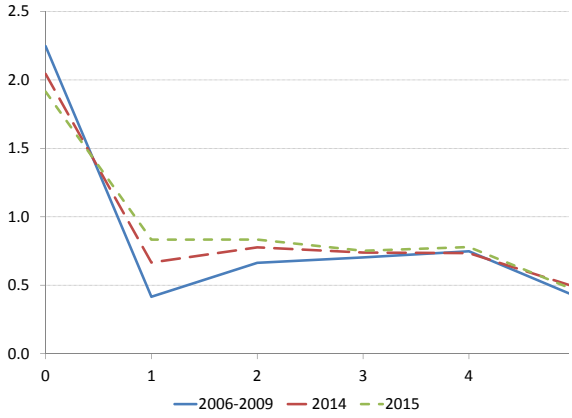
We derive the implicit social welfare weights for the initial income support system and after the reforms. Specifically, we calculate the social welfare weights for the baseline period 2006–2009 (using averages for this period), 2014 (just before the major reform in 2015) and 2015. In 2014 and 2015 we use the gross incomes per

Table 2: Implicit social welfare weights lone parents: 2006–2009

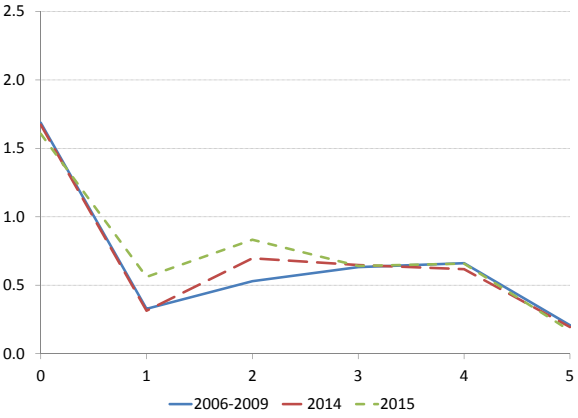
Gross earnings	Net income	Net tax	Intensive elasticity	Extensive elasticity	Share	Social welfare weights
Panel A: Lone parents with a youngest child 0–17 years of age						
0	293	-293	–	–	0.25	2.25
200	314	-114	0.04	0.04	0.15	0.42
326	384	-58	0.06	0.13	0.15	0.66
423	441	-18	0.06	0.16	0.15	0.70
544	503	41	0.05	0.20	0.15	0.75
851	659	192	0.12	0.35	0.15	0.42
Panel B: Lone parents with a youngest child 0–3 years of age						
0	296	-296	–	–	0.43	1.69
184	379	-195	0.29	0.29	0.11	0.33
289	445	-156	0.07	0.48	0.11	0.53
378	522	-143	0.12	0.59	0.11	0.63
478	579	-101	0.07	0.58	0.11	0.66
704	697	7	0.13	0.89	0.11	0.21
Panel C: Lone parents with a youngest child 4–11 years of age						
0	295	-295	–	–	0.29	1.87
198	314	-116	0.01	0.01	0.14	0.80
309	381	-72	0.06	0.12	0.14	0.69
398	446	-48	0.07	0.17	0.14	0.74
507	508	1	0.06	0.24	0.14	0.76
769	645	124	0.15	0.51	0.14	0.25
Panel D: Lone parents with a youngest child 12–17 years of age						
0	289	-289	–	–	0.18	2.04
206	300	-94	0.00	0.00	0.16	0.97
344	371	-27	0.06	0.08	0.16	0.72
447	426	22	0.05	0.10	0.16	0.78
575	493	81	0.05	0.14	0.16	0.80
914	672	241	0.11	0.24	0.16	0.57

Figure 2: Social welfare weights lone parents over time

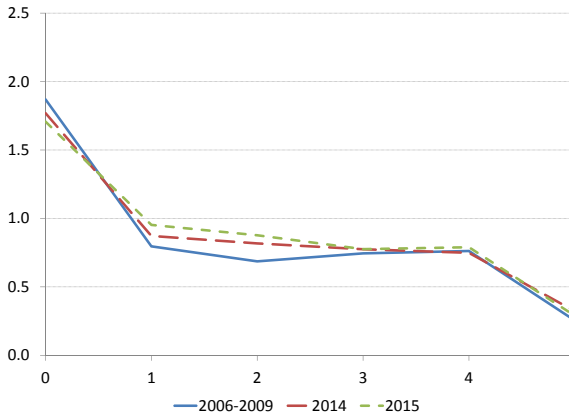
(a) Lone parents youngest child 0–17



(b) Lone parents youngest child 0–3



(c) Lone parents youngest child 4–11



(d) Lone parents youngest child 12–17

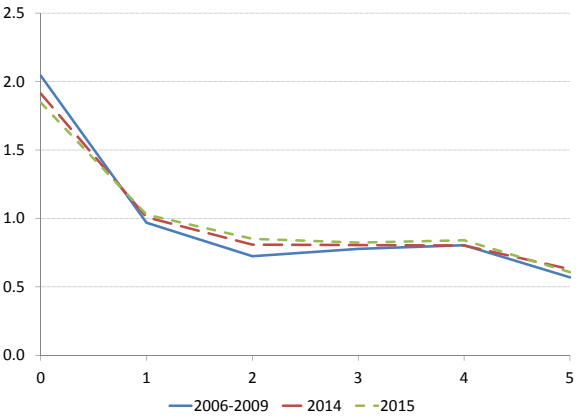


Table 3: Social welfare weights lone parents over time

	2006–2009			2014			2015		
Gross earnings	Net tax	Share	Social welfare weights	Net tax	Share	Social welfare weights	Net tax	Share	Social welfare weights
Panel A: Lone parents with a youngest child 0–17 years of age									
0	-293	0.25	2.25	-299	0.23	2.04	-300	0.23	1.91
200	-114	0.15	0.42	-133	0.15	0.67	-153	0.16	0.83
326	-58	0.15	0.66	-86	0.16	0.78	-103	0.16	0.83
423	-18	0.15	0.70	-38	0.15	0.74	-50	0.15	0.75
544	41	0.15	0.75	27	0.15	0.73	15	0.15	0.78
851	192	0.15	0.42	164	0.16	0.49	166	0.15	0.46
Panel B: Lone parents with a youngest child 0–3 years of age									
0	-296	0.43	1.69	-304	0.43	1.67	-304	0.41	1.61
184	-195	0.11	0.33	-203	0.11	0.31	-224	0.12	0.56
289	-156	0.11	0.53	-184	0.12	0.70	-206	0.13	0.83
378	-143	0.11	0.63	-156	0.11	0.65	-166	0.12	0.64
478	-101	0.11	0.66	-104	0.11	0.62	-112	0.11	0.66
704	7	0.11	0.21	3	0.11	0.19	4	0.11	0.17
Panel C: Lone parents with a youngest child 4–11 years of age									
0	-295	0.29	1.87	-301	0.28	1.77	-302	0.27	1.71
198	-116	0.14	0.80	-133	0.14	0.87	-156	0.14	0.95
309	-72	0.14	0.69	-104	0.15	0.82	-122	0.15	0.88
398	-48	0.14	0.74	-68	0.14	0.77	-78	0.15	0.78
509	1	0.14	0.76	-12	0.14	0.75	-21	0.14	0.79
769	124	0.14	0.25	102	0.15	0.32	105	0.15	0.29
Panel D: Lone parents with a youngest child 12–17 years of age									
0	-289	0.18	2.07	-295	0.17	1.94	-295	0.16	1.88
206	-94	0.16	0.99	-117	0.16	1.02	-135	0.16	1.03
344	-27	0.16	0.70	-60	0.17	0.79	-77	0.17	0.84
447	22	0.16	0.78	-10	0.17	0.81	-25	0.17	0.83
575	81	0.16	0.80	47	0.17	0.80	32	0.17	0.84
914	241	0.16	0.57	177	0.17	0.63	179	0.17	0.61

option from 2006–2009, but apply the tax-benefit system of 2014 and 2015.[13] Note that the shares of lone parents in the 6 different options are endogenous, hence we account for e.g. the change in the participation rate by lone parents when simulating the 2014 and 2015 tax-benefit systems.[14]

The input for the calculations of the initial tax-benefit system (2006–2009) is given in Table 2. In the top panel we have the input for the whole group of lone parents (with a youngest child 0–17 years of age) and in the subsequent panels we have the inputs for subgroups that differ by age of the youngest child.[15] For all groups we observe that net income increases as gross income increases. Furthermore, for all groups the intensive and extensive elasticity is larger for groups that have more gross income, and extensive elasticities are larger than intensive elasticities (except for group 1, for which these elasticities are the same by definition, since option $i-1$ is option 0). Also, the elasticities are lower for lone parents with an older youngest child.

The last column in Table 2 gives the resulting implicit social welfare weights, using the system of equations (4)–(6). These are also shown graphically in Figure 2 (blue solid lines). We see that for the whole group of lone parents, as well as for all subgroups, the social welfare weights are not monotonically declining in income. In particular, social welfare weights increase when we go from working lone parents with a relatively low income to lone parents that have a higher income. Hence, although lone parents with lower gross income have lower net income than lone parents with higher gross income, the initial system suggests that they are less deserving of additional income than lone parents with higher gross income. This anomaly is particularly strong for lone parents with a youngest child 0–3 years of age. These results are in line with the findings of Blundell et al. (2009) for lone mothers in Germany and the UK.[16] They also find that lone mothers with a relatively low income implicitly get a lower social welfare weight than lone parents

[13] We simulate the tax-benefit system of 2014 and 2015 for all four years in our data period 2006–2009. The nominal parameters of the tax-benefit system in 2014 and 2015 are deflated with the CPI to prices 2006–2009.

[14] The gross earnings for each option are averages for quintiles based on gross weekly earnings.

[15] Using the method in this paper to study optimal redistribution between these subgroups, or between lone parents and other groups on the labour market, is not straightforward.

[16] In our dataset, 88% of lone parents are lone mothers. Indeed, most children of separated parents reside with the mother.

with higher income (Blundell et al. 2009, Table 3). Furthermore, they also find that this anomaly is more pronounced for lone mothers with all children under school-age (Blundell et al. 2009, Table 4 and 5).[17]

Table 3 gives the changes in outcomes when we move from the tax-benefit system in 2006–2009 to 2014 and to 2015.[18] Figure 2 shows the development of the social welfare weights graphically (the red dashed lines give the results for 2014 and the dotted green lines give the results for 2015). The reforms improved the financial incentives to work for all groups; net taxes are typically lower in the work options. This results in a larger participation rate for all groups. After the reforms, the social welfare weights become grosso modo well-behaved, monotonically declining in income, except for lone parents with a youngest child 0–3 years of age. The anomaly for lone parents with a youngest child 0–3 years of age is mitigated, but remains.

5 Optimal income support for different degrees of inequality aversion

The analysis above suggests that after a decade of reforms, the implicit social welfare weights in the income support system of lone parents have become well-behaved, except for lone parents with a youngest child 0–3 years of age. In this section we consider the implicit inequality aversion in the income support system in 2015, and consider changes in the tax-benefit system that would be optimal for different degrees of inequality aversion.

Specifically, again following Blundell et al. (2009), we consider the optimal system of income support for sets of social welfare weights that are the following function of net income: $g_i = 1/(pC_i^v)$, where p is a scaling variable that we use to normalize the weighted sum of social welfare weights to 1 and v measures the preferences for inequality aversion. Specifically, the higher is v, the higher is the aversion to inequality. Following Blundell et al. (2009), we consider values for v of 0.25, 1.00 and 2.00.[19] We compare the outcomes for the different sets of social welfare weights

[17] For Germany they even find a negative weight for lone mothers with all children under school-age in option 2. This would imply that an extra euro for this group would *reduce* social welfare.

[18] Note that the points on the horizontal axis are not evenly spaced in gross income, see Table 3 for the gross incomes corresponding to points 0–5 in Figure 2.

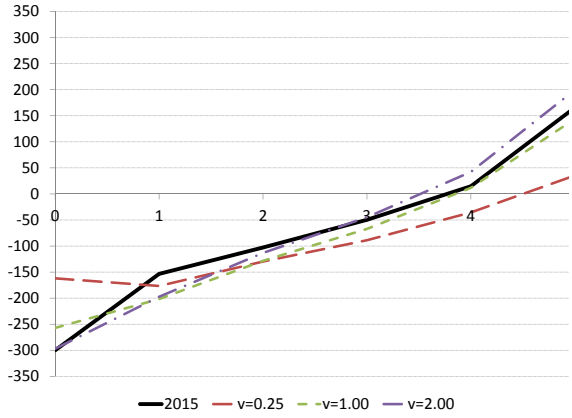
[19] According to Saez (2002), a value of 1.00 already corresponds to a relatively strong taste for

Table 4: Optimal income support for different tastes for redistribution

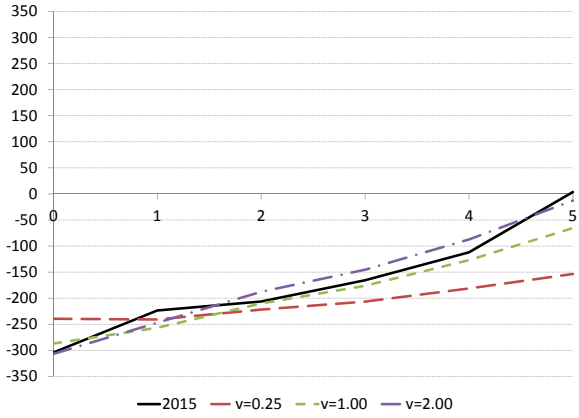
	2015			v=0.25			v=1.00			v=2.00		
Gross earnings	Net tax	Share	Social welfare weights	Net tax	Share	Social welfare weights	Net tax	Share	Social welfare weights	Net tax	Share	Social welfare weights
Panel A: Lone parents with a youngest child 0–17 years of age												
0	-300	0.23	1.91	-162	0.13	1.29	-257	0.19	1.65	-297	0.23	1.86
200	-153	0.16	0.83	-177	0.16	1.04	-202	0.16	1.05	-197	0.16	1.04
326	-103	0.16	0.83	-130	0.17	0.99	-128	0.17	0.93	-113	0.16	0.85
423	-50	0.15	0.75	-89	0.17	0.96	-67	0.16	0.86	-45	0.15	0.75
544	15	0.15	0.78	-36	0.17	0.94	12	0.16	0.80	42	0.15	0.65
851	166	0.15	0.46	35	0.18	0.86	144	0.16	0.60	199	0.15	0.39
Panel B: Lone parents with a youngest child 0–3 years of age												
0	-304	0.41	1.61	-240	0.25	1.18	-287	0.35	1.45	-307	0.42	1.60
184	-224	0.12	0.56	-241	0.14	1.02	-257	0.14	0.94	-247	0.13	0.81
289	-206	0.13	0.83	-222	0.15	0.98	-210	0.13	0.84	-188	0.12	0.66
378	-166	0.12	0.64	-207	0.15	0.94	-176	0.13	0.75	-145	0.11	0.55
478	-112	0.11	0.66	-181	0.14	0.92	-127	0.12	0.69	-87	0.11	0.47
704	4	0.11	0.17	-154	0.17	0.86	-66	0.13	0.54	-13	0.12	0.29
Panel C: Lone parents with a youngest child 4–11 years of age												
0	-302	0.27	1.71	-184	0.17	1.24	-268	0.24	1.55	-302	0.28	1.72
198	-156	0.14	0.95	-187	0.15	1.03	-195	0.15	1.05	-188	0.15	1.06
309	-122	0.15	0.88	-149	0.16	0.99	-137	0.15	0.93	-120	0.15	0.85
398	-78	0.15	0.78	-117	0.16	0.96	-88	0.15	0.85	-64	0.14	0.73
509	-21	0.14	0.79	-76	0.17	0.93	-25	0.15	0.78	7	0.14	0.62
769	105	0.15	0.29	-40	0.19	0.86	51	0.16	0.58	101	0.15	0.35
Panel D: Lone parents with a youngest child 12–17 years of age												
0	-296	0.17	1.85	-141	0.11	1.33	-253	0.15	1.68	-298	0.18	1.92
206	-132	0.16	1.03	-158	0.16	1.05	-185	0.16	1.09	-185	0.16	1.12
344	-70	0.17	0.85	-99	0.18	1.00	-100	0.18	0.96	-90	0.17	0.90
447	-14	0.17	0.82	-44	0.18	0.97	-27	0.17	0.90	-10	0.17	0.82
575	49	0.17	0.84	20	0.18	0.94	61	0.17	0.83	86	0.16	0.72
914	208	0.17	0.61	117	0.19	0.86	230	0.17	0.62	283	0.16	0.43

Figure 3: Optimal tax profiles lone parents

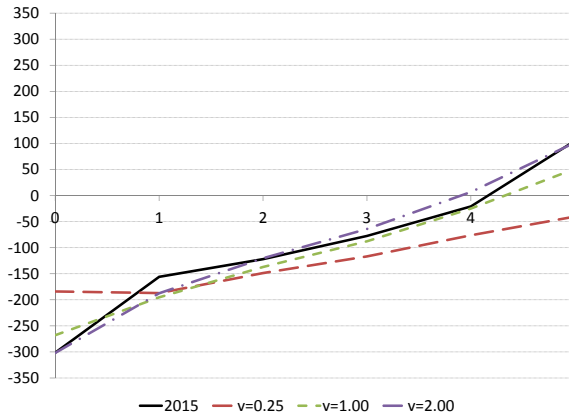
(a) Lone parents youngest child 0–17



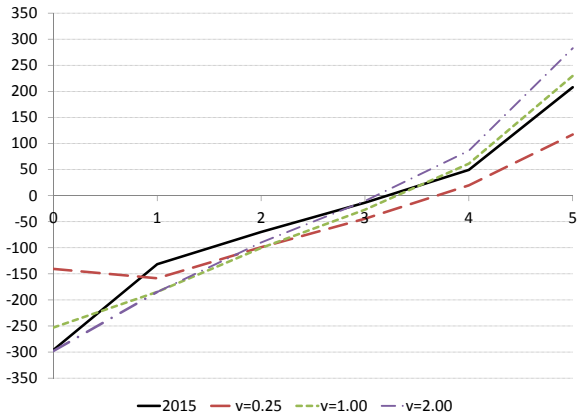
(b) Lone parents youngest child 0–3



(c) Lone parents youngest child 4–11



(d) Lone parents youngest child 12–17



using the outcomes for 2015 as the base. Specifically, the endogenous shares in the different options for the alternative income support systems are calculated using equation (7) and 2015 as the base, and we require the total net transfer to lone parents (for the whole group and for all subgroups) to be the same as in 2015.

The results are given in Table 4 and illustrated in Figure 3. In Figure 3, the solid black lines give the income support in the 2015 system, the dashed red lines give the income support for the set of social welfare weights with a relatively low taste for redistribution (v=0.25), the green dotted lines for the set of social welfare weights with an intermediate taste for redistribution (v=1.00) and the purple dashed and dotted lines for the set of social welfare weights with a relatively high taste for redistribution (v=2.00).

First, we consider which measure of inequality aversion best approximates the 2015 system, using the sum of squared differences or the sum of absolute differences (both measures give the same result). For the whole group of lone parents, for lone parents with a youngest child 0–3 years of age and for lone parents with a youngest child 4–11 years of age, the 2015 system grosso modo appears closest to the optimal tax-benefit system with strong preferences for redistribution (v=2.00).[20] For lone parents with a youngest child 12–17 years of age, the 2015 system is grosso modo closer to the optimal tax-benefit system with intermediate preferences for redistribution (v=1.00).

When the taste for redistribution is low (v=0.25) or intermediate (v=1.00), we see that non-working parents get less income support than in the 2015 system. For all tastes for redistribution, the 'working poor' lone parents of option 1 get more income support than in the 2015 system. Income support for options 3, 4 and 5 is either somewhat higher or somewhat lower than in the 2015 system, depending on the preferences for redistribution. Finally, when the taste for redistribution is relatively low ($v = 0.25$), marginal tax rates going from group 0 to group 1 are negative, so income support for 'working poor' lone parents should then be higher than for 'non-working poor' lone parents.[21]

---

redistribution.

[20]This is consistent with the findings for Germany and the UK by Blundell et al. (2009, Figure 3 and 4) who also find that the weights implicit in the tax-benefit system for lone parents most closely resemble the weights corresponding to relatively strong preferences for redistribution.

[21]Blundell et al. (2009) find that negative marginal tax rates going from option 0 to option 1 are never optimal, also not for low preferences for redistribution although in this case, both for

Summarizing, we observe that the 2015 system can be characterized as a system with relatively strong inequality aversion. In an optimal system of income support, for all tastes for redistribution considered here, income support for the group of working lone parents with the lowest gross wage incomes should always be higher than in the 2015 system. Optimal income support for working lone parents with a higher wage income can be either higher or lower than the 2015 system, depending on whether the aversion to inequality is weaker or stronger than implicit in the 2015 system.

6 Discussion and conclusion

In this paper we have studied whether the reforms in income support for lone parents in the Netherlands over the past decade have moved the income support system closer to an 'optimal' system, using the inverse-optimal method of optimal taxation, own estimates for extensive and intensive labour supply responses and an advanced tax-benefit calculator. Our results suggest that the initial system was suboptimal, with the implicit social welfare weights not monotonically declining in income. After the reforms, the social welfare weights are well-behaved, monotonically declining in income, except for lone parents with a youngest child 0–3 years of age. An optimal tax analysis for different degrees of inequality aversion suggests that the 2015 system can be characterized as a system with relatively strong inequality aversion. Furthermore, for both weak and strong levels of inequality aversion, income support for the group of working lone parents with the lowest gross wage incomes is always higher than in the current system.

Future research could consider a number of extensions to the analysis outlined here. It would be interesting to study whether the results are robust to the inclusion of involuntary unemployment. So far, we assume that what we observe in the data is all driven by choices by lone parents. However, when both chance and choice play a part in outcomes, this may affect the optimal level of income support for e.g. working vs. non-working lone parents, and hence also the implicit social welfare weights. From an international perspective, involuntary unemployment is rather

Germany and the UK, net taxes for individuals in option 0 and 1 are very close (Blundell et al. 2009, Table 6, 7 and 8). In our case, when preferences for redistribution are low, net taxes are also close in option 0 and 1, but marginal tax rates are actually negative going from 0 to option 1.

low in the Netherlands though. Furthermore, in the analysis we use a set of social welfare weights that is not linked directly to the estimated preferences used for the calculation of the labour supply responses. An optimal tax analysis using the estimated preferences directly, along the lines of Blundell and Shephard (2012), also seems an interesting avenue for future research.

References

Aaberge, R., Dagsvik, J., and Strom, S. (1995). Labor supply responses and welfare effects of tax reforms. *Scandinavian Journal of Economics*, 97(4):635–659.

Ahmad, E. and Stern, N. (1984). The theory of reform and Indian indirect taxes. *Journal of Public Economics*, 25(3):259–298.

Bargain, O., Dolls, M., Immervoll, H., Neumann, D., Peichl, A., Pestel, N., and Siegloch, S. (2014a). Tax policy and income inequality in the United States, 1979–2007. *Economic Inquiry*.

Bargain, O. and Keane, C. (2011). Tax-benefit-revealed redistributive preferences over time: Ireland 1987–2005. *Labour*, 24:141–167.

Bargain, O., Orsini, K., and Peichl, A. (2014b). Comparing labor supply elasticities in Europe and the United States: New results. *Journal of Human Resources*, 49(3):723–838.

Blundell, R., Brewer, M., Haan, P., and Shephard, A. (2009). Optimal income taxation of lone mothers: An empirical comparison of the UK and Germany. *Economic Journal*, 119(535):F101–F121.

Blundell, R., Chiappori, P.-A., and Meghir, C. (2007). Collective labour supply: Heterogeneity and non-participation. *Review of Economic Studies*, 74:417–455.

Blundell, R. and Shephard, A. (2012). Employment, hours of work and the optimal taxation of low income families. *Review of Economic Studies*, 79(2):481–510.

Bourguignon, F. and Spadaro, A. (2012). Tax–benefit revealed social preferences. *Journal of Economic Inequality*, 10(1):75–108.

Christiansen, V. and Jansen, E. (1978). Implicit social preferences in the Norwegian system of indirect taxation. *Journal of Public Economics*, 10(2):217–245.

Decoster, A. and Schokkaert, E. (1989). Equity and efficiency of a reform of Belgian indirect taxes. *Recherches Economiques de Louvain*, 55(2):155–176.

Diamond, P. A. (1980). Income taxation with fixed hours of work. *Journal of Public Economics*, 13(1):101–110.

European Union (2014). *Taxation trends in the European Union, 2014 edition.* European Union.

Heckman, J. (1979). Sample selection bias as a specification error. *Econometrica*, 47(1):153–161.

Jacobs, B., Jongen, E., and Zoutman, F. (2017). Redistributive preferences of Dutch political parties. *Journal of Public Economics*, forthcoming.

Jongen, E., De Boer, H.-W., and Dekker, P. (2014). MICSIM: A behavioural microsimulation model for the analysis of tax-benefit reform in the Netherlands. CPB Background Document, The Hague.

Keane, M. and Moffitt, R. (1998). A structural model of multiple welfare program participation and labor supply. *International Economic Review*, 39(3):553–589.

Koot, P., Vlekke, M., Berkhout, E., and Euwals, R. (2016). MIMOSI: Microsimulatiemodel voor belastingen, sociale zekerheid, loonkosten en koopkracht. CPB Background Document, The Hague.

Mastrogiacomo, M., Bosch, N., Gielen, M., and Jongen, E. (2017). Heterogeneity in labour supply responses: Evidence from a major tax reform. *Oxford Bulletin of Economics and Statistics*, 79(5):769–796.

McFadden, D. (1978). Modeling the choice of residential location. In Karlqvist, A., Lundqvist, L., Snickars, F., and Weibull, J., editors, *Spatial Interaction Theory and Planning Models*, pages 75–96. North-Holland.

Ministry of Social Affairs and Employment (2012). Kindregelingen. Letter to Parliament, February 2nd, The Hague.

Mirrlees, J. (1971). An exploration in the theory of optimum income taxation. *Review of Economic Studies*, 38(2):175–208.

Saez, E. (2002). Optimal income transfer programs: Intensive versus extensive labor supply responses. *Quarterly Journal of Economics*, 117(3):1039–1073.

Statistics Netherlands (2012). Documentatierapport Arbeidsmarktpanel 1999-2009V1. Statistics Netherlands, Leidschenveen.

Stern, N. (1977). Welfare weights and the elasticity of the marginal valuation of income. In Artis, M. and Nobay, A., editors, *Studies in Modern Economic Analysis*. Basil Blackwell Publishers, Oxford.

Train, K. (2003). *Discrete Choice Methods with Simulation*. Cambridge University Press.

Van Soest, A. (1995). Structural models of family labor supply: A discrete choice approach. *Journal of Human Resources*, 30(1):63–88.

Appendix

A Parameters tax-benefit system: 2006–2015

Table A.1: Targeted income support lone parents

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Supplement welfare benefits (in €)	2,890	2,979	3,041	3,096	3,123	3,161	3,206	3,175	3,257	0
Tax credit for lone parents (in €)	1,414	1,437	1,459	902	945	931	947	947	947	0
Tax credit for working lone parents (in €)										
Maximum	1,414	1,437	1,459	1,484	1,513	1,523	1,319	1,319	1,319	0
Phase-in rate (in %)	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	–
End phase-out	32,884	33,419	33,930	34,512	35,186	35,419	30,674	30,674	30,674	–
Income-dependent child benefit lone parents (in €)										
Maximum for 1 child	924	939	994	1,011	1,011	1,011	1,017	1,017	1,017	4,082
Maximum for 2 children	924	939	994	1,322	1,322	1,466	1,478	1,553	1,553	4,932
Maximum for 3 children	924	939	994	1,505	1,505	1,826	1,661	1,736	1,736	5,056
Maximum for 4 children	924	939	994	1,611	1,611	2,110	1,767	1,842	1,842	5,162
Maximum for 5 children	924	939	1,662	1,662	2,299	1,873	1,767	1,948	1,948	5,268
Additional amount per child > 5 chld	–	–	–	51	51	189	106	106	231	106
Additional amount child aged 12–15[a]	–	–	–	–	231	231	231	231	296	231
Additional amount child aged 16–17[a]	–	–	–	–	296	296	296	296	296	412
Start phase-out	28,521	28,978	29,413	29,914	28,897	28,897	28,897	26,147	26,147	19,463
Phase-out rate (in %)	5.75	5.75	5.75	6.50	7.60	7.60	7.60	7.60	7.60	6.75
Level at end of phase-out	0	0	0	0	0	0	0	0	0	0

[a] Part of the WTOS scheme during the years 2006–2009.

Table A.2: Selected other parameters of the tax-benefit system

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Welfare benefits singles (in €)	10,116	10,428	10,644	10,836	10,932	11,064	11,220	11,112	11,400	11,544
General child benefit (in €)										
Per child 0–5 years of age	722	755	768	780	780	780	760	767	767	767
Per child 6–11 years of age	877	917	933	947	947	947	923	931	931	931
Per child 12–17 years of age	1,032	1,079	1,097	1,114	1,114	1,114	1,086	931	931	931
Tax bracket rates (in %)										
Income bracket 1	34,15	33.65	33.60	33.50	33.45	33.00	33,10	37,00	36,25	36.50
Income bracket 2	41,45	41.40	41.85	42.00	41.95	41.95	41.95	42.00	42.00	42.00
Income bracket 3	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00
Income bracket 4	52.00	52.00	52.00	52.00	52.00	52.00	52.00	52.00	52.00	52.00
Top of the tax bracket (in €)										
Income bracket 1	17,046	17,319	17,579	17,878	18,218	18,628	18,945	19,645	19,645	19,822
Income bracket 2	30,631	31,122	31,589	32,127	32,738	33,436	33,863	33,363	33,363	33,589
Income bracket 3	52,228	53,064	53,860	54,776	54,367	55,694	56,491	55,991	56,531	57,585
Income bracket 4	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
General tax credit (in €)										
Maximum	1,990	2,043	2,074	2,007	1,987	1,987	2,033	2,001	2,103	2,203
Start phase-out	–	–	–	–	–	–	–	–	19,645	19,822
End phase-out	–	–	–	–	–	–	–	–	56,495	56,934
Level at end of phase-out	–	–	–	–	–	–	–	–	1,366	1,342
Earned income tax credit (in €)										
Maximum	1,357	1,392	1,443	1,504	1,489	1,574	1,611	1,723	2,097	2,220
Level at start of phase-in	146	148	151	154	157	158	161	161	161	163
Start phase-in	8,132	8,312	8,587	8,859	9,041	9,209	9,295	8,816	8,913	9,010
End phase-in	17,883	18,382	18,981	19,763	20,246	20,861	21,065	18,509	19,253	19,463
Start phase-out	–	–	–	42,509	43,385	44,126	45,178	40,248	40,721	49,770
End phase-out	–	–	–	44,429	47,866	50,287	51,418	69,573	83,971	100,670
Level at end of phase-out	–	–	–	1,480	1,433	1,497	1,533	550	367	184
Combination credit (in €)										
Maximum	754	849	858	1,765	1,859	1,871	2,133	2,133	2,133	2,152
Level at start of phase-in	–	–	–	770	775	780	1,024	1,024	1,024	1,033
Start phase-in	–	–	–	4,619	4,706	4,734	4,814	4,814	4,814	4,857
End phase-in	–	–	–	30,803	33,232	33,445	32,539	32,539	32,539	32,832
Child care subsidy										
Maximum first child (% of hourly price)	96.5	96.5	96.5	95.5	95.5	92.0	90.7	90.7	90.7	90.7
Max. 2nd (3rd etc.) child (% of hourly price)	96.5	96.5	96.5	96.5	96.5	96.0	93.3	93.3	93.3	93.3
Start phase-out, all children (in €)	16,119	16,493	16,925	17,553	18,087	18,099	18,546	17,229	17,575	17,918
End phase-out, first child (in €)	96,543	132,551	134,311	113,016	116,456	100,280	91,652	118,189	103,574	105,594
End phase-out, second (3rd etc.) child (in €)	96,543	100,649	101,376	162,936	157,054	168,010	172,160	168,160	171,540	174,885
Minimum first child (% of hourly price)	25.0	33.3	33.3	33.3	33.3	33.3	33.3	0.0	18.0	18.0
Min. 2nd (3rd etc.) child (% of hourly price)	90.7	90.7	90.7	85.0	85.0	82.8	58.2	58.2	58.2	58.2
Maximum hourly price daycare (in €)	5.72	5.86	6.10	6.10	6.25	6.36	6.36	6.46	6.70	6.84
Max. hourly price out-of-school care (in €)	6.03	6.02	6.10	6.10	5.82	5.93	5.93	6.02	6.25	6.38

B Demographic characteristics lone parents in the dataset

We start by pooling all lone parents with a youngest child 0–17 years of age. For the empirical analysis, we model the labour supply decision for employed lone parents, lone parents on welfare benefits, and lone parents without personal income. We exclude lone parents who are either self-employed or have multiple sources of income, because we cannot determine their budget constraint. Furthermore, we exclude lone parents who are on disability or unemployment benefits, assuming that they are constrained in their labour supply choice. After these selections are made, we further drop lone parents with missing information on individual or household characteristics. This leaves us with 41,339 observations.

Column (1) in Table B.1 shows descriptive statistics for this whole group. The share of single mothers is much higher (88%) than the share of single fathers (12%). Next, we follow Blundell et al. (2009) and distinguish subgroups based on the age of the youngest child: pre-primary school age 0–3, primary school age 4–11 and secondary school age 12–17 years of age.

Table B.1: Descriptive statistics lone parents

	Lone parents 0-17		Lone parents 0-3		Lone parents 4-11		Lone parents 12-17	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age	43.23	6.98	33.83	6.05	40.35	5.77	46.88	5.10
Male	0.12	0.33	0.04	0.19	0.08	0.27	0.17	0.38
Female	0.88	0.33	0.96	0.19	0.92	0.27	0.83	0.38
Native	0.71	0.45	0.58	0.49	0.71	0.45	0.74	0.44
Western immigrant	0.10	0.30	0.10	0.30	0.10	0.30	0.11	0.31
Non-Western immigrant	0.18	0.39	0.32	0.47	0.19	0.39	0.15	0.36
Lower education	0.35	0.48	0.42	0.49	0.34	0.47	0.34	0.48
Middle education	0.42	0.49	0.39	0.49	0.44	0.50	0.42	0.49
Higher education	0.23	0.42	0.20	0.40	0.22	0.42	0.24	0.43
Gross hourly wage	16.10	6.94	14.76	5.34	15.89	5.67	16.38	7.70
Participation rate	0.76	0.43	0.56	0.50	0.71	0.45	0.83	0.38
Hours worked per week	29.88	8.91	28.19	8.42	28.21	8.35	31.04	9.09
Observations	41,339		4,171		14,792		22,376	

C Discrete-choice model for labour supply

We use a structural model for labour supply, where lone parents are assumed to maximise a utility function. The systematic part of utility, U^s, depends on disposable income y, hours worked h and hours of formal childcare c. For the functional form of U^s we use the flexible translog specification:

$$\begin{aligned} U^s(\nu) &= \nu'\mathbf{A}\nu + \mathbf{b}'\nu + \mathbf{d}'\mathbf{1}[\mu > \mathbf{0}], \\ &\quad \nu = (\log(y), \log(1 - h/T), \log(c)), \\ &\quad \mu = (h, c), \end{aligned} \tag{C.1}$$

with $\mathbf{A}$ being a symmetric matrix of quadratic coefficients and $\mathbf{b}$ being a vector of linear coefficients corresponding to the vector of the aforementioned variables ν. The hours worked variable h in the vector ν has been transformed into an indicator of leisure utilisation, representing the fraction of weekly time endowment T which is spent on activities unrelated to work (including household production). The vector $\mathbf{d}$ captures fixed costs of work and using formal childcare. Since these fixed costs are specified in the utility metric, they represent an amalgamation of different factors such as intrinsic disutility from work, or market frictions and other costs related to job search. Above we present the most extensive specification of the utility function with formal childcare. However, only lone parents with a youngest child 0–11 years of age use formal childcare. Older children (12–17 years of age) go to secondary school and their parents do not use formal childcare, and therefore the childcare terms in the utility function drops out.

We allow for preference variation through observed individual and household characteristics $\mathbf{x}_2$, $\mathbf{x}_3$ in parameters b_2 and b_3:

$$\begin{aligned} &\mathbf{b} = (b_1, b_2, b_3), \\ &b_1 = \beta_1, \quad b_2 = \mathbf{x}'_2\beta_2 + \psi_2, \quad b_3 = \mathbf{x}'_3\beta_3 + \psi_3 \end{aligned} \tag{C.2}$$

which are the linear utility terms in leisure and hours of formal childcare. The same variation is also allowed for the fixed costs parameters $\mathbf{d}$ (for a full list of the covariates used, see Table C.1). We start by estimating a random parameters model where we allow for unobserved preference heterogeneity in the preference

parameters for leisure (ψ_2) and childcare (ψ_3).[22] As it turns out, the results of the random parameters models are very similar to the homogeneous model without unobserved heterogeneity. For simplicity we therefore use the homogeneous model as our baseline specification.

For lone parents, the full translog specification resulted in a significant share (>5%) of households with negative marginal utility of income in the observed choices for the full sample of lone parents with a youngest child 0–17 years of age and the subsamples of lone parents with a youngest child 4–11 and 12–17 years of age. This is not consistent with utility maximisation and drives down the labour supply elasticities to implausible values. Therefore we dropped the interaction terms between income and leisure for these samples, which resulted in a low share of households with negative marginal utility of income (<5%). We also obtained an 'inverted' pattern for the marginal utility of income for lone parents with a youngest child 12–17 years of age, with a negative (log) linear term and a positive (log) quadratic term. This results in implausible (positive) income effects, and therefore we dropped the quadratic term in income. Finally, the translog specification was still not flexible enough for lone parents with a youngest child 12–17 years of age. In particular, we do not capture the distribution of hours worked at the top very well, and we introduce a third-order term for (log) leisure, which then improves the fit at the top.

Disposable household income is given by:

$$y = wh - T(w, h; q) - TC(p_c, c; q) + S(p_c, c, y_t; q), , \tag{C.3}$$

where w denotes the gross hourly wage,[23] $T(.)$ denotes taxes and employees' premiums, q denotes individual and household characteristics, $TC(.)$ is the total cost of formal childcare, with p_c denoting its price per hour, and $S(.)$ is the childcare subsidy, which depends on the hourly price of formal childcare, the hours of formal childcare, taxable income y_t and household characteristics (e.g. the ages of the children).

For workers, we observe gross hourly wages which are used to compute the work-related part of income for each alternative in the choice set. For non-workers, we

[22] We use Halton sequences to draw the random terms as they provide a better coverage of the distribution than pseudo-random draws for finite samples (Train 2003).

[23] For simplicity we assume that the gross hourly wage does not depend on the hours worked.

simulate wages using estimates from a model that accounts for selection (Heckman 1979)[24], and we account for wage heterogeneity by taking multiple draws from the estimated wage error distribution. Similarly, for households that use formal childcare we use observed hourly prices of formal childcare, and for non-users we simulate hourly prices using estimates from a model that accounts for selection and we account for price heterogeneity by taking multiple draws from the estimated gross hourly price error distribution.

For our empirical specification we use a discrete-choice model. Households choose their preferred combination of hours of work from a finite set of alternatives $j \in \{1, ..., J\}$. Next to the systematic part $U^s(\nu_j)$, the utility function contains alternative-specific stochastic terms ε_j:

$$U(\nu_j) = U^s(\nu_j) + \varepsilon_j. \tag{C.4}$$

These stochastic terms are assumed to be independent and identically distributed across alternatives, and to be drawn from a Type 1 Extreme-Value distribution. This leads to a multinomial logit specification of the discrete-choice model (McFadden 1978).

We discretise the data for the discrete-choice model. Lone parents are able to choose from 6 labour supply options: working 0, 1, 2, 3, 4 or 5 days per week, each day equaling 8 hours.[25] For childcare, we allow for 0, 1, 2 and 3 days,[26] with data showing a typical childcare day to equal 10 hours,[27] and a typical out-of-school-care day equals 5 hours.[28] Lone parents with a youngest child aged 0 to 3 or 4 to 11 have the largest choice set: $6 \cdot 4 = 24$ alternatives. Lone parents with older children (12–17 years of age) do not use formal childcare, and their budget set has 6 alternatives.

To determine disposable household income in each discrete option we use the advanced tax-benefit calculator MIMOSI (Koot et al. 2016). MIMOSI is the official tax-benefit calculator of the Dutch government for the (non-behavioural) analysis of the impact of reform proposals on the disposable income distribution and the

[24]Here we follow e.g. Blundell et al. (2007) and Bargain et al. (2014b).

[25]Classified as: $0 \in [0, 5), 8 \in [5, 13), 16 \in [13, 21), 24 \in [21, 29), 32 \in [29, 37), 40 \in [37, \infty)$.

[26]The data show that using formal childcare for more than 3 days per week is rare in the Netherlands. The remaining childcare needs are usually met by informal care or parents themselves.

[27]Classified as: $0 \in [0, 0], 10 \in [0, 15), 20 \in [15, 25), 30 \in [25, \infty)$.

[28]Classified as: $0 \in [0, 0], 5 \in [0, 7.5), 10 \in [7.5, 12.5), 15 \in [12.5, \infty)$.

government budget. MIMOSI allows for a very accurate calculation of the budget constraints. Indeed, it takes into account all (national[29]) taxes, social security premiums, and income independent subsidies and tax credits. In accordance with the law, we ensure that household disposable income cannot drop below the welfare level.

Random preference heterogeneity, together with the draws from the estimated wage for non-workers and estimated price for non-users of childcare, complicate the estimation of the likelihood function. We use R draws from the wage distribution for non-workers, the price distribution for non-users of childcare and the random terms for unobserved heterogeneity.[30] The likelihood function has no closed-form solution and therefore we use simulated maximum likelihood. For each draw r we calculate the likelihood and then take the average of the likelihood over R draws. Hence, the resulting likelihood function has the following form:

$$L = \prod_{i=1}^{N} \frac{1}{R} \sum_{r=1}^{R} \left(\exp(U_k^{ir}) / \sum_{j=1}^{J} \exp(U_j^{ir}) \right)^{D_{ki}} \tag{C.5}$$

with D_{ki} being an indicator function taking the value 1 for the observed choice, and zero otherwise.

The resulting preferences are given in Table C.1. Figure C.1 show that the models predict the observed frequencies well.

[29]Local taxes account for only a small portion of total taxes in the Netherlands (3.3% in 2007, European Union 2014).

[30]The number of draws in our specification is 50, and it is kept relatively low to limit the computational complexity of the model. Increasing the number of draws did not change the predictions of our model.

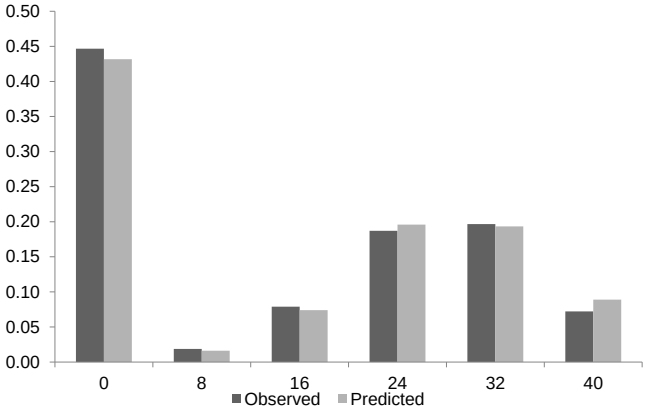
Table C.1: Estimated preferences

	Lone parents Youngest child 0-3	Lone parents Youngest child 4-11	Lone parents Youngest child 12-17
Income	8.959***	1.668***	1.359***
Income^2	-1.909***	0.030***	
Leisure	-36.912***	-49.265***	-4.340***
X (age-38)/10	-1.092***	-0.420***	-2.042***
X (age-38)^2/100	-0.187***	1.079***	2.002***
Leisure^2	-128.317***	-143.894***	128.600***
Leisure^3			445.800***
Fixed costs of work	-4.512***	-3.789***	-1.347***
X 1(low educated)	-0.834***	-1.397***	-1.314***
X 1(medium educated)	0.101***	-0.417***	-0.298***
X 1(non-Western allochtonous)	-0.803***	-1.299***	-1.142***
X 1(Western allochtonous)	-0.465***	-0.605***	-0.672***
X 1(>=150,000 inhabitants)	-0.361***	-0.334***	
Hours of formal child care	1.714***	-0.496***	
X 1(non-Western allochtonous)	0.974***	1.063***	
X 1(Western allochtonous)	0.428***	0.216***	
X 1(>=150,000 inhabitants)	0.215***	0.268***	
Hours of formal childcare^2	-0.372***	-0.229***	
Fixed costs of formal child care	-1.671***	-1.575***	
X 1(low educated)	-1.567***	-1.237***	
X 1(medium educated)	-0.855***	-0.629***	
X 1(non-Western allochtonous)	-2.012***	-0.940***	
X 1(Western allochtonous)	-0.687***	-0.195***	
Income X leisure			
Income X hours of formal child care	-0.677***	-0.491***	
Leisure X hours of formal child care	-5.726***	-8.457***	
Observations	4,171	14,792	22,376

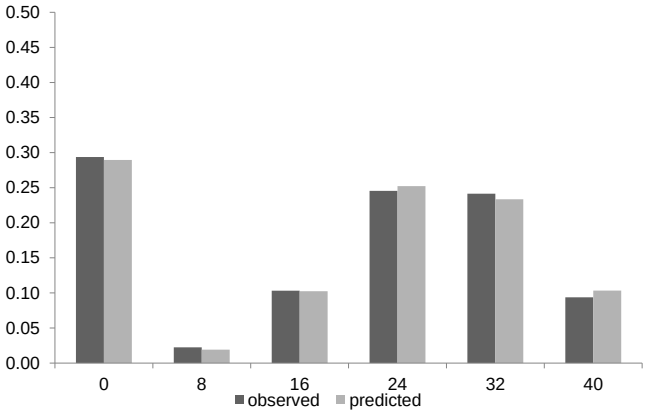
Notes: The variables income, leisure and hours of formal child care are in logs.

Figure C.1: Observed and predicted frequencies

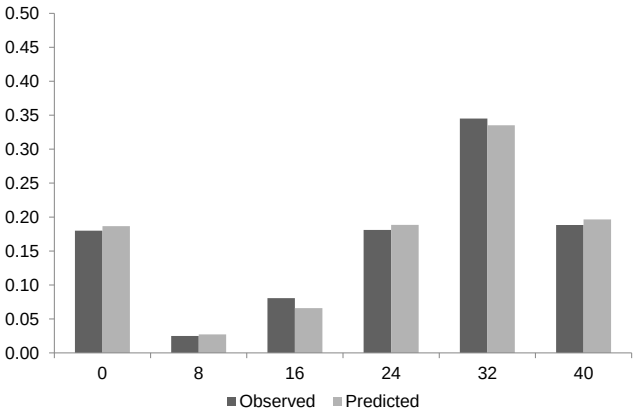
(a) Lone parents youngest child 0–3



(b) Lone parents youngest child 4–11



(c) Lone parents youngest child 12–17



Publisher:

CPB Netherlands Bureau for Economic Policy Analysis
P.O. Box 80510 | 2508 GM The Hague
T (088) 984 60 00

September 2017