How to Reduce Poverty among Lone Mothers? Empirical Evidence from a Model of Work and Welfare Participation Decisions

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1 Introduction

Lone mothers are overrepresented among poor people in many European countries, with worrying consequences for themselves and their children. Also in Norway, which is known as a country of economic and welfare success, lone mothers are at least three times more likely to be poor than married mothers with children in the same age-range. In 1998, a reform of lone parental benefits was undertaken. The main changes involved one of the more generous benefits, the so-called transitional benefit. The maximum amount of the benefit was increased, working and educational requirements were introduced, and new time limits were imposed.

The aim of this paper is to compare the effect of the reform estimated using a quasi-experimental evaluation design (Mogstad and Pronzato, 2008) with that estimated with a static structural model of earnings and welfare participation decisions.

Using the reform as an instrument, in a quasi-experimental setting, we can understand whether lone mothers' behaviour is influenced by public policies, without strong assumptions and referring only intuitively to the economic theory. However, we cannot distinguish the effects of the different parts of the reform, cannot understand the mechanisms, and cannot predict what

kind of policy would have made lone mothers better off. Thinking more generally, researchers can not always wait for "good" reforms to answer questions which are important from a policy point of view. And even if reforms are implemented, there are still things we would need to know in order to make our findings useful for policy makers.

This seems to be an area of research investigated only by a few papers, but necessary to give credibility to both the approaches, and to reconcile them. This is the appeal to young economists made by Keane (2006), during his keynote lecture at the Duke Conference on Structural Models in Labor, Aging and Health (2005), titled "Structural versus Atheoretic Approaches to Econometrics". He underlines the necessity of considering descriptive statistics, reduced and structural forms as well as experimental methods as complementary approaches to the study of the effects of policy changes. He encourages researchers to perform validation exercises to test the extent to which structural models give "reasonable" predictions of the reality. Reasonable may be still judged in a subjective way, but via multiple validation exercises consensus may be reached. Examples are offered by Todd and Wolpin (2006), Keane and Wolpin (2007), Brewer et al. (2006) and Blundell (2006). Todd and Wolpin (2006) use data from a randomized social experiment in Mexico to study and validate a dynamic behavioural model of parental decisions about fertility and child schooling. The PROGRESA is a randomized social experiment implemented by the Mexican government, in which around 500 rural villages were randomly assigned to participate or not in the program which provided payments to parents who regularly send their children to school. They estimate the behavioural model without using observations from the treated villages and predict the potential fertility and child schooling of families in untreated villages. The impact of the program predicted by the behavioural model tracks the experimental results. Keane and Wolpin (2007) adopt another approach to validate a behavioural

model. They construct and estimate a dynamic structural model of female behaviour, in which work, welfare participation, marriage and fertility decisions are jointly considered. In order to validate the model, they use a "holdout sample", a sample which differs from the sample used in the estimation and whose policy regime is well outside the support of the data. They use data from some US states to estimate the model, and from others to predict and validate the model. Brewer, Duncan, Shephard and Suarez (2006) estimate a static structural model of labour supply and programme participation using data from before and after the introduction of the Working Families' Tax Credit in the UK. They simulate the effect of the reform, taking into account all related changes in benefits and taxes, and compare the results with the ones obtained from other ex-ante (Blundell et al., 2000a, 2000b) and ex-post evaluations (Blundell et al., 2005; Francesconi and Van der Klaauw, 2004; Leigh, 2005; Gregg and Harkness, 2003). Blundell (2006) focuses on the effects of the Earned Income Tax Credit policies on lone mothers' working decisions, by validating a structural model of labour supply with a difference-in-difference evaluation strategy, and then finds the optimal policy, defined by a certain social welfare function.

Using a similar approach in a comparable policy context as in Blundell (2006), in this paper, I compare the effect of the 1998 Norwegian welfare reform on lone mothers' earnings estimated using a quasi-experimental evaluation design (Mogstad and Pronzato, 2008) and a static structural model of earnings and welfare participation decisions, using the same data and the same outcome variable for the two analyses. The behavioural parameters are then used to find the optimal policy, defined as the policy which provides the lowest level of poverty.

The model, together with the econometric specification, is explained in Section 2. The data and the procedure to derive the budget sets are presented in Section 3. After estimating the structural

parameters (Section 4), the reform is simulated, and the predictions compared with the ones obtained with the quasi-experimental method (Section 5). Despite the model making strong assumptions, the results predicted are comparable with the quasi-experimental ones. In Section 6, the structural parameters are used to find the policy parameters which minimize poverty among lone mothers. Robustness checks (Section 7) and conclusions (Section 8) follow.

2 A Model of Earnings and Welfare Participation Decisions [1]

The Norwegian register data, I use for the estimation of the model, provide accurate information on incomes and demographic characteristics but not credible information on hours of work. The model outlined below takes this feature into account: lone mothers choose how much to earn (and not how much to work) and time of work is allowed to be measured with an error.

A lone mother, labelled *n*, is assumed to maximize a utility function

$$U_n\ (x,t,w) \tag{1}$$

over income *x*, time of work *t* and welfare participation *w*, under the budget constraint

$$x_n\ = T(l_n, t_n, y_n) \tag{2}$$

[1] This paragraph follows Train's book on Discrete Choice Methods and Simulations, chapter 2 (2003). Other papers used as references to write the model are Mc Fadden (1974), Moffitt (1983), MaCurdy et al. (1990), Ilmakunnas and Pudney (1990), Van Soest (1995), Hoynes (1996), Aaberge et al. (1999), and Creedy and Kalb (2005), Creedy et al. (2006).

where

- x_n is the net household income,
- l_n is the gross monthly labour income of the lone mother,
- t_n is the number of equivalent full time months of work in one calendar year,
- y_n is exogenous household gross income,
- *T(.)* is the tax-benefit function which transforms gross income to net income.

The lone mother faces a set of *J* discrete alternatives, defined by the combination of earnings and welfare participation decisions. The lone mother would obtain a certain level of utility for each alternative *j*, which belongs to *J*. She knows how much utility she would get from each alternative *j* and chooses the alternative which provides the largest one. We cannot observe her utility, but can decompose it into two parts: the deterministic part and the stochastic part

$$U_{nj} = V_{nj} + \varepsilon_{nj} \qquad \forall j \in J \tag{3},$$

where V_{nj} captures the portion of utility which derives from observable characteristics, while ε_{nj} the portion from unobservable ones. The observed part of the utility V_{nj}, so-called representative utility, may be seen as a function which relates the observable characteristics to the lone mothers' utility

$$V_{nj} = V(z_{nj}, s_n) \qquad \forall j \in J \tag{4},$$

where z_{nj} are some attributes of the alternatives as faced by the lone mother, and s_n some socio-demographic attributes of the lone mother. I specify the observed part of utility to be linear in parameters with a constant

$$V_{nj} = z'_{nj}\,\beta + k_j \qquad \forall j \in J \tag{5}$$

where z_{nj} is a vector of variables that relate to alternative j as faced by the lone mother n, β are the coefficients of these variables, and k_j is a constant that is specific to alternative j. The constant k_j captures the average effect on utility of all factors not included in the model. The vector z_{nj} includes the net income available to the lone mother at alternative j and its square, the time of work implied by alternative j and its square, a welfare participation indicator, and their interactions. The socio-demographic variables s_n cannot enter the model directly, since they do not vary across alternatives. They are interacted with net income, time of work and the welfare indicator to allow utility from income and disutility from time of work and welfare participation to be different for women with different levels of education, age, nationality, numbers and ages of children:

$$\begin{aligned} V_{nj} = {} & \beta_1 x_{nj} + \beta_2 x_{nj}{}^2 + \beta_3 t_{nj} + \beta_4 t_{nj}^2 + \beta_5 w_{nj} + \beta_6 x_{nj} t_{nj} + \beta_7 t_{nj} w_{nj} + \beta_8 x_{nj} w_{nj} + \\ & + k_j + (x_{nj} s_n)'\delta + (t_{nj} s_n)'\gamma + (w_{nj} s_n)'\lambda \qquad \forall j \in J \end{aligned} \tag{6}$$

where x_{nj} is her net household income, t_{nj} her time of work, w_{nj} her welfare participation indicator in each alternative *j*, and s_n are her demographic characteristics.

Time of work t_n is not observed in the register data. I derive the expected time of work $\bar{t}_n$, expressed in equivalent full time months of work in a year, as the ratio between each woman's annual earnings in the register data ($l_n t_n$) and the predicted monthly earnings from survey data ($\overline{l_n}$) in a full time job of a woman with same human capital characteristics:

$$\bar{t}_n = \frac{l_n t_n}{\overline{l_n}} \tag{7}.$$

The relationship between true time of work t_n and expected time of work $\bar{t}_n$ is given by

$$t_n = \frac{\bar{l}_n}{l_n}\overline{t_n} = \alpha \bar{t}_n \tag{8},$$

where α is negatively correlated with the unobservable characteristics which make a woman earn more. If a woman earns more than what, on average, a woman with the same observable characteristics does, it means that she needs to work less time than what I predict as expected time of work. α connects true and expected time of work and is assumed to be normally distributed. Therefore (6) becomes

$$V_{nj} = \beta_1 x_{nj} + \beta_2 x_{nj}^{\ 2} + \widetilde{\beta}_3 \bar{t}_{nj} + \widetilde{\beta}_4 \bar{t}_{nj}^{2} + \beta_5 w_{nj} + \widetilde{\beta}_6 x_{nj} \bar{t}_{nj} + \widetilde{\beta}_7 \bar{t}_{nj} w_{nj} + \beta_8 x_{nj} w_{nj} + \\ + k_j + (x_{nj} s_n)'\delta + (\bar{t}_{nj} s_n)'\widetilde{\gamma} + (w_{nj} s_n)'\lambda \qquad \forall j \in J \tag{9}$$

where, for example,

$$\widetilde{\beta}_6 = \beta_6 \alpha \tag{10}.$$

The model I estimate allows disutility from time $\widetilde{\beta}_3$ to be different for women with different unobservable characteristics:

$$V_{nj} = \beta_1 x_{nj} + \beta_2 x_{nj}^{\ 2} + (\beta_3 \nu)\bar{t}_{nj} + \widetilde{\beta}_4 \bar{t}_{nj}^{2} + \beta_5 w_{nj} + \widetilde{\beta}_6 x_{nj} \bar{t}_{nj} + \widetilde{\beta}_7 \bar{t}_{nj} w_{nj} + \beta_8 x_{nj} w_{nj} + \\ + k_j + (x_{nj} s_n)'\delta + (\bar{t}_{nj} s_n)'\widetilde{\gamma} + (w_{nj} s_n)'\lambda \qquad \forall j \in J \tag{11}.$$

Some points need clarification. First, the method of measuring expected time of work, by comparing observed earnings and predicted earnings, holds if the wage rate is constant over time of work. Second, ν coincides with α only if there is no difference in tastes due to unobservables among women. However, I do not need to identify α because the main aim is to take into account that time of work is measured with an error. Third, $\widetilde{\beta}_4, \widetilde{\beta}_6, \widetilde{\beta}_7, \widetilde{\gamma}$ should be also allowed to vary among women but, in practice, the model does not converge when allowing unobservable heterogeneity in many parameters. Fourth, the estimated coefficients $\widetilde{\gamma}$ related to the interactions between time of work and variables also used in the earnings equation (age and

level of education) capture different disutility from time of work but can also capture misspecification of the earnings equation, so that their interpretation is not possible.

The probability that a lone mother chooses the alternative *i*, which belongs to *J*, is

$$\begin{aligned} P_{ni} &= P(U_{ni} > U_{nj}) \qquad \forall j \neq i \\ &= P(V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj}) \qquad \forall j \neq i \\ &= P(\varepsilon_{nj} - \varepsilon_{ni} < V_{ni} - V_{nj}) \qquad \forall j \neq i \end{aligned} \tag{12}.$$

The stochastic component ε_{nj} is assumed iid extreme value for all *j*. The probability that the lone mother *n* chooses *i* is then given by

$$P_{ni} = \frac{e^{\beta' z_{ni}}}{\sum_j e^{\beta' z_{nj}}} \tag{13},$$

which is the expression of the conditional logit regression.

3 The Data

The empirical analysis is based on a sample from register household panel data set which covers the entire resident population of Norway in the period 1993-2001. The sample is made of women who were lone mothers before the time of the reform of the transitional benefit in 1998, which

represents the sample one would use in a typical ex-ante evaluation. It is a sub-sample of what I used in Mogstad and Pronzato (2008). Beyond the selection criteria as defined in Mogstad and Pronzato (2008), women with missing information for any variable used through the whole paper are also dropped.

Lone mothers face at most 8 alternative choices, given by the joint decision of how much to earn (4 alternatives) and whether or not participating in the welfare (2 alternatives).

As explained in Section 2, expected time of work is obtained comparing annual earnings observed in the register data with potential monthly full time earnings from survey data. Potential earnings are obtained by using a Heckman regression and selecting women aged 18-55 from the Norwegian part of EU-SILC (2004). The dependent variable is hourly gross labour income. In the outcome equation I include two dummy variables for education (secondary and tertiary education), a variable for potential working experience (age - years of schooling - 7), its square, and a part time dummy.[2] In the selection equation, I also consider the presence of dependent children, other household income, whether being in a couple, and living in a city. Results are reported in Table 1. In order to make survey earnings comparable to annual earnings in the register data, predicted hourly earnings are multiplied by typical hours of work in a full time job (mode: 38) and number of weeks in a month, and adjusted in order to take into account nominal and real growth. [3]

The 4 earnings alternatives are defined in the following way:

[2] I include a part time dummy to test whether the wage rate can be considered constant over time of work. Part time wage rate is not significantly different from full time wage rate, as shown in Table 1.

[3] Prices are deflated to €-1998. Real growth is taken into account looking at the variation, year by year, of the basic amount (*grunnbeløp*), which is the official reference amount used for the up-rating of benefits and pensions.

- First earning alternative ("no work"): ratio between annual observed earnings and expected monthly earnings in a full time job smaller than 3;
- Second earning alternative ("short part time"): ratio between observed annual earnings and expected monthly earnings in a full time job larger or equal to 3 and smaller than 6;
- Third earning alternative ("part time"): ratio between observed annual earnings and expected monthly earnings in a full time job larger or equal to 6 and smaller than 9;
- Fourth earning alternative ("full time"): ratio between observed annual earnings and expected monthly earnings in a full time job larger or equal to 9.

In the observed choice, the three objects of the utility function are defined as follows: the observed welfare participation decision, the net income which derives from observed earnings through the tax-benefit function (2) and the expected number of months of work, obtained dividing the observed annual earning by potential monthly earnings in a full time job. For the other 7 alternatives I construct counterfactuals.

Suppose her observed earnings are €17,500 and she participates in the welfare. Given her human capital characteristics, she is supposed to earn €2,500 per month in a full time job. I classify her as working "part time" (17,500 / 2,500 = 7 equivalent full time months). I construct three other earning alternatives: "no work", working "short part time", working "full time" (see Table 2, first five columns). The number of months in each (untaken) earning alternative is drawn from the distribution of months from people choosing that alternative. Predicted earnings are then

calculated. In the example, Table 2, the drawn numbers of months are 0, 4 and 12, and earnings are, respectively, €0, €10,000, and €30,000.

For each earning alternative, she can decide whether to participate in the welfare. The transitional benefit is calculated as follows. The maximum annual amount of the benefit is around €8,000 per year. From this maximum amount, 40% of earnings exceeding €2,500 are subtracted. In Table 2, 6th column, we can see the corresponding amounts. For this woman, the 7th alternative is dropped, since the related full time earnings are too large to be still eligible for the benefit.

I then simulate the childcare benefit, another benefit which depends on labour supply, given as a reimbursement for extra-costs for childcare, occurred when the mother works. All other benefits are included in the model as exogenous, since they do not depend on her earnings. Finally, I simulate taxes, and I obtain the total net income she can have in different earnings/welfare alternatives (8th column, Table 2). Poverty is defined by a dichotomous variable taking the value of 1 if the lone mother's household has annual equivalent disposable income below 60 percent of the median annual equivalent disposable income in the overall population, and 0 otherwise. The 9th column (Table 2) indicates in which alternatives the household is considered poor: in the example, the household would be poor if the mother decided not to work, or worked short part time and did not take-up the benefit. The variable, in the 10th column (Table 2), indicates the decision observed.

4 Model Estimates

I estimate the effects of income, time of work, welfare participation and their interactions with other socio-demographic variables, on the probability of choosing one of the alternatives, using a mixed logit specification with the coefficient of time of work treated as random coefficient, assumed to be normally distributed, as outlined in Section 2. Results are reported in Table 3.

To check that the utility function respects the concavity and monotonicity properties, I check the derivates with respect to the utility arguments. The first derivative with respect to income is positive for the whole sample; the first derivative with respect to time of work is negative for 97% of the sample. Second derivatives are in the expected direction, as shown in Table 3.

The standard deviation of the random coefficient is significantly different from zero, revealing an important role of unobserved heterogeneity and/or measurement error.

The interaction between income and time of work is positive but not significantly different from zero. The interaction between welfare participation and income is positive and significant as well as the interaction between welfare and time of work. Women who work more may suffer less from welfare stigma because they feel they do not completely depend on welfare; or they may be more informed because they are more likely to talk with other people at the place of work. Since a large part of lone mothers' income is from other benefits, the positive interaction between income and welfare could reveal that the cost of participating is lower for women who also participate in other welfare programs.

Results concerning number and age of children are in the expected direction: on the one hand, having more and younger children increases the cost of working; on the other hand, it increases utility from income.

Immigrant women have more disutility from time of work. This finding could also signal that they are in jobs poorly paid, given their level of education.

Younger women have less disutility from participating in the welfare while the cost of the welfare is not linear by years of education. Compared with high educated women, women with secondary schooling have less disutility from participating in the welfare while lower educated women have more disutility. This may capture different aspects of welfare participation. If information is needed then better educated women may be more prompt to apply for the benefit. On the other hand, better educated women can suffer more to be dependent from welfare.

5 Comparing the Estimated Effects of the Reform

In this section, I compare the estimated effects of the reform on lone mothers' earnings, when using the quasi-experimental evaluation design (Mogstad and Pronzato, 2008) and the structural model. The effect of the reform, estimated by the quasi-experimental approach, is shown in the top part of Table 4 for all women, and by level of education, together with the 95% confidence intervals.[4]

In order to simulate the reform with the structural model, I need to parameterize the transitional benefit according to the new rules. As explained above, the reform increases the maximum amount of the benefit, imposes new age limits, and introduces new working requirements.

[4] The model is estimated applying probability weights to control for different observable characteristics of women before and after the reform (Section 3.5.1).

The increase of the maximum amount not only makes the transitional benefit more generous but also makes women more likely to be eligible: before the reform, only women earning less than €1,900 per month can receive the benefit while, after the reform, women earning until €2,200 per month are also eligible. This results in a larger number of alternatives in the choice set for those women now eligible to receive the benefit.

According to the change of the age limit, women with the youngest child aged 9 years old are not allowed to receive the transitional benefit anymore.

The reform requires lone mothers to be in training, to work at least part time, or to seek work. In the model I do not include in the choice set the alternatives related to "training" or "seeking work" because I do not have information about these two activities in the available register data. Therefore, I construct an interval of what may have happened:

$$Interval0 = (lower0, upper0)$$

where

$$lower0 = \frac{\sum_{j=1}^{8}(l_j t_j)p_j}{N} \quad when \quad P(E \mid t < 6) = 1$$

and

$$upper0 = \frac{\sum_{j=1}^{8}(l_j t_j)p_j}{N} \quad when \quad P(E \mid t < 6) = 0 \qquad (14).$$

$\frac{\sum_{j=1}^{8}(l_j t_j)p_j}{N}$ are average earnings per woman, given by earnings in each alternative multiplied by the probability of choosing that alternative, divided by the number of lone mothers in the sample. $P(E)$ is the probability of being eligible for the benefit. In *lower0* the probability of being eligible when working less than part is equal to 1 and it represents the extreme case where all women can choose to seek work or attend training. In *upper0* the probability of being eligible when working less than part is equal to 0 and it represents the extreme case where all women have to work to be eligible for the benefit.

Results are reported in the bottom panel of Table The estimated "experimental" effect and the 95% confidence interval are included in the *interval0* of the "structural" effects. It is the most I can do without any further assumption, but it does not seem to be enough to validate the structural model. Therefore, I try to tighten the interval of the "structural" effects, by using information available on lone mothers receiving the benefit after the reform (which are the treatment group in the quasi-experimental design, Mogstad and Pronzato, 2008). The new interval is defined as follows

Interval1 = (lower1, upper1)

where

$$lower1 = \frac{\sum_{j=1}^{8}(l_j t_j)p_j}{N} \quad when \quad P(E \mid t < 6) = 1 - [P(R \mid s,t,before) - P(R \mid s,t,after)] =$$

$$= 1 - \left(\left(\frac{e^{z_1}}{1+e^{z_1}} \right) - \left(\frac{e^{z_2}}{1+e^{z_2}} \right) \right)$$

and

$$upper1 = \frac{\sum_{j=1}^{8}(l_j t_j)p_j}{N}$$

$$when \quad P(E \mid t < 6) = 1 - [P(R \mid s,t,before) - P(R \mid s,t,after) \frac{P(t = k \mid s,after)}{P(t = k \mid s,before)}] =$$

$$= 1 - \left(\left(\frac{e^{z_1}}{1+e^{z_1}} \right) - \left(\frac{e^{z_2}}{1+e^{z_2}} \right) \left(\frac{e^{z_{3k}}}{\sum_{k=1}^{4} e^{z_{3k}}} \right) \right)$$

where

$$z_1 = \left(s'_{BEF} \, \vartheta_{BEF} + t'_{BEF} \, \varsigma_{BEF} \right)$$

$$z_2 = \left(s'_{BEF} \, \vartheta_{AFT} + t'_{BEF} \, \varsigma_{AFT} \right)$$

$$z_{3k} = \left(s'_{BEF} \, \tau_{AFT,k} \right) \qquad (15).$$

In this interval the probability of being eligible is given by the difference of the probability of receiving the benefit before and after the reform ($P(R)$). The probability of receiving the benefit before the reform coincides with the probability of participating in the welfare since all women are eligible. After the reform, the probability of receiving the benefit is given by the joint probability of being eligible (which depends on time of work *t*) and participating. Controlling for the determinants of the welfare participation behaviour *(s)*, the difference $P(R \mid s,t,before) - P(R \mid s,t,after)$ should be suggestive of the reduced eligibility.

In Table 5, 1st column, I show the probability of receiving the benefit before the reform, by time of work, which may be expressed by $\left(\frac{e^{z_1}}{1+e^{z_1}} \right)$. In Table 6, I show the estimates of the probability of receiving the benefit after the reform as function of welfare participation determinants (demographic characteristics and expected amount of the benefit) and eligibility factors (time of work). We observe a strong negative effect of working less than part time on the probability of receiving the benefit after the reform. I use the estimates from Table 6 to predict the probability of receiving the benefit for lone mothers before the reform $\left(\frac{e^{z_2}}{1+e^{z_2}} \right)$, which is shown in the 2nd column of Table 5. We observe, for example, that the probability of receiving the benefit has decreased from 81.7% to 54.6% for non-working women.

In the *lower1* I am assuming that the reform itself has no effect on labour supply. But we can think, as opposite extreme case, that all inactive women started working because they would have been non-eligible otherwise (*upper1*). In Table 7 I show the distribution of women across the *K* time of work, before the reform, after the reform, and the predicted distribution of women before

the reform if they lived in the time after the reform which may be expressed by $\left(\frac{e^{z_{3k}}}{\sum_{k=1}^{4} e^{z_{3k}}} \right)$ (as predict by the model whose estimates are shown in Table 8). The percentage of non-working women goes from 27% to 20% (Table 7). If 7% start working in order to receive the benefit then $\left(\frac{e^{z_2}}{1+e^{z_2}} \right)\left(\frac{e^{z_{3j}}}{\sum_{j=1}^{4} e^{z_{3j}}} \right)$ gives the probability of receiving the benefit after the reform.

In order to reproduce what I observe in the data, I drop randomly the alternatives of non-working and participating in the welfare for non-eligible women, where eligibility is defines as

- In the *lower1* case: $P(E \mid t < 3) = 0.73$,
  $P(E \mid t \geq 3 \& t < 6) = 0.88$.
- In the *upper1* case: $P(E \mid t < 3) = 0.57$,
  $P(E \mid t \geq 3 \& t < 6) = 0.80$.

Table 9 shows that the interval defined by using information on recipients of the benefit after the reform give "structural" effects which are more comparable to the "experimental" ones: the reform has increased earnings of €311 (experimental) while the interval of the structural predictions give an interval between €119 and €458. The structural model predicts well also by level of education: the positive effect is positive for low-medium educated women, while marginally negative for high educated women.

I can now separate the effects of the introduction of the working requirements and new age limits from the effect of more generous benefits. Table 10 summarizes the results. The introduction of working requirements has increased labour supply, as expected. The effect is larger for low and medium educated women than for high educated women. Also the new age limit has a positive effect on work decisions. Even if it only affects a small subgroup of lone mothers, mothers of older children have less disutility from work than lone mothers of younger children (see estimates, Table 3), so that their probability of working increases. Making the benefit more generous has the expected negative effect on annual earnings. However, the effect is larger for highly educated women. In fact, for high educated women, the increase in the maximum amount has made them eligible in more work alternatives. For low- medium educated lone mothers the increase in the generosity has raised the net income in the 4 work alternatives of the same amount.

6 New Policy Scenarios

The robustness of the comparison between the results of the structural model and the quasi-experimental model makes me confident to use of the behavioural estimates to find what policy changes to the transitional benefit would minimize poverty among lone mothers. Before the reform, the percentage of poor lone others is 11.8, as shown in the 1st column of Table 11. At the bottom of the Table, the parameters of the reform are reported.

The aim is to find the policy parameters which minimize poverty in two situations:

- when the working requirements are those implemented at the time of the reform (*upper1*);
- when the working requirements are strictly introduced without the possibility of training or seeking work (*upper0*).

In the 2nd and 3rd columns of Table 11, I report the simulated effects of the actual reform parameters on poverty in the two policy scenarios. Poverty decreases to 8.6% (*upper1*) and to 9.4 (*upper0*) while the average cost per woman is, respectively, €3,163 and €1,908.

In order to find the optimal policies, under revenue neutrality, I vary the maximum amount of the benefit, the withdrawal rate, the disregarded amount, the age limit and, only for the *upper0* case, the working requirements.

In order to find the parameters of the reform, I proceed with a two-step maximization procedure. In the first step, I widen the interval around each parameter in turn to try all possible combinations of the parameters, until I cannot find any additional combination that gives lower level of poverty. When I arrive to this stage, the policy parameters' intervals are:

- Maximum amount: 6,672—13,344 (*upper1*); 3,336—10,008 (*upper0*).
- Withdrawal rate: 0—64 % (*upper1*); 16—48 % (*upper0*).
- Disregarded amount: 1,005—5,026 (*upper1*); 0—8,042 (*upper0*).
- Age limit: 7-10 (*upper1, upper0*).
- Working requirements: 0—8 equivalent full time months of work (*upper0*).

In the second step, within the above intervals for each parameter I try all the possible combinations considering small variation in the parameters each time, in order to find the "optimal" solutions which minimize poverty.

Both results suggest, as ways to reduce poverty, a reinforcement of the working requirements, trough a reduction of the withdrawal rate.

The above analysis shows interesting elements which need further development to be useful for policymakers. In fact, all the analyses are done using only "new" pre-married lone mothers and excluding lone mothers for longer time and lone mothers who did not go through a marriage/cohabitation: but all of them are potentially influenced by any change of the transitional benefit. Second, increasing labour market participation and reducing poverty as suggested by the "optimal policies" may lead some women to work instead of investing in training /seeking work, that may be good in the short run but not in the long (Vignoles et al, 2004).

7 Robustness Checks

In this section, I repeat the analyses, using alternative specifications of the econometric model and different ways of defining the choice set. I then compare the predictions of each model with the ones provided by the main specification outlined in Section 2 and 3.

Table 12 summarizes the results. Each panel reports the results of a different model: the predicted effects of the increase of the benefit, of the new age limit, of the working requirements (*upper1*) and of the whole effect of the reform (*upper1*).

The top panel reports results when using the main model (effect of time of work as random coefficient).

I first estimate the model without unobserved heterogeneity (2nd panel, Table 12). The effect of the reform would be larger, driven by a larger effect of the introduction of the working requirements on earnings.

I then estimate the model allowing unobserved heterogeneity in time of work, income and welfare participation (3rd panel, Table 12). The whole effect of the reform would be somehow smaller, due to a more negative effect on earnings of the increased generosity of the benefit.

In the 4th panel of Table 12 I estimate the model defining time of work for each earnings alternative as fixed rather then drawn from the empirical distribution.

As explained in Section 3, only the transitional benefit and the childcare benefit are simulated while other benefits, which in the available data are summed up, are considered as exogenous income. From Table 13 we observe that part of these benefits may be related to their working decisions and their earnings. Probably I capture programs like the social assistance, which does not depend on work decisions but is related to situations of poverty and exclusion. I use this regression to simulate this kind of welfare and estimate again the model with these new budget constraints. Results are shown in the 5th panel, Table 12.

On the whole, predicted effects from these alternative models are close to the ones provided by the main specification used in the paper.

8 Conclusions

In this paper, I compare the effect of the 1998 Norwegian welfare reform on lone mothers' earnings estimated using a quasi-experimental evaluation design (Mogstad and Pronzato, 2008) and a static structural model of earnings and welfare participation decisions. The reform increases the maximum amount of the transitional benefit, introduces new working requirements and changes time limits in order to be eligible for it. From both the evaluation methods, we observe a positive effect on lone mothers' earnings, driven by behavioural responses of lower and medium educated women. The two strategies help the understanding of the policy impact in a complementary way: while the focus of the quasi-experimental evaluation design is to measure what really happened, the challenge of the structural model is to predict what potentially can happen. Both aspects are important from a policy point of view. The fact that predictions provided by the structural model track the results of the quasi-experimental evaluation gives credibility to both the approaches. From the researcher's point of view, working with the two evaluations methods helps one not to forget part of the story: while the attention when working with the structural model is to understand the mechanisms and to carefully reproduce what opportunities individuals face, all economic predictions need to be compared with a measure of what happened. One aspect of the reform I would have forgotten, if only working with the quasi-experimental method, is the take-up decision: despite the generosity of the welfare, only 70% of the women take up the transitional benefit at the time of the reform. This may be important when judging the strength of the effects of the reform and when finding the optimal policy which minimizes poverty. On the other hand, if working only with the structural model, I would have not analyzed how new requirements have been implemented at the time of the reform.

There are number aspects that need further improvements I hope to be able to carry out in the future. From a substantive point of view, I would like to have more information on what opportunities women faced at the time of the reform. How easy/difficult it was for them to prove to be "seeking actively work" or to find any "training" to attend? For how these activities were compatible with being eligible? Another element not considered in this paper is the dynamic component: lone mothers, after the reform, can receive the benefit only for a period up to 3 years. From an empirical point of view, I hope to have access to better information on hours of work from Norwegian Register data, which should be available soon; or at least to a Norwegian survey dataset, with the same years of the register data I am using, to have more comparable earnings. Another improvement could derive from using a validated micro-simulation model of taxes and benefits for Norway.

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10 Tables

Table 1: Earnings Equation

	Beta	St err
Hourly wage		
Tertiary education	7.066***	0.908
Secondary education	2.605***	0.655
Lower education		
Work experience	0.431***	0.112
Work experience sq.	-0.007***	0.002
Part time job	-0.021	0.255
Constant	6.700***	2.164
Selection		
Tertiary education	1.163***	0.120
Secondary education	0.518***	0.108
Lower education		
Work experience	0.162***	0.011
Work experience sq.	-0.003***	0.000
Married/cohabitant	0.260***	0.084
Dependent children	-0.182***	0.070
Household income	-0.026***	0.006
Living in a city	0.000	0.058
Constant	-1.508***	0.146
Lambda	1.051	1.462
Rho	0.21	
Observations	2,667	

Notes: Heckman regression; *** significant at 1% level, ** significant at 5% level, *significant at 10% level. Hourly wage is expressed in € - 1998. Source: EU-SILC (2004).

Table 2: An Example of a Choice set

Work	Take up	Alternative	Time of work	Labour income	Transitional benefit	…	Total net income	Poor	Decision
No Work	Yes	1	0	0	8,000		17,000	1	0
No Work	No	2	0	0	0		9,000	1	0
Short Part	Yes	3	4	10,000	5,000		23,000	0	0
Short Part	No	4	4	10,000	0		18,000	1	0
Part Time	Yes	5	7	17,500	2,000		26,000	0	1
Part Time	No	6	7	17,500	0		24,000	0	0
Full Time	Yes	7	12	30,000	0		-	-	-
Full Time	No	8	12	30,000	0		33,000	0	0

Notes: Choice set of a woman who participates in the welfare, who's observed earnings are €17,500 and potential monthly earnings are €2,500.

Table 3: Model Estimates

	Beta	St err		Beta	St err	
Income	1.04***	0.07	Time	-0.80***	0.10	Welfare
			St dev (time)	0.24***	0.03	
Income sq.	-0.01***	0.00	Time sq.	0.00*	0.00	
Income*time	0.00	0.00	Time*welfare	0.18***	0.04	Income*welfare
Income interacted with			**Time interacted with**			**Welfare interacted wit**
Mother's age (< 32)	0.02	0.03	Mother's age (< 32)	-0.01	0.04	Mother's age (< 32)
Mother's age (32-36)	0.02	0.03	Mother's age (32-36)	0.02	0.03	Mother's age (32-36)
Mother's age (> 36)			Mother's age (> 36)			Mother's age (> 36)
Schooling (< 11)	0.06*	0.03	Schooling (< 11)	-0.19***	0.04	Schooling (< 11)
Schooling (11-12)	-0.04	0.03	Schooling (11-12)	-0.10**	0.04	Schooling (11-12)
Schooling (> 12)			Schooling (> 12)			Schooling (> 12)
One child	-0.13***	0.03	One child	0.34***	0.04	One child
Two children	-0.02	0.02	Two children	0.13***	0.03	Two children
More than two			More than two			More than two
Youngest child 4-5	0.06**	0.03	Youngest child 4-5	-0.11***	0.03	Youngest child 4-5
Youngest child 6-7	0.03	0.03	Youngest child 6-7	-0.06	0.03	Youngest child 6-7
Youngest child 8-9			Youngest child 8-9			Youngest child 8-9
Immigrant	0.00	0.07	Immigrant	-0.24**	0.10	Immigrant
No-work intercepts			**Short time intercepts**			**Part time intercepts**
Welfare	-1.13***	0.23	Welfare	-1.54***	0.15	Welfare
No welfare	0.68**	0.31	No welfare	-1.11***	0.20	No welfare
Observations				61,855		

Notes: mixed logit regression with time treated as random coefficient; *** significant at 1% level, ** significant at 5% level, *significant at 10% level. Income variables divided by 1,000. Time of work expressed in equivalent full time months.

Table 4: Comparison of the Effects of the Reform on Earnings, obtained with the Quasi-Experimental Method and the Structural Model of Earnings and Welfare Participation

	All women	Low educated	Medium educated	High educated
Quasi - experimental				
Estimated effect	311	517	378	-70
95% confidence interval	168–455	210–824	179–576	-348–207
Structural model				
Reform (lower0)	-444	-363	-412	-585
Reform (upper0)	2,426	3,202	2,753	1,024

Notes: "Reform (lower0)" is the predicted effect of the reform can choose to seek work or attend training; "Reform (upper0)" is the predicted effect of the reform when all women need to work to be eligible for the benefit.

Table 5: Parameterization of the Working Requirements

Time of work	Probability of receiving the transitional benefit		
	Before the reform	After the reform	
		Lower1	Upper1
No work	81.7	54.6	39.1
Short part time	85.8	74.1	65.8
Part time	74.6	70.7	71.9
Full time	56.4	52.1	65.3

Notes: The probability of receiving the benefit before the reform coincides with the proportion of women participating in the welfare before the reform. *Lower1* indicates the maximum probability of receiving the benefit after the reform, while *upper1* the minimum.

6 Probability of Receiving the Benefit after the Reform

	Beta	St err
Welfare participation		
Age	-0.06***	0.01
Years of schooling	-0.07***	0.02
Age of the youngest child	-0.13***	0.02
Number of children	-0.08**	0.04
Immigrant	0.54**	0.21
Expected amount of the benefit	0.44***	0.03
Constant	2.93***	0.31
Eligibility		
No work	-2.82***	0.25
Short part time	-0.89***	0.19
Part time	0.06	0.11
Observations	6,463	

Notes: Logistic regression; *** significant at 1% level, ** significant at 5% level, *significant at 10% level.
Sample: lone mothers after the reform, 1999-2001.

7 Work Alternatives before and after the Reform

Time of wok	Before the reform %	After the reform %	Predicted %
No work	27.3	16.1	19.6
Short part time	13.8	10.8	12.3
Part time	24.0	24.4	24.4
Full time	34.9	48.8	43.8

Notes: distribution of lone mothers across time of work, before (1995-1997) and after the reform (1999-2001). The last column represents the probability of working for lone mothers before the reform if they lived in the years after the reform (predicted from regression in Table 4.8).

8 Probability of Working after the Reform

	Short time		Part time		Full time	
	Beta	St err	Beta	St err	Beta	St err
Age	-0.05***	0.01	-0.09***	0.01	-0.28***	0.01
Years of schooling	0.10***	0.03	0.16***	0.02	0.12***	0.02
Experience points	0.04***	0.00	0.08***	0.00	0.14***	0.00
Age of the youngest child	0.09**	0.04	0.08**	0.03	0.21***	0.03
Number of children	0.08	0.07	0.19***	0.06	0.28***	0.06
Immigrant	-0.47*	0.26	-0.55**	0.24	-0.22	0.25
Constant	-1.02**	0.46	-0.60	0.40	34***	0.40
Observations			6,463			

Notes: Multinomial regression, "no work" as excluded category; *** significant at 1% level, ** significant at 5% level, *significant at 10% level. Sample: lone mothers after the reform, 1999-2001.

Table 9: Comparison of the Effects of the Reform on Earnings, obtained with the Quasi-Experimental Method and the Structural Model of Earnings and Welfare Participation

	All women	Low educated	Medium educated	High educated
Quasi - experimental				
Estimated Effect	311	517	378	-70
95% Confidence Interval	168–455	210–824	179–576	-348–207
Structural model				
Reform (lower0)	-444	-363	-412	-585
Reform (lower1)	119	307	231	-284
Reform (upper1)	458	763	581	-80
Reform (upper0)	2,426	3,202	2,753	1,024

Notes: "Reform (lower0)" is the predicted effect of the reform can choose to seek work or attend training; "Reform (upper0)" is the predicted effect of the reform when all women need to work to be eligible for the benefit. "Reform (lower1)" is the predicted effect of the reform when the probability of being eligible is 0.73 for non-working women and 0.88 for women working short part time; Reform (upper1)" is the predicted effect of the reform when the probability of being eligible is 0.57 for non-working women and 0.80 for women working short part time.

Table 10: Effects of Different Changes in Policy Parameters on Earnings

	All women	Low educated	Medium educated	High educated
Structural model				
Increased Generosity	-679	-657	-661	-736
Age Limit	171	221	185	95
Work requirements (lower1)	479	593	546	235
Work requirements (upper1)	791	979	899	396
Work requirements (upper0)	2,373	2,993	2,655	1,212

Notes: "Work requirements (lower1)" is the predicted effect of the introduction of working requirements when the probability of being eligible is 0.73 for non-working women and 0.88 for women working short part time; "Work requirements (upper1)" is the predicted effect of the introduction of working requirements when the probability of being eligible is 0.57 for non-working women and 0.80 for women working short part time; "Work requirements (upper0)" is the predicted effect of the introduction of working requirements when all women need to work to be eligible for the benefit.

Table 11: New Policy Scenarios

		Actual reform		Optimal policy	
	Before	Upper1	Upper0	Upper1	Upper0
Poverty (%)	11.8	8.6	9.4	7.2	9.0
Policy parameters					
Max amount	8,340	9,591		8,340	8,173
Withdrawal rate	40%	40%		24%	30%
Disregarded amount	2,513	2,513		2,061	2,990
Age limit	10	9		9	9
Work requirements	none	as in 1998	work ≥ 6FT	as in 1998	work ≥ 6FT
Average cost	€2,634	€3,163	€1,920	≤ €3,163	≤ €1,920

Notes: "upper1" means that the probability of being eligible is 0.57 for non-working women and 0.80 for women working short part time; "upper0" means that all women need to work to be eligible for the benefit.

Table 12: Robustness Checks

	All women	Low educated	Medium educated	High educated
Results (Section 5)				
Increased generosity	-679	-657	-661	-736
Age limit	171	221	185	95
Work requirements (u1)	791	979	899	396
Reform(u1)	458	763	581	-80
No random coefficients				
Increased generosity	-797	-889	-764	-772
Age limit	228	313	242	116
Work requirements (u1)	1,165	1,475	1,324	552
Reform(u1)	772	1,117	948	90
Random coefficients: time, income, welfare				
Increased generosity	-838	-883	-835	-800
Age limit	197	277	207	99
Work requirements (u1)	880	1,124	988	430
Reform(u1)	402	707	506	-102
Fixed time per alternative				
Increased generosity	-527	-881	-307	-609
Age limit	229	312	246	115
Work requirements (u1)	1108	1415	1255	519
Reform(u1)	1069	1273	1410	201
Simulation of other work-related benefits				
Increased generosity	-813	-786	-809	-846
Age limit	177	226	191	100
Work requirements (u1)	767	971	861	383
Reform(u1)	378	701	483	-146

Notes: "Work requirements (u1)" is the predicted effect of the introduction of working requirements when the probability of being eligible is 0.57 for non-working women and 0.80 for women working short part time; Reform (u1)" is the predicted effect of the reform when the probability of being eligible is 0.57 for non-working women and 0.80 for women working short part time.

Table 13: Other Benefits

	Beta	St err
One child		
Two children	3,216***	108
Three children	4,997***	140
Four children	5,783***	268
Five children	6,462***	548
Six children	6,011***	1037
No work	1,084***	274
Short part time	880***	238
Part time	724***	170
Full time		
Earnings / 1000	-56***	10
Immigrant	1,421***	419
Constant	7,283***	267
Observations	8,262	

Notes: Linear regression; *** significant at 1% level, ** significant at 5% level, *significant at 10% level.
Sample: lone mothers before the reform, 1995-1997.