Optimal income support for lone parents in the Netherlands: are we there yet?

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

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Abstract

The Netherlands witnessed major reforms in income support for lone parents over the past decade, to simplify the support system and to improve the financial incentives to work. We consider whether the new system can be considered closer to 'optimal', using the inverse-optimal tax(ation) method. In our base model we find social welfare weights that were not monotonically declining in income before the reforms. The reforms fixed this anomaly for the group of lone parents as a whole, but the anomaly remains for lone parents with a child 0–3 years old. For a wide range of redistributive preferences we find that subsidies for working lone parents could be increased further.

JEL codes: C63, H21, H31
Keywords: Optimal taxation, revealed social preferences, lone parents

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1 Introduction

Lone parents are a group of particular interest to policymakers. The tax-benefit system of developed OECD countries typically includes 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 Mastrogiacomo et al. 2017; De Boer and Jongen 2023). The theory of optimal income 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; Haan and Wrohlich 2009; Bargain and Keane 2011; Bourguignon and Spadaro 2012; Bargain et al. 2015; Lockwood and Weinzierl 2016; Jacobs et al. 2017; Hendren 2020). 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. Of particular interest are two potential anomalies (see also Bourguignon and Spadaro 2012; Jacobs et al. 2017). First, negative social welfare weights for a particular group suggest that a Pareto improvement is possible, where reducing the tax burden on that particular group will make them better off and will also improve the government budget. Second, social welfare weights that do not monotonically decline in income. Indeed, the (social) marginal value of an extra euro is typically considered to be higher for individuals or households that have a lower income relative to individuals or households that have a higher income.

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 seek to answer this question using the inverse-optimal method of optimal taxation to reveal potential anomalies in the implicit social welfare weights for different groups of lone parents in the Netherlands.

Following Blundell et al. (2009), we invert the optimal tax model of Saez (2002) 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 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). We also consider how sensitive the results are to changes in the estimated extensive and intensive elasticities, to the inclusion of involuntary unemployment and to changes in the discretization of the model.

Our main findings are as follows. First, in our base model 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 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 for 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, for a wide range of preferences for redistribution. Fourth, accounting for the uncertainty in the estimated elasticities or for involuntary unemployment hardly affects the results, but increasing the number of discrete choice options for lone parents mitigates the anomaly of relatively low social welfare weights for working lone parents

with a relatively low income (in particular for lone parents with a youngest child 0-3 years of age).

We make a number of contributions to the literature. First, we show that the inverse-optimal method can be a powerful tool to assist policymakers in optimizing their tax-benefit system. In line with Haan and Wrohlich (2009) we consider the set of social welfare weights both before and after a reform, but also consider an optimal-tax analysis (to see if 'we are there yet') and account for the endogeneity of the shares of lone parents in the different choice options as in Saez (2002) and Blundell et al. (2009). We also use a relatively large and rich dataset that allows us to estimate preferences and calculate elasticities for each subgroup of lone parents by age of the youngest child separately, including high quality data on the price and use of childcare observed at the household level that is an important part of the budget constraint and preferences over income and 'leisure' (including care for children). 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. 2015; 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. Finally, we consider whether the results from the optimal tax analyses are robust to accounting for involuntary unemployment, and for the discretization of the model. It is reassuring to see that the results are robust to accounting for involuntary unemployment (noting that involuntary unemployment is relatively low in the Netherlands), but the level of discretization is not innocuous (although the results become less precise with more discrete points), and it would be interesting to explore whether or not this is the case in other contexts as well.

The outline of the paper is as follows. In Section 2 we consider the changes in income support for lone parents in the Netherlands over the period 2006–2015. Section 3 then outlines the optimal tax model and the inversion. Section 4 describes the dataset that we use for the empirical analysis, and gives descriptive statistics. In Section 5 we recover the sets of implicit social welfare weights for different groups of lone parents over time. Subsequently, we calculate optimal income support for sets of social welfare weights that differ in preferences for redistribution in Section 6. Section 7 considers a number of limitations of the base analysis and considers how these (may) affect the

results. Section 8 concludes. Additional material is given in an online appendix.

2 Income support for lone parents in the Netherlands

In this section we first discuss the system of income support for lone parents in the Netherlands, and subsequently consider the changes in this system over the period 2006–2015.

We focus on the system of income support for lone parents in the years 2006, 2009, 2014 and 2015. In the quantitative analysis, as our baseline we use the average employment rate, gross 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. We will use graphs to illustrate the reforms in the different income support schemes in this section, 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 online appendix A.

Income support in 2006 Lone parents typically receive welfare benefits when they do not work. Lone parents receive welfare benefits if they are long-term unemployed and are not entitled to unemployment benefits. The withdrawal rate of welfare benefits with gross labour income is 100 percent. Welfare benefits for lone parents and singles without children are 70% of the so-called social minimum, but in addition, lone parents on welfare benefits receive a supplement of 20% of the social minimum. Finally, lone parents on welfare benefits also receive the general child benefit.

Working lone parents do not receive welfare benefits or the supplement, but they do receive the general child benefit and a number of specific tax credits (provided they have enough taxable income to claim them). First, there is an income-dependent tax credit for lone parents with a youngest child of up to 18 years of age. This tax credit is targeted at lone parents with a relatively low gross income. Second, there is a tax credit for lone parents with a youngest child up to 18 years of age. Third, there is a tax credit for working lone parents with a youngest child up to 16 years of age that increases with gross income. Finally, working lone parents with a youngest child up to 12 years of age also qualify for the so-called combination credit, which was income-independent in 2006 (provided that gross labour income exceeded a minimum threshold). Figure 1(a) shows

the resulting, 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 income-dependent tax credit targeted at lone parents with a relatively low gross income was replaced by a income-dependent child subsidy (which can be claimed independent of whether the lone parent pays taxes). Second, the tax credit for working lone parents with a youngest child up to 12 years of age became income-dependent, increasing in income. Finally, there was a reduction of the lone parent tax credit. 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.

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. There was however a substantial increase in the combination credit for working lone parents with a youngest child up to 12 years of age. The income support system for lone parents in 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. 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.[1] In the analysis below we take into account the use of child care and child care subsidies.

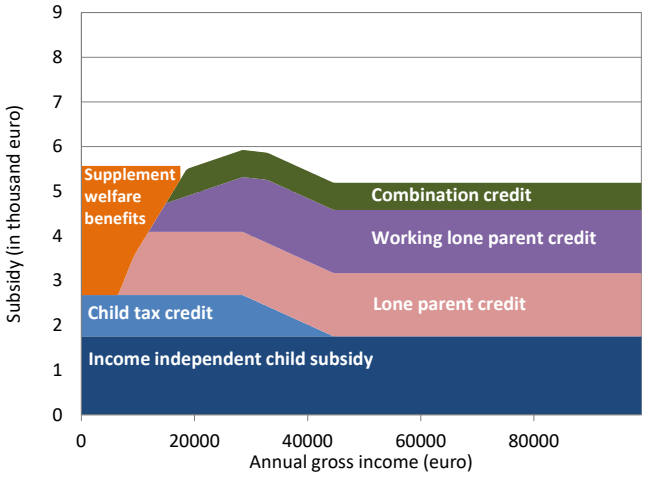
Income support in 2015 2015 then witnessed a major reform in the income support system for lone parents. The two main goals of the reform were i) to further improve the financial incentives to work, and ii) to simplify the system of income support for lone parents (Ministry of Social Affairs and Employment 2012).[2] The new system is shown graphically in Figure 1(d).

[1] Appendix A gives the changes in child care subsidies over the period 2006–2015.

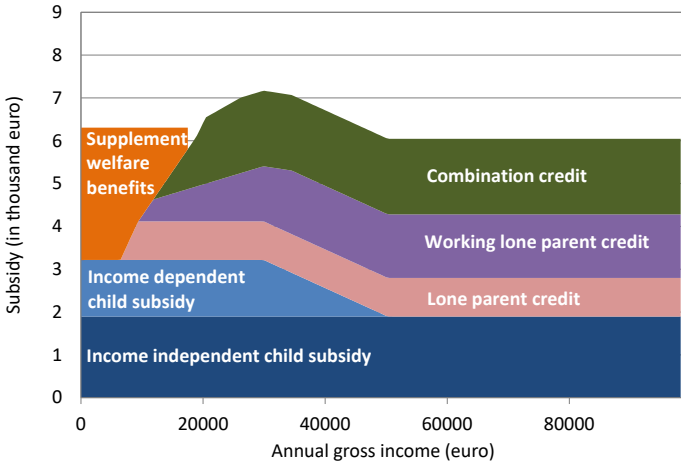
[2] The reform was already discussed in the report of a working committe of experts in Ministry of Finance (2010), building on earlier reports still. Indeed, the basic setup of the reform for lone parents was already discussed before

Figure 1: Targeted income support for lone parents over time

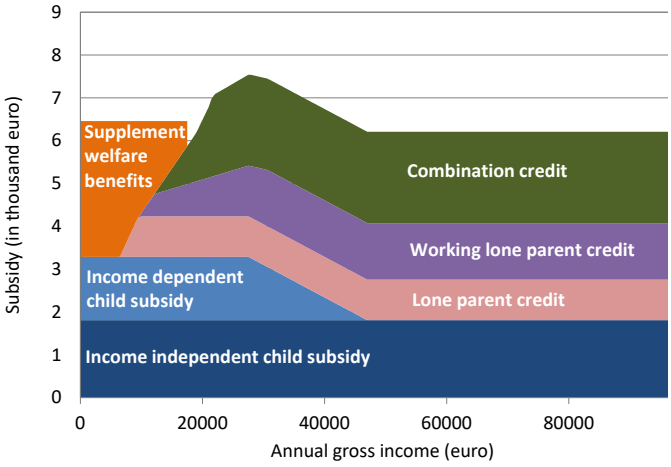
(a) 2006



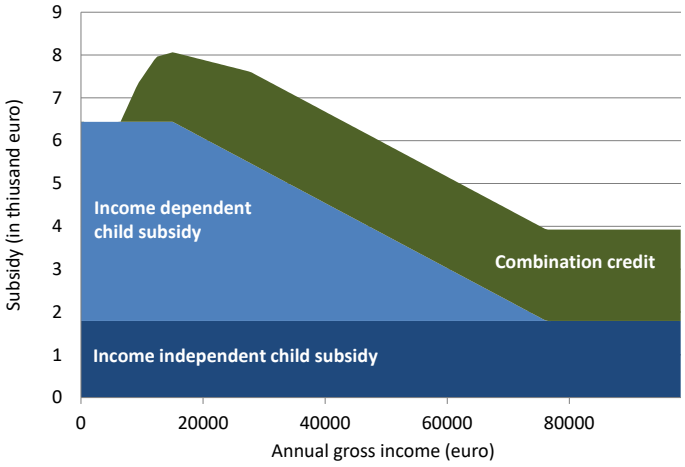
(b) 2009



(c) 2014



(d) 2015



Notes: Figure 1 shows the income support programs for lone parents in the years 2006, 2009, 2014 and 2015. The stacked total level of the support schemes (on the y-axis), and its components, are shown by the level of income of the lone parent (on the x-axis). Over time we observe an increase in the income support for both lone parents without gross income (0 on the horizontal axis, lone parents that are not working) and lone parents with gross income (lone parents that are working). However, the increase is larger for lone parents with gross income, with the exception of (the small group of) lone parents with a relatively high gross income (close to 50 thousand euro in 2015), for whom the total level of income support declined. We further observe that the 2015 reform reduced the number of support schemes from six to three. These figures are based on own calculations using the *Koopkrachtmodel* (Purchasing-power model) of the Dutch Ministry of Social Affairs and Employment. We show the targeted income support for a lone parent with two children 8 years of age. Detailed parameters of the tax-benefit system for 2006–2015 can be found in Table A.1 and Table A.2 in online appendix A.

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. For working lone parents with a relatively low income, the reform improved the financial incentives to work. 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. Hence, overall, the government spent more on income support for lone parents than before the reform.[3]

3 The optimal tax model

Following Blundell et al. (2009), we use the optimal tax model of Saez (2002). There are $I+1$ occupations on the labour market. Single parents that do not work are in 'occupation' 0, and earn $w_0 = 0$. Single parents that work in occupation i earn w_i, with $i \in \{1, ..., I\}$ and $0 < w_i < ... < w_I$. The salaries in each occupation are assumed fixed. Net taxes in occupation i are T_i, noting that when $T_i < 0$ the single parent receives a net transfer from the government. Consumption is assumed to equal after-tax income $c_i = w_i - T_i$.

The population of single parents is normalized to one, and we denote the share of single parents in occupation i by h_i. Single parents have heterogeneous tastes and the share of single parents that choose occupation i depends on after-tax income in all occupations: $h_i = h_i(c_0, ..., c_I)$. Specifically, single parent $m \in M$ chooses her or his optimal occupation i^* that maximizes her or his utility function $u^m(c_i, i)$. For a given tax schedule $(c_0, .., c_I)$ we can then partition the share of M single parents into subsets $M_0, ..., M_I$ that choose occupations $h_0, ..., h_I$.

the Great Recession.

[3]Indeed, when we calculate the weighted sum of net taxes in the model for the different time periods, net transfers to lone parents are higher after the reform (2015) than before the reform (2014).

The government then maximizes the following social welfare function:

$$W = \int_M \mu^m u^m(c_{i^*}, i^*) dv(m), \tag{1}$$

where $v(m)$ is the measure of individuals on M, subject to the budget constraint:

$$\sum_{i=0}^{I} h_i T_i = H, \tag{2}$$

where H is some exogenously fixed per capita net tax (or transfer) to single parents by the government. The resulting expressions for the optimal level of net taxes in occupation i, relative to occupation $i-1$, are (see Saez 2002):

$$\frac{T_i - T_{i-1}}{c_i - c_{i-1}} = \frac{1}{\zeta_i h_i} \sum_{j=i}^{I} h_j \left[1 - g_j - \eta_j \frac{T_j - T_0}{c_j - c_0} \right], \tag{3}$$

where ζ_i is the intensive elasticity of labour supply at i, h_i is the share of individuals that chooses occupation i, η_j is the extensive elasticity at choice j and g_j is the social welfare weight of individuals at occupation j (the social value of one more euro for individuals in occupation j). The intensive and extensive elasticity of labour supply are defined respectively as:

$$\zeta_i = \frac{c_i - c_{i-1}}{h_i} \frac{dh_i}{d(c_i - c_{i-1})}, \tag{4}$$

and:

$$\eta_j = \frac{c_j - c_0}{h_j} \frac{dh_j}{d(c_j - c_0)}. \tag{5}$$

As noted in Saez (2002), the aggregated functions h_i are a sufficient statistic for labor supply responses in the optimal tax analysis, and hence the underlying structure of individual utilities is not essential for the optimal tax analysis. Finally, the social welfare weight for occupation j is defined as:

$$g_j = \frac{1}{p} \frac{1}{h_j} \int_M \mu^m \frac{\partial u^m(c_{j^*}, j^*)}{\partial c_j} dv(m), \tag{6}$$

where p is the multiplier on the government budget constraint. What is important to note is that the social welfare weight depends on the individual's marginal utility of consumption $\frac{\partial u^m(c_{j^*}, j^*)}{\partial c_j}$

and how much weight μ^m the social planner puts on this. Since the social welfare weights g_i have a more direct interpretation than the 'primitive' weights μ^m - the g_i respresent the euro equivalent value of distributing an extra euro to individuals in occupation i - we focus on recovering the g_i.

The next step is then to invert the optimality conditions for the optimal tax rates to 'free' the social welfare weights (Bourguignon and Spadaro 2012). Following the numerical implementation in Blundell et al. (2009), in our base model we solve for 6 discrete occupations, $i \in (0, 1, 2, 3, 4, 5)$, where option $i = 0$ is the 'occupation' where the individual does not work. For the highest income group $i = I = 5$ we have a social welfare weight:

$$g_I = 1 - \zeta_I \frac{T_I - T_{I-1}}{c_I - c_{I-1}} - \eta_I \frac{T_I - T_0}{c_I - c_0}, \tag{7}$$

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

$$g_i = 1 - \zeta_I \frac{T_i - T_{i-1}}{c_i - c_{i-1}} - \eta_i \frac{T_i - T_0}{c_i - c_0} + \frac{1}{h_i} \sum_{j=i+1}^{I} h_j \left[1 - g_j - \eta_j \frac{T_j - T_0}{c_j - c_0} \right]. \tag{8}$$

The system of equations (7) and (8) 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:

$$\sum_{i=0}^{I} h_i g_i = 1, \tag{9}$$

the weighted average of the g_i's for the relevant group of lone parents equals one.[4]

The system of equations (7)-(9) give the social welfare weights implicit in the tax system, given the elasticity parameters η_i and ζ_i, and the share of individuals h_i in each option. 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

[4] In the absence of income effects, the weighted average of the social welfare weights equals one, 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).

according to the following rule:

$$h_i = h_i^0 \cdot \left(\frac{c_i - c_0}{c_i^0 - c_0^0} \right)^{\eta_i}, \tag{10}$$

where the superscript 0 indicates baseline values. We calculate the share in the non-working option as the residual.

4 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, year and month of birth, 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, gross income from different sources (wages, benefits etc.) and the price and use of formal child care per child.

Table 1 gives descriptive statistics of the 2006–2009 sample we use in the analyses, and in the estimation of the extensive and intensive margin elasticities.[5] 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. We next distinguish between subgroups by 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. Lone parents with a youngest child 0–3 years of age are the smallest group (10%). 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.

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). Section C in the online appendix

[5] Appendix B gives descriptive statistics for all individual and household characteristics.

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

	Share	Employment rate (in %)	Working hours (employed)	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: Table 1 shows key descriptive statistics of lone parents in the sample. Included are lone parents 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.

describes the setup of our discrete-choice model, the likelihood, the estimated parameters of the utility function and the fit of the model. The corresponding extensive and intensive elasticities are discussed below.[6]

To determine disposable household income and net taxes paid to the government in each discrete option[7] we use the tax-benefit calculator MIMOSI (Koot et al. 2016). MIMOSI is the official tax-benefit calculator of the Dutch government for the analysis of the impact of reform proposals on the disposable income distribution and the government budget.

We do not have the microdata for the years 2014 and 2015. Therefore we use the gross incomes per option from 2006–2009, but apply the tax-benefit system of 2014 and 2015, where the nominal parameters of the tax-benefit system in 2014 and 2015 are deflated with the CPI to prices 2006–2009. 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.[8]

[6]To simulate the elasticities for the optimal tax model we use the so-called calibration method, where we take draws from the extreme value distribution that are consistent with the observed choices. Further details are available on request.

[7]The gross earnings and net taxes for each option are averages for quintiles based on gross weekly earnings over the period 2006–2009.

[8]The change in the state of the business cycle between 2006–2009 and 2014-2015 makes it difficult to compare the predicted shares from the model following equation (10) with the observed shares. Table D.1 in the online appendix compares the predicted changes in the employment rate for lone parents by age of the youngest child from the model with the observed changes for lone parents by age of the youngest child in the Labour Force Survey (LFS). Whereas the model predicts an increase in the employment rate from the period 2006–2009 to 2014, due to higher financial incentives to work, we observe a decline in the LFS. For 2014 to 2015 both the model and the LFS show an increase in the employment rate. However, as shown by the last lines in Table D.1, we are comparing periods with substantially different states of the business cycle. The unemployment rate was lower in 2006–2009 than in 2014 and 2015. For a proper comparison, we would need a control group that displays the same time effects as lone parents. This is however challenging for the Dutch case, as the reform targets all lone parents, and singles without children do not have the same time effects as lone parents (Bettendorf et al. 2014).

5 Implicit social welfare weights over time

We derive the implicit social welfare weights for the baseline period 2006–2009 (using averages for this period), 2014 (just before the major reform in 2015) and 2015.

Figure 2 (blue solid lines) gives the resulting implicit social welfare weights for 2006–2009, using the system of equations (7)–(9).[9] The input for the calculations of the social welfare weights is given in Table E.1 in the online appendix. For all groups, net income increases when gross income increases. Lone parents with a youngest child 0–3 have a relatively large income gain when they move from option 0 to 1, which is due to the relatively high child care subsidy they get.[10] 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 higher for lone parents with a youngest child 0–3. This is consistent with previous studies on labour supply responses for lone parents in the Netherlands (Mastrogiacomo et al. 2017; De Boer and Jongen 2023).[11]

Turning to the social welfare weights, we see that for all groups of lone parents they 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. These results are in line with the findings of Blundell et al. (2009) for lone mothers in Germany and the UK.[12] They also find that lone mothers with a relatively low income implicitly get a lower social welfare weight than lone parents with higher income (Blundell et al.

[9] Note that the points on the horizontal axis are not evenly spaced in gross income, see Table E.1 for the gross incomes corresponding to points 0–5.

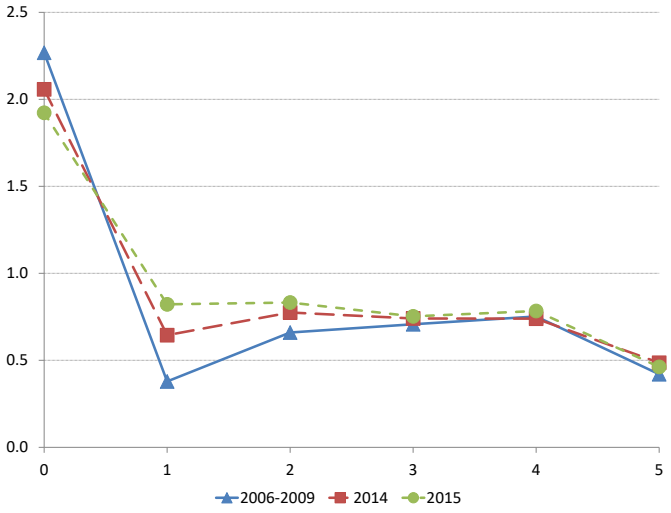
[10] Though the income gains between the occupations are somewhat sensitive to the discretization of the model, see the robustness check with nine occupations in the Discussion section.

[11] Haan and Wrohlich (2009, Table 3) find no consistent higher or lower pattern for elasticities by age of the youngest child in Germany and Blundell et al. (2009, Table 5) find higher elasticities for lone parents with older children. However, the latter two studies draw the line at 7 years of age for the youngest child to distinguish between groups, where we use 4 years of age, and the elasticities we get are actually also somewhat higher for 12–17 than for 4–11.

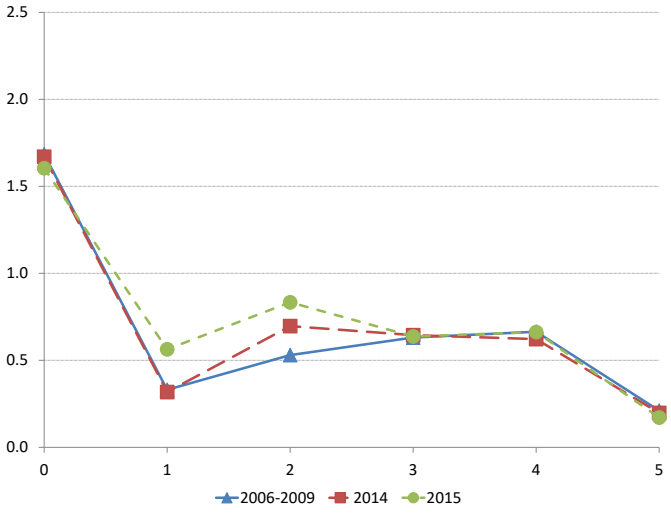
[12] In our dataset, 88% of lone parents are lone mothers. Indeed, most children of separated parents reside with the mother.

Figure 2: Social welfare weights lone parents over time

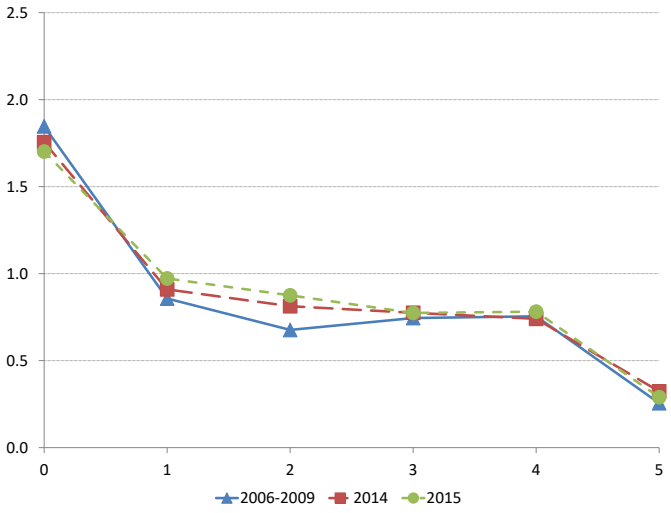
(a) Lone parents youngest child 0–17



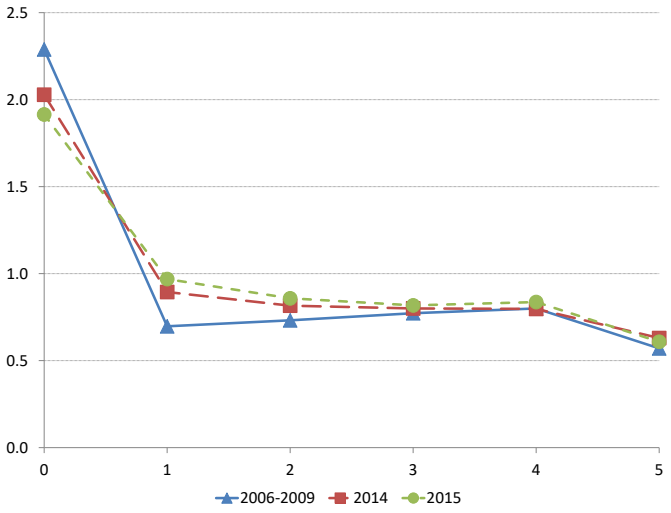
(b) Lone parents youngest child 0–3



(c) Lone parents youngest child 4–11



(d) Lone parents youngest child 12–17



Notes: Figure 2 shows the resulting social welfare weights using equations (7)-(9) and the numerical inputs (net incomes/consumption, net taxes and extensive and intensive elasticities per gross income level) from Table E.1 (for 2006–2009) and Table E.2 (for 2014 and 2015) in the online appendix. We show the results for the whole group of lone parents with a youngest child 0–17 years of age, and for subgroups by age of the youngest child (0–3, 4–11 and 12–17). We calculate the social welfare weights at discrete levels of gross income (points 0 to 5). Point 0 is the social welfare weight on non-working lone parents, and points 1 to 5 are the social welfare weights of working lone parents, ordered by their gross income level and grouped into five groups of equal size in the baseline (2006-2009). Although we find that the social welfare weights are *grosso modo* declining in the gross income level, we find that in the baseline the 'working poor' lone parents at gross income positions 1 and/or 2 have a lower social welfare weight than those at gross income positions 3 and 4. This is anomalous given that it suggests that a marginal unit of income is valued less for lone parents with a lower income than lone parents with a higher income. In 2015, after the reforms, this anomaly has largely disappeared, except for lone parents with a youngest child 0–3 years of age.

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).

Figure 2 also shows the development of the social welfare weights when we move from the tax-benefit system in 2006–2009 to 2014 (red dashed lines) and 2015 (green dotted lines), also see Table E.2 in the online appendix. The reforms improved the financial incentives to work for all groups; net taxes are typically lower in the work options after the reform. This results in a larger participation rate for all groups (see Table E.2). 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.

6 Optimal income support for different degrees of inequality aversion

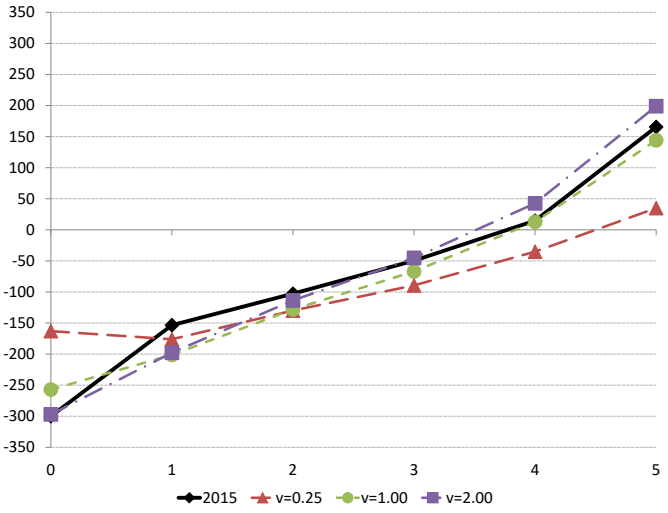
The analysis above suggests that after a decade of reforms, the implicit social welfare weights in the income support system of lone parents have become *grosso modo* well-behaved, except for lone parents with a youngest child 0–3 years of age. In this section we consider the implicit inequality aversion in the income support system in 2015, and consider changes in the tax-benefit system that would make the system closer to optimal still, for different degrees of inequality aversion. Of particular interest are changes in the tax-benefit system that would be optimal for all degress of inequality aversion (and hence may be considered 'robust').

Specifically, following Saez (2002) and 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 c_i in option i: $g_i = 1/p * 1/(c_i^v))$, where p is a scaling variable that we use to normalize the weighted sum of social welfare weights to 1 for different levels of v which measures the social preference for inequality aversion. Specifically, the higher is v, the higher is the aversion to inequality.[13] This is a flexible way of specifying a set of social welfare weights that are monotonically declining in income and positive for all income groups (Saez 2002). For ease of comparison, we follow Blundell

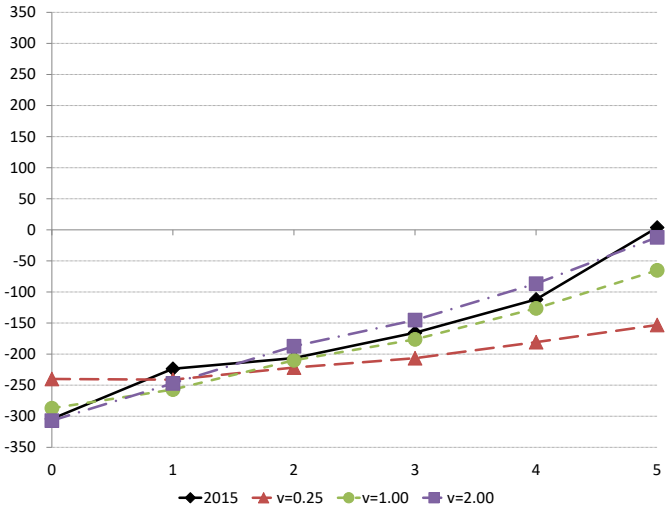
[13] We can think of the g_i as (social) marginal utility, where (social) marginal utility declines more rapidly in net income when v is higher. Also compare with equation (6), where p is the multiplier on the government budget constraint, and the remainder is average social marginal utility at occupation i.

Figure 3: Optimal tax profiles lone parents

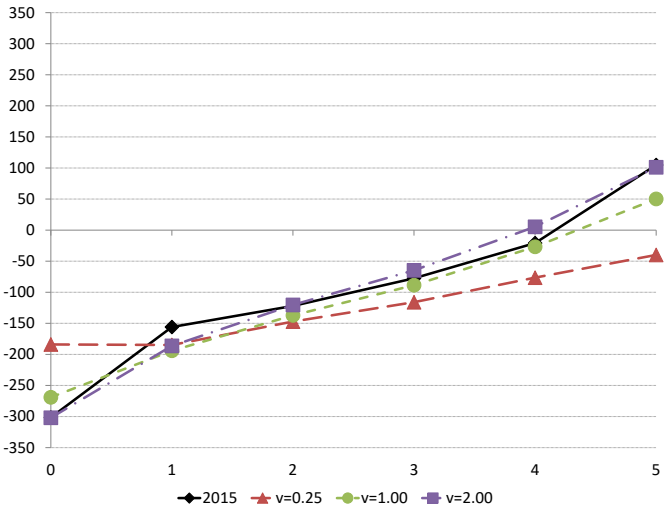
(a) Lone parents youngest child 0–17



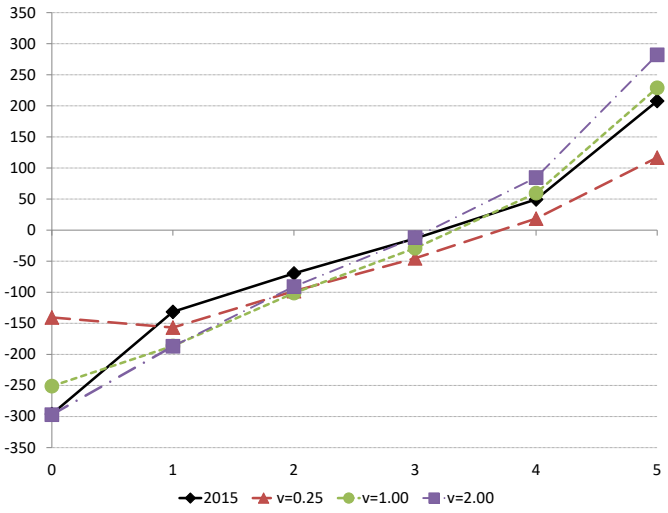
(b) Lone parents youngest child 0–3



(c) Lone parents youngest child 4–11



(d) Lone parents youngest child 12–17



Notes: Figure 3 shows for each gross income level of lone parents the net tax (benefits minus taxes) level in 2015 and the optimal net tax level using equations (2)-(3), the numerical inputs (group shares, gross incomes, the extensive and intensive elasticities and net taxes in the year 2015 per gross income level) from Table E.3 in the online appendix and the social welfare weights given by the following function of net income c_i in option i: $g_i = 1/p * 1/(c_i^v)$ (where p is a scaling variable that we use to normalize the weighted sum of social welfare weights to 1 for different levels of v, and the higher is v, the higher is the aversion to inequality). We show the results for the whole group of lone parents with a youngest child 0–17 years of age, and for subgroups by age of the youngest child (0–3, 4–11 and 12–17). We calculate the net tax level in 2015 and the optimal tax level at discrete levels of gross income (points 0 to 5). Point 0 are net taxes for non-working lone parents, and points 1 to 5 are net taxes for working lone parents, ordered by their gross income level and grouped into five groups of equal size in the baseline. We find 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 incomes is always higher than in the 2015 system (for all subgroups).

et al. (2009) and consider values for v of 0.25, 1.00 and 2.00. We compare the outcomes for the different sets of social welfare weights using the outcomes for 2015 as the base, where the shares are calculated using equation (10), and the net transfer to the group of lone parents remains constant.

The results are given in Figure 3 (see also Table E.3 in the online appendix). 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). This is consistent with the findings for Germany and the UK by Blundell et al. (2009, Figure 3 and 4). 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 (Blundell et al. 2009, find that negative marginal tax rates going from option 0 to option 1 are never optimal for Germany and the UK).

7 Discussion

Next, we consider the (potential) impact of a number of extentions and limitations of the base model on the resulting social welfare weights and optimal tax systems.

First, there may be uncertainty about the precise value of the intensive and extensive margin elasticities. To explore this issue we have determined a 95% confidence interval for the estimated elasticities. Specifically, we take 200 draws from the preference parameters using the variance/covarance matrix of the estimates which then gives 200 sets of elasticities. From this we take the 2.5th and 97.5th percentile to determine the bounds of the 95% confidence interval. The results are given in online appendix F. We find that the confidence intervals are quite tight. As a result, the corresponding sets of social welfare weights and optimal tax profiles remain very close to the base results.[14]

Second, a key question is how involuntary unemployment may affect the results. There is not a 'standard' inversion of an optimal tax model with involuntary unemployment.[15] We therefore proceed as follows. We extend the discrete-choice model where we estimate the preferences for the elasticities in a double-hurdle model with involuntary unemployment, which is explained in more detail in online appendix G. We find that allowing for involuntary unemployment lowers the labour supply elasticities somewhat, see Table G.1. Indeed, the relative small effect of involuntary unemployment on the estimated elasticities is in line with the relatively low share of involuntary unemployment in our data period. In online appendix H we calculate the implicit welfare weights for 2006–2009, 2014 and 2015 where we scale the extensive and intensive margin elasticities in line with the percentage drop in these elasticities when we compare the model with involuntary unemployment to the model without involuntary unemployment. We find that the resulting social welfare weights are very similar to the base model without involuntary unemployment, and the same is true for the subsequent optimal tax analysis for different degrees of inequality aversion.

Third, another key question is whether the discretization of the optimal tax model makes a

[14] This still leaves the possibility that policymakers have different elasticities in mind when they set their policies, see also Bargain et al. (2014a). However, for the remaining anomaly for lone parents with a youngest child 0–3 years of age to go away (in 2015), the elasticity at gross income point 1 needs to be 60% lower than in the baseline, which is well outside the range of the confidence intervals in appendix F.

[15] An interesting direction for future research would be to see if one can invert the model by Kroft et al. (2020), which however also requires elasticities that are not readily available for the Netherlands, like the macro participation elasticity next to the micro participation elasticity.

difference to the results. Online appendix I gives the results when we slice up the data in nine instead of six discrete choice options (with option 0 still the non-participation option, and then eight different occupations or work options). For the group of lone parents with a youngest child 0–3 we still have the anomaly that the social welfare weights are not monotonically declining in income, although the anomaly is less pronounced. This is the net result of smaller differences in net incomes between the options at the lower end on the one hand, but also lower elasticities on the other. For the whole group of lone parents with a child 0–17 years of age the anomaly almost disappears (although the social welfare weights are still rather flat over the income distribution from occupation 1 to 7). We also find that the highest income group of lone parents with a youngest child 0–3 years of age now gets a negative social welfare weight, due to the higher elasticity for this smaller subgroup. In the optimal tax analyses, we now also find lower optimal net tax rates for working lone parents with a youngest child 0–3 years of age, especially when they have a relatively high income.[16]

These results may also reflect that the elasticities are becoming harder to measure if we slice up the data in smaller pieces, but it would be interesting to study whether the level of discretization also matters in other contexts. *A priori* it is hard to determine which level of discretization is 'optimal'.[17] Indeed, discrete-choice models are partly motivated by the observation that individuals seem to make labour supply choices in discrete steps. In a related paper, Jacobs et al. (2017) derive the social welfare weights in the baseline and for several political party proposals for the 2002 elections in the Netherlands. Although they use a continuous model (but with both intensive and extensive margins), and calibrate rather than estimate the behavioural elasticities (and using the elasticity of taxable income rather than the labour supply elasticity), they also find that (the whole group of) 'working poor' lone parents receive a lower social welfare weight than working lone parents with a higher gross income (Jacobs et al. 2017, Appendix J).

There are a number of other extensions and limitations that cannot readily be explored within the current setup, but that could potentially affect the results. For example, the model is entirely static. It ignores that parents and children will move from one group in the model to the next

[16] Unsurprinsingly, as the negative social welfare weight in the baseline in 2015 implies that taxes for this group are set beyond the top of the ' Laffer'-curve (Jacobs et al. 2017).

[17] Saez (2000) derives and compares a continuous and a discrete model for optimal taxation, but then goes on to do a calibration exercise for the discrete model only.

as the children age, ignores the option of borrowing and saving and potential career effects for lone parents or effects on the development of children. The results might be different when we account for lifecycle effects in a dynamic model, which is however beyond the scope of this paper. 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 elasticities. An optimal tax analysis using the estimated preferences directly, along the lines of Blundell and Shephard (2012), would be an interesting avenue for future research. However, this method has a high computational burden for which we would need a much more efficient tax-benefit calculator than we use now. Also, we do not consider other individuals and households in the economy, and hence we can only study the social welfare weights within the group of lone parents. An interesting question is how the social welfare weights for lone parents compare to other groups, and how the reforms we consider (which increased transfers to lone parents as a group) has affected the social welfare weights of lone parents relative to these other groups. Finally, it would be interesting to study how other factors, like non-welfarist motives or political economy considerations (see e.g. Jacobs et al. 2017; Bierbrauer et al. 2021), may shape the system of taxes and transfers for lone parents.[18]

8 Conclusions

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 the official tax-benefit calculator of the Dutch government. Our base model suggests that in the initial system the implicit social welfare weights do not monotonically decline in income. After the reforms, the social welfare weights become well-behaved, by which we mean monotonically declining in income and positive, 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

[18] Of course the list does not end here. For example, the model also ignores child related paid leave schemes, which were however relatively short in the Netherlands in the dataperiod (4 months of paid maternity leave around child birth for the mother, and 3 months (2006-2008) to 6 months (2009) of unpaid parental leave, with rather limited take up, see SCP and CBS (2010)).

the group of working lone parents with the lowest gross wage incomes is always higher than in the 2015 system. We also find that accounting for the uncertainty regarding the intensive and extensive margin elasticities or the inclusion involuntary unemployment have a limited effect on the outcomes, but different levels of discretization of the model do seem to affect part of the results and warrant further study.

Declarations

Funding: No funding was received for conducting this study.

Conflicts of interest/competing interests: The authors have no relevant financial or non-financial interests to disclose.

Availability of data and material: The datasets are available via remote access at Statistics Netherlands.

Code availability: All codes used in the analysis are available on request.

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Supplementary material to:

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

Henk-Wim de Boer and Egbert L.W. Jongen

January 2023

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-in	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 child	–	–	–	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

Notes: All amounts are annual. [a]Part of the WTOS scheme (a subsidy for parents for school related expenditures) during 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

Notes: All amounts are annual.

B Individual and household characteristics of 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 (7% of the observations) or have multiple sources of income (6% of the remaining observations), because we cannot determine their budget constraint. Furthermore, we exclude lone parents who are on disability or unemployment benefits (4% of the remaining observations), 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 (6% of the remaining observations). 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 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.

Table B.1: Descriptive statistics lone parents in the sample

	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
Gross hourly price daycare	5.49	0.46	5.49	0.46	5.49	0.46		
Gross hourly price out-of-school care	5.52	0.49	5.52	0.49	5.52	0.49		
Observations	41,339		4,171		14,792		22,376	

Notes: Own calculations using the Labour Market Panel (2012) of Statistics Netherlands.

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).[19] 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

[19] 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).

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,[20] $T(.)$ 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 simulate wages using estimates from a model that accounts for selection (Heckman 1979)[21], 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.[22] For childcare, we allow for 0, 1, 2 and 3 days,[23] with data showing a typical childcare day to equal 10

[20] For simplicity we assume that the gross hourly wage does not depend on the hours worked.
[21] Here we follow e.g. Blundell et al. (2007) and Bargain et al. (2014b).
[22] Classified as: $0 \in [0, 5), 8 \in [5, 13), 16 \in [13, 21), 24 \in [21, 29), 32 \in [29, 37), 40 \in [37, \infty)$.
[23] The data show that using formal childcare for more than 3 days per week is rare in the Netherlands. The

hours,[24] and a typical out-of-school-care day equals 5 hours.[25] 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 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 government budget. MIMOSI allows for a very accurate calculation of the budget constraints. Indeed, it takes into account all (national[26]) 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.[27] 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 (k), and zero otherwise.

The resulting preferences are given in Table C.1.[28] Figure C.1 show that the models predict the observed frequencies quite well.

remaining childcare needs are usually met by informal care or parents themselves.

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

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

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

[27] 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.

[28] For completeness, Table C.2 provides the estimated preferences for the standard (log) quadratic utility function, without restrictions or extensions.

Table C.1: Estimated preferences preferred specification

	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.

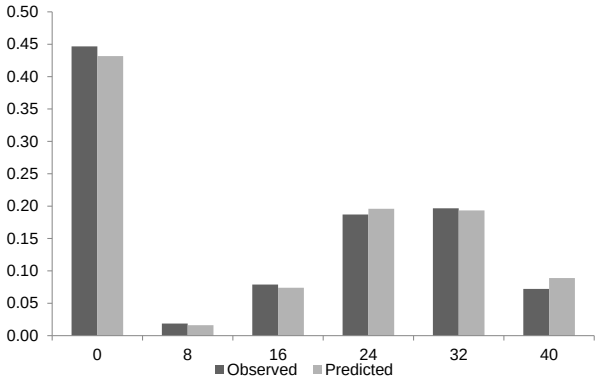
Table C.2: Estimated preferences 'standard' quadratic specification

	Lone parents youngest child 0-3	Lone parents youngest child 4-11	Lone parents youngest child 12-17
Income	9.750**	42.020***	1.974***
Income^2	-5.309***	-17.260***	-0.782***
Leisure	-49.900***	-51.730***	-35.280***
X (age-38)/10	-1.469***	-1.309***	-1.846***
X (age-38)^2/100	0.413	1.214***	1.962***
Leisure^2	-157.800***	-145.100***	-125.300***
Leisure^3			
Fixed costs of work	-3.722***	-3.214***	-3.186***
X 1(low educated)	-2.032***	-1.981***	-1.265***
X 1(medium educated)	-0.686***	-0.748***	-0.283***
X 1(non-Western allochtonous)	-0.943***	-1.358***	-1.134***
X 1(Western allochtonous)	-0.585***	-0.590***	-0.664***
X 1(>=150,000 inhabitants)	-0.409***	-0.332***	
Hours of formal childcare	0.173	-1.341***	
X 1(non-Western allochtonous)	1.041***	1.353***	
X 1(Western allochtonous)	0.326	0.381***	
X 1(>=150,000 inhabitants)	0.182***	0.368***	
Hours of formal childcare^2	-0.530***	-0.479***	
Fixed costs of childcare	-1.414***	-1.620***	
X 1(low educated)	-1.853***	-1.266***	
X 1(medium educated)	-0.679***	-0.606***	
X 1(non-Western allochtonous)	-2.169***	-1.076***	
X 1(Western allochtonous)	-0.704*	-0.280**	
Income X leisure	13.250	6.821***	-9.447***
Income X hours of formal childcare	3.948***	2.103***	
Leisure X hours of formal childcare	-8.562***	-9.135***	
Observations	4,171	14,792	22,376
Log likelihood	-8,680	-32,517	-31,904

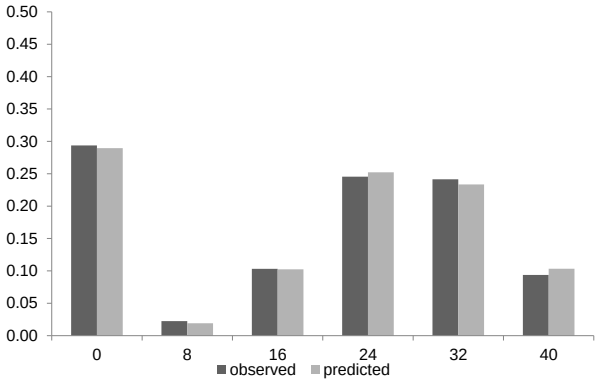
Notes: The variables income, leisure and hours of formal child care are in logs.

Figure C.1: Observed and predicted frequencies preferred specification

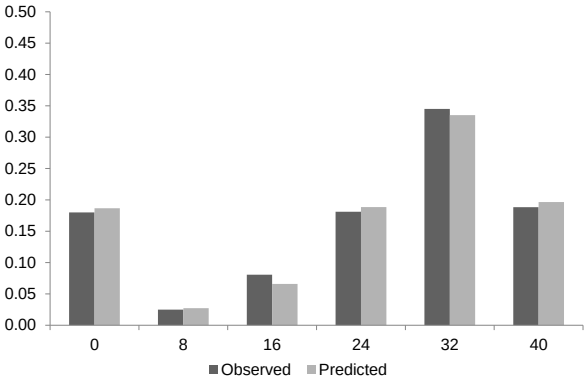
(a) Lone parents youngest child 0–3



(b) Lone parents youngest child 4–11



(c) Lone parents youngest child 12–17



Notes: Figure C.1 shows the predicted frequencies of the estimated structural model for each discrete labour supply option, using equation (C.5), and the observed frequencies in the datasetof online appendix B. We estimate the model separately for lone parents with a youngest child 0–3, 4–11 or 12–17 years of age. For all subgroups, the estimated model predicts the observed frequencies quite well.

D Comparison predicted and observed changes in employment rates

Table D.1: Comparison predicted changes in the employment rate in the model with observed changes in the Labour Force Survey

	Lone parent youngest child 0–17	Lone parent youngest child 0–3	Lone parent youngest child 4–11	Lone parent youngest child 12–17
		Changes in percentage points		
Employment rate model[a]				
2014 relative to 2006–2009	0.0130	0.0078	0.0102	0.0090
2015 relative to 2006–2009	0.0214	0.0278	0.0158	0.0138
Employment rate LFS[b]				
2014 relative to 2006–2009	-0.0433	-0.0471	-0.0431	-0.0531
2015 relative to 2006–2009	-0.0036	-0.0272	-0.0285	0.0266
Unemployment rate LFS[c]				
2014 relative to 2006–2009	0.0511	0.0585	0.0573	0.0460
2015 relative to 2006–2009	0.0107	0.0055	0.0272	0.0004

Notes: Table D.1 compares the predicted changes in the employment rate of the optima tax model using equation (10) with the observed changes in the employment rate in the Labour Force Survey.
[a] Change in employment rate predicted by the model (see Table E.1).
[b] Change in employment rate observed in the Labour Force Survey (own calculations).
[c] Change in unemployment rate observed in the Labour Force Survey (own calculations).

E Tables base outcomes optimal tax analyses

Table E.1: Implicit social welfare weights lone parents for 2006–2009

Gross earnings per week	Net income per week	Net tax per week	Intensive elasticity	Extensive elasticity	Share	Social welfare weights	Relative social welfare weights
Panel A: Lone parents with a youngest child 0–17 years of age[a]							
0	293	-293	–	–	0.25	2.27	1.00
200	314	-114	0.04	0.04	0.15	0.38	0.17
326	384	-58	0.06	0.13	0.15	0.66	0.29
423	441	-18	0.06	0.16	0.15	0.71	0.31
544	503	41	0.05	0.20	0.15	0.75	0.33
851	659	192	0.12	0.35	0.15	0.42	0.19
Panel B: Lone parents with a youngest child 0–3 years of age[b]							
0	296	-296	–	–	0.43	1.68	1.00
184	379	-195	0.29	0.29	0.11	0.33	0.20
289	445	-156	0.07	0.48	0.11	0.53	0.31
378	522	-143	0.12	0.59	0.11	0.63	0.37
478	579	-101	0.07	0.58	0.11	0.66	0.39
704	697	7	0.13	0.89	0.11	0.21	0.13
Panel C: Lone parents with a youngest child 4–11 years of age[c]							
0	295	-295	–	–	0.29	1.85	1.00
198	314	-116	0.01	0.01	0.14	0.86	0.46
309	381	-72	0.06	0.12	0.14	0.68	0.37
398	446	-48	0.07	0.17	0.14	0.74	0.40
507	508	1	0.06	0.24	0.14	0.75	0.41
769	645	124	0.15	0.51	0.14	0.26	0.14
Panel D: Lone parents with a youngest child 12–17 years of age[d]							
0	289	-289	–	–	0.18	2.29	1.00
206	300	-94	0.01	0.01	0.16	0.70	0.30
344	371	-27	0.06	0.08	0.16	0.73	0.32
447	426	22	0.05	0.10	0.16	0.77	0.34
575	493	81	0.05	0.14	0.16	0.80	0.35
914	672	241	0.11	0.24	0.16	0.57	0.25

Notes: Table E.1 gives the numerical inputs and outcomes for Figure 2 (2006-2009).
[a]41,339 observations, [b]4,171 observations, [c]14,792 observations, [d]22,376 observations.

Table E.2: Social welfare weights lone parents over time

	2006–2009				2014				2015			
Gross earnings per week	Net tax per week	Share	Social welfare weights	Relative social welfare weights	Net tax per week	Share	Social welfare weights	Relative social welfare weights	Net tax	Share	Social welfare weights	Relative social welfare weights
Panel A: Lone parents with a youngest child 0–17 years of age[a]												
0	-293	0.25	2.27	1.00	-299	0.23	2.06	1.00	-300	0.23	1.92	1.00
200	-114	0.15	0.38	0.17	-133	0.15	0.64	0.31	-153	0.16	0.82	0.43
326	-58	0.15	0.66	0.29	-86	0.15	0.77	0.38	-103	0.16	0.83	0.43
423	-18	0.15	0.71	0.31	-38	0.15	0.74	0.36	-50	0.15	0.75	0.39
544	41	0.15	0.75	0.33	27	0.15	0.74	0.36	15	0.15	0.78	0.41
851	192	0.15	0.42	0.19	164	0.15	0.49	0.24	166	0.15	0.46	0.24
Panel B: Lone parents with a youngest child 0–3 years of age[b]												
0	-296	0.43	1.68	1.00	-304	0.43	1.67	1.00	-304	0.41	1.60	1.00
184	-195	0.11	0.33	0.20	-203	0.11	0.32	0.19	-224	0.12	0.56	0.35
289	-156	0.11	0.53	0.31	-184	0.12	0.70	0.42	-206	0.13	0.83	0.52
378	-143	0.11	0.63	0.37	-156	0.11	0.64	0.39	-166	0.12	0.64	0.40
478	-101	0.11	0.66	0.39	-104	0.11	0.62	0.37	-112	0.11	0.66	0.41
704	7	0.11	0.21	0.12	3	0.11	0.20	0.11	4	0.11	0.17	0.11
Panel C: Lone parents with a youngest child 4–11 years of age[c]												
0	-295	0.29	1.85	1.00	-301	0.28	1.76	1.00	-302	0.27	1.70	1.00
198	-116	0.14	0.86	0.46	-133	0.14	0.91	0.52	-156	0.14	0.97	0.57
309	-72	0.14	0.68	0.37	-104	0.15	0.81	0.46	-122	0.15	0.88	0.51
398	-48	0.14	0.74	0.40	-68	0.14	0.77	0.44	-78	0.15	0.77	0.45
509	1	0.14	0.75	0.41	-12	0.14	0.74	0.42	-21	0.14	0.78	0.46
769	124	0.14	0.26	0.14	102	0.15	0.32	0.18	105	0.15	0.29	0.17
Panel D: Lone parents with a youngest child 12–17 years of age[d]												
0	-289	0.18	2.29	1.00	-295	0.17	2.03	1.00	-296	0.17	1.91	1.00
206	-94	0.16	0.70	0.30	-114	0.16	0.89	0.44	-132	0.17	0.97	0.51
344	-27	0.16	0.73	0.32	-53	0.17	0.82	0.40	-70	0.17	0.86	0.45
447	22	0.16	0.77	0.34	1	0.17	0.80	0.39	-14	0.17	0.82	0.43
575	81	0.16	0.80	0.35	64	0.16	0.80	0.39	49	0.17	0.84	0.44
914	241	0.16	0.57	0.25	205	0.17	0.63	0.31	208	0.17	0.61	0.32

Notes: Table E.2 gives the additional numerical inputs and outcomes for Figure 2 for the years 2014 and 2015.
[a]41,339 observations, [b]4,171 observations, [c]14,792 observations, [d]22,376 observations.

Table E.3: Optimal income support for different tastes for redistribution

Gross earnings per week	2015 Net tax per week	Share	Social welfare weights	v=0.25 Net tax per week	Share	Social welfare weights	v=1.00 Net tax per week	Share	Social welfare weights	v=2.00 Net tax per week	Share	Social welfare weights
Panel A: Lone parents with a youngest child 0–17 years of age[a]												
0	-300	0.23	1.92	-163	0.13	1.28	-257	0.19	1.65	-297	0.23	1.87
200	-153	0.16	0.82	-176	0.17	1.04	-201	0.16	1.05	-198	0.16	1.04
326	-103	0.16	0.83	-130	0.18	0.99	-128	0.17	0.93	-114	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	-35	0.17	0.94	13	0.16	0.80	43	0.15	0.66
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[b]												
0	-304	0.41	1.60	-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	0.97	-210	0.13	0.84	-187	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	0.91	-126	0.12	0.69	-87	0.11	0.47
704	4	0.11	0.17	-153	0.17	0.86	-65	0.13	0.54	-12	0.11	0.29
Panel C: Lone parents with a youngest child 4–11 years of age[c]												
0	-302	0.27	1.70	-184	0.17	1.24	-269	0.24	1.54	-302	0.28	1.72
198	-156	0.14	0.97	-185	0.15	1.03	-194	0.15	1.06	-186	0.14	1.06
309	-122	0.15	0.88	-147	0.16	0.99	-137	0.16	0.93	-120	0.15	0.85
398	-78	0.15	0.77	-116	0.16	0.96	-89	0.15	0.85	-65	0.14	0.73
509	-21	0.14	0.78	-76	0.17	0.93	-27	0.15	0.77	5	0.14	0.62
769	105	0.15	0.29	-40	0.19	0.86	50	0.16	0.58	101	0.15	0.35
Panel D: Lone parents with a youngest child 12–17 years of age[d]												
0	-296	0.17	1.91	-141	0.10	1.33	-251	0.15	1.70	-297	0.17	1.95
206	-132	0.17	0.97	-157	0.17	1.05	-186	0.17	1.09	-187	0.17	1.11
344	-70	0.17	0.86	-98	0.18	1.00	-101	0.18	0.96	-91	0.17	0.91
447	-14	0.17	0.82	-45	0.18	0.97	-29	0.17	0.90	-12	0.17	0.81
575	49	0.17	0.84	19	0.18	0.94	60	0.17	0.83	85	0.16	0.72
914	208	0.17	0.61	117	0.19	0.86	229	0.17	0.62	282	0.16	0.43

Notes: Table E.3 gives the numerical inputs and outcomes for Figure 3. Relative social welfare weights can be obtained by dividing the social welfare weight of the specific choice by the social welfare weight of non-working lone parents.
[a] 41,339 observations, [b] 4,171 observations, [c] 14,792 observations, [d] 22,376 observations.

F Results optimal tax analyses for lower and upper bounds 95% confidence interval estimated elasticities

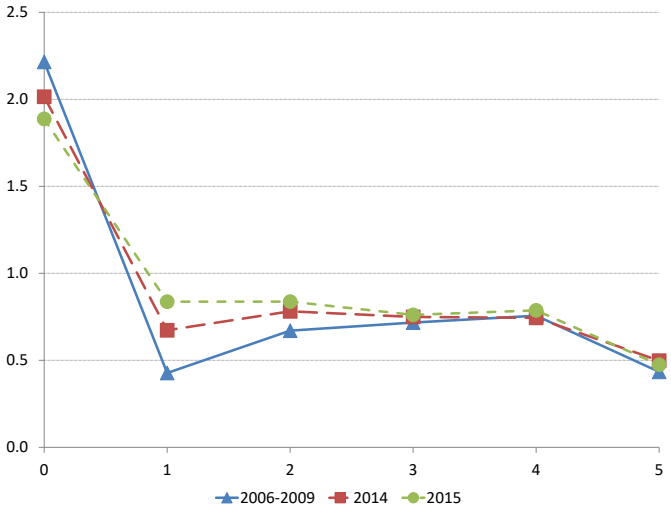
Table F.1: 95% confidence interval intensive and extensive elasticities

	Lone parents 0-17		Lone parents 0-3		Lone parents 4-11		Lone parents 12-17	
Gross income option	Intensive	Extensive	Intensive	Extensive	Intensive	Extensive	Intensive	Extensive
1	[0.037, 0.043]	[0.037, 0.043]	[0.284, 0.396]	[0.284, 0.396]	[0.008, 0.011]	[0.008, 0.011]	[0.007, 0.007]	[0.007, 0.007]
2	[0.058, 0.062]	[0.126, 0.134]	[0.057, 0.079]	[0.419, 0.574]	[0.055, 0.064]	[0.114, 0.127]	[0.058, 0.061]	[0.078, 0.082]
3	[0.058, 0.062]	[0.155, 0.166]	[0.095, 0.138]	[0.521, 0.675]	[0.065, 0.074]	[0.163, 0.179]	[0.049, 0.052]	[0.097, 0.102]
4	[0.049, 0.051]	[0.196, 0.206]	[0.060, 0.080]	[0.506, 0.663]	[0.057, 0.063]	[0.228, 0.253]	[0.049, 0.051]	[0.138, 0.143]
5	[0.117, 0.123]	[0.342, 0.364]	[0.110, 0.156]	[0.746, 1.016]	[0.140, 0.159]	[0.484, 0.540]	[0.107, 0.113]	[0.233, 0.246]

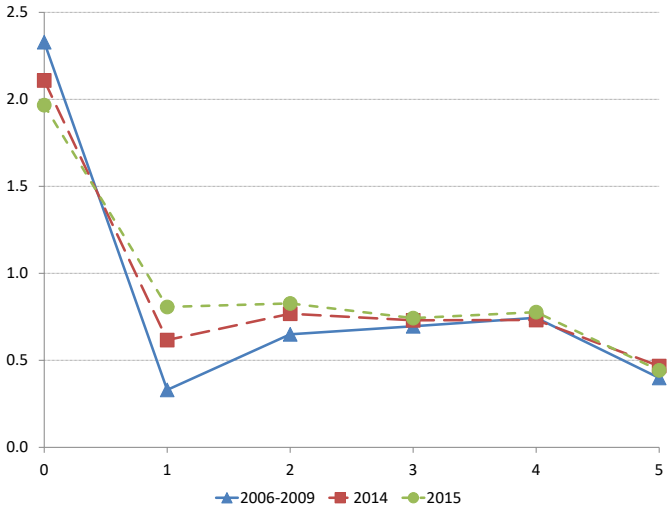
Notes: Table F.1 gives the 95% confidence interval on the intensive and extensive elasticities between gross income options. First, we draw 200 sets of the preference parameters using the variance/covariance matrix of the estimates which then gives 200 elasticities for the intensive and extensive margins for the income groups. Second, we take the 2.5th percentile and the 97.5th percentile from the distribution of the elasticities to derive the 95% confidence intervals.

Figure F.1: Social welfare weights at lower and upper bounds 95% CI elasticities, 0–17 and 0–3

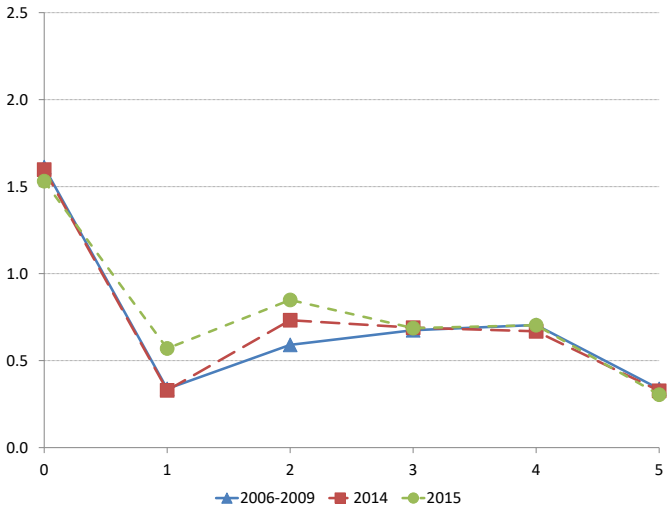
(a) Youngest child 0–17, lower bound



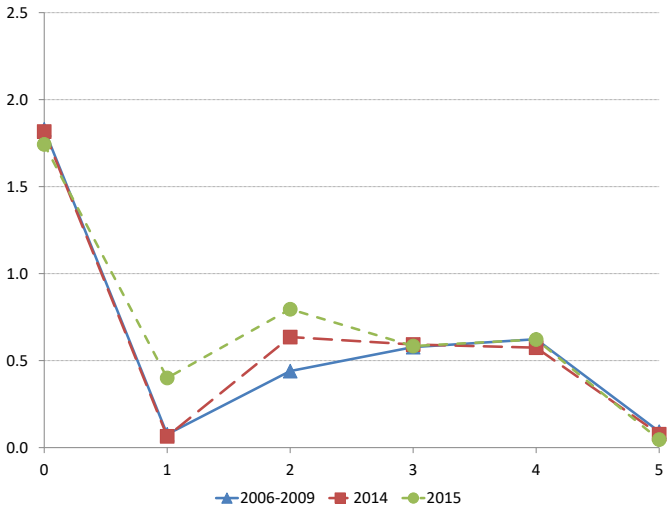
(b) Youngest child 0–17, upper bound



(c) Youngest child 0–3, lower bound



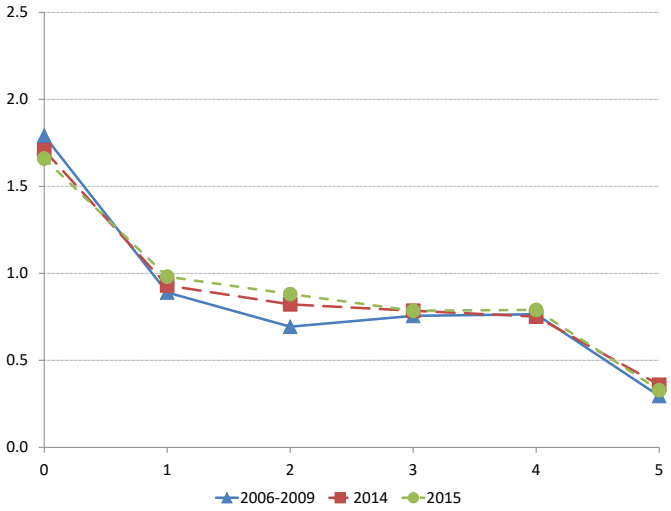
(d) Youngest child 0–3, upper bound



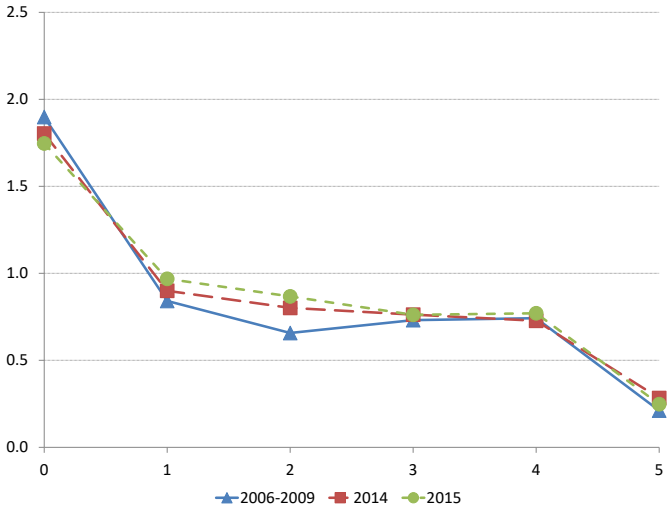
Notes: Figure F.1 shows the resulting social welfare weights using equations (7)-(9) and the net incomes/consumption and net taxes per gross income level from Table E.1 (for 2006–2009) and Table E.2 (for 2014 and 2015), but with the intensive and extensive elasticities at the lower (left hand panels) and upper (right hand pandels) bounds from Table F.1. In this figure we show the results for the whole group of lone parents with a youngest child 0–17 years of age and for the subgroup of lone parents with a youngest child 0–3 years of age. We calculate the social welfare weights at discrete levels of gross income (points 0 to 5). Point 0 is the social welfare weight on non-working lone parents, and points 1 to 5 are the social welfare weights of working lone parents, ordered by their gross income level and grouped into five groups of equal size in the baseline (2006-2009). The results are qualitatively the same as in the baseline, see Figure 2 in the main text, though the anomalies at points 1 and 2 become more (less) pronounced at the upper (lower) bounds of the behavioural elasticities. Indeed, when lone parents are more responsive to financial incentives, the social planner needs to care less about the 'working poor' lone parents to rationalize the relatively low financial incentives to work for these lone parents in the tax-benefit system.

Figure F.2: Social welfare weights at lower and upper bounds 95% CI elasticities, 4–11 and 12–17

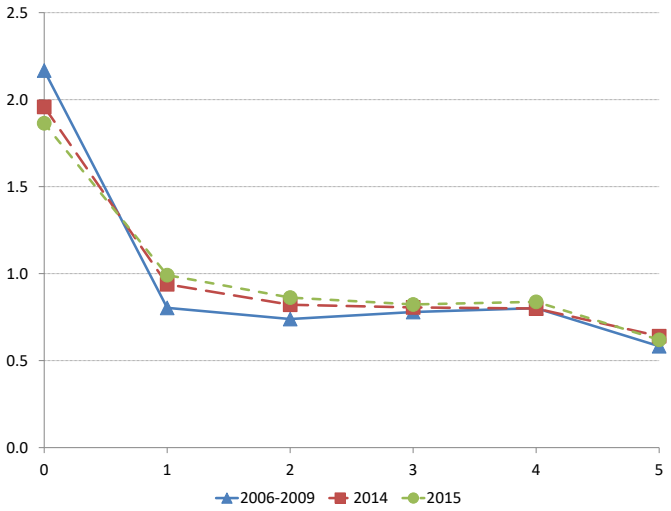
(a) Youngest child 4–11, lower bound



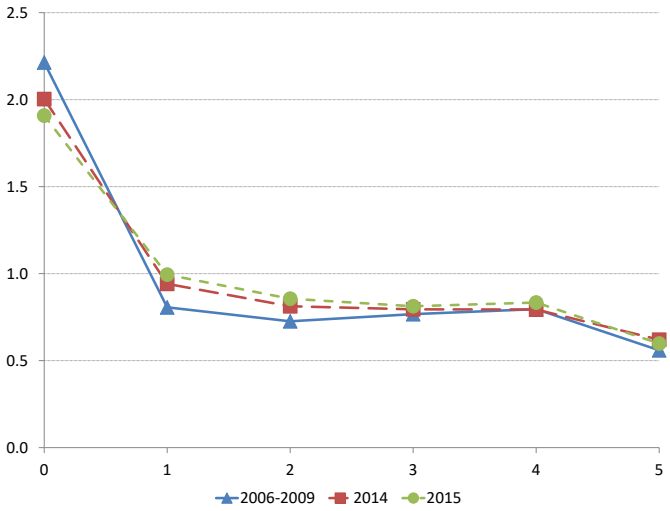
(b) Youngest child 4–11, upper bound



(c) Youngest child 12–17, lower bound



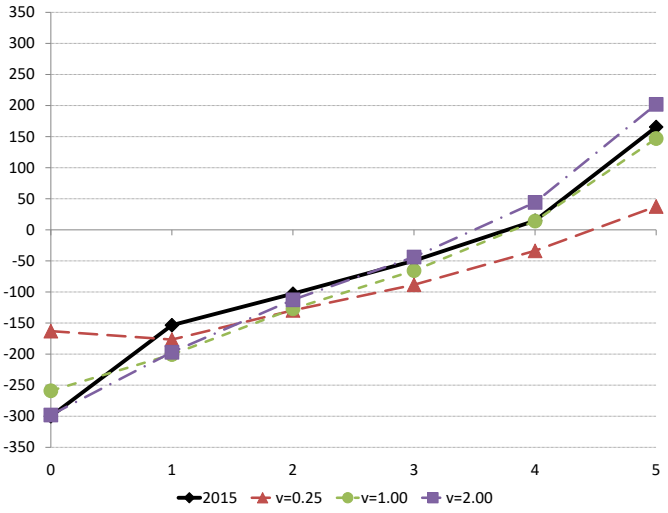
(d) Youngest child 12–17, upper bound



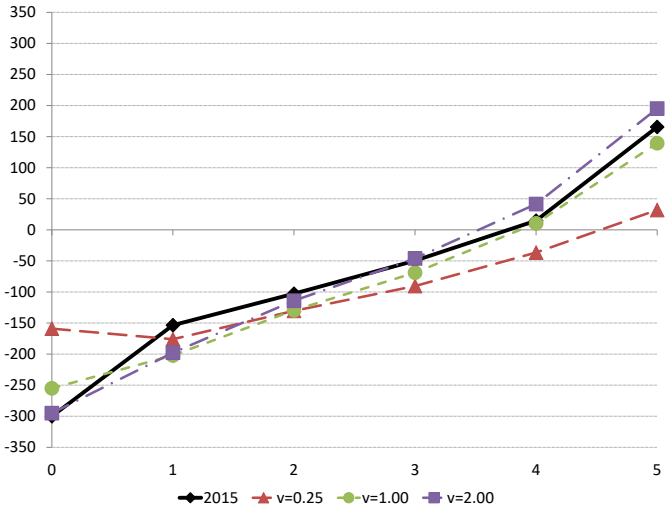
Notes: Figure F.2 shows the resulting social welfare weights using equations (7)-(9) and the net incomes/consumption and net taxes per gross income level from Table E.1 (for 2006–2009) and Table E.2 (for 2014 and 2015), but with the intensive and extensive elasticities at the lower (left hand panels) and upper (right hand pandels) bounds from Table F.1. In this figure we show the results for the subgroup of lone parents with a youngest child 4–11 years of age and for the subgroup of lone parents with a youngest child 12–17 years of age. We calculate the social welfare weights at discrete levels of gross income (points 0 to 5). Point 0 is the social welfare weight on non-working lone parents, and points 1 to 5 are the social welfare weights of working lone parents, ordered by their gross income level and grouped into five groups of equal size in the baseline (2006-2009). The results are qualitatively the same as in the baseline, see Figure 2 in the main text, though the anomalies at point 2 become more (less) pronounced at the upper (lower) bounds of the behavioural elasticities. Indeed, when lone parents are more responsive to financial incentives, the social planner needs to care less about the 'working poor' lone parents to rationalize the relatively low financial incentives to work for these lone parents in the tax-benefit system.

Figure F.3: Optimal tax profiles at lower and upper bounds 95% CI elasticities, 0–17 and 0–3

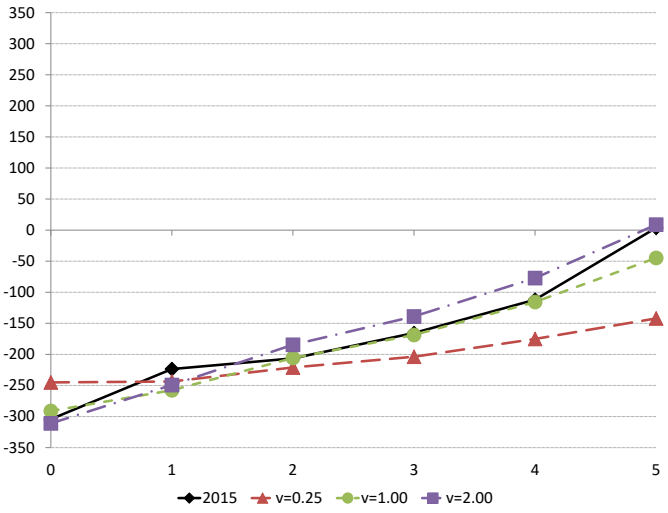
(a) Youngest child 0–17, lower bound



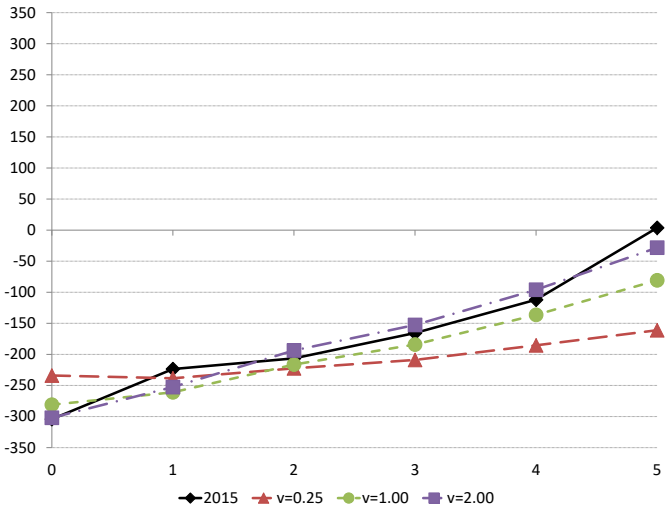
(b) Youngest child 0–17, upper bound



(c) Youngest child 0–3, lower bound



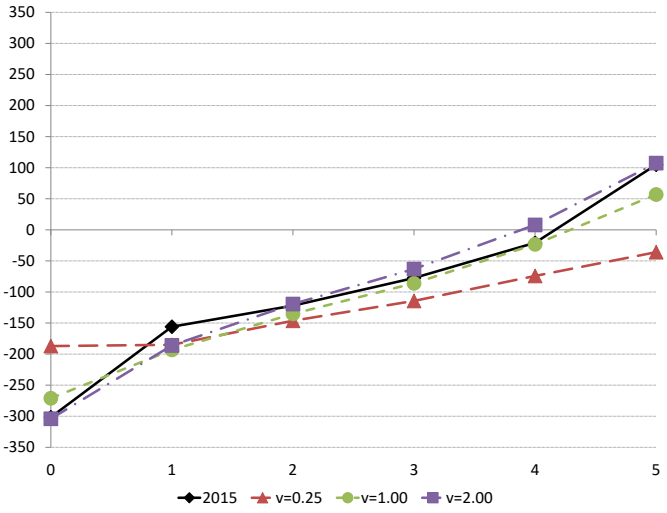
(d) Youngest child 0–3, upper bound



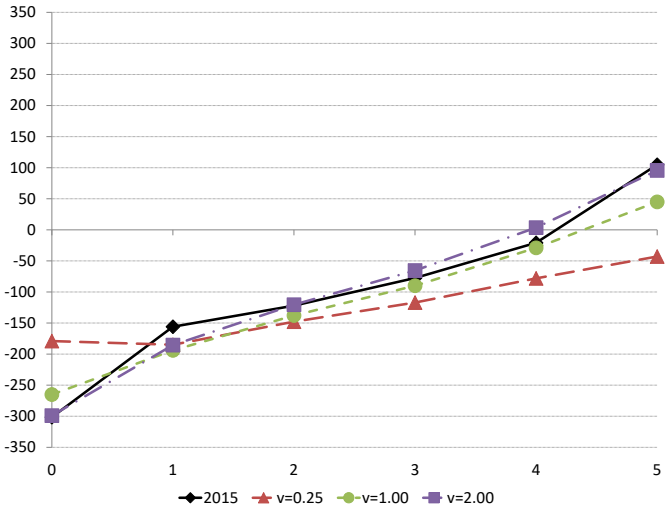
Notes: Figure F.3 shows for each gross income level of lone parents the net tax (benefits minus taxes) level in 2015 and the optimal net tax level using equations (2)-(3), the group shares, gross incomes and net taxes in the year 2015 per gross income level from Table E.3, the social welfare weights given by the following function of net income c_i in option i: $g_i = 1/p * 1/(c_i^v)$ (where p is a scaling variable that we use to normalize the weighted sum of social welfare weights to 1 for different levels of v, and the higher is v, the higher is the aversion to inequality), but with the intensive and extensive elasticities at the lower (left hand panels) and upper (right hand panels) bounds from Table F.1. We show the results for the whole group of lone parents with a youngest child 0–17 years of age and for the subgroup of lone parents with a youngest child 0–3 years of age. We calculate the net tax level in 2015 and the optimal tax level at discrete levels of gross income (points 0 to 5). Point 0 are net taxes for non-working lone parents, and points 1 to 5 are net taxes for working lone parents, ordered by their gross income level and grouped into five groups of equal size in the baseline. The results are qualitatively similar as in the baseline, see Figure 3 in the main text, though for higher (lower) elasticities the optimal level of the absolute level of net taxes are lower (on the one hand, optimal welfare benefits are lower for non-working lone parents, and on the other hand, taxes are lower for working lone parents as well).

Figure F.4: Optimal tax profiles at lower and upper bounds 95% CI elasticities, 4–11 and 12–17

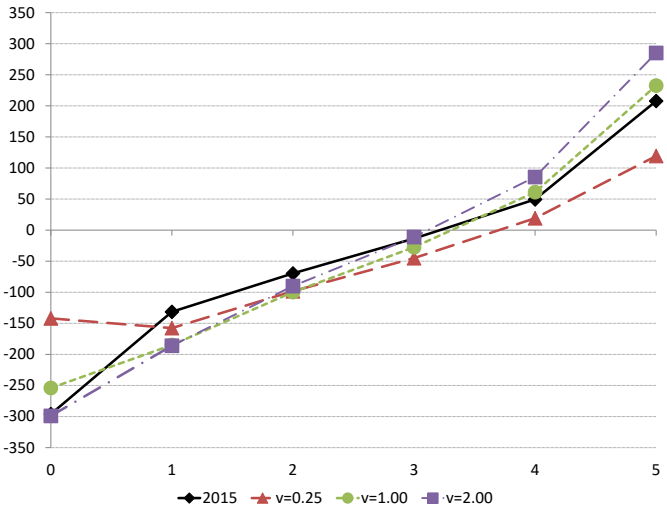
(a) Youngest child 4–11, lower bound



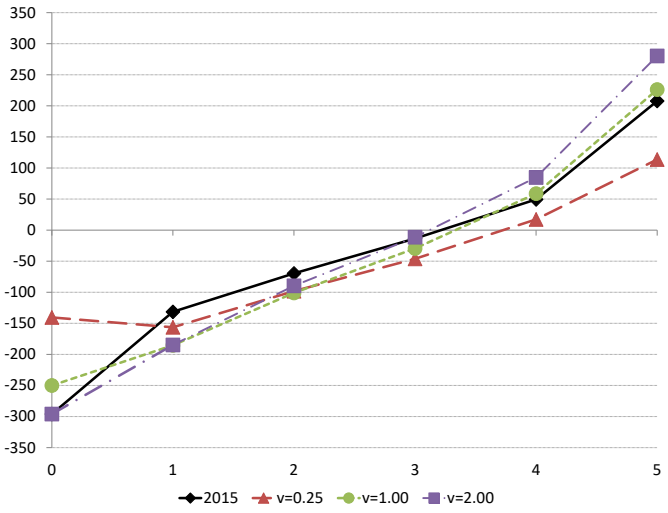
(b) Youngest child 4–11, upper bound



(c) Youngest child 12–17, lower bound



(d) Youngest child 12–17, upper bound



Notes: Figure F.4 shows for each gross income level of lone parents the net tax (benefits minus taxes) level in 2015 and the optimal net tax level using equations (2)-(3), the group shares, gross incomes and net taxes in the year 2015 per gross income level from Table E.3, the social welfare weights given by the following function of net income c_i in option i: $g_i = 1/p * 1/(c_i^v)$ (where p is a scaling variable that we use to normalize the weighted sum of social welfare weights to 1 for different levels of v, and the higher is v, the higher is the aversion to inequality), but with the intensive and extensive elasticities at the lower (left hand panels) and upper (right hand panels) bounds from Table F.1. We show the results for the subgroup of lone parents with a youngest child 4–11 years of age and for the subgroup of lone parents with a youngest child 12–17 years of age. We calculate the net tax level in 2015 and the optimal tax level at discrete levels of gross income (points 0 to 5). Point 0 are net taxes for non-working lone parents, and points 1 to 5 are net taxes for working lone parents, ordered by their gross income level and grouped into five groups of equal size in the baseline. The results are qualitatively similar as in the baseline, see Figure 3 in the main text, though for higher (lower) elasticities the optimal level of the absolute level of net taxes are lower (on the one hand, optimal welfare benefits are lower for non-working lone parents, and on the other hand, taxes are lower for working lone parents as well).

G Estimated preferences accounting for involuntary unemployment

In our structural model we implicitly assume individuals can freely choose their preferred alternative from the discrete choice set. In reality, demand side restrictions may limit these discrete choice sets. We extend our model by taking into account the possibility that individuals are restricted in their choices. In our data set for 2006–2009, we observe individual job search behaviour, and we can use this information to identify whether individuals are involuntarily unemployed or not. We follow the approach by Bargain et al. (2010) who proceeds in two steps. The first step is to estimate the determinants of involuntary employment by a standard probit regression. Next, we use this information to simulate a probability of involuntary unemployment for all individuals in our data set. The second step is to include these probabilities in the simulated maximum likelihood function.

The probability of involuntary unemployment is modelled as a probit:

$$I_i = \Phi(\beta \boldsymbol{X_i}) + \nu_i \tag{G.1}$$

We first estimate the determinants of the probability that an individual is rationed (parameters β), given the demographic characteristics $\boldsymbol{X_i}$, using the involuntarily unemployed and the employed. The probit model assumes that the error terms ν_i are independent and normally distributed: $\nu_i \sim IID(0, \sigma_\nu^2)$. We then use this information to simulate an individual probability of involuntary unemployment, $\Phi(\boldsymbol{X_i})$, for all individuals in our sample. Given the simulated probability of rationing we can form the likelihood to estimate preferences over income and leisure.

We distinguish between three possible states on the labor market:
1) Lone parent is voluntarily unemployed, where P_i^{VOL} is the probability of being voluntary unemployed:

$$P_i^{VOL} = \frac{\exp(U_{i1})}{\sum_{j=1}^{J} \exp(U_{ij})}, \tag{G.2}$$

2) Lone parent is involuntarily unemployed, where P_i^{INVOL} is the probability of being involuntary unemployed

$$P_i^{INVOL} = \Phi(\beta \boldsymbol{X}) \sum_{k \in (h>0)}^{J} \frac{\exp(U_{ik})}{\sum_{j=1}^{J} \exp(U_{ij})}, \tag{G.3}$$

3) Lone parent is employed:

$$P_{i,k\in(h>0)}^{EMP} = (1 - \Phi(\beta \boldsymbol{X})) \frac{\exp(U_{ik})}{\sum_{j=1}^{J} \exp(U_{ij})}. \tag{G.4}$$

The contribution of the voluntary unemployed to the likelihood function is straightforward and

Table G.1: Elasticities model without and with involuntary unemployment

	Model without involuntary unemployment	Model with involuntary unemployment
Youngest child 0–17 years of age		
Total elasticity	0.20	0.18
Extensive margin	0.17	0.16
Intensive margin	0.03	0.02
Youngest child 0–3 years of age		
Total elasticity	0.28	0.25
Extensive margin	0.25	0.23
Intensive margin	0.03	0.03
Youngest child 4–11 years of age		
Total elasticity	0.22	0.20
Extensive margin	0.20	0.18
Intensive margin	0.02	0.02
Youngest child 12–17 years of age		
Total elasticity	0.18	0.16
Extensive margin	0.13	0.12
Intensive margin	0.05	0.04

Notes: This table gives the elasticities for the models without and with involuntary unemployment.

equals the probability of the observed choice, which is the logit probability that zero working hours has the highest utility (equation G.2). Involuntary unemployed individuals prefer another alternative than the observed outcome. Unfortunately we do not have information on their preferred number of working hours, so we only know that they want to participate and that one of the working alternatives is preferred. Their contribution to the likelihood is the sum of the probabilities of all positive hours values from the choice set, multiplied by the probability of involuntary unemployment (equation G.3). For workers we use the observed number of working hours. In reality, the preferred number of working hours may differ from the actual hours for workers as well. For instance, Bargain et al. (2010) use desired hours instead of actual working hours. We have no information on the desired number of working hours, hence we implicitly that there is no involuntary part-time or full-time employment. However, we believe this effect is limited in the Netherlands. Data from the OECD (2013) shows that only 5% of women working in part-time would like to work more hours, whereas this share is much higher in other OECD countries (13% in Germany, 28% in France and 55% in Spain). Finally, the contribution of an employed individual to the likelihood function equals the probability of the observed choice multiplied by the probability that the individual is not rationed on the labour market (equation G.4).

Table G.1 shows the probabilistic elasticities for the model without and with involuntary unemployment, where we calculate the probability distribution of hours worked in the base and when we increase wages by 10 percent. We only include individuals for who we observe job search behaviour in our data set, so we end up with less observations than in the original sample. The first column presents the elasticities for this new baseline model without involuntary unemployment. Allowing for the possibility of involuntary unemployed lowers the labor supply response which is

in line with Bargain et al. (2010). The differences between both models are limited which is line with the same mall share of involuntary unemployment in our data period Only 5% of the lone parents is involuntary unemployed in the period 2006–2009.

H Results optimal-tax analyses with proxy for involuntary unemployment

Table H.1: Implicit social welfare weights 2006–2009 with proxy for involuntary unemployment

Gross earnings per week	Net income per week	Net tax per week	Intensive elasticity	Extensive elasticity	Share	Social welfare weights	Relative social welfare weights
Panel A: Lone parents with a youngest child 0–17 years of age[a]							
0	293	-293	-	-	0.25	2.16	1.00
200	314	-114	0.04	0.04	0.15	0.44	0.20
326	384	-58	0.04	0.12	0.15	0.69	0.32
423	441	-18	0.04	0.15	0.15	0.72	0.33
544	503	41	0.04	0.19	0.15	0.75	0.35
851	659	192	0.08	0.32	0.15	0.49	0.23
Panel B: Lone parents with a youngest child 0–3 years of age[b]							
0	296	-296	-	-	0.43	1.59	1.00
184	379	-195	0.30	0.30	0.11	0.30	0.19
289	445	-156	0.06	0.45	0.11	0.56	0.35
378	522	-143	0.09	0.53	0.11	0.66	0.42
478	579	-101	0.05	0.48	0.11	0.71	0.44
704	697	7	0.09	0.56	0.11	0.50	0.31
Panel C: Lone parents with a youngest child 4–11 years of age[c]							
0	295	-295	-	-	0.29	1.68	1.00
198	314	-116	0.01	0.01	0.14	0.79	0.47
309	381	-72	0.04	0.10	0.14	0.73	0.43
398	446	-48	0.06	0.16	0.14	0.76	0.45
509	508	1	0.05	0.19	0.14	0.78	0.46
769	645	124	0.09	0.29	0.14	0.57	0.34
Panel D: Lone parents with a youngest child 12–17 years of age[d]							
0	289	-289	-	-	0.18	1.96	1.00
206	300	-94	0.00	0.00	0.16	0.96	0.49
344	371	-27	0.04	0.08	0.16	0.75	0.38
447	426	22	0.04	0.09	0.16	0.80	0.41
575	493	81	0.04	0.13	0.16	0.81	0.42
914	672	241	0.09	0.22	0.16	0.62	0.32

Notes: Table H.1 gives the numerical inputs and outcomes for Figure H.1 (2006-2009).
[a]41,339 observations, [b]4,171 observations, [c]14,792 observations, [d]22,376 observations.

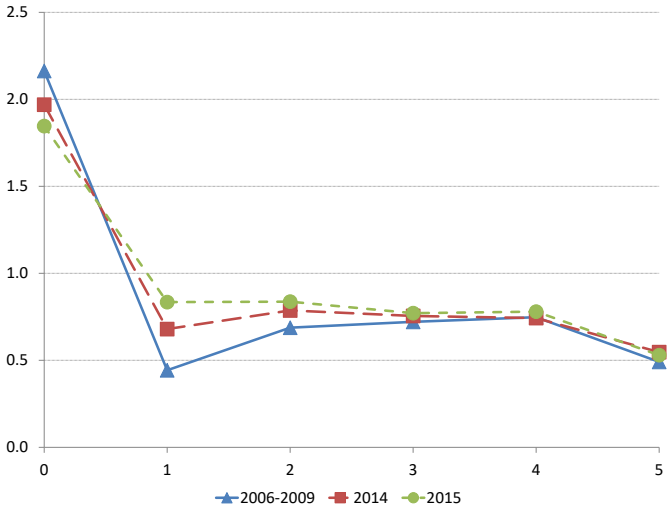
Table H.2: Social welfare weights over time with proxy for involuntary unemployment

Gross earnings per week	2006–2009 Net tax per week	Share	Social welfare weights	Relative social welfare weights	2014 Net tax per week	Share	Social welfare weights	Relative social welfare weights	2015 Net tax	Share	Social welfare weights	Relative social welfare weights
Panel A: Lone parents with a youngest child 0–17 years of age[a]												
0	-293	0.25	2.16	1.00	-299	0.24	1.97	1.00	-300	0.23	1.85	1.00
200	-114	0.15	0.44	0.20	-133	0.15	0.68	0.35	-153	0.16	0.83	0.45
326	-58	0.15	0.69	0.32	-86	0.15	0.79	0.40	-103	0.16	0.84	0.45
423	-18	0.15	0.72	0.33	-38	0.15	0.76	0.38	-50	0.15	0.77	0.42
544	41	0.15	0.75	0.35	27	0.15	0.74	0.38	15	0.15	0.78	0.42
851	192	0.15	0.49	0.23	164	0.15	0.55	0.28	166	0.15	0.53	0.29
Panel B: Lone parents with a youngest child 0–3 years of age[b]												
0	-296	0.43	1.59	1.00	-304	0.43	1.58	1.00	-304	0.41	1.50	1.00
184	-195	0.11	0.30	0.19	-203	0.11	0.29	0.19	-224	0.12	0.55	0.36
289	-156	0.11	0.56	0.35	-184	0.12	0.71	0.45	-206	0.13	0.83	0.55
378	-143	0.11	0.66	0.42	-156	0.11	0.68	0.43	-166	0.12	0.68	0.45
478	-101	0.11	0.71	0.44	-104	0.11	0.67	0.43	-112	0.11	0.71	0.47
704	7	0.11	0.50	0.31	3	0.11	0.49	0.31	4	0.11	0.47	0.31
Panel C: Lone parents with a youngest child 4–11 years of age[c]												
0	-295	0.29	1.68	1.00	-301	0.28	1.58	1.00	-302	0.27	1.52	1.00
198	-116	0.14	0.79	0.47	-133	0.14	0.87	0.55	-156	0.14	0.95	0.62
309	-72	0.14	0.73	0.43	-104	0.15	0.84	0.53	-122	0.15	0.89	0.59
398	-48	0.14	0.76	0.45	-68	0.14	0.79	0.50	-78	0.15	0.79	0.52
509	1	0.14	0.78	0.46	-12	0.14	0.77	0.49	-21	0.14	0.80	0.52
769	124	0.14	0.57	0.34	102	0.14	0.61	0.38	105	0.14	0.59	0.38
Panel D: Lone parents with a youngest child 12–17 years of age[d]												
0	-289	0.18	1.96	1.00	-295	0.17	1.83	1.00	-296	0.17	1.77	1.00
206	-94	0.16	0.96	0.49	-114	0.16	1.00	0.55	-132	0.16	1.02	0.58
344	-27	0.16	0.75	0.38	-53	0.17	0.82	0.45	-70	0.17	0.86	0.49
447	22	0.16	0.80	0.41	1	0.17	0.82	0.45	-14	0.17	0.84	0.47
575	81	0.16	0.81	0.42	64	0.16	0.81	0.44	49	0.17	0.85	0.48
914	241	0.16	0.62	0.32	205	0.17	0.67	0.37	208	0.17	0.65	0.37

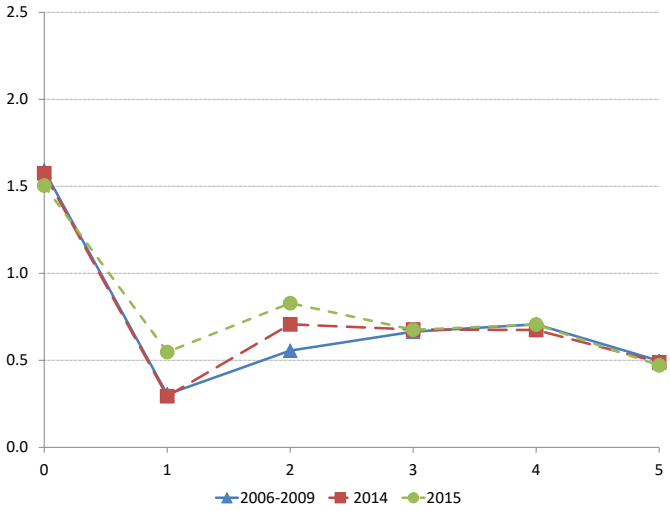
Notes: Table H.2 gives the additional numerical inputs and outcomes for Figure H.1 for the years 2014 and 2015.
[a]41,339 observations, [b]4,171 observations, [c]14,792 observations, [d]22,376 observations.

Figure H.1: Social welfare weights over time with proxy for involuntary unemployment

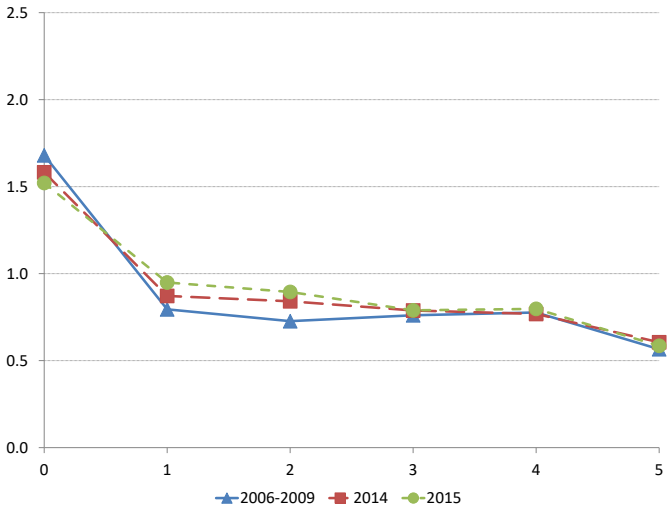
(a) Lone parents young. child 0–17



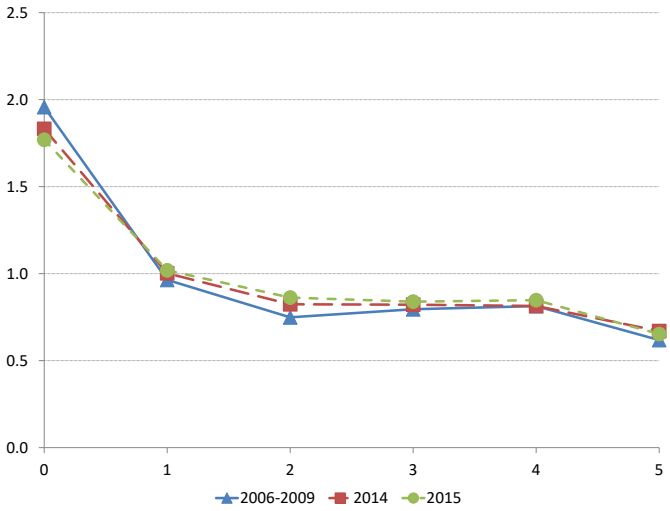
(b) Lone parents youngest child 0–3



(c) Lone parents youngest child 4–11



(d) Lone parents youngest child 12–17



Notes: Figure H.1 shows the resulting social welfare weights using equations (7)-(9) and the numerical inputs (net incomes/consumption, net taxes and extensive and intensive elasticities per gross income level) from Table H.1 (for 2006–2009) and Table H.2 (for 2014 and 2015). We show the results for the whole group of lone parents with a youngest child 0–17 years of age, and for subgroups by age of the youngest child (0–3, 4–11 and 12–17). We calculate the social welfare weights at discrete levels of gross income (points 0 to 5). Point 0 is the social welfare weight on non-working lone parents, and points 1 to 5 are the social welfare weights of working lone parents, ordered by their gross income level and grouped into five groups of equal size in the baseline (2006-2009). The results are very similar to the base results, see Figure 2 in the main text, as the share of involuntary unemployment is rather low for lone parents.

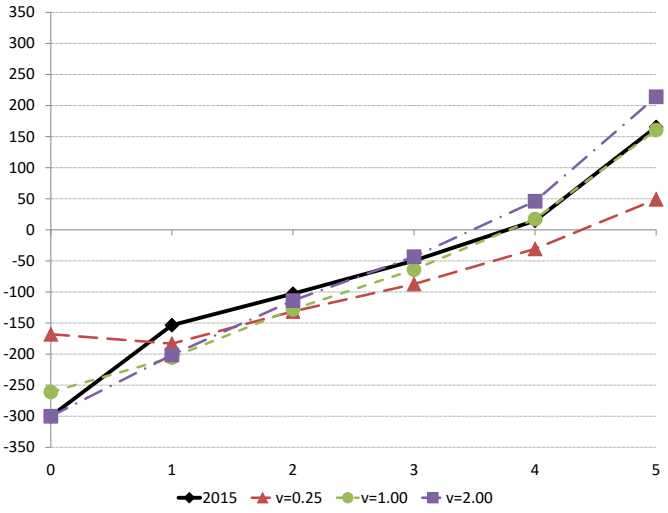
Table H.3: Optimal income support with proxy for involuntary unemployment

Gross earnings per week	2015 Net tax per week	Share	Social welfare weights	v=0.25 Net tax per week	Share	Social welfare weights	v=1.00 Net tax per week	Share	Social welfare weights	v=2.00 Net tax per week	Share	Social welfare weights
Panel A: Lone parents with a youngest child 0–17 years of age[a]												
0	-300	0.23	1.85	-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	0.84	-130	0.17	0.99	-128	0.17	0.93	-113	0.16	0.85
423	-50	0.15	0.77	-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	0.53	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[b]												
0	-304	0.41	1.50	-243	0.27	1.16	-289	0.36	1.42	-309	0.43	1.57
184	-224	0.12	0.55	-242	0.15	1.01	-259	0.14	0.93	-252	0.13	0.79
289	-206	0.13	0.83	-222	0.15	0.97	-212	0.13	0.82	-191	0.12	0.65
378	-166	0.12	0.68	-205	0.14	0.94	-175	0.12	0.74	-145	0.11	0.55
478	-112	0.11	0.71	-175	0.14	0.91	-118	0.12	0.69	-80	0.11	0.48
704	4	0.11	0.47	-130	0.14	0.86	-28	0.12	0.56	28	0.11	0.33
Panel C: Lone parents with a youngest child 4–11 years of age[c]												
0	-302	0.27	1.52	-201	0.20	1.20	-279	0.26	1.47	-309	0.29	1.64
198	-156	0.14	0.95	-182	0.15	1.03	-195	0.15	1.04	-189	0.15	1.05
309	-122	0.15	0.89	-144	0.16	0.98	-136	0.15	0.92	-121	0.15	0.85
398	-78	0.15	0.79	-114	0.16	0.95	-87	0.15	0.84	-65	0.14	0.73
509	-21	0.14	0.80	-70	0.16	0.92	-20	0.15	0.78	11	0.14	0.63
769	105	0.14	0.59	-9	0.17	0.86	95	0.15	0.61	148	0.14	0.41
Panel D: Lone parents with a youngest child 12–17 years of age[d]												
0	-296	0.17	1.77	-141	0.11	1.33	-253	0.15	1.68	-298	0.18	1.92
206	-132	0.16	1.02	-158	0.16	1.05	-185	0.16	1.09	-185	0.16	1.12
344	-70	0.17	0.86	-99	0.18	1.00	-100	0.18	0.96	-90	0.17	0.90
447	-14	0.17	0.84	-44	0.18	0.97	-27	0.17	0.90	-10	0.17	0.82
575	49	0.17	0.85	20	0.18	0.94	61	0.17	0.83	86	0.16	0.72
914	208	0.17	0.65	117	0.19	0.86	230	0.17	0.62	283	0.16	0.43

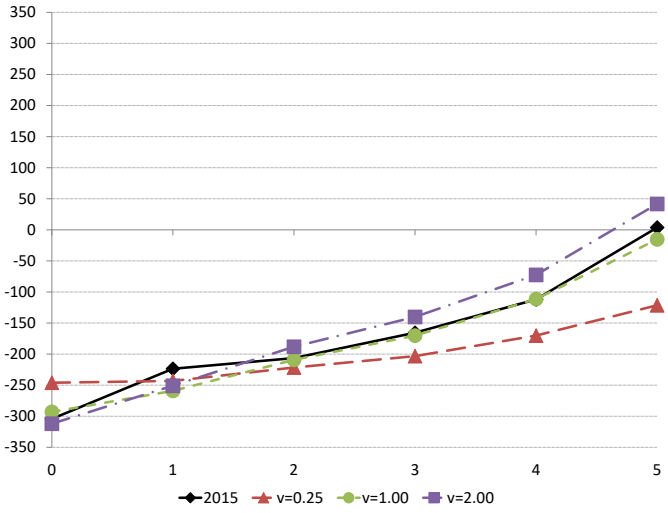
Notes: Table H.3 gives the numerical inputs and outcomes for Figure H.2. Relative social welfare weights can be obtained by dividing the social welfare weight of the specific choice by the social welfare weight of non-working lone parents.
[a] 41,339 observations, [b] 4,171 observations, [c] 14,792 observations, [d] 22,376 observations.

Figure H.2: Optimal tax profiles with proxy for involuntary unemployment

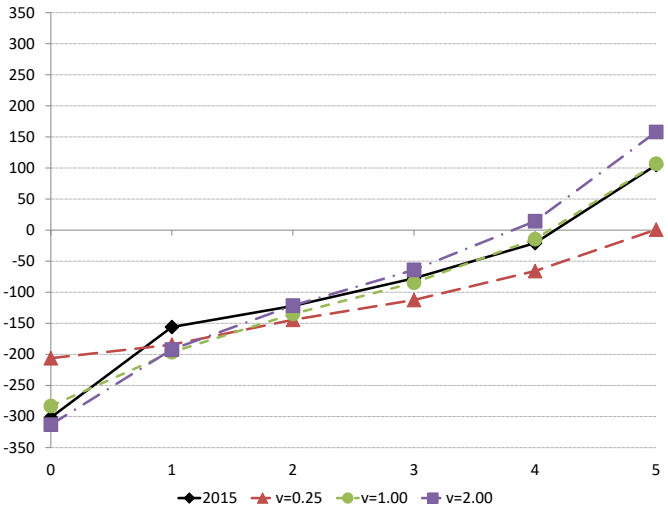
(a) Lone parents youngest child 0–17



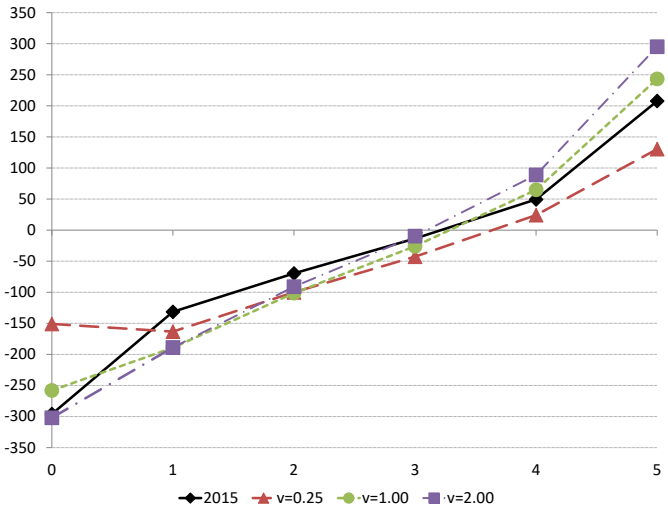
(b) Lone parents youngest child 0–3



(c) Lone parents youngest child 4–11



(d) Lone parents youngest child 12–17



Notes: Figure H.2 shows for each gross income level of lone parents the net tax (benefits minus taxes) level in 2015 and the optimal net tax level using equations (2)-(3), the numerical inputs (group shares, gross incomes, the extensive and intensive elasticities and net taxes in the year 2015 per gross income level) from Table H.3 and the social welfare weights given by the following function of net income c_i in option i: $g_i = 1/p * 1/(c_i^v)$ (where p is a scaling variable that we use to normalize the weighted sum of social welfare weights to 1 for different levels of v, and the higher is v, the higher is the aversion to inequality). We show the results for the whole group of lone parents with a youngest child 0–17 years of age, and for subgroups by age of the youngest child (0–3, 4–11 and 12–17). We calculate the net tax level in 2015 and the optimal tax level at discrete levels of gross income (points 0 to 5). Point 0 are net taxes for non-working lone parents, and points 1 to 5 are net taxes for working lone parents, ordered by their gross income level and grouped into five groups of equal size in the baseline. The results are very similar to the base results, see Figure 3 in the main text, as the share of involuntary unemployment is rather low for lone parents.

I Results optimal-tax analyses with nine choice options

Table I.1: Implicit social welfare weights 2006–2009 nine options

Gross earnings per week	Net income per week	Net tax per week	Intensive elasticity	Extensive elasticity	Share	Social welfare weights	Relative social welfare weights
Panel A: Lone parents with a youngest child 0–17 years of age[a]							
0	293	-293	-	-	0.25	1.92	1.00
181	312	-132	0.01	0.01	0.09	0.81	0.42
283	344	-61	0.02	0.05	0.09	0.75	0.39
345	380	-35	0.04	0.08	0.09	0.75	0.39
405	418	-13	0.02	0.11	0.09	0.76	0.40
468	446	21	0.02	0.13	0.09	0.74	0.38
546	482	64	0.02	0.17	0.09	0.70	0.36
661	537	124	0.04	0.22	0.09	0.68	0.35
973	677	296	0.08	0.36	0.09	0.36	0.19
Panel B: Lone parents with a youngest child 0–3 years of age[b]							
0	296	-296	-	-	0.43	2.16	1.00
168	311	-144	0.05	0.05	0.07	0.20	0.09
253	350	-97	0.07	0.15	0.07	0.41	0.19
306	385	-78	0.07	0.24	0.07	0.53	0.24
358	394	-36	0.04	0.27	0.07	0.15	0.07
413	430	-18	0.04	0.38	0.07	0.25	0.12
479	458	21	0.04	0.42	0.07	0.19	0.09
564	502	62	0.08	0.50	0.07	0.27	0.12
799	596	203	0.13	1.08	0.07	-1.00	-0.46
Panel C: Lone parents with a youngest child 4–11 years of age[c]							
0	295	-295	-	-	0.29	1.67	1.00
185	325	-140	0.01	0.01	0.09	0.89	0.53
274	360	-87	0.03	0.05	0.09	0.81	0.48
325	388	-63	0.02	0.07	0.09	0.82	0.49
378	420	-41	0.02	0.10	0.09	0.81	0.48
440	448	-9	0.02	0.13	0.09	0.77	0.46
507	479	28	0.02	0.17	0.09	0.75	0.45
618	520	98	0.04	0.23	0.09	0.67	0.40
874	629	245	0.10	0.36	0.09	0.29	0.17
Panel D: Lone parents with a youngest child 12–17 years of age[d]							
0	289	-289	-	-	0.18	2.69	1.00
181	303	-122	0.01	0.01	0.10	0.94	0.35
300	327	-27	0.03	0.05	0.10	0.58	0.21
367	381	-13	0.06	0.11	0.10	0.67	0.25
430	417	12	0.03	0.14	0.10	0.67	0.25
498	451	46	0.03	0.18	0.10	0.63	0.23
580	493	87	0.04	0.22	0.10	0.61	0.23
702	552	150	0.06	0.29	0.10	0.58	0.22
1055	725	330	0.12	0.37	0.10	0.35	0.13

Notes: Table I.1 gives the numerical inputs and outcomes for Figure I.1 (2006-2009).
[a]41,339 observations, [b]4,171 observations, [c]14,792 observations, [d]22,376 observations.

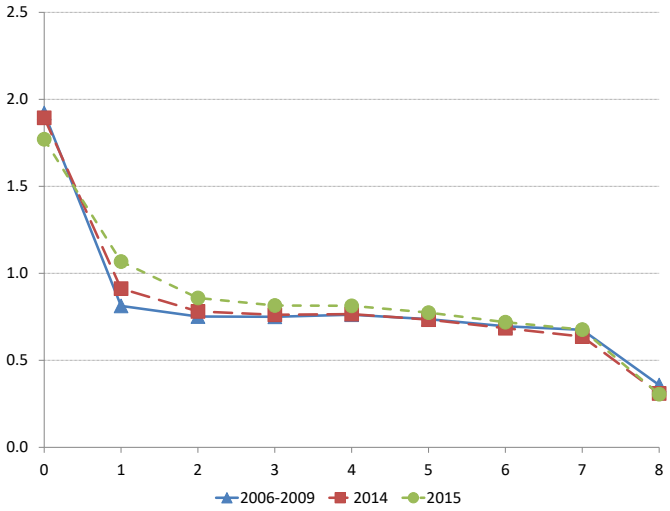
Table I.2: Social welfare weights over time with nine choice options

	2006–2009				2014				2015			
Gross earnings per week	Net tax per week	Share	Social welfare weights	Relative social welfare weights	Net tax per week	Share	Social welfare weights	Relative social welfare weights	Net tax	Share	Social welfare weights	Relative social welfare weights
Panel A: Lone parents with a youngest child 0–17 years of age[a]												
0	-293	0.25	1.92	1.00	-299	0.25	1.89	1.00	-300	0.24	1.77	1.00
181	-132	0.09	0.81	0.42	-148	0.09	0.91	0.48	-196	0.10	1.07	0.60
283	-61	0.09	0.75	0.39	-74	0.09	0.78	0.41	-113	0.10	0.86	0.48
345	-35	0.09	0.75	0.39	-45	0.09	0.76	0.40	-75	0.10	0.82	0.46
405	-13	0.09	0.76	0.40	-20	0.09	0.77	0.40	-43	0.10	0.81	0.46
468	21	0.09	0.74	0.38	17	0.09	0.73	0.39	-1	0.09	0.77	0.44
546	64	0.09	0.70	0.36	64	0.09	0.68	0.36	48	0.09	0.72	0.41
661	124	0.09	0.68	0.35	131	0.09	0.64	0.34	117	0.09	0.68	0.38
973	296	0.09	0.36	0.19	307	0.09	0.31	0.16	302	0.09	0.31	0.17
Panel B: Lone parents with a youngest child 0–3 years of age[b]												
0	-296	0.43	2.16	1.00	-304	0.44	2.12	1.00	-304	0.41	1.96	1.00
168	-144	0.07	0.20	0.09	-158	0.07	0.50	0.23	-205	0.08	1.02	0.52
253	-97	0.07	0.41	0.19	-109	0.07	0.46	0.22	-147	0.08	0.71	0.36
306	-78	0.07	0.53	0.24	-87	0.07	0.54	0.26	-116	0.08	0.81	0.41
358	-36	0.07	0.15	0.07	-44	0.07	0.12	0.06	-70	0.08	0.23	0.12
413	-18	0.07	0.25	0.12	-23	0.07	0.23	0.11	-44	0.07	0.40	0.20
479	21	0.07	0.19	0.09	18	0.07	0.16	0.08	0	0.07	0.31	0.16
564	62	0.07	0.27	0.12	65	0.07	0.17	0.08	54	0.07	0.24	0.12
799	203	0.07	-1.00	-0.46	212	0.07	-1.19	-0.56	208	0.07	-1.18	-0.60
Panel C: Lone parents with a youngest child 4–11 years of age[c]												
0	-295	0.29	1.67	1.00	-301	0.29	1.67	1.00	-302	0.28	1.58	1.00
185	-140	0.09	0.89	0.53	-156	0.09	0.95	0.57	-203	0.09	1.06	0.67
274	-87	0.09	0.81	0.48	-99	0.09	0.82	0.49	-137	0.09	0.87	0.55
325	-63	0.09	0.82	0.49	-74	0.09	0.83	0.50	-105	0.09	0.88	0.56
378	-41	0.09	0.81	0.48	-49	0.09	0.81	0.48	-73	0.09	0.85	0.54
440	-9	0.09	0.77	0.46	-13	0.09	0.77	0.46	-33	0.09	0.81	0.51
507	28	0.09	0.75	0.45	26	0.09	0.75	0.45	10	0.09	0.79	0.50
618	98	0.09	0.67	0.40	101	0.09	0.64	0.38	89	0.09	0.68	0.43
874	245	0.09	0.29	0.17	253	0.09	0.23	0.14	250	0.09	0.22	0.14
Panel D: Lone parents with a youngest child 12–17 years of age[d]												
0	-289	0.18	2.69	1.00	-295	0.18	2.63	1.00	-295	0.17	2.47	1.00
181	-122	0.10	0.94	0.35	-139	0.10	1.03	0.39	-190	0.10	1.30	0.53
300	-27	0.10	0.58	0.21	-41	0.10	0.63	0.24	-80	0.11	0.61	0.25
367	-13	0.10	0.67	0.25	-23	0.10	0.69	0.26	-50	0.11	0.77	0.31
430	12	0.10	0.67	0.25	5	0.10	0.68	0.26	-16	0.10	0.74	0.30
498	46	0.10	0.63	0.23	42	0.10	0.64	0.24	25	0.10	0.68	0.28
580	87	0.10	0.61	0.23	89	0.10	0.59	0.22	73	0.10	0.63	0.26
702	150	0.10	0.58	0.22	160	0.10	0.51	0.19	143	0.10	0.58	0.24
1055	330	0.10	0.35	0.13	342	0.10	0.31	0.12	338	0.10	0.30	0.12

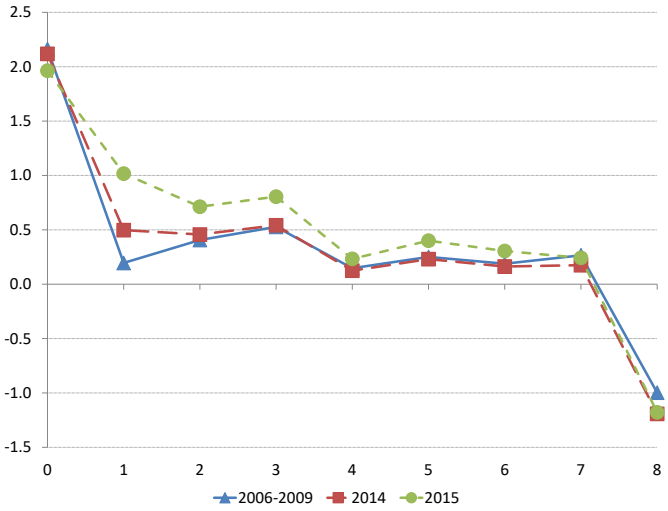
Notes: Table I.2 gives the additional numerical inputs and outcomes for Figure I.1 for the years 2014 and 2015.
[a]41,339 observations, [b]4,171 observations, [c]14,792 observations, [d]22,376 observations.

Figure I.1: Social welfare weights over time with nine choice options

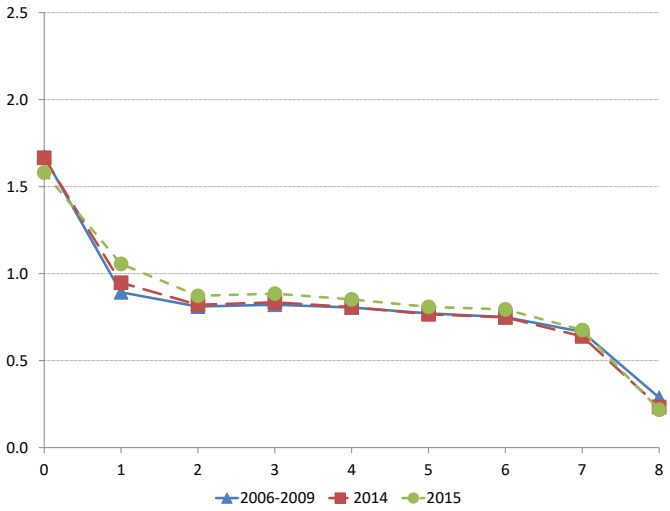
(a) Lone parents young. child 0–17



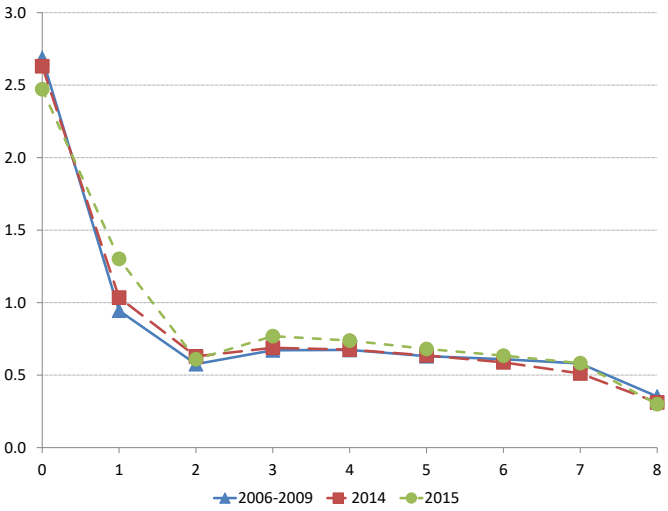
(b) Lone parents youngest child 0–3



(c) Lone parents youngest child 4–11



(d) Lone parents youngest child 12–17



Notes: Figure I.1 shows the resulting social welfare weights using equations (7)-(9) and the numerical inputs (net incomes/consumption, net taxes and extensive and intensive elasticities per gross income level) from Table I.1 (for 2006–2009) and Table I.2 (for 2014 and 2015). We show the results for the whole group of lone parents with a youngest child 0–17 years of age, and for subgroups by age of the youngest child (0–3, 4–11 and 12–17). We calculate the social welfare weights at discrete levels of gross income (points 0 to 8). Point 0 is the social welfare weight on non-working lone parents, and points 1 to 8 are the social welfare weights of working lone parents, ordered by their gross income level and grouped into five groups of equal size in the baseline (2006-2009). For the group of lone parents with a youngest child 0–3 years of age we still find the anomaly that the social welfare weights are not monotonically declining in income, but this anomaly largely disappears for the whole group of lone parents (with a child 0–17 years of age). Furthermore, we now find that the social welfare weights turn negative at the top for lone parents with a youngest child 0–3 years of age, due to the higher elasticity in this setup. We should interpret these results carefully however, as we slice up the data in smaller groups, which makes the elasticities harder to estimate.

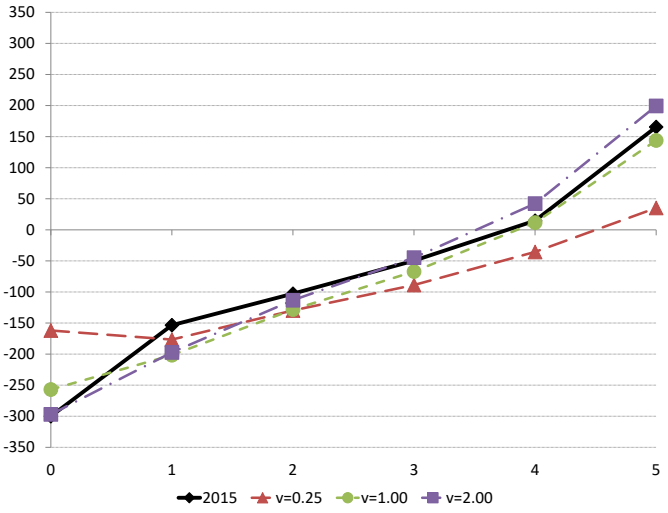
Table I.3: Optimal income support with nine choice options

Gross earnings per week	2015 Net tax per week	Share	Social welfare weights	v=0.25 Net tax per week	Share	Social welfare weights	v=1.00 Net tax per week	Share	Social welfare weights	v=2.00 Net tax per week	Share	Social welfare weights
Panel A: Lone parents with a youngest child 0–17 years of age[a]												
0	-300	0.24	1.77	-165	0.16	1.27	-262	0.21	1.57	-299	0.24	1.78
181	-196	0.10	1.07	-196	0.10	1.03	-213	0.10	1.05	-208	0.10	1.05
283	-113	0.10	0.86	-142	0.10	1.00	-142	0.10	0.97	-130	0.10	0.93
345	-75	0.10	0.82	-114	0.10	0.98	-103	0.10	0.92	-86	0.10	0.86
405	-43	0.10	0.81	-82	0.10	0.97	-61	0.10	0.89	-42	0.10	0.80
468	-1	0.09	0.77	-47	0.10	0.95	-16	0.10	0.85	7	0.09	0.75
546	48	0.09	0.72	-10	0.11	0.94	35	0.10	0.81	63	0.09	0.68
661	117	0.09	0.68	33	0.11	0.91	102	0.10	0.74	137	0.09	0.58
973	302	0.09	0.31	107	0.12	0.84	239	0.10	0.56	299	0.09	0.35
Panel B: Lone parents with a youngest child 0–3 years of age[b]												
0	-304	0.41	1.96	-176	0.13	1.29	-257	0.24	1.67	-291	0.31	1.82
168	-205	0.08	1.02	-227	0.08	1.06	-237	0.08	1.06	-220	0.08	1.03
253	-147	0.08	0.71	-201	0.09	1.02	-196	0.09	0.95	-171	0.08	0.86
306	-116	0.08	0.81	-184	0.10	1.00	-171	0.09	0.90	-144	0.08	0.76
358	-70	0.08	0.23	-163	0.10	0.99	-141	0.09	0.86	-111	0.08	0.70
413	-44	0.07	0.40	-145	0.11	0.97	-116	0.09	0.81	-83	0.08	0.63
479	0	0.07	0.31	-124	0.11	0.95	-83	0.09	0.76	-46	0.08	0.56
564	54	0.07	0.24	-106	0.11	0.92	-51	0.09	0.70	-8	0.08	0.47
799	208	0.07	-1.18	-91	0.18	0.86	-20	0.14	0.52	27	0.12	0.26
Panel C: Lone parents with a youngest child 4–11 years of age[c]												
0	-302	0.28	1.58	-198	0.21	1.20	-279	0.26	1.45	-309	0.29	1.62
185	-203	0.09	1.06	-194	0.09	1.02	-207	0.09	1.03	-202	0.09	1.04
274	-137	0.09	0.87	-155	0.09	0.99	-151	0.09	0.95	-138	0.09	0.91
325	-105	0.09	0.88	-130	0.10	0.98	-116	0.09	0.92	-100	0.09	0.86
378	-73	0.09	0.85	-103	0.10	0.96	-80	0.09	0.88	-61	0.09	0.80
440	-33	0.09	0.81	-73	0.10	0.95	-39	0.09	0.85	-16	0.09	0.75
507	10	0.09	0.79	-44	0.10	0.93	3	0.09	0.80	30	0.09	0.68
618	89	0.09	0.68	-7	0.10	0.90	64	0.09	0.73	100	0.09	0.58
874	250	0.09	0.22	43	0.11	0.84	164	0.10	0.57	221	0.09	0.36
Panel D: Lone parents with a youngest child 12–17 years of age[d]												
0	-295	0.17	2.47	-49	0.03	1.78	-205	0.10	2.15	-270	0.15	2.36
181	-190	0.10	1.30	-211	0.10	1.06	-227	0.10	1.08	-216	0.10	1.09
300	-80	0.11	0.61	-135	0.11	1.03	-139	0.11	1.01	-122	0.11	0.97
367	-50	0.11	0.77	-101	0.12	1.01	-98	0.12	0.95	-78	0.11	0.87
430	-16	0.10	0.74	-62	0.12	1.00	-54	0.11	0.91	-32	0.11	0.81
498	25	0.10	0.68	-20	0.12	0.98	-5	0.11	0.88	19	0.11	0.75
580	73	0.10	0.63	24	0.13	0.97	50	0.11	0.83	77	0.11	0.68
702	143	0.10	0.58	76	0.13	0.94	123	0.11	0.76	157	0.10	0.58
1055	338	0.10	0.30	169	0.13	0.86	287	0.11	0.57	346	0.10	0.34

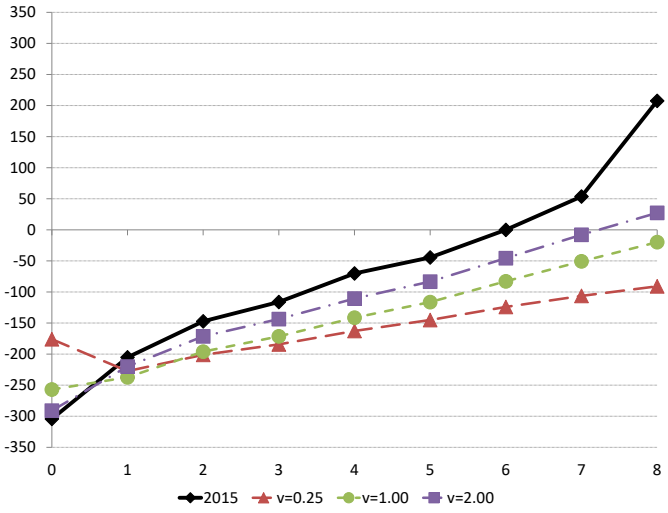
Notes: Table I.3 gives the numerical inputs and outcomes for Figure I.2. Relative social welfare weights can be obtained by dividing the social welfare weight of the specific choice by the social welfare weight of non-working lone parents.
[a]41,339 observations, [b]4,171 observations, [c]14,792 observations,

Figure I.2: Optimal tax profiles with nine choice options

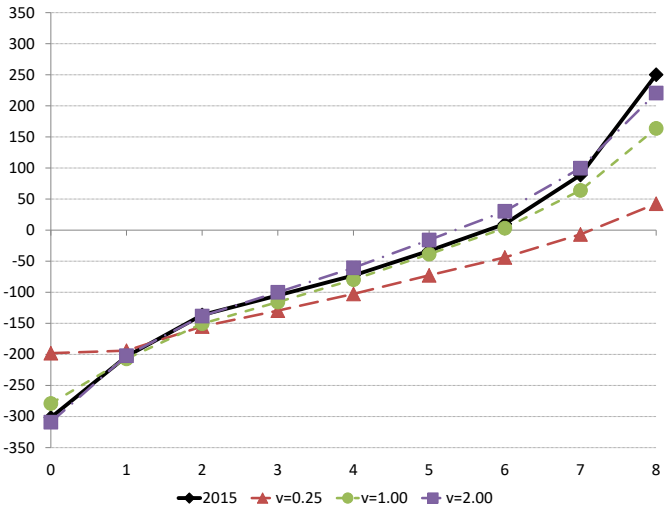
(a) Lone parents youngest child 0–17



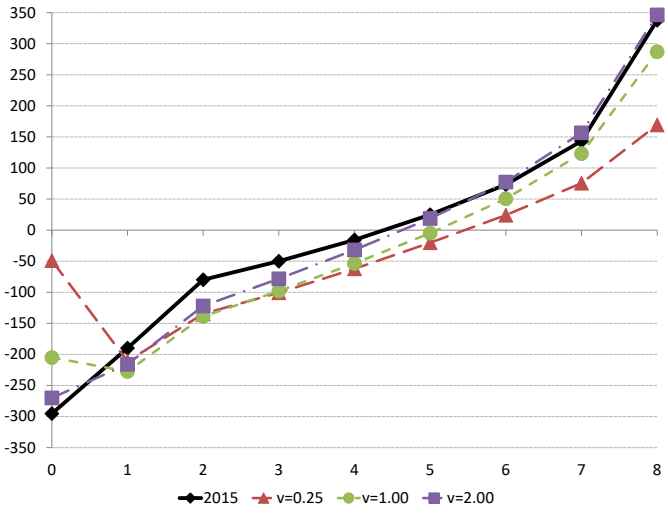
(b) Lone parents youngest child 0–3



(c) Lone parents youngest child 4–11



(d) Lone parents youngest child 12–17



Notes: Figure I.2 shows for each gross income level of lone parents the net tax (benefits minus taxes) level in 2015 and the optimal net tax level using equations (2)-(3), the numerical inputs (group shares, gross incomes, the extensive and intensive elasticities and net taxes in the year 2015 per gross income level) from Table I.3 and the social welfare weights given by the following function of net income c_i in option i: $g_i = 1/p * 1/(c_i^v)$ (where p is a scaling variable that we use to normalize the weighted sum of social welfare weights to 1 for different levels of v, and the higher is v, the higher is the aversion to inequality). We show the results for the whole group of lone parents with a youngest child 0–17 years of age, and for subgroups by age of the youngest child (0–3, 4–11 and 12–17). We calculate the net tax level in 2015 and the optimal tax level at discrete levels of gross income (points 0 to 8). Point 0 are net taxes for non-working lone parents, and points 1 to 8 are net taxes for working lone parents, ordered by their gross income level and grouped into five groups of equal size in the baseline. Similar to the baseline, we still find that for a large range of preferences for redistribution, 'working poor' lone parents should pay lower net taxes, as in the baseline with 6 discrete gross income options. However, we now also find that optimal net taxes at the top for lone parents with a youngest child 0–3 years of age should be much lower, due to the higher elasticity in this setup. We should interpret these results carefully however, as we slice up the data in smaller groups, which makes the elasticities harder to estimate.