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FIGHTING LONE MOTHERS' POVERTY THROUGH IN-WORK BENEFITS METHODOLOGICAL ISSUES AND POLICY SUGGESTIONS

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ABSTRACT

Lone mothers are overrepresented among the poor in many European countries, with detrimental consequences for them and their children. Even in Norway, which is known for its successful economic and welfare development, lone mothers were at least three times more likely to be poor than married mothers. To redress this issue, the Norwegian government instituted welfare reform in 1998, increasing lone-parent benefit levels and introducing working requirements. Using a quasi-experimental model, Mogstad and Pronzato (2008) found that the reform had a positive effect on lone mothers' labor supply and slightly reduced poverty. Yet given the extent of public resources invested, was this the most that policy makers could expect in terms of reducing poverty? To answer this question, I estimate a discrete choice model of work and welfare participation decisions, and use the behavioral estimates to derive the policy parameters that would have minimized poverty among lone mothers. To produce more robust results, a prerequisite for developing policy recommendations, the discrete choice model is validated by comparing its predictions with the estimated effects of the reform obtained from a quasi-experiment (Mogstad and Pronzato, 2008).

JEL classification: I38, J22, C25
Keywords: lone mothers, in-work benefits, poverty, discrete choice models, comparison of methods

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1 Introduction

Lone mothers are overrepresented among the poor in many European countries, with detrimental consequences for them and their children. Even in Norway, which is known for its successful economic and welfare development, lone mothers were at least three times more likely to be poor than married mothers of children in the same age range. To redress this issue, in 1998, the Norwegian government introduced reforms of its lone parent welfare system. The main changes concerned the most generous form of benefit, the so-called transitional benefit: the maximum amount of the benefit was increased, working requirements were introduced, and new time limits were imposed. Although the transitional benefit is available to lone parents of either gender, policy discussion about how its reform could avoid creating work disincentives mainly took place with lone mothers' work and poverty rates in mind. The reasons are twofold. First of all, as many as 9 in 10 lone parents were women at the time. But more importantly, lone mothers tend to have lower human capital and socio-economic status than lone fathers, presumably because the stringent selection process can make it harder for lone fathers to gain daily custody of their children (Kjeldstad and Rønsen, 2004).

Using a quasi-experimental model, Mogstad and Pronzato (2008) found that the reform had a positive effect on lone mothers' labor supply and slightly alleviated poverty. Given the extent of public resources invested, however, was this the most policy makers could expect in terms of reducing poverty? In answering this question, it is not enough to use the reform as an instrument in a quasi-experimental setting. Although this does allow us to determine whether public policies influence lone mothers' behavior - without making strong assumptions and by referring intuitively to economic theory - we cannot distinguish the effects of different parts of the reform, understand their mechanisms, or predict what kind of policy would have made lone mothers better off. These questions require a more structural approach: thinking about what matters for lone mothers' decisions (e.g., income, hours of work, children's ages), estimating the weight lone mothers give to those factors, and using the estimated behavioral parameters to predict new policy scenarios.

Despite their clear advantage for providing policy suggestions, structural models are based on relatively stronger assumptions than quasi-experimental models. How can one be sure that the economic model devised realistically reproduces lone mothers' decision-making process? In this paper, I use behavioral estimates to simulate the changes induced by the 1998 reform in Norway and then compare the predictions made with the effects of the reform estimated according to a quasi-experimental model, whose assumptions are less restrictive. After validating the discrete choice model, I can use it as the basis for policy recommendations.

Blended use of quasi-experimental methods and structural models for policy evaluation has been undertaken by relatively few studies until now, but is necessary if we want to bring credibility to and reconcile the two

approaches. This is the appeal launched to young economists by Keane (2006, 2010) during his keynote lecture at the Duke Conference on Structural Models in Labor, Aging and Health (2005), titled “Structural versus Atheoretic Approaches to Econometrics”. Keane underlined the need to consider descriptive statistics, reduced and structural forms, and 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 provide "reasonable” predictions of reality. The adjective “reasonable” may still be considered subjective, but consensus can be reached through multiple validation exercises. Recently, as part of the Mirrlees Review, Blundell (2012) has underlined the importance of using different empirical strategies to evaluate the effects of earnings taxation on labor market decisions in order to design better tax policy reforms.

Examples are offered by Todd and Wolpin (2006), Blundell (2006), Brewer et al. (2006), Keane and Wolpin (2007) and, more recently, by Bernal and Keane (2010), Hansen and Liu (2011), Geyen et al. (2012) and Thoresen and Vattø (2012). Todd and Wolpin (2006) use data from a randomized social experiment in Mexico to study and validate a dynamic behavioral model of parental decisions about fertility and child schooling. PROGRESA was a randomized social experiment implemented by the Mexican government, in which around 500 rural villages were randomly assigned to participate in a scheme providing payment to parents who regularly sent their children to school. The researchers estimate the behavioral 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 behavioral model was similar to the experimental results. Keane and Wolpin (2007) adopt a different approach to validating a behavioral model. They construct and estimate a dynamic structural model of female behavior, 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 other states to predict and validate the model. Bernal and Keane (2010) evaluate the effects of maternal work and childcare use on cognitive child development using a sample of single mothers in the National Longitudinal Survey of Youth. In order to take into account the selection process in work and childcare use, they develop a model of mothers’ employment and childcare decisions. To identify the model, they use exogenous variations in welfare rules and local demand conditions across states and over time. They also employ the same instrumental variables for a straight linear IV regression. The estimated effects on children’s cognitive development were very close when comparing the IV strategy and the structural model.

While the above studies construct and estimate dynamic structural models, a number of empirical works validate static structural models with quasi-experimental evidence, mainly looking at labor market changes in response to welfare reform. Brewer, Duncan, Shephard and Suarez (2006) estimate a static structural model of labor supply and program 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 those obtained from other ex-ante (Blundell et al., 2000a, 2000b) and ex-post evaluations (Blundell et al., 2005; Francesconi and Van der Klaauw, 2004, 2007; Leigh, 2005; Gregg and Harkness, 2009). Blundell (2006) focuses on the effects of the Earned Income Tax Credit policies on lone mothers' working decisions, by validating a structural model of labor supply with a difference-in-difference evaluation strategy, and then finds the optimal policy, defined by a certain social welfare function. Other recent papers exploit the introduction of a specific reform to compare the results from quasi-experimental methods and structural models: Geyen, Hann, and Wrohlich (2012) estimate the introduction of a parental leave reform in Germany by comparing the working behavior of mothers of children born just before or after the reform and compare the results with those obtained by a structural model of return to work; Thoresen and Vattø (2012) evaluate a tax reform by comparing a before-after change in labor supply with the effect predicted by a structural model of labor supply; Hansen and Liu (2011) compare the effect of higher welfare benefits for young people in Quebec predicted by their structural model of labor supply and welfare participation with the one estimated with a discontinuity regression model by Le Mieux and Milligan (2008).

Using a similar approach in a policy context comparable to that in Blundell (2006), here I validate a discrete choice model of work and welfare participation decisions with the results provided by a quasi-experimental model (Mogstad and Pronzato, 2008). After validation of the discrete choice model, the behavioral parameters are used to find the optimal policy, defined as the policy that provides the lowest level of poverty.

The paper is organized as follows. In Section 2, I describe the 1998 reform and report the effects of the reform obtained by Mogstad and Pronzato (2008) with a quasi-experimental model. I explain the discrete choice model in Section3 and present the data in Section 4. After estimating the behavioral parameters, the reform is simulated, and its predictions compared with the estimated effects obtained with the quasi-experimental model: although the discrete choice model makes stronger assumptions, the predictions from the discrete choice model are close to the quasi-experimental ones (Section 5). I then simulate new policy scenarios in Section 6 and conclude in Section 7.

2 The 1998 Reform of the Transitional Benefit

In this section, I describe the 1998 reform of the transitional benefit and summarize the effects of the reform found by Mogstad and Pronzato (2008) estimated with a quasi-experimental model. [1] These effects will then be compared with the simulated reform effects obtained through the discrete choice model, which represents the contribution of this paper.

The transitional benefit used to be the most generous benefit targeted exclusively at lone parents, mainly represented by lone mothers. Lone mothers with at least one child under 10 years old received up to €700 per month, regardless of their labor market decisions, but 40% of their monthly earnings exceeding €200 were deducted from the benefit. A reform of the transitional benefit was undertaken on the 1st of January 1998. First, working requirements were imposed upon mothers whose youngest child was older than three years old: to be eligible, lone mothers were required to work at least part-time, to actively seek work, or to be in training. Second, the timing of the benefit was changed: lone mothers could receive the benefit until the youngest child was 8 years old (instead of 10)[2] and for a period up to 3 years (rather than up to 10 years before the reform). Finally, the maximum amount of the benefit was increased from approximately €700 to €800 per month.

The aim of the reform was to improve the labor market attachment of lone mothers, and thereby to reduce welfare dependency and alleviate poverty. Since the aim of the paper (Mogstad and Pronzato, 2008) was to evaluate the workfare aspects of the reform, the evaluation was carried out only on the sample of lone mothers whose youngest child was older than 3, for whom working requirements were introduced. A final important feature of the reform was that phase-in period provisions were introduced so that a subgroup of lone mothers, who were entitled to and had applied for benefits by January 1, 1998, could continue to receive the transitional benefit under pre-reform rules – without working requirements - for three years (until January 2001). Since the classical difference-in-difference model could only be applied to lone mothers in 1997 who remained lone mothers until 2001[3], Mogstad and Pronzato (2008) evaluated the reform by comparing pre-reform and post-

[1] A revised version of the paper was published in 2012 in the Scandinavian Journal of Economics. The main difference between the two versions is in the sample selection: in the working paper (2008), the control group is made up of lone mothers in the years 1995-1997; in the published version, the control group is made up of lone mothers in the year 1997 alone. Both evaluation exercises result in a reform effect of approximately €400 more in annual earnings. Since I prefer to estimate the structural model with a relatively larger sample size (around 7,900 lone mothers in 1995-1997 rather than 2,300 lone mothers in 1997) for greater precision in estimation, I refer to the 2008 working paper in my comparison.

[2] Before the reform, a lone mother could receive the benefit until June in the tenth year of the youngest child; after the reform, the benefit stops as soon as the child turns ten. The main difference is that, after the reform, the ninth year of the child's life no longer grants eligibility for the benefit.

[3] In the Scandinavian Journal of Economics (2012), Mogstad and Pronzato also evaluated the effects of the reform on this sub-group of "lasting" lone mothers who were eligible both in 1997 and in 2001. The effect on annual gross earnings was very large (about €1,000). However, the group was quite selected if compared with "newly" lone mothers, especially in terms of education (an average of 11 years of schooling versus 12) and of labor market experience (an average of 8 years rather than 11).

reform differences in the average growth rate of the outcome of interest between mothers in a couple who stay in a couple (stayers) and those who split up and become lone mothers (splitters). The reform effects were therefore given as a difference between pre-reform and post-reform difference-in-difference estimators of the effects of becoming a lone mother on the outcomes of interest.[4] By using Norwegian register data, Mogstad and Pronzato (2008) found that lone mothers' annual gross earnings increase by around €400[5] because of the reform, while the poverty rate decreased by around one percentage point.[6]

[4] This evaluation method cannot be used for never married mothers; these, however, represent only 3% in the first year of life of the child.

[5] The Norwegian register data, like other national register data, contains no information on hours of work. As work outcome, Mogstad and Pronzato (2008) used annual gross earnings.

[6] The reform does not seem to have had an effect on the probability of becoming a lone mother (Mogstad and Pronzato, 2009).

3 A Discrete Choice Model of Work and Welfare Participation Decisions [7]

In this section, I describe the features of the discrete choice model, whose estimates are used to simulate and evaluate the 1998 reform. In the model, women are assumed to make their decisions about work and welfare participation under a certain budget constrain. After estimating the model, the changes introduced by the 1998 reform (new working requirements, new age limits, increased amount of the benefit) are included in the model, and the effect of the 1998 reform is simulated by using the estimated behavioural parameters.

The Norwegian register data, I use for the estimation of the model (described in Section 4), provides accurate information on incomes and demographic characteristics, but not time of work. Therefore, time of work is predicted and – in the model – allowed to be measured with an error.

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

$$U_n(C, L, W) \tag{1}$$

under the budget constraint

$$C_n = T(F_n, L_n, Y_n) \tag{2}$$

where

- C_n is the net household income,
- F_n is the gross monthly labor income of the lone mother in a full-time job,
- L_n is the number of equivalent full-time months of work in one calendar year,
- W_n is a welfare participation indicator,
- Y_n is exogenous household gross income,
- $T(.)$ is the tax-benefit function that transforms gross income into net income.

The lone mother faces a set of *J* discrete alternatives, defined by the combination of earnings and welfare participation decisions. She knows how much utility she would get from each alternative *j* and chooses the alternative that provides the largest amount. We can decompose the utility function into two parts: the deterministic part and the stochastic part

[7] 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), Creedy and Kalb (2005), Creedy et al. (2006), Keane (2011), Bargain et al. (2012).

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

where V_{nj} captures the portion of utility that derives from observable characteristics, and ε_{nj} the portion from unobservable ones. The deterministic part of the utility V_{nj} may be seen as a function that 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 the observed attributes of the alternatives faced by the lone mother, and s_n are her observed socio-demographic characteristics. I specify the deterministic part of the utility to be linear in parameters with a constant

$$V_{nj} = q'_{nj}\theta + k_j \qquad \forall j \in J \tag{5}$$

where q'_{nj} is a vector of variables that relate to alternative *j* as faced by the lone mother *n*, θ 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 required by alternative *j* and its square, a welfare participation indicator, and their interactions. The socio-demographic variables $s_n$cannot be included in 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:

$$V_{nj} = \beta_1 C_{nj} + \beta_2 C_{nj}^2 + \beta_3 L_{nj} + \beta_4 L_{nj}^2 + \beta_5 W_{nj} + \beta_6 C_{nj} L_{nj} + \beta_7 L_{nj} W_{nj} + \beta_8 C_{nj} W_{nj} + k_j + \left(C_{nj} s_n\right)' \delta + \left(L_{nj} s_n\right)' \gamma + \left(W_{nj} s_n\right)' \lambda \qquad \forall j \in J \tag{6}$$

where C_{nj} is her net household income, L_{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 L_{nj} is not observed in the register data. I derive the expected time of work $\bar{L}_{nj}$, expressed in equivalent full-time months of work in a year, as the ratio between each woman's annual earnings in the register

data ($F_{nj}L_{nj}$)and the predicted monthly earnings from survey data $\bar{F}_{nj}$ in a full-time job of a woman with same human capital characteristics:

$$\bar{L}_{nj} = \frac{(F_{nj}L_{nj})}{\bar{F}_{nj}} \tag{7}.$$

The relationship between actual time of work L_{nj} and expected time of work $\bar{L}_{nj}$ is given by

$$L_{nj} = \frac{\bar{F}_{nj}}{F_{nj}}\bar{L}_{nj} = \alpha\bar{L}_{nj} \tag{8},$$

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

$$V_{nj} = \beta_1 C_{nj} + \beta_2 C_{nj}^2 + \tilde{\beta}_3 \bar{L}_{nj} + \tilde{\beta}_4 \bar{L}_{nj}^2 + \beta_5 W_{nj} + \tilde{\beta}_6 C_{nj}\bar{L}_{nj} + \tilde{\beta}_7 \bar{L}_{nj} W_{nj} + \beta_8 C_{nj} W_{nj} + k_j + \left(C_{nj}s_n\right)'\delta + \left(\bar{L}_{nj}s_n\right)'\tilde{\gamma} + \left(W_{nj}s_n\right)'\lambda \qquad \forall j \in J \tag{9}$$

where, for example,

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

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

$$V_{nj} = \beta_1 C_{nj} + \beta_2 C_{nj}^2 + (\beta_3 v)\bar{L}_{nj} + \tilde{\beta}_4 \bar{L}_{nj}^2 + \beta_5 W_{nj} + \tilde{\beta}_6 C_{nj}\bar{L}_{nj} + \tilde{\beta}_7 \bar{L}_{nj} W_{nj} + \beta_8 C_{nj} W_{nj} + k_j + \left(C_{nj}s_n\right)'\delta + \left(\bar{L}_{nj}s_n\right)'\tilde{\gamma} + \left(W_{nj}s_n\right)'\lambda \qquad \forall j \in J \tag{11}.$$

v coincides with α only if there is no difference in tastes due to unobservables among women.[8] However, I do not need to identify α because the main aim is to take into account the fact that time of work is measured with an error.

[8] The model is estimated using the software Stata (command: mixlogit). $\tilde{\beta}_4, \tilde{\beta}_6, \tilde{\beta}_7, \tilde{\gamma}$ should also be allowed to vary among women, but, in practice, the model does not converge when allowing unobservable heterogeneity in many parameters.

4 The Data

The data used for the empirical analysis is from the register data of the Norwegian population, which contains household and demographic information, and is merged with detailed income data from the Tax Assessment Files through unique individual identifiers. The income data is collected from tax records and other administrative registers rather than through interviews or self-assessment. The coverage and reliability of Norwegian register data are considered to be exceptional, receiving the highest rating in a data quality survey in the Luxembourg Income Study database (Atkinson et al., 1995).

The sample for the discrete choice model contains 7,921 lone mothers observed before the reform (in the years 1995, 1996, 1997), representing what one would use in a typical ex-ante evaluation. They are between 18 and 55 years old, with the youngest child between 4 and 9 years old. Self-employed women, students, and women receiving permanent disability benefits are excluded from the analysis.

As explained in Section 3, the expected time of work is obtained by comparing annual earnings observed in the register data with potential monthly full-time earnings from survey data. In order to construct potential earnings, I use the Norwegian part of the European Union Survey of Income and Living Conditions for the year 2004, selecting women in the same age-range (18-55) and estimating a Heckman regression. The dependent variable is hourly gross labor 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.[9] In the selection equation, I also consider the presence of dependent children, other household income (which excludes her labor income), whether being in a couple, and living in a city. Results are reported in Table A1. In order to make survey earnings comparable to earnings in the register data, predicted hourly earnings are multiplied by typical hours of work in a full-time job (38) and number of weeks in a month, and adjusted in order to take into account nominal and real growth. [10]

I assume lone mothers face at most 8 alternative choices, given by the joint decision of how much to work (4 alternatives) and whether or not collect the welfare benefit (2 alternatives). The 4 work alternatives are defined as follows:

[9] 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 A1.

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

1) First work alternative (which will be called “no work”): ratio between annual observed earnings and expected monthly earnings in a full-time job smaller than 3, which corresponds to fewer than 9.5 hours a week (on average, in the data, 1.5 hours per week).
2) Second work alternative (which will be called “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, which corresponds to 9.5-19 hours a week (on average, in the data, 13 hours per week).
3) Third work alternative (which will be called “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, which corresponds to 19-28.5 hours a week (on average, in the data, 22 hours per week).
4) Fourth work alternative (which will be called “full time”): ratio between observed annual earnings and expected monthly earnings in a full-time job larger or equal to 9, which corresponds to more than 28.5 hours a week (on average, in the data, 33 hours per week).

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

Suppose a lone mother’s observed earnings are €17,500 and she participates in the welfare program (see example in Table 1). Given her human capital characteristics, she is supposed to earn, for example, €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; 22 hours per week). I construct three other earning alternatives: “no work”, working “short part time”, working “full time” (see Table 1, first five columns). The number of months chosen for each untaken work alternative (no work / short part time / full time) is drawn from the distribution of months of people choosing that alternative (no work / short part time / full time) (Aaberge et al., 2009). Predicted earnings are then imputed. In the example, Table 1, 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 collect the benefit. 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 1, column 6, we can see the corresponding amounts. For this woman, the 7th alternative is dropped, since the related full-time earnings are too large to maintain eligibility for the benefit.

I then simulate the childcare benefit, another benefit which depends on labor supply, given as a reimbursement for extra costs for childcare incurred when the mother works. All other remaining benefits are only available in the data as a total amount. However, none of them depends on her working decisions. Finally, I simulate taxes,

obtaining the total net income she can have in different work/welfare alternatives (Table 1, column 8). Poverty is defined by a dichotomous variable assuming the value of 1 if the lone mother's household has an annual equivalent disposable income below 60 percent of the median annual equivalent disposable income in the overall population, and 0 otherwise. Table 1, column 9 indicates the alternatives in which 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 collect the benefit. The variable in Table 1, column 10, indicates the decision observed.

Descriptive statistics of the sample of lone mothers before the time of the reform are shown in Table 2: lone mothers worked an average of 8 full-time months per year, had a total disposable income of €25,000, almost 50% of them received the transitional benefit, 12% could be defined as poor, only 19% had a high level of education (12 years of full-time education or more), 68% had two or more children, with the youngest one below 6 years old (50%). The sample is the one used as a reference for the simulation of the optimal policy described in Section 6.

5 Comparing the Estimated Effects of the Reform

5.1 Estimated Behavioral Parameters from the Discrete Choice Model

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 work alternatives, using a mixed logit specification with the coefficient of time of work treated as a random coefficient, assumed to be normally distributed, as outlined in Section 3. Results are reported in Table 3. The model is estimated without any restriction imposed on the utility function. To check that the utility function respects the concavity and monotonicity properties, I check the derivatives with respect to the utility arguments. The first derivative with respect to income is positive for the whole sample as well as the first derivative, while time of work is negative for the whole sample. Second derivatives are in the expected direction, as shown in Table 3. Utility is decreasing in welfare participation for 96% of the sample. The standard deviation of the random coefficient is significantly different from zero, revealing an important role of unobserved heterogeneity and/or measurement error. We can now calculate the elasticity with respect to labor income and the elasticity with respect to welfare income: for an increase of 1% in labor income, the predicted time work increases by 0.8%; for an increase of 1% in welfare income, the predicted time of work decreases by 0.5%.[11] To judge the goodness of the model from a statistical point of view, I draw – for each woman – 100 draws from a logistic distribution and add this stochastic part to the deterministic one to predict the choice made (Train, 2003). In 40 % of the cases, the model guesses the choice of the woman.[12]

Turning to the effects of the interactions between the objects of the utility function, the interaction between income and time of work is positive. This might be explained by the presence of better positions in the labor market, for although they imply longer hours of work (which we cannot control for perfectly), they may increase the woman's utility. The interaction between welfare participation and income is also positive: since a large part of lone mothers' income comes from other benefits in Norway, the positive interaction could reveal that the cost of participating is lower for women who also participate in other welfare programs. Finally, the interaction between welfare and time of work is also positive. This may seem surprising at first. However, women who work more may be better informed, because they are more likely to talk with other people at their place of work or they may suffer less from welfare stigma because they feel they do not completely depend on welfare. [13]

[11] See Aaberge et al (1999b) for a comparison with Norway and Bargain et al(2012) for a comparison with other European countries and US.

[12] If we did completely random, we would guess 13% of the cases. An alternative way to test the goodness of the fit is simply count how many times the choice taken coincides with the one the model predicts as the most likely. In this way, the percentage of choice guessed is almost 50%.

[13] Generally speaking, in the Norwegian context, where applications can be filled on line and transfers can be received in the bank account without friends and family necessarily knowing, we can expect the role of welfare stigma to be relatively less important.

The 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 stem from the fact that, given their level of education, they are in poorly paid jobs. Younger women have less disutility from participating in welfare, while the cost of welfare is not linear by years of education. Women with secondary schooling have less disutility from collecting welfare than higher- and lower-educated women. This may capture different aspects of welfare participation: on the one hand, if information is needed, then better educated women may be more prompt to apply for the benefit; on the other hand, better educated women may suffer more from being dependent on welfare.

Finally, since we do not observe the true time of work, the estimated coefficients related to the interactions between time of work and variables that are also used in the earnings equation (age and level of education) capture different disutility from time of work but they could also capture misspecification of the earnings equation, so I refrain from interpreting them.

5.2 Simulating the Effect of the Reform

In order to simulate the effect of the reform with the discrete choice model, I need to parameterize the transitional benefit according to the new rules. There are three important changes. First, working requirements are imposed. Second, the age limit for eligibility on the youngest child is lowered and time limits on welfare participation are introduced. And third, in-work benefit levels are raised.

The increase of the maximum amount (from around €8,300 to €9,500 per year) 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 could receive the benefit while, after the reform, women earning up to €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 whose youngest child is 9 years old are no longer eligible for the transitional benefit. The reform requires lone mothers to be in training, to be working at least part time, or to be seeking work. The law does not provide details about “training” and “seeking work” activities. I do not have any information on what these activities consist of, whether it was difficult to find a training position, or what women were asked in case to verify that they were seeking work. I also do not know whether these activities were easily approved by the public administration, or how long they were compatible with being eligible for the benefit. Moreover, register data does not provide information on training or periods of seeking work, so it is impossible to know who was making these decisions, even after the reform. What I can do is to assume that lone mothers receiving the maximum amount of the transitional benefit after the reform

are engaged in one of the two activities. In fact, the maximum amount is given only to women earning less than €200 per month, and it is reasonable to assume that there is no part-time job in Norway paying less than €200 a month. The percentage of non-working women on welfare after the reform (assumed to be in training or seeking-work activities) is 7.0%, while the percentage of non-working women on welfare was 18.5% before the reform. While before the reform the possibility of receiving the transitional benefit and not working was a woman's decision, after the reform it is the result of the woman's decision and the new constraints imposed by the law. We may expect women with lower levels of education to be more likely to be observed in training or seeking work activities after the reform, but this does not seem to be the case when looking at post-reform data. The percentage of non-working women receiving the benefit before the reform was 26.4% among low-educated women, 14.0% among medium-educated women, 11.0% among highly-educated women. The percentage of non-working women receiving the benefit after the reform (assumed to be in training or seeking work activities) is 8.7% among low-educated women, 6.3% among medium-educated women, 7.6% among highly-educated women. In order to reproduce what I observe in the data, I randomly drop the alternatives of non-working and participating in the welfare for a number of women so that the percentage of women making this decision - with the new rules - is 7.0%.

The simulated effects of the reform from the structural model are calculated as weighted earnings, given by the sum of earnings in each alternative times the probability of choosing that alternative. The results are shown in the top section of Table 4. The simulated effect of the whole reform is positive: on average, lone mothers increase their earnings by €450 per year.[14] The effect appears heterogeneous for women with different level of education: positive and stronger for low- and medium-educated women, while negative and smaller for highly-educated women.[15]

We can now separate the effects of the introduction of the working requirements and new age limits from the effect of more generous benefits. Lines three, four and five of Table 4 report the results.

The introduction of working requirements has increased women's earnings, as expected, by making lone mothers substitute non-working time with working time. The effect is larger for low- and medium-educated women than for highly-educated women. The new age limit also has a positive but small effect on working decisions by making women of older children work more. Finally, making the benefit more generous has the opposite effect on annual earnings: this ingredient of the reform induces an income effect, leading women to decrease their working time.

[14] In order to calculate the confidence intervals around the predictions from the structural model, I employ the bootstrap method: I draw 100 new samples from the original one, each of them containing the original number of observations (N = 7,921), where each observation may be repeated more than once (with replacement); I re-estimate the model using each of the 100 new samples; I parameterize the reform and get 100 sets of predictions. From these predictions I calculate means, standard errors, and confidence intervals.

[15] Imposing the proportion of women in training or seeking work activities to 7.0% implies, according to the discrete choice model estimates, granting the possibility of collecting the benefit without working to 40 women out of 100.

The effect is relatively large even for highly-educated women. In fact, for highly-educated women, the increase in the maximum amount has made them eligible for more work alternatives. Results from different specifications of the model are included in the Appendix (Table A2).

Comparisons between the simulations from the structural model and the estimated effects of the experimental model (Mogstad and Pronzato, 2008) are reported, respectively, in the top and in the bottom part of Table 4. The similarity of the results represents the first contribution of the paper. The experimental model confirms predictions from the discrete choice model, usually considered econometrically more fragile. The results from the two methods are, in fact, positive and significant, confidence intervals overlap, and point estimates are rather close. In addition, the results are reinforced by comparing sub-samples of the population. In fact, the discrete choice model provides accurate predictions also by level of education: the positive effect is larger for low-educated women, still positive for medium-educated women, while slightly negative for highly-educated women.

In comparing the results of the two models, we need to consider that the structural model, however, does not take into account the introduction of welfare time limits. From a theoretical point of view, the long-term static effect of these measures is to eliminate welfare completely for certain lone mothers, which should increase labor supply for the same reasons that welfare decreases labor supply in the first place. Moreover, there are some dynamic effects that go in the same direction. First, one may expect lone mothers on welfare to anticipate the date when benefits will run out and begin to intensify their job search or even to accept job offers at an increasing rate when approaching this date.[16]

[16] Moffitt (1985) and Røed and Zhang (2005) find this behavior for unemployment insurance recipients approaching the time their benefits will run out.

6 New Policy Scenarios

The comparison between the results of the discrete choice model and the triple-difference model makes me confident in using the behavioral estimates to discover which policy changes to the transitional benefit would have minimized poverty among lone mothers. Before the reform, the percentage of poor lone mothers was 11.8, as shown in Table 5, column 1. The bottom section of the table reports the parameters of the reform.
The aim is to find the policy parameters that minimize poverty. I look at two situations:

- when the working requirements are those implemented at the time of the reform: in order to be eligible for the benefit, women are required to be in part-time work, to be seeking work or to be doing training (case 1);
- when the working requirements are introduced without the possibility of training or seeking work (case 2).

These two scenarios should be interesting benchmarks for policy makers. The first scenario represents a case in which policy makers want to introduce working requirements but also to allow women to invest time in training and seeking work. The second scenario can be seen as a "long-term" realization of the reform: after the first period spent in training or seeking work, women have to work to be maintain eligibility status for the benefit. In this last scenario, I also allow time of work to vary in order to choose the working requirement that minimizes poverty. In the first scenario, instead, working requirements are reproduced as observed at the time of the reform. Another difference between the two scenarios is the amount of resources involved: "stricter" working requirements (case 2) imply less public expenditure, which derives from giving less generous benefits (due to the withdrawal rate) and from cancelling welfare for any women who decide not to work. In Table 5, columns 2 and 3, I report the simulated effects of the actual reform on poverty in the two policy scenarios. Poverty decreases to 8.6% (case 1) and to 9.4% (case 2) while the average cost per woman is, respectively, €3,163 and €1,920.
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, just for case 2, the working requirements. In order to find the parameters of the reform I proceed with a two-step maximization procedure.[17] The results are shown

[17] 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 a lower level of poverty. When I arrive at this stage, the policy parameter intervals are: maximum amount: 6,672–13,344 (case 1), 3,336–10,008 (case 2), withdrawal rate: 0–64 % (case 1), 16–48 % (case 2), disregarded amount: 1,005–5,026 (case 1), 0–8,042 (case 2); age limit: 7–10 (case 1, case 2); working requirements: 0–8 equivalent full-time months

in Table 5. If we consider the case where working requirements are implemented, as in 1998, with the possibility of training and seeking work (case 1), with an average expenditure of €3,163 per lone mother, we observe a further decrease in poverty to 7.2%. Comparing the parameters of the benefit between the "actual reform" and the "optimal policy", we see that the reduction in poverty is a consequence of the reduction of the withdrawal rate and of the disregarded amount, while the maximum amount and age limit are the ones observed, respectively, in the pre- and post-reform period. In the second scenario (case 2), we also observe a decline in poverty, which is now equal to 9.0%. In this case, too, the withdrawal rate is the parameter that is more distant from the observed one. The maximum amount is still around €8,000 per year, while the disregarded amount has increased. In this scenario, I allowed the required time of work to vary. However, the optimal scenario is confirmed to be 6 months a year (part time), and the age limit is confirmed to be 9 years old.

Could policy makers have reformed the transitional benefit in a more efficient way while investing the same amount of public resources? Yes. This paper shows that it would have been possible, not by increasing the generosity of the benefit, but through a reduction of the withdrawal rate, making the decision to work more attractive, leading to higher income, and lower poverty.

of work (case 2). In the second step, within the above intervals for each parameter I try all the possible combinations considering small variations in the parameters each time, in order to find the "optimal" solutions that minimize poverty.

7 Conclusions

In this paper, I validate a discrete choice model of work and welfare participation decisions of lone mothers by comparing its predictions with the effects of the 1998 Norwegian welfare reform estimated with a quasi-experimental evaluation model. The reform increased the maximum amount of the transitional benefit, introduced new working requirements and changed the duration of eligibility. The first contribution the paper makes is to compare two methods of policy evaluation. Both methods revealed that the reform had a positive effect on lone mothers' earnings, driven by the behavioral responses of lower and medium educated women. The two strategies are complementary: while the focus of the quasi-experimental model is to measure what really happened, the challenge of the discrete choice model is to predict what might happen. Both aspects are important from a policy point of view. The fact that the predictions provided by the discrete choice model match the results of the triple-difference analysis lends credibility to both approaches. From a policy point of view, the availability of structural models gives policy makers the opportunity to plan how to make rational use of the resources at disposal to pursue their social goals. The main contribution of the paper is that it identifies a better way of fighting poverty among lone mothers and their children. In the case studied, we observe that – under revenue neutrality – reducing the withdrawal rate would be more effective at alleviating lone mothers' poverty. This would give women the incentive to work and earn more, and to achieve a level of income above the poverty line.

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TABLES

Table 1: An Example of a Choice Set

Work	Collecting the Benefit	Alternative	Time of Work	Labor 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: The choice set of a woman who collects the transitional benefit with observed annual earnings equal to €17,500 and potential monthly earnings equal to €2,500.

Table 2: The Sample of Lone Mothers before the Reform

Variable	Mean
Income (€ - 1998)	24,855
	(6,550)
Time of work	8.38
	(5.14)
Welfare participation	0.489
Poverty rate (%)	11.8
Age: under 32	0.362
Age: 32-36	0.341
Age: over 36	0.297
< 11 years of schooling	0.253
11-12 years of schooling	0.553
> 12 years of schooling	0.194
Youngest child 4-5 years old	0.499
Youngest child 6-7 years old	0.310
Youngest child 8-9 years old	0.191
One child	0.320
Two children	0.455
More than two children	0.225
Immigrant	0.010
Observations	7,921

Notes: average values, standard deviations in brackets for continuous variables. Time of work expressed in equivalent full-time months.

Table 3: Discrete Choice Model Estimates

	Beta	St err		Beta	St err		Beta	St err
Income	1.090***	0.074	Time	-0.793***	0.116	Welfare	-3.647***	0.550
			St dev (time)	0.254***	0.036			
Income sq.	-0.012***	0.001	Time sq.	0.001	0.003			
Income*time	0.009***	0.003	Time*welfare	0.169***	0.046	Income*welfare	0.031***	0.011
Income interacted with			Time interacted with			Welfare interacted with		
Mother's age (< 32)	0.007	0.030	Mother's age (< 32)	-0.003	0.038	Mother's age (< 32)	0.393**	0.156
Mother's age (32-36)	-0.001	0.025	Mother's age (32-36)	0.053	0.034	Mother's age (32-36)	0.342***	0.124
Mother's age (> 36)			Mother's age (> 36)			Mother's age (> 36)		
Schooling (< 11)	0.077*	0.042	Schooling (< 11)	-0.250***	0.060	Schooling (< 11)	-0.213	0.224
Schooling (11-12)	-0.036	0.035	Schooling (11-12)	-0.128**	0.054	Schooling (11-12)	0.547***	0.158
Schooling (> 12)			Schooling (> 12)			Schooling (> 12)		
One child	-0.154***	0.031	One child	0.389***	0.044	One child	0.044	0.150
Two children	-0.045*	0.024	Two children	0.157***	0.033	Two children	-0.049	0.123
More than two			More than two			More than two		
Youngest child 4-5	0.068**	0.027	Youngest child 4-5	-0.133***	0.036	Youngest child 4-5	-0.208*	0.126
Youngest child 6-7	0.046*	0.027	Youngest child 6-7	-0.081**	0.036	Youngest child 6-7	-0.003	0.12
Youngest child 8-9			Youngest child 8-9			Youngest child 8-9		
Immigrant	0.038	0.082	Immigrant	-0.280**	0.113	Immigrant	-0.261	0.496
No-work intercepts			Short time intercepts			Part time intercepts		
Welfare	-1.064***	0.242	Welfare	-1.421***	0.159	Welfare	-0.606***	0.106
No welfare	0.654**	0.323	No welfare	-1.059***	0.207	No welfare	-0.770***	0.120
Observations				59,293				

Notes: Mixed logit regression with time treated as a random coefficient; *** significant at 1% level, ** significant at 5% level, *significant at 10% level. Income variables divided by 1,000 (€ - 1998). Time of work expressed in equivalent full-time months.

Table 4: Effects of the Reform: Comparison between the Discrete Choice Model and the Quasi-experimental Model

	All Women € - 1998	Low Educated (< 11 years of schooling) € - 1998	Medium Educated (11-12 years of schooling) € - 1998	Highly Educated (>12 years of schooling) € - 1998
Discrete Choice Model				
Whole reform	450	788	516	-176
(95% confidence interval)	(399,501)	(728,848)	(462,569)	(-215,-136)
Increased generosity	-835	-907	-861	-665
Age limit	115	15	156	130
Activity requirements	916	1,071	1,030	390
Observations	7,921	2,002	4,380	1,539
Quasi-experimental Model				
Reform	384	658	476	-79
(95% confidence interval)	(195,572)	(276,1040)	(238,714)	(-550,392)
Observations	1,121,898	207,808	633,870	358,294

Notes: The top section shows simulated effects of the whole reform with 95% confidence intervals and simulated effects of each policy parameter changed by the reform, predicted by using the estimated parameters of the discrete choice model. The bottom section shows estimated effects of the reform when using the quasi-experimental model, with 95% confidence intervals (see Mogstad and Pronzato, 2008).

Table 5: New Policy Scenarios

	Before the Reform	Actual Reform		Optimal Policy	
		Case 1	Case 2	Case 1	Case 2
Poverty (%)	11.8	8.6	9.4	7.2	9.0
Policy parameters					
Max amount (€-1998)	8,340	9,591		8,340	8,173
Withdrawal rate	40%	40%		24%	30%
Disregarded amount (€-1998)	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 (€ - 1998)	2,634	3,163	1,920	≤ 3,163	≤ 1,920

Notes: Case 1 - a lone mother, in order to be eligible for the benefit, is required to work part-time, seek work or be in training; Case 2 - a lone mother, in order to be eligible for the benefit, is required to work for a given amount of time.

Appendix

Table A1: 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 A2: Sensitivity Analyses

	All Women (€ - 1998)	Low Educated (€ - 1998)	Medium Educated (€ - 1998)	Highly Educated (€ - 1998)
Random Coefficients: Time (Table 4)				
Reform	450	788	516	-176
Increased generosity	-835	-907	-861	-665
Age limit	115	15	156	130
Activity requirements	916	1,071	1,030	390
No Random Coefficients				
Reform	797	1,328	846	-34
Increased generosity	-1,034	-1,034	-1,117	-797
Age limit	207	314	204	74
Activity requirements	1,431	1,945	1,537	459
Random Coefficients: Time, Income, Welfare				
Reform	416	704	482	-145
Increased generosity	-833	-894	-853	-698
Age limit	119	30	165	104
Activity requirements	915	1,079	1,034	365

Notes: Simulated effects of the reform when using different econometric specifications of the discrete choice model. The top section reports the estimates shown in Table 4, the middle section reports the estimates without unobserved heterogeneity, and the bottom section reports the estimates when allowing unobserved heterogeneity in time of work, income and welfare participation.