CPB Netherlands Bureau for Economic Policy Analysis

CPB Background Document | 27 November 2014

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November 2014

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Abstract

In this paper we present MICSIM. MICSIM is a behavioural microsimulation model for the analysis of structural labour supply effects of changes in the tax-benefit system in the Netherlands. The core of the model is a discrete choice model for labour supply. We estimate preferences for a large number of subgroups, using an exceptionally large and rich administrative household panel dataset. We find that men in couples have much smaller labour supply elasticities than women in couples, in particular when young children are present. Furthermore, cross-elasticities of women in couples are non-negligible. The labour supply elasticity is relatively high for single parents with young children, much lower for single parents with older children, and also relatively low for singles without children. The decision whether or not to participate is much more responsive to financial incentives than the hours per week decision, though for women in couples with young children the hours worked per week response is also relevant. We illustrate the workings of the model with a number of policy simulations. Because intensive margin responses are small, and cross-effects of the income of the husband on the labour supply of women are non-negligible, the impact of marginal tax rates on total hours worked of couples is limited. Because people are more responsive along the extensive margin, changes in the participation tax rate, via e.g. changes in social assistance and in the income dependent subsidy for families with children, have larger effects on total hours worked. An in-work tax credit targeted more at lower incomes is more effective in increasing labour supply than an across-the-board in-work tax credit. Fiscal incentives to work for mothers with young children are effective. Childcare subsidies are also an implicit subsidy for work for mothers with young children, but they are expensive from the perspective of the government because they encourage substitution of informal for formal care.

JEL codes: C25, C52, H31, J22
Keywords: labour supply, tax-benefit system, microsimulation, Netherlands

Contents

Preface

Building a behavioural microsimulation model for labour supply takes considerable effort and ingenuity of various people. During the project, we have benefitted greatly from contributions made by colleagues and from very helpful comments and suggestions by a large number of academics and policymakers. Below we want to thank a number of individuals and institutions in particular.

We are particularly grateful to the following (former) colleagues who have made contributions to the project: Leon Bettendorf, Nicole Bosch, Frank van Erp, Miriam Gielen, Mauro Mastrogiacomo, André Nibbelink and Mathijn Wilkens. Furthermore, within CPB we have also benefitted from comments and suggestions by Casper van Ewijk, Laura van Geest, Johannes Hers, Albert van der Horst, Arjan Lejour, Ruud de Mooij, Coen Teulings and Bas ter Weel.

We have benefitted from helpful comments and suggestions by the members of the scientific sounding board: Hans Bloemen (Free University Amsterdam), Stefan Boeters (CPB), Rob Euwals (CPB), Jan Kabatek (Tilburg University), Chris van Klaveren (Maastricht University), Arthur van Soest (Tilburg University), Jan Dirk Vlasblom (Social and Cultural Office) and Isolde Woittiez (Social and Cultural Office).

Furthermore, we have benefitted from helpful comments and suggestions by the members of the policymakers sounding board: Kees den Boogert (Ministry of Finance), Ayolt de Groot (Ministry of Economic Affaris), Theodoor de Jong (Ministry of Social Affairs and Employment), Patrick Koot (Ministry of Social Affairs and Employment), Jacco van Maldegem (Ministry of Economic Affairs), Pieter van Winden (Ministry of Social Affairs and Employment) and Roland Zwiers (Social Economic Councel).

Research visits to the IFS, IZA and Statistics Norway have been very useful, and we are particularly grateful to our respective hosts Richard Blundell, Andreas Peichl and Rolf Aaberge. We also acknowledge useful comments and suggestions from discussants and participants at various seminars, workshops and conferences, in particular those by participants of the CPB Workshop Behavioural Responses to Taxation and Optimal Tax Policy May 2013 in the Hague.

Finally, we thank Statistics Netherlands for the construction of the dataset

used in the empirical analysis, and the Ministry of Social Affairs and Employment for co-financing the construction of this data set.

1 Introduction

In setting taxes and transfers policymakers face the fundamental trade-off between equity and efficiency (Mirrlees, 1971). Redistribution from rich to poor households generates a more equitable income distribution but discourages labour supply. The response of labour supply to changes in financial incentives, traditionally measured by the wage elasticity of labour supply, plays a key role in the efficiency losses from redistributive taxes and transfers. Therefore, it is important to have good empirical knowledge of the labour supply responses to changes in financial incentives. Furthermore, we need to know the labour supply elasticities for a large number of subgroups, e.g. singles versus couples, household with versus households without children etc., and for different decision margins, e.g. the decision of whether or not to participate versus the decision of how many hours or days per week to work, to optimize taxes and transfers given their preferences for redistribution across demographic and income groups.

In this paper we present MICSIM. MICSIM is a behavioural microsimulation model for the analysis of changes in the Dutch tax-benefit system. For a given tax-benefit reform the model produces a large set of outcomes relevant for policymakers: i) the budgetary effects absent behavioural changes, ii) the redistributional effects absent behavioural changes, iii) changes in labour participation in persons, iv) changes in labour participation in hours, v) changes in labour productivity per hour, and vi) the knock-on effects of behavioural changes for the government budget.

The core of the model is a structural discrete choice model for labour supply. To estimate the structural parameters we exploit a very large and rich administrative household panel dataset for Dutch households, the *Arbeidsmarktpanel* (Labour Market Panel) of Statistics Netherlands (2012). The size of this dataset allows us to precisely estimate preferences over income, leisure and formal childcare (for young parents), and the corresponding labour supply elasticities, for a large number of subgroups. Many of these subgroups are not present in related studies or have to be pooled in the regressions because of insufficient data (e.g. Bargain et al., 2014). Furthermore, the data period covers a large reform of childcare subsidies and in-work tax credits, which generates large exogenous changes in financial incentives that strengthens the

identification of the structural parameters. We validate key behavioural responses of the structural model by comparing simulation results with the findings of a number of quasi-experimental studies.

The estimated preferences are then applied to another dataset, the *Inkomenspanelonderzoek* (Income Panel) of Statistics Netherlands. CPB already uses the Income Panel to determine the budgetary and redistributional effects of changes in the tax-benefit system (Romijn et al., 2008). The Income Panel panel is very rich when it comes to financial information. However, crucial information for estimating preferences relevant for labour supply is missing, such as education, or is only available in broad classes (age) or aggregated to the household level (total expenditures and use of formal daycare and out-of-school care). Furthermore, we do not have access to the panel dimension of the Income Panel on-site. Using the available information in both datasets we impute education, age and the use of formal childcare in the Income Panel. We then use 'static ageing' to make a projection for 2014, adjusting the weights to target the age and household composition in 2014, adjusting gross incomes for inflation, and updating the parameters of the tax-benefit system to 2014. For 2014 we then simulate tax-benefit reforms using the enriched Income Panel.

Our main findings are as follows. Regarding the empirical estimates, we find that men in couples have much smaller labour supply elasticities than women in couples, in particular when young children are present. Furthermore, cross-elasticities of women in couples are non-negligible. The labour supply elasticity is relatively high for single parents with young children, much lower for single parents with older children, and also relatively low for singles without children. The decision whether or not to participate is much more responsive to financial incentives than the hours per week decision, though for women in couples with young children the hours worked per week response is also relevant. Because intensive margin responses are small, and cross-effects of the income of the husband on the labour supply of the wife are non-negligible, the impact of marginal tax rates on total hours worked is limited. Furthermore, because people are more responsive along the extensive margin, changes in the participation tax rate, via e.g. changes in social assistance, have larger effects on total hours worked. An in-work tax credit targeted more at lower incomes is more effective in increasing labour supply than an across-the-board in-work tax

credit. Fiscal incentives to work for mothers with young children are particularly effective. Childcare subsidies are also an implicit subsidy for work for mothers with young children, but they are expensive from the perspective of the government because they encourage substitution of informal for formal care.

We build on a large body of literature using structural discrete choice models to study labour supply responses to changes in financial incentives (Van Soest, 1995; Keane and Moffitt, 1998; Aaberge et al., 1999; Blundell et al., 2000; Blundell and Shephard, 2012). An excellent, recent overview of labour supply elasticities can be found in Bargain et al. (2014). They estimate labour supply elasticities for a large number of countries and for several subgroups using a common methodology and comparable data across countries. As we will see below, our estimated labour supply elasiticities are in line with the results found by Bargain et al. (2014), but our much larger dataset allows us to capture much more heterogeneity in labour supply responses in subgroups. A large reform of the tax-benefit system in our dataset benefits the identification of the structural parameters. Indeed, our approach satisfies all the requirements set out by Meghir and Phillips (2010, p. 227) "[E]stimating incentive effects in a convincing way thus requires us to find solutions to all these problems at the same time. This calls for a sufficiently flexible approach, that allows for fixed costs of work, does not impose theory a priori everywhere in the sample (thus in a sense increasing model flexibility), uses exogenous changes to work incentives to identify their effect, and allows for taxes and benefits. This is of course a large set of requirements, but all have been shown to be important empirically; in our review of empirical results we will use these criteria to judge the value of the estimates." Furthermore, we also present a number of 'reality checks' (Blundell, 2012) on the behavioural responses of the structural model, by comparing the simulated behavioural responses of recent reforms with the findings of three quasi-experimental studies on the same reforms (Bettendorf et al., 2012, 2014; Bosch and Jongen, 2013). In this way we contribute to the small but growing literature that seeks to validate the behavioural responses in structural models using (quasi-)experimental methods (Todd and Wolpin, 2006; Hansen and Liu, 2011).

The outline of the paper is as follows. Section 2 develops the structural model and the empirical methodology. In Section 3 we discuss the dataset used

in the empirical analysis, the household types we distinguish and some definitions. Section 4 then discusses the estimated labour supply and childcare elasticities, the validation of the structural model using the results from quasi-experimental studies, and a comparison of the empirical results with the findings of related studies on Dutch data and abroad. In Section 5 we discuss how we integrate the estimated preferences of the Labour Market Panel in the simulation model where we use the Income Panel. In Section 6 we present simulation results for a number of hypothetical tax-benefit reforms. Finally, Section 7 discusses some potential limitations of the analysis and concludes. Additional material is included in various appendices.

2 Structural model and empirical methodology

Households are assumed to maximize a unitary household utility function. We outline the richest specification for couples below, where both partners choose their labour hours and the amount of formal childcare. We explicitly model the use of formal childcare for households with a youngest child 0–11 years of age. The utility functions for other household types (defined below) are a special case of this utility function. Specifically, the utility function for couples without children, or with a youngest child older than 11 years of age, is similar, but without the childcare choice. The model for single parents is similar, but without the partners' choice. And finally, the utility function for singles, for adult children living at home and for couples where one of the partner does not have a choice to participate on the labour market, is similar, but without the partners' choice and without the childcare choice.

The systematic part of household utility, U^s, depends on disposable income y, hours worked by the male h_m, hours worked by the female h_f, and hours of formal childcare c. The functional form of U^s is log-quadratic,

$$\begin{aligned} U^s(\nu) &= \nu'\mathbf{A}\nu + \mathbf{b}'\nu + \mathbf{d}'\mathbf{1}[\mu > \mathbf{0}], \\ &\quad \nu = (\log(y), \log(1 - h_m/T), \log(1 - h_f/T), \log(c)), \\ &\quad \mu = (h_m, h_f, c), \end{aligned} \tag{2.1}$$

with $\mathbf{A}$ being a symmetric matrix of quadratic coefficients and $\mathbf{b}$ being a vector of linear coefficients corresponding to the vector of the aforementioned variables ν.[1] The vector $\mathbf{d}$ captures fixed costs of work for men and women and fixed costs of using formal childcare. Since these fixed costs are specified in the utility metric, they represent an amalgamation of different factors such as intrinsic disutility from work, or market frictions and other costs related to job search and childcare use.

We allow for preference variation through observed individual and household characteristics $\mathbf{x}_2$, $\mathbf{x}_3$ and $\mathbf{x}_4$ in parameters b_2, b_3 and b_4

$$b_2 = \mathbf{x}'_2\beta_2, \quad b_3 = \mathbf{x}'_3\beta_3, \quad b_4 = \mathbf{x}'_4\beta_4, \tag{2.2}$$

[1] Note that the parental work variables h_m and h_f in the vector ν have been transformed into indicators of leisure utilization, representing the fraction of time endowment T which is spent on activities unrelated to work.

which are the linear utility terms in leisure of the male, leisure of the female, and hours of formal childcare, respectively. The same variation is also allowed for the fixed costs parameters **d** (for a full list of covariates per household type, see appendix C).

For some household types the full log-quadratic specification was too flexible, resulting in a significant share (>5%) of households with negative marginal utility of income in the observed choices. This drives down the labour supply elasticities to implausible values. To solve this problem we dropped the interaction terms between income and leisure for these household types. For some households we also obtained an 'inverted' pattern for the marginal utility of income, with a negative (log) linear term and a positive (log) quadratic term. This results in implausible income effects, and for these households we dropped the (log) quadratic term in income. Finally, for some household types the log-quadratic specification was not flexible enough. In particular, in some cases we do not capture the distribution of hours worked at the top very well, and we introduce a third order term for leisure, which then improves the fit at the top.

The budget constraint takes the following form

$$y = w_m h_m + w_f h_f - T(w_m, h_m, w_f, h_f; q) - TC(p_c c; q) + S(p_c, c, y_t; q), \quad (2.3)$$

where w_m and w_f denote the gross hourly wage for the male and the female,[2] $T(.)$ denotes taxes and employees' premiums, q denotes individual and household characteristics, $TC(.)$ is the total cost of formal childcare, with p_c denoting the price per hour of formal childcare, and $S(.)$ is the childcare subsidy, which depends on the hourly price of formal childcare, hours of formal childcare, taxable income y_t and household characteristics like the age distribution of the children.

Our econometric specification is based on a discrete choice model. Parents choose their preferred combination of hours of work and the hours of formal childcare from a finite set of alternatives $j \in \{1, ..., J\}$. Disposable household income depends on these choices, rising in hours worked and falling in formal childcare demanded. For workers we observe gross wages which are used to compute the work-related part of income for each alternative in their choice sets. For non-workers we estimate a Heckman-type wage equation which is used to

[2] We assume that the gross hourly wage does not depend on the hours worked.

simulate their wages. We account for wage heterogeneity by taking multiple draws from the wage error distribution. Similarly, for households that use formal childcare we use observed hourly prices of formal childcare, and for non-users we simulate hourly prices using the same estimation strategy as for hourly wages (a detailed description of both simulation exercises can be found in appendix A and B, respectively).

Next to the systematic part $U^s(\nu_j)$, the utility function also contains alternative-specific stochastic terms ε_j,

$$U(\nu_j) = U^s(\nu_j) + \varepsilon_j. \tag{2.4}$$

The stochastic terms are assumed to be i.i.d. across alternatives, and to be drawn from the Type 1 Extreme Value distribution. This leads to a multinomial logit specification of the discrete choice model.

For all household types we also estimated models where we allow for the possibility that families which are observationally equivalent might have different tastes for work and formal childcare, using the so-called latent classes approach.[3] We assume that there is a finite number K of latent household classes (or types), with households having homogeneous preferences within each class but heterogeneous preferences across classes. In practice, this means that we estimate a finite mixture model with K parametrizations of the utility function, corresponding to K distinct subsets of our data. All the preference parameters therefore become class-specific, which is equivalent to the assumption that they are drawn from a mass-point distribution. The full set of parameters to be estimated is then

$$\theta = (\theta_1, ..., \theta_K) = (\mathbf{A}_1, \mathbf{b}_1, \mathbf{d}_1, ..., \mathbf{A}_K, \mathbf{b}_K, \mathbf{d}_K). \tag{2.5}$$

Since the classes are by definition unobservable, we cannot determine whether a given household belongs to a specific class or not. Instead, we have to construct household-level probabilities of class membership $P_i(class = k)$, which reflect how likely is household i to be driven by the preferences corresponding to class k, conditional on the household's choices and other observable

[3] Limiting the distributional assumptions on unobserved heterogeneity by using mass points was pioneered by Heckman and Singer (1984). Recently, Train (2008) introduced a tractable way of estimating latent class discrete choice models using the EM-algorithm.

characteristics. These probabilities are then used as individual weights for a set of class-specific multinomial logit models with separate parameter vectors θ_k. The resulting log-likelihood function of the finite mixture model has the following form

$$\mathcal{L} = \sum_{i=1}^{I} \frac{1}{R} \sum_{r=1}^{R} \log \left(\sum_{k=1}^{K} P_i(class = k) \cdot \sum_{j=1}^{J} \left(\frac{\exp\left(U_{ij}^{s}(\nu_r, \theta_k)\right)}{\sum_{j'=1}^{J} \exp\left(U_{ij'}^{s}(\nu_r, \theta_k)\right)} \cdot D_{ij} \right) \right), \tag{2.6}$$

where R denotes the number of draws from the estimated wage and price equation for non-workers and non-users of formal childcare.[4] D_{ij} is an indicator function which takes the value 1 for the observed choice, and zero otherwise.

To solve the latent class models, we use the EM algorithm, as proposed by Train (2008). This approach has been chosen since the likelihood frontier is likely to violate global concavity, which renders the solution by conventional methods based on maximum likelihood practically infeasible.

For some household types the latent classes models work very well, in particular for couples with a youngest child 0–3 and 4-11 years of age (as we show below). However, for some household types the latent classes models produce implausible results, in particular for single parents, with a large share of negative marginal utility of income in the observed choices. For most of the other household types, labour supply responses are hardly affected when compared to the 'homogeneous' model with only 1 class. Based on these results we decided to use the latent classes models for couples with a youngest child 0–3 and 4–11 years of age, and the homogeneous specification for all other groups.

[4] The number of draws in our specification is 10, and it is kept relatively low to limit the computational complexity of the model.

3 Dataset for estimations: Labour Market Panel

3.1 Dataset

To estimate the preferences of the different household types we use the Labour Market Panel (in Dutch: *Arbeidsmarktpanel*) of Statistics Netherlands (2012). The backbone of the Labour Market Panel are the annual observations of the Labour Force Survey (in Dutch: *Enquete Beroepsbevolking*) for the period 1999–2009, which contains the education level of adult members of the household. Statistics Netherlands supplements this data set with three additional data sources. First, administrative data from municipalities for the period 1999–2009 (in Dutch: *Gemeentelijke Basisadministratie*) that contains information on individual and household characteristics like age, ethnicity, ages of the children and area of residence. Second, administrative data from the Social Statistical Panel for the period 1999–2009 (in Dutch: *Sociaal Statistisch Bestand*) on hours worked and gross income. Third, administrative data on formal childcare from the Formal Childcare Database of the Tax Office for the period 2006–2009 (in Dutch: *Wet Kinderopvangtoeslag*). With respect to formal childcare, a distinction is made between daycare (children 0–3 years of age) and out-of-school care (children 4–11 years of age).

We estimate a structural model for the simultaneous choice of labour supply and, if applicable, the use of formal childcare.[1] Because data on childcare in our data set is available from 2006 onwards, we restrict the sample to the period 2006–2009. Furthermore, formal childcare subsidies are available to parents up to the point where the child goes to secondary school. Therefore, we only allow households with a youngest child 0–11 years of age to choose formal childcare. For households without children, or with a youngest child 12 years of age or older, the childcare terms in the utility function drop out. We exclude households with missing information on individual or household characteristics. To limit the computational burden we take a 15% sample of the full data set after the selections made above. Furthermore, for couples with a youngest child 0–11 years of age, we take a 5% sample of the full data set, again to limit the

[1] Unfortunately, informal childcare is not in our administrative dataset. However, De Boer et al. (2014) show that including informal childcare, calculated as the overlap in working hours of parents minus the hours of formal childcare, does not affect the results.

computational burden.[2]

3.2 Household types

In the empirical analysis we distinguish between the following household types:

1. Singles without children
2. Single parents with a youngest child 0-3
3. Single parents with a youngest child 4-11
4. Single parents with a youngest child 12-17
5. Single parents with a youngest child 18 and older
6. Adult child living with their parent(s)
7. Couples without children where both adult partners can adjust their labour supply
8. Couples without children where only the man can adjust his labour supply
9. Couples without children where only the woman can adjust her labour supply
10. Couples with children where both partners can adjust their labour supply with a youngest child 0-3
11. Couples with children where both partners can adjust their labour supply with a youngest child 4-11
12. Couples with children where both partners can adjust their labour supply with a youngest child 12-17
13. Couples with children where both partners can adjust their labour supply with a youngest child 18 and older
14. Couples with children where only the man can adjust his labour supply
15. Couples with children where only the woman can adjust her labour supply

Individuals who adjust their labour supply in our model are individuals who are employed, on welfare benefits or without any income resources. We do not model and effectively ignore the labour supply of the following types of individuals: students, retired, disabled, self-employed. Below we will refer to these individuals as having 'inflexible' labour supply. We do not include these

[2] These households have more choice opportunities than other households, because they can also choose the amount of formal childcare they want to use.

individuals because we do not have reliable information on their hours worked, or because we are unable to determine their budget constraint. For now, we also drop individuals with unemployment benefits, implicitly assuming that they are constrained in their labour supply choice. Furthermore, we also drop same sex households. Finally, we drop individuals under 18 years of age, and individuals over 63 years of age.

3.3 Disposable income and net revenue

We use the tax-benefit model MIMOSI (Romijn et al., 2008) to calculate disposable income for each of the alternatives. MIMOSI is a highly advanced tax-benefit model employed by CPB to determine the redistributional and budgettary effects of reform proposals for the tax-benefit system. MIMOSI calculates the budget constraints very accurately, taking into account taxes, premiums and a large number of group specific, income independent and income dependent, subsidies and tax credits. Disposable income is defined as gross income after taxes, employees' premiums, the nominal health care fee, expenditures on formal childcare and inclusive of childcare subsidies. Disposable income in the utility function, in the estimations and simulations, is in 2006 prices.

We also use MIMOSI to calculate net revenue for the government for each of the alternatives. Net revenue is defined as gross wage income minus disposable income. We use gross wage income because we want to exclude changes in employers' premiums, which are largely 'benefit taxes'[3] in the Netherlands. Furthermore, in the net revenue calculation, disposable income excludes childcare costs but includes childcare subsidies. Hence, net revenue not only takes taxes and employees' premiums into account, but also the expenditures on social assistance and childcare subsidies.

[3] Employer's premiums are used for different types of benefits for employees, like unemployment and disability, and there is a link between the individual premium and the (potential) benefit received. In this case, more hours worked increase employers' premiums but also entitlements to future benefits.

4 Estimation results: Labour Market Panel

4.1 Labour supply elasticities

The estimated preferences are given in appendix C.[1] However, in discrete choice models, we do not have an analytical solution for the labour supply elasticity. This has to be simulated. We simulate these elasticities by increasing gross wages by 10%. Here, we present the total elasticity (the percentage change in total hours worked over the percentage change in the gross wage rate), and the decomposition of this total elasticity into the extensive margin elasticity (the percentage change in the participation rate over the percentage change in the gross wage rate) and the intensive margin (the percentage change in hours worked by the employed over the percentage change in the gross wage rate). Here we present the elasticities in graphs, the numbers can be found in Table 4.3 below.

Figure 4.1 gives the simulated labour supply elasticities for couples in which both partners can choose whether or not to work and for how many days per week. We estimate this for several subgroups, where subgroups are defined by the age of the youngest child, including a category for flexible couples without children. We find small, positive labour suppy elasticities for men, see panel (a). The labour supply elasticities are much higher for women, on the extensive margin but also on the intensive margin, see panel (b). Furthermore, the labour supply elasticities for women in couples are particularly high when the youngest child is 0–3 years of age (pre primary school age) or 4–11 years of age (primary school age).

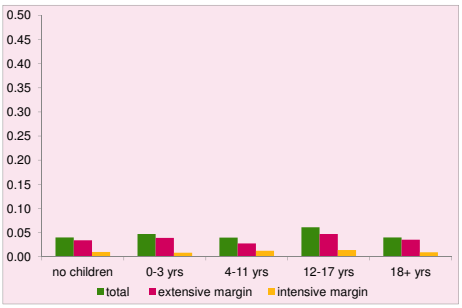
Figure 4.2 gives the so-called cross-elasticities, e.g. the percentage change in total hours worked by one partner over the percentage change in the gross wage rate of the other partner. Panel (a) shows that cross-elasticities are negative but close to zero for men. But for women, cross elasticities are non-negligible.

Next, Figure 4.3 panel (a) shows that the labour supply elasticity is relatively low for singles without children. The labour supply elasticity is much higher for single parents with young children. The labour supply elasticity of single parents whose youngest child is no longer in primary school is much lower, though still

[1] The fit of the hours distributions and annual gross wage distributions are given in Appendix D and E respectively.

Figure 4.1: Households with two flexible persons

(a) Men



(b) Women

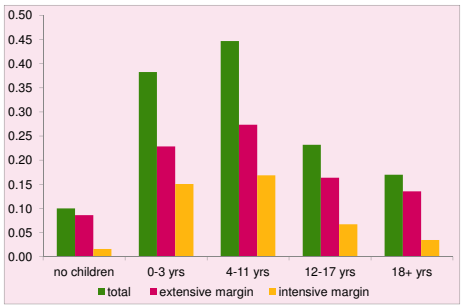
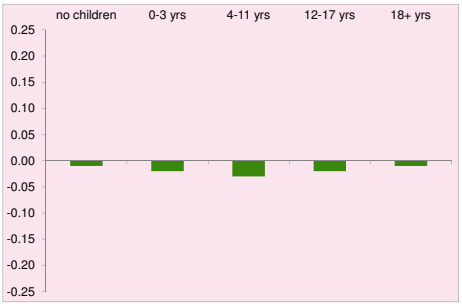


Figure 4.2: Cross elasticities in households with two flexible persons

(a) Men



(b) Women

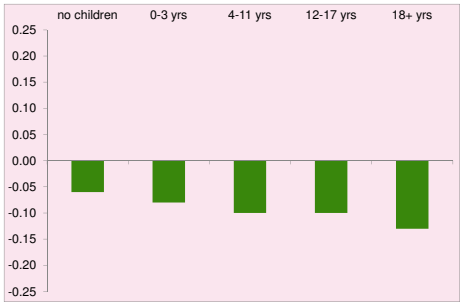
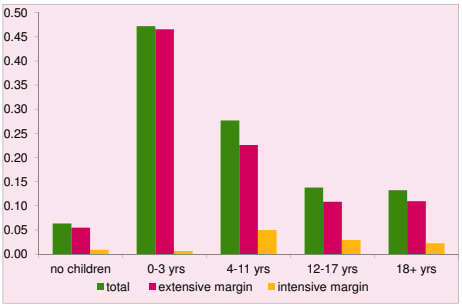
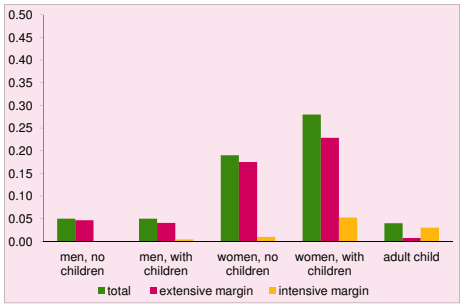


Figure 4.3: Households with one flexible person, and adult children

(a) Singles and single parents



(b) Individuals with an inflexible partner, and adult children living at home



higher than for singles without children. Also note that the differences across single parents are primarily driven by differences in the extensive margin elasticity. The intensive margin response for single parents is quite small.[2]

Panel (b) gives the labour supply elasticities for men and women in couples where one of the partners labour supply is inflexible (because this person is e.g. disabled or retired). For these groups we pool couples with children of all ages. Most men with an inflexible partner work, and typically also fulltime (see Appendix D). Hence, there is little upward potential in terms of total hours worked, and they have a relatively low labour supply elasticity. For women there is more upward potential in total hours worked, both in terms of the participation rate and in terms of hours worked per employed. Women with an inflexible partner have a higher labour supply elasticity, in particular on the extensive margin. Panel (b) also gives the labour supply elasticity for adult children living at the home of their parents. They have a very high participation rate (when they are not disabled etc.), resulting in a very low labour supply elasticity.

Below we present a comparison of predictions by the structural model with the findings from three recent quasi-experimental studies. Next, we consider how our results compare to the findings of related studies for the Netherlands, and to the findings of related studies abroad.

4.2 Comparison with results quasi-experimental studies

There is a small but growing literature that evaluates the performance of structural models by comparing simulated policy responses with the results from quasi-experimental studies (Todd and Wolpin, 2006; Hansen and Liu, 2011; Geyer et al., 2014). In this section we present three such comparisons: i) one for couples with a youngest child 0–3 and 4–11 years of age, ii) one for single parents with a youngest child 12–15 years of age, and iii) one for the intensive margin responses for broad classes of household types.

[2] Their budget constraint plays an important role here, where working only a few days per week often does not generate net income higher than net income out of work.

Couples with children 0–3 and 4–11 years of age

In Table 4.1 we present a test of our structural model for couples with a youngest child 0–3 and 4-11 years of age.[3] Bettendorf et al. (2012) use difference-in-differences (DD) to analyse the employment effects of a combination of reforms targeted at households with children 0–11 years of age. Specifically, over the period 2005–2009 there was an increase in childcare subsidies (the additional budgetary spending was $\approx$ 2 billion euro), an increase in an in-work benefit for secondary earners with children 0–11 years of age (the additional budgetary spending was $\approx$ 1 billion euro), and the in-work benefit for both primary and secondary earners with children 0–11 years of age was abolished (the budgetary cut was $\approx$ 0.5 billion euro). See Bettendorf et al. (2012) for a detailed description of the reforms. The identification in Bettendorf et al. (2012) comes mostly from the intertemporal dimension, using a before–after comparison with data for the period 1995–2009. The identification in our analysis comes in part from intertemporal variation from the policy reforms in the period 2006–2009, but in part also from the cross-sectional variation. Bettendorf et al. (2012) present estimation results for mothers in couples with a youngest child 0–11 years of age. Furthermore, they report effects for mothers with a youngest child 0–3, 4–7 and 8–11 of age, but this includes single mothers. To make the comparison with the DD as clean as possible, we used the same sample as Bettendorf et al. (2012) to estimate responses for the subgroups we consider in the empirical analysis, that is men and women in couples with a youngest child 0–3 or 4–11 years of age. The results are given in Table 4.1, along with the simulation results for the estimated structural model.

Table 4.1 shows that the results for the structural model are very much in line with the results of the DD analysis for mothers. Indeed, we can not reject that the DD estimates for the effect on hours worked and participation of mothers are equal to the simulated effects. The estimated effects on the participation rate of fathers is again very much in line with the prediction from the structural model, and we can not reject that they are the same. For the intensive margin, for fathers with a youngest child 4–11 years of age, the DD analysis suggests a smaller negative effect on hours worked per week by the

[3] This comparison draws on De Boer et al. (2014).

Table 4.1: Quasi-experimental check: couples with young children

	Structural model				DD analysis[a]	
	Childcare subsidies	Combi. Credit	Income-Depend. Combi. Credit	Total	Coefficient	SE
Model with latent classes			Changes in levels			
Youngest child 0–3 yrs						
Participation rate women	0.017	–0.005	0.018	0.030	0.020	0.007
Hours worked per week women	0.693	–0.098	0.566	1.185	1.222	0.223
Participation rate men	0.003	–0.002	0.003	0.004	0.006	0.004
Hours worked per week men	0.059	–0.017	0.024	0.075	–0.509	0.237
Youngest child 4–11 yrs						
Participation rate women	0.004	–0.008	0.020	0.017	0.022	0.007
Hours worked per week women	0.173	–0.133	0.566	0.616	0.750	0.221
Participation rate men	0.000	–0.001	0.002	0.001	0.003	0.004
Hours worked per week men	0.016	0.005	–0.027	-0.001	–0.180	0.234
Model without latent classes						
Youngest child 0–3 yrs						
Participation rate women	0.017	–0.005	0.018	0.030	0.020	0.007
Hours worked per week women	0.671	–0.091	0.549	1.147	1.222	0.223
Participation rate men	0.003	–0.002	0.003	0.004	0.006	0.004
Hours worked per week men	0.069	–0.030	0.045	0.091	–0.509	0.237
Youngest child 4–11 yrs						
Participation rate women	0.002	–0.004	0.015	0.013	0.022	0.007
Hours worked per week women	0.101	–0.078	0.418	0.445	0.750	0.221
Participation rate men	0.000	–0.001	0.003	0.002	0.003	0.004
Hours worked per week men	0.020	–0.029	0.061	0.056	–0.180	0.234

[a] Additional estimates on the same sample as Bettendorf et al. (2012), full regression results available on request.

employed than the structural model, although the coefficient is not significantly different from the prediction of the structural model. The only coefficient of the DD analysis which differs significantly from the prediction of the structural model is the intensive margin response by fathers with a youngest child 0–3 years of age, for which the DD analysis suggests a larger, negative response than the structural model.

Table 4.1 also shows the predictions of the structural model when we do not allow for latent classes. In this case the predictions of the structural model move away from the DD estimates, in particular for hours worked per week by women in couples with a youngest child 4–11 years of age. Hence, a comparison with the DD analysis seems to favour a model with latent classes over a model without latent classes for this group.

Single parents with a youngest child 12–15 years of age

In Table 4.2 we present a test of our structural model for single parents with a youngest child 12–15 years of age. Bettendorf et al. (2014) use DD and regression discontinuity (RD) to study the impact of an in-work benefit targeted at single parents. Specifically, in 2002 the target group for this in-work benefit was extended from single parents with a youngest child 0–11 years of age to single parents with a youngest child 0–15 years of age. The upshot of the analysis is that they find a small effect on labour participation, both for the DD analysis and the RD analysis, not significantly different from zero. As shown by Bettendorf et al. (2014), this is at odds with most of the quasi-experimental studies on in-work benefits for single parents. Indeed, that single parents are relatively responsive to changes in financial incentives is considered a stylized fact in the empirical labour supply literature (Meghir and Phillips, 2010).

Bettendorf et al. (2014) offer a number of explanations for their result. In particular, they show that using singles as the control group for single parents is problematic, since they differ in trend growth in participation rates and in observable characteristics (and hence presumably also in unobservable characteristics). Using singles as the control group for single parents leads to an upward bias of the treatment effect. More important here is that they also suggest that differences may be partly the result of the age of the youngest child

Table 4.2: Quasi-experimental check: single parents

	Structural model	DD analysis[a]		RD analysis[a]	
		Coefficient	SE	Coefficient	SE
Participation rate		Changes in levels			
Youngest child 12–15 yrs	–0.006	0.004	0.006	0.004	0.011
Youngest child 4–11 yrs	–0.014				
Youngest child 0–3 yrs	–0.027				

[a] For details of the DD and RD results, see Bettendorf et al. (2014).

of the treatment group. Whereas other studies consider the treatment effect on all single mothers, including those with a relatively young child, Bettendorf et al. (2014) can only study the effect on single mothers with a youngest child 12–15 years of age. The pre-reform participation rate of single mothers with a youngest child 12–15 years of age is already relatively high to start with, which limits the upward potential for further increases in labour participation. We can use the structural model to investigate to what extent the age of the youngest child makes a difference.

Table 4.2 shows the effect of abolishing the in-work benefit targeted at single parents.[4] We simulate the effect on the participation rate[5] of single parents with a youngest child 0–3, 4–11 and 12–15 years of age. We see that whereas the effect on the participation rate of –2.7%-points is quite sizeable for single parents with a youngest child 0–3 years of age, the effect drops to –1.4%-points for single parents with a youngest child 4–11 years of age, and to –0.6%-points for single parents with a youngest child 12–15 years of age. Indeed, single parents with an older youngest child are already much less responsive to financial incentives than single parents with a young child. Finally, note that the simulated effect for

[4] In 2010, 81% of single parents was female. The permanent residence of most children of single parents is the mother's residence.

[5] Bettendorf et al. (2014) do not consider the effect of the reform on hours worked (due to missing data issues). However, to study the effect on the intensive margin, in the supplementary material they report the treatment effect (Bettendorf et al., 2014, Table A.9) on the log of taxable labour income. Also for taxable labour income they find a treatment effect that is small and not significantly different from zero. The structural model also predicts a small effect on the intensive margin.

single parents with a youngest child 12–15 years of age is not significantly different from the estimated coefficient in the DD and RD analysis in Bettendorf et al. (2014).

Intensive margin responses

The top of Table 4.3 gives labour supply elasticities for several subgroups in our study. An important outcome of the empirical analysis is that intensive margin responses are much smaller than extensive margin responses. We can compare this prediction with the results of Bosch and Jongen (2013). They use the 2001 tax reform, which generated large heterogeneous variation in marginal tax rates, to estimate intensive margin elasticities for men and women in couples, single men and women, and single mothers. They use the DD method developed in Blundell et al. (1998), and instrument net wages by education-cohort-period dummies where the 2001 tax reform generates the exogenous variation over education-cohort groups.

Consistent with the structural model, for men in couples they find very low intensive margin responses, not significantly different from zero (point estimate 0.00, standard error 0.01). For women in couples, they find elasticities that are significantly different from zero,[6] with a point estimate of 0.15 and a standard error of 0.06. This is in line with the response at the intensive margin for women with young children in the structural model, and somewhat higher than for the other groups of women in couples. However, the comparison is somewhat complicated by the fact that for the structural model we present gross wage elasticities, and for the DD analysis we present net wage elasticities, and the latter are typically higher (Bargain et al., 2014). Furthermore, the intensive margin response in the structural model also potentially captures a composition effect if new entrants work different hours than incumbents (this problem is essentially absent for men, whose working hours are much less dispersed when they work). For singles and single parents Bosch and Jongen (2013) find somewhat higher intensive margin elasticities, running from 0.15 to 0.20, than in

[6] Bosch and van der Klaauw (2012) apply the estimator of Blundell et al. (1998) to estimate the intensive margin responses for women in couples, using data from the Labour Force Survey. They find a coefficient insignificantly different from zero.

the structural model. But again the comparison is complicated by the difference in gross and net wage elasticities, and a potential composition effect.

4.3 Comparison with results related studies for the Netherlands

Table 4.3 gives an overview of structural empirical labour supply studies using Dutch data. For comparability we limit the overview to studies from 2000 onwards, older studies used data from the 1980s, when the participation rate of women were much lower. This table underscores the value added of our analysis. We use a much larger data set than previous studies, which enables to estimate preferences of subgroups more precisely and enables us to also study subgroups that have received little attention in previous studies (like singles and single parents). Furthermore, previous studies have relied mostly on data from the 1990s (and 1980s), when participation rates were much lower, whereas we use data from 2006–2009. With less upward potential along the extensive margin, this drives down labour supply elasticities (Blau and Kahn, 2007; Heim, 2007; Bargain and Peichl, 2013; Bargain et al., 2014). It is important to take this into account when considering the effects of policy changes in a recent or future context.

We compare our elasticities to the results from related studies. We compare the results for the findings for the (own) wage elasticity of total hours worked, the participation rate and hours per employed. Most studies focus on couples, we consider this group first. We find small elasticities for total hours for men in couples, both with and without children. This is in line with the other studies. Also, for men in couples we find an intensive margin elasticity close to zero, again in line with the other studies. We find larger elasticities for women in couples. Our results are somewhat below the results of the recent studies, using more recent data, and substantially below the results of the older studies, using older data. The higher participation rate of women in couples in our more recent data set is likely to play an important role here. In line with the other studies we typically find that most of the response is on the extensive margin.

The studies also report information on cross elasticities in couples (not in the table). We find negligible cross elasticities for men in couples, but sizeable cross elasticities for women in couples. Van Soest and Das (2001) also find

Table 4.3: Estimates of labour supply elasticities for the Netherlands

Study	Sample	Data period	Indiv.	Total hours		Participation		Hours per employed	
				Men	Women	Men	Women	Men	Women
This study	Couples without children	2006–2009	13,066	0.04	0.10	0.03	0.09	0.01	0.02
	Couples, young. child 0–3	2006–2009	8,332	0.05	0.38	0.04	0.23	0.01	0.15
	Couples, young. child 4–11	2006–2009	10,024	0.04	0.45	0.03	0.27	0.01	0.17
	Couples, young. child 12–17	2006–2009	11,750	0.06	0.23	0.05	0.16	0.01	0.07
	Couples, young. child 18+	2006–2009	10,912	0.04	0.17	0.04	0.14	0.01	0.03
	Singles without children	2006–2009	30,383	0.06	0.07	0.05	0.06	0.01	0.01
	Single parents, young. child 0–3	2006–2009	4,171	0.31	0.48	0.34	0.47	–0.03	0.01
	Single parents, young. child 4–11	2006–2009	14,793	0.22	0.28	0.18	0.23	0.04	0.05
	Single parents, young. child 12–17	2006–2009	20,767	0.12	0.14	0.09	0.11	0.02	0.03
	Single parents, young. child 18+	2006–2009	9,171	0.11	0.14	0.10	0.11	0.02	0.02
	Couples, inflex. partner w/o chd	2006–2009	6,831	0.05	0.19	0.05	0.17	0.00	0.01
	Couples, inflex. partner w/ chd	2006–2009	20,232	0.05	0.28	0.04	0.23	0.00	0.05
	Adult children living at home	2006–2009	25,088	0.03	0.05	0.01	0.01	0.03	0.04
Vlasblom et al. (2001)[a]	Couples	{1985,1992}	1,856		0.42		0.35		
Van Soest and Das (2001)	Couples	1995	4,017	0.08	0.71				
Van Soest et al. (2002)[b]	Couples	1995	1,794		1.04		0.44		
Vermeulen (2005)[c]	Couples w/o children	1995-2003	680					–0.03	0.27
	Singles	1995-2003	1,430					0.01	0.00
Bloemen and Kapteyn (2008)[d]	Couples	1985	849		0.42		0.25		
Bloemen (2009)[e]	Unmarried couples w/o children	1990-2001	2,491	0.24	0.22				
	Married couples w/o children	1990-2001	5,558	–0.06	0.61				
Bloemen (2010)[f]	Couples w/o children	1990-2001	8,049			–0.02	0.31	0.00	0.26
Bargain et al. (2014)[g]	Couples	1998	1,806	0.06	0.32	0.06	0.20	0.01	0.13
	Singles and single parents	1998	900	0.08	0.16	0.08	0.11	0.01	0.02

[a] Elasticities are reported in Vlasblom (1998, Table 5.12). [b] Van Soest et al. (2002, Table 2), estimates with second order polynomial for the utility function. The participation elasticity in Van Soest et al. (2002) is the change in percentage points in response to a 1% increase in the wage rate. [c] Vermeulen (2005, Table 7), unitary model for couples (own wage elasticities). [d] Average of the estimation results of the variant with simulated scores and the variant with discrete choices and a third order polynomial utility function, as reported in Bloemen (2010, p. 27). [e] Bloemen (2009, Table 7), reduced form estimates. [f] Bloemen (2010, Table 8), with unrestricted sharing rule and fixed costs. [g] Bargain et al. (2014, Table A8–A11), results for the Netherlands. Intensive margin elasticities are for individuals employed in the data only ('pure intensive margin').

substantial cross elasticities for women in couples (about half of their own wage elasticity), but not for men in couples. Van Soest *et al.* (2002) also report nonnegligible cross elasticities for women in couples (–0.1). Vermeulen (2005) finds nonnegligible cross elasticities on the intensive margin for both men (–0.1) and women (–0.1). Bloemen (2009) finds small cross elasticities for men in couples without children, but somewhat larger cross elasticities for women in couples without children (–0.1 for unmarried couples and –0.2 for married couples). Bloemen (2010) also finds small cross elasticities for men and somewhat bigger cross elasticities for women in some specifications. Hence, our simulated cross elasticities are in line with those found in related studies.

Only two studies consider singles, using rather small data sets.[7] Vermeulen (2005) estimates very small intensive margin elasticities for both single men and women (without children), as do we. He does not study the effect on the extensive margin. Bargain et al. (2014) find a total hours elasticity of 0.08 respectively 0.16 for single men and women, with and without children. This is in between our results for singles and single parents. Furthermore, they find that most of the response is on the extensive margin, as do we.

4.4 Comparison with results related studies on other countries

Next, we compare our estimated labour supply elasticities with estimated labour supply elasticities abroad. Excellent surveys of the labour supply elasticity in a large number of countries can be found in Blundell and MaCurdy (1999), Bargain and Peichl (2013) and the recent estimates presented in Bargain et al. (2014). We compare our results with the recent estimates for Europe and the US in Bargain et al. (2014).

Bargain et al. (2014) find that for married women the total hours elasticity ranges from 0.1 to 0.6 across countries (with a mean of 0.27). Our estimates for women in couples with young children fall in this range. The estimates for

[7] Not included in Table 4.3 is the study by Euwals and Van Soest (1999) on singles and single parents, since it was published before 2000 (and uses data from the 1980s). In the specification that is closest to ours (Euwals and Van Soest, 1999, Table 8, Column 1) they find a total hours elasticity of 0.15 for single men and 0.19 for single women (due to the limited number of observations they pool the data for these groups in the estimations). This is in between our results for singles and single parents.

women in couples with older children or no children are somewhat lower. However, the participation rate of women in the Netherlands is relatively high from an international point of view. For married men, the total hours elasticity ranges from 0.05 to 0.15 across countries (with a mean of 0.10). Our estimates for men in couples without and with children are on the lower end of this range. For single men Bargain et al. (2014) find a total hours elasticity ranging from of 0.0 to 0.4 (and some even higher). For single women they find an elasticity ranging from 0.1 to 0.5 (and again some even higher). Our estimates for singles are on the lower end of this range, and our results for single parents are more in the middle and upper part. Bargain et al. (2014) find that the extensive margin elasticity is typically (much) more important than the intensive margin elasticity, which is what we find as well. They also find that cross elasticities for women in couples are non-negligible, and are close to zero for men in couples. This is what we find as well.

4.5 Formal childcare elasticities

We explicitly model the choice of formal childcare for households with a youngest child 0-3 and 4-11 years of age. We consider the price elasticity of childcare when we increase the gross price of formal childcare by 10%. To make the results comparable with the literature, we calculate the elasticity of the use of formal childcare with respect to the change in net parental fee for formal care.[8]

For couples with a youngest child 0–3 years of age we find a price elasticity of –0.42. The extensive margin elasticity (whether or not to use formal childcare) is –0.28 and the intensive margin elasticity (hours of formal childcare per week) is –0.15. For couples with a youngest child 4–11 years of age we find somewhat higher elasticities: total elasticity –0.60, extensive elasticity –0.48, intensive elasticity –0.13.[9] The price elasticity for single parents is much lower. –0.13 for single parents with a youngest child 0–3 years of age, and –0.07 for

[8] Hence, we calculate the percentage change in the parental fee that corresponds to the percentage change in the gross hourly price. The two are not equal because parents receive a subsidy only up to a maximum price.

[9] To the best of our knowledge, this is the first price elasticity estimate for parents using out-of-school care.

single parents with a youngest child 4–11 years of age.[10]

[10] This may be due to their low initial parental fee. The subsidy rate is much higher for low household incomes.

5 Transition to Income Panel

We estimate the preferences of the different household types using the Labour Market Panel. However, CPB uses the Income Panel of Statistics Netherlands to calculate the budgetary and redistributional effects of proposals for tax-benefit reform (Romijn et al., 2008). To have one model to generate all the relevant output we integrate the discrete choice model for labour supply and formal childcare with the tax-benefit calculator using the Income Panel.

The first step is to construct all the relevant variables for the labour supply module for the Income Panel. In the Income Panel we do not have education.[1] We impute education in the Income Panel using demographic characteristics observed in both the Income Panel (for the year 2010) and the Labour Market Panel (for the year 2009, the last year of the panel). Details are given in Appendix F. For the employed we also include hourly wages as an explanatory variable next to the demographic variables. We divide education in three classes (low, middle and high) and estimate ordered logit models on the Labour Market Panel. We estimate models separately for the different household types (and sexes in couples). We then use the estimated equations and the demographics and hourly wages observed in the Income Panel to impute education. The resulting education distribution per household type is very similar to the Labour Market Panel, see Table F.2. However, there are minor differences, which are inevitable given the (apparent) sampling variation in the characteristics (both datasets are respresentative samples of the Dutch population using the respective weights supplied by Statistics Netherlands).

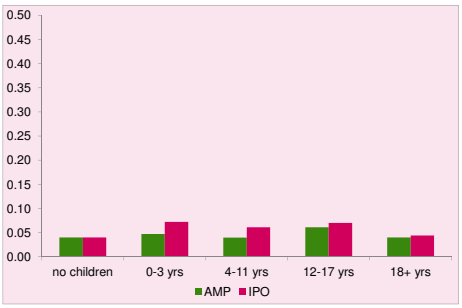
For workers we observe the hourly gross wage in the Income Panel. For non-workers we need to impute (potential) hourly gross wages. We use the estimated wage equations of Appendix A of the Labour Market Panel (applying the appropriate inflation correction) to impute wages, taking into account the imputed education level. This guarantees that education and wages have the correlation in the data.

For users of formal childcare we observe the hourly gross price. For

[1] Other challenges are that we have age only in classes of 5 years, and formal childcare is aggregated to household totals for daycare and out-of-school care. We assume that all the children of pre-primary school age in a family use the same daycare, and all the children of primary school age in a family use the same out-of-school care.

Figure 5.1: Labour supply elasticities households with two flexible persons

(a) Men



(b) Women

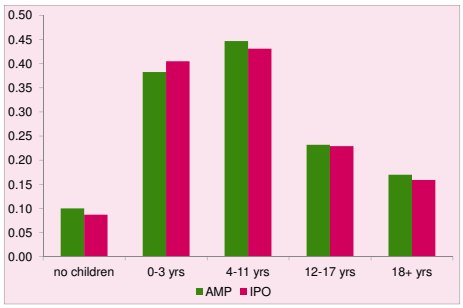
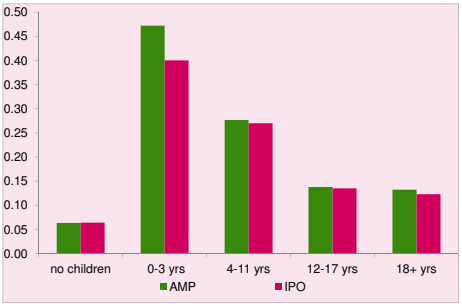
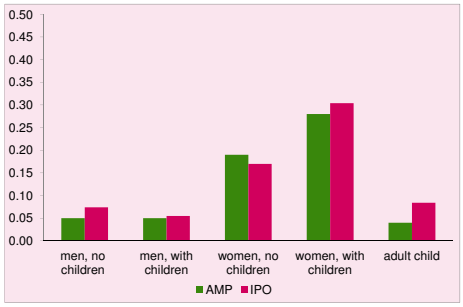


Figure 5.2: Labour supply elasticities households with one flexible person, and adult children

(a) Singles and single parents



(b) Individuals with inflexible partner, and adult children living at home



non-users we impute the (potential) hourly gross price. We use the estimated price equations of Appendix B of the Labour Market Panel.

We then have an enriched version of the Income Panel dataset, which we can use to simulate labour supply and formal childcare use. However, we then want to simulate policy changes in a later year. Below we will consider 2014. We use 'static ageing' to generate a dataset for 2014 that is consistent with the demographic projection from Statistics Netherlands. We uprate all the price and income variables to 2014 (keeping the real values relevant for utility in 2006 prices). Finally, we update the parameters of the tax-benefit system to 2014.

We then compare the behavioural responses using the enriched and uprated Income Panel for 2014 with the behavioural responses using data from the Labour Market Panel for 2007. The resulting labour supply elasticities are given in Figure 5.1 and 5.2. The labour supply elasticities are remarkably similar.[2] The predicted hours distributions are also very similar, see Appendix G. The gross wage distribution is 'shifted to the right' when we compare the Income Panel uprated to 2014 with data from the Labour Market Panel for 2007, as we might expect (see Appendix H). There has been some increase in gross wages over the period 2007–2014.

[2] The proverbial exceptions are single parents with a youngest child 0–3 years of age and adult children living at home, which differ to some extent in their observed characteristics, see Appendix F.

6 Policy simulations: Income Panel

To illustrate the workings of the model, we present three sets of policy simulations. In the first set we consider changes in tax bracket rates, in the second set we consider changes in welfare benefits and in-work tax credits, and in the third set we consider changes in subsidies and tax credits for working parents. All simulations are for 2014. In the simulation results, income and substitution effects drive the behavioural responses. Before we turn to the numerical results, it is instructive to briefly consider these effects in a stylized model.

6.1 Income and substitution effects

To illustrate the role played by income and substitution effects, we consider a stylized model of the labour supply decision, see Figure 6.1. For simplicity we show the labour supply decision for a single person, who can choose from a continuous number of hours of work, and faces a linear budget constraint. The same mechanisms are at work in our discrete choice model, with choices in up to three dimensions, and with much more complicated budget constraints.

The individual maximizes utility by choosing the optimal number of leisure days during the working week. Figure 6.1 shows indifference curves, combinations of income and leisure that generate the same level of utility. Utility increases in both income and leisure, and indifference curves further away from the origin are therefore associated with higher utility. Furthermore, there are diminishing returns to income and leisure in utility. To keep the same level of utility, the individual requires an increasing amount of income (leisure) for each additional unit of leisure (income) they give up (the indifference curves 'bend away' from the axes). Figure 6.1 also shows the budget constraint for this individual in the base. When the individual does not work, 5 days of leisure, she receives some income from the government (e.g. welfare benefits). When she starts to work, her income grows linearly with the amount of time worked. The optimal amount of leisure in this example is 3 days per week. At this amount of leisure, the marginal utility gain of income from working one more hour is equal to the marginal utility loss of losing one more hour of leisure.

Now consider what happens when we introduce a lump-sum subsidy,

Figure 6.1: Base

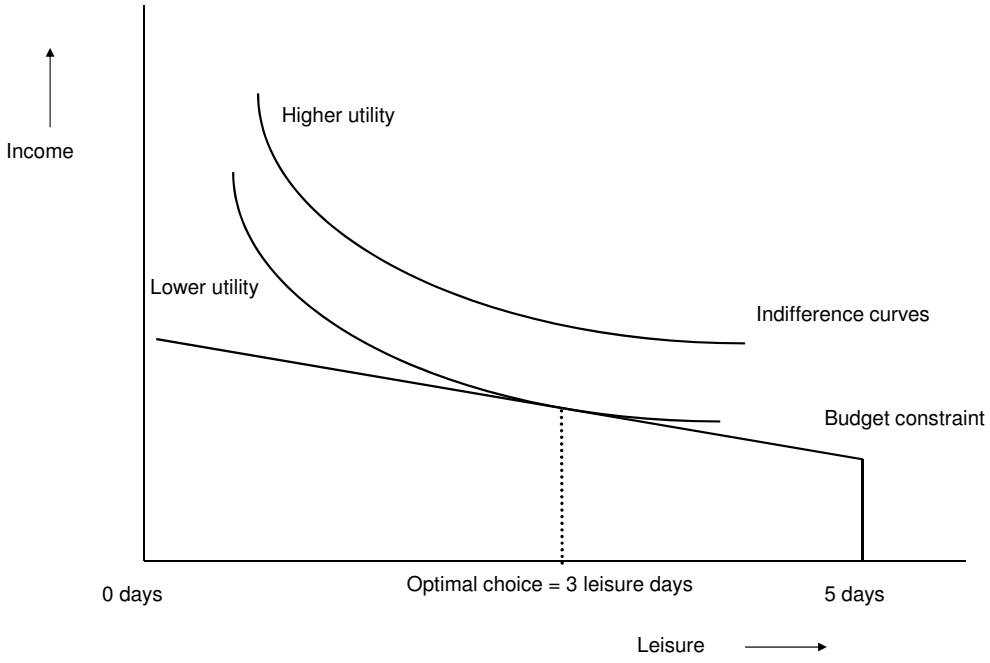


Figure 6.2: Income effect

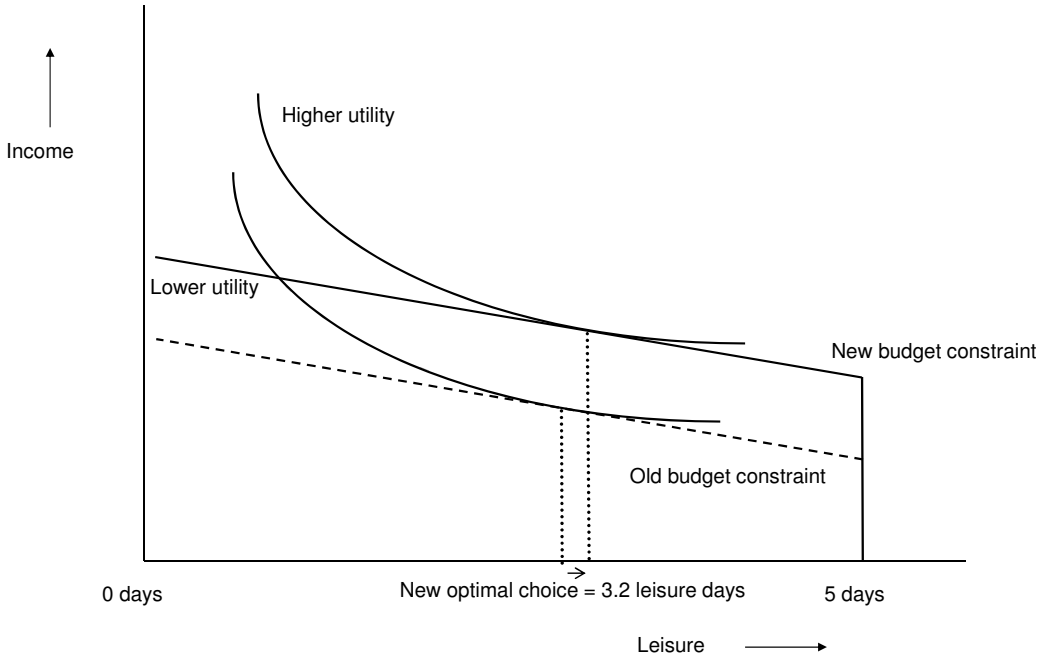


Figure 6.3: Income and substitution effect

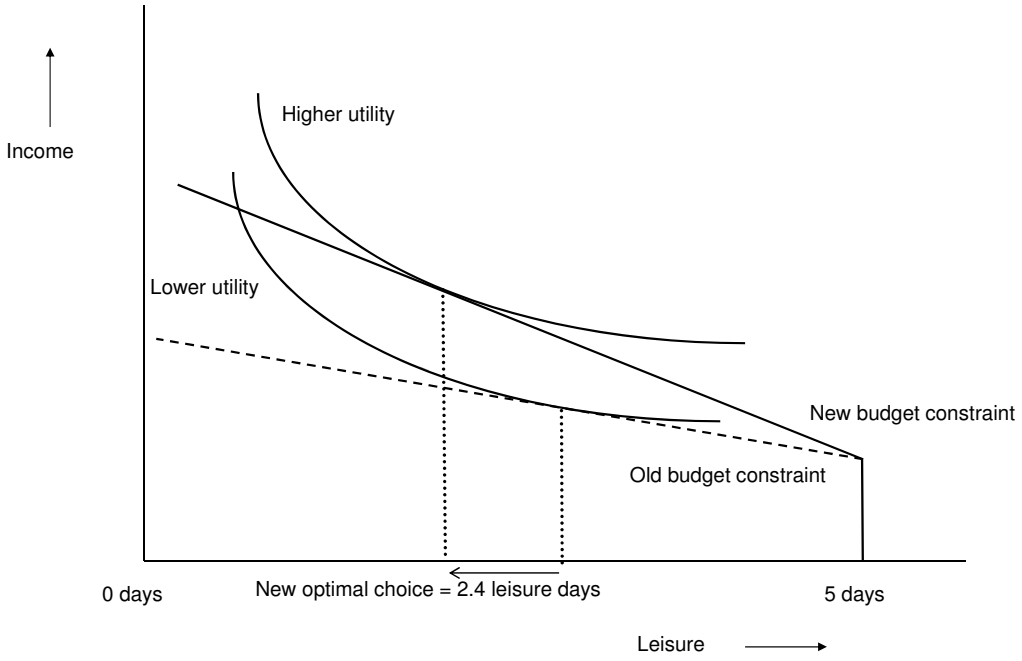
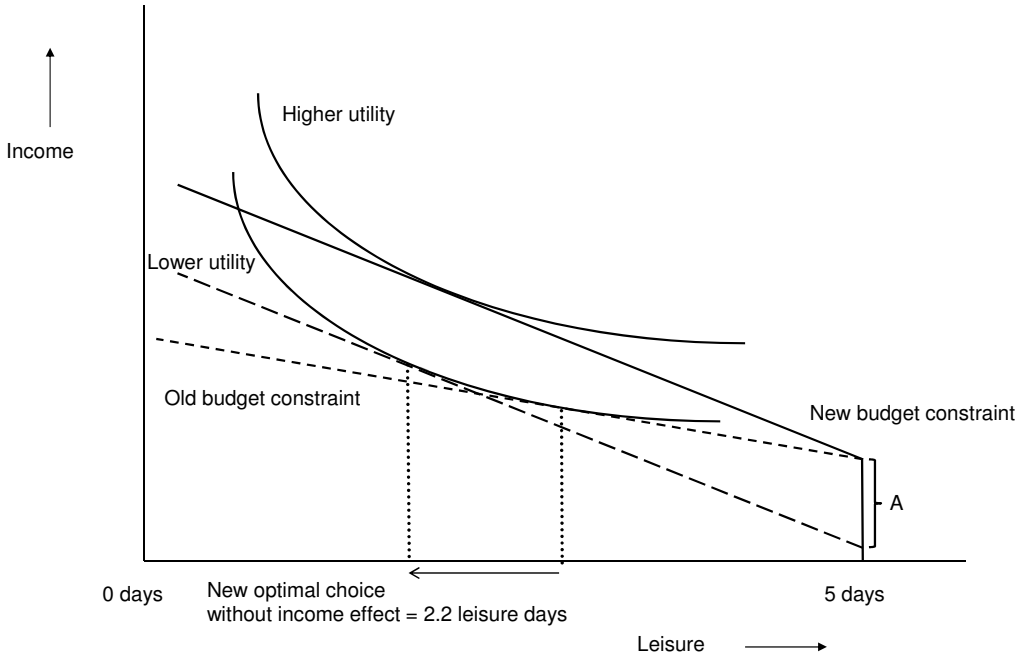


Figure 6.4: Substitution effect



independent of income or days of leisure, see Figure 6.2. The budget constraint shifts up and the individual faces a new budget constraint. With higher income to start with, the marginal utility of additional income decreases somewhat at each level of leisure. The individual again chooses leisure so that the marginal utility gain of income from working one more hour is equal to the marginal utility loss of losing one more hour of leisure, and this will be at a somewhat higher level of leisure. In the example, the individual now chooses 3.2 leisure days per week, and thus works 0.2 days per week less.

In couples, income effects may also come from the partner. The marginal value of an additional unit of income depends on joint income. Hence, when the income of the male increases, this will generate an income effect on the labour supply of females in couples. Finally, we note that although income effects on labour supply are typically small, this is not always the case. In particular, for individuals with low initial income, income effects may be larger. Indeed, the gain in utility loss of giving 100 euro may be much larger for e.g. single parents on welfare benefits than for working single parents.

Next, we consider a reform that generates both income and substitution effects. Suppose that we lower a proportional tax on income earned, see Figure 6.3. This changes the slope of the budget constraint. The individual now faces a new budget constraint. The individual again maximizes utility by equating the marginal utility gain of additional income from working an extra hour and the corresponding utility loss of giving up an additional hour of leisure. The new optimum has 2.4 days of leisure per week, and the individual works 0.6 day per week more than when facing the old budget constraint. We can decompose the total effect on hours worked into a (positive) substitution effect and an (negative) income effect. The substitution effect comes from the change in the slope of the budget constraint at the optimal point, as the marginal income gain from working an extra hour increases. We can isolate the substitution effect from the income effect, by putting the individual back on the initial utility level at the new slope of the budget constraint (the new 'relative prices'), budget constraint in Figure 6.4. When facing budget constraint, the individual would choose a bit less leisure, 2.2 days per week. But facing the new budget constraint, the individual also pays the lower proportional tax on inframarginal earned income, so that income rises at each amount of leisure. This slightly

lowers the marginal utility of an additional unit of income. As a result, the individual chooses 2.4 days of leisure per week under new budget constraint, rather than 2.2 days per week, due to the income effect.

Empirically, substitution effects are typically larger than income effects, and hours worked rise as marginal tax rates fall. Also note that when we lower marginal tax rates over only part of earned income, this will increase the income effect relative to the substitution effect. Indeed, consider an individual with income just at the start of the fourth tax bracket. For this individual, lowering the tax rate in the fourth tax bracket has a substitution effect, but no income effect.

6.2 Changes in bracket rates

After discussing the role played by income and substitution effects, we now turn to the simulated labour supply effects of policy reforms. We first consider the effects of changes in tax bracket rates. Specifically, we consider the effects of decreasing income tax rate in the first, second, third and fourth (open) income tax bracket so that tax receipts decrease by 1.5 billion euro. Due to the smaller tax base in the higher brackets than the lower brackets, the percentage point decrease in the tax rate in the higher brackets is larger than in the lower brackets. Specifically, the decrease in the tax rate is respectively: 0.8, 2.1, 3.5 and 4.9 percentage points.

Table 6.1 gives the results and the group averages in the base for comparison. To keep the table to a manageable size, we report aggregate results for the following groups

- 'Men in couples young. child 0–17' and 'Women in couples young. child 0–17' are respectively men and women in couples with a youngest child 0–17 years of age, and both partners can choose all hours options.
- 'Men in other couples' and 'Women in other couples' are respectively men and women in couples without children, in couples with a youngest child 18 years of age or older, and in couples with a partner whose labour supply is 'fixed' (e.g. disabled, self-employed etc.).
- 'Single parents young. child 0–17' are single parents with a youngest 0–17 years of age.

- 'Singles' consists of singles without children, single parents with a youngest child 18 years of age or older, and adult children living with their parents.

Furthermore, the total results over all groups are for individuals whose labour supply is determined within the model only, so excluding the 'fixed' labour supply by partners in couples that are e.g. disabled, self-employed etc.

For these groups we report the effects on hours worked per week and on the participation rate. Hours worked per week includes the zeros for the non-employed. The participation rate is the number of persons employed over the total number of persons, employed and non-employed, where the non-employed only include individuals whose labour supply is not determined outside the model. We also report the effect on labour costs per person per week (assumed equal to marginal product), including the zeros for the non-employed, in thousands of euro per year. Finally, we calculate labour productivity per hour which is obtained by subtracting the change in hours worked from the change in labour costs which in turn is an approximation for output.

Men in couples have the highest participation rate in the base, and also the highest number of hours worked per week. Women in couples have much lower participation rates than men (more than 20 percentage points less), and also work fewer hours per week (this is also true for employed women in couples when compared to employed men in couples). The participation rate of singles and their hours worked per week are closer to men in couples than to women in couples. Single parents have the lowest participation rate, but their average hours worked is larger than for women in couples.

Column T1 gives the results for the decrease in the tax rate in the first bracket. Overall, we find hardly any effect of changing the tax rate in the first bracket on hours worked, the participation rate and output. However, this is the net result of some groups that decrease their labour supply, and some that increase their labour supply. First, consider the effects on the labour supply of couples. We see that there is a modest decrease in participation and hours worked by men in couples, with and without dependent children. For men in couples, the first bracket is typically inframarginal, and changing the first bracket rate only generates an income effect. Women in couples with dependent children raise their labour supply. They typically have less income and lowering the tax rate in the first tax bracket has both an income and a substitution effect

Table 6.1: Changes in bracket rates

	(0)	(T1)	(T2)	(T3)	(T4)
Simulation	Base	First bracket	Second bracket	Third bracket	Fourth bracket
Change in bracket rate		–0.8	–2.1	–3.5	–4.9
Ex ante impulse (in €bln)		1.5	1.5	1.5	1.5
			Percentage changes		
Gini coefficient[a]	0.28	–0.29	0.17	0.63	1.02
Hours worked per week	28.1	–0.02	0.09	0.06	0.01
– Men in couples young. child 0–17	36.7	–0.09	0.04	0.10	0.06
– Women in couples young. child 0–17	17.6	0.12	0.18	–0.03	–0.09
– Men in other couples	36.5	–0.04	0.05	0.08	0.04
– Women in other couples	21.7	–0.01	0.07	0.02	–0.01
– Single parents young. child 0–17	22.3	–0.15	0.25	0.17	0.05
– Singles	32.2	0.00	0.10	0.06	0.01
Participation rate	0.86	0.00	0.03	–0.01	–0.02
– Men in couples young. child 0–17	0.97	–0.05	0.05	0.01	–0.04
– Women in couples young. child 0–17	0.78	0.10	–0.03	–0.15	–0.12
– Men in other couples	0.96	–0.02	0.04	0.04	0.01
– Women in other couples	0.74	0.01	0.02	–0.04	–0.03
– Single parents young. child 0–17	0.72	–0.14	0.17	0.07	0.01
– Singles	0.90	–0.01	0.04	0.03	0.01
Labour costs (in €1,000 per year)	38.4	–0.03	0.07	0.08	0.04
Labour productivity per hour (in €)	26.3	–0.01	–0.02	0.02	0.03
Knock-on effects (in %)[b]		–6	6	7	6

[a] Gini coefficient of disposable household income, using equivalence scales. The Gini coefficient is calculated over the full Dutch adult population with gross income above 66% of the annual minimum wage.
[b] Knock-on effect for individuals in the labour supply sample.

for them.[1] The substitution effect dominates for women with children, and they raise their labour supply. For women in other couples and singles, the effect on labour supply is close to zero. This is the net effect of individuals with high income who only have a small negative income effect on hours worked, and individuals with low earnings who have a positive substitution effect on hours worked. Single parents show the largest, negative response to the increase in the tax rate in the first tax bracket. Their disposable income is rather low to start with, in particular for the 28% that are on welfare benefits. The decrease in the tax rate leads to a significantly larger gain in utility for non-employed single parents than for employed single parents, resulting in a relatively large income effect for this group.

Column T2 gives the effect of lowering the tax rate in the second bracket. The effect on overall labour supply in hours and output is positive, though the effect on labour supply in persons is small. For men in couples with children 0 to 17 years of age, the effect is small. Some of these men have high incomes, and there is again the negative income effect on hours worked, similar to the first tax bracket. However, some of these men have lower incomes, and they will face a lower marginal tax rate, the substitution effect dominates and leads to an increase in their labour supply. Many of the women in couples with children 0 to 17 years of age face a lower marginal tax rate, and they raise their labour supply. Men and women in other couples also raise their labour supply, as the tax rate in the second tax bracket is the relevant marginal tax rate for part of this group, and their substitution effect dominates their income effect. The same is true for singles. The effect on hours worked by single parents is now positive. The decrease in the tax rate in the second tax bracket generates a substitution effect for a larger part of the employed single parents than the first tax bracket. When we compare the effects on total hours worked per week with the effects on the participation rate, we see that most of the response comes from changes in hours worked when employed (the intensive margin), as opposed to the number of persons employed (the extensive margin) for this policy change. Here the cross-effect of higher income for males in couples on the labour supply of the females in couples plays an important role. This 'income effect' stimulates some

[1] The Dutch tax system is individual (though some subsidies and taxes do depend on household income) as opposed to e.g. Germany and the US.

women in couples, with a child 0-17 years of age, to leave the labour market (ceteris paribus), the reverse of the so-called 'added worker effect' (Lundberg, 1985).

Column T3 gives the effects of the decrease in the third tax bracket rate. The increase in overall labour supply in hours is somewhat smaller than T2. Men in couples now raise their hours worked more than under T2, for a large part of them the third tax bracket is the relevant marginal tax bracket, and the substitution effect dominates the income effect for men in the third and fourth tax bracket. Whereas the labour supply of men in couples increases, the labour supply of women in couples with children falls. Indeed, although for part of these women the third tax bracket is the relevant marginal tax bracket, their own income effect and the income effect from higher income of the male dominates. For single parents and singles we have a positive effect on labour supply in hours, they do not have an income effect coming from a partner and the substitution effect of the lower marginal tax rate dominates. Labour supply in persons actually goes down when we lower the third tax bracket rate. This is due to women in couples that leave the labour market when household income goes up (the reverse of the added worker effect at work again). Labour productivity per hour increases which is due to a composition effect. Men in couples raise their hours worked more under T3 than T2, and their productivity per hour is relatively high. Women in couples with children decrease their hours worked under T3, whereas they raise their hours under T2, but their productivity per hour is relatively low.

Column T4 gives the effects of the decrease in the fourth tax bracket. Lowering the fourth tax bracket has only a small positive effect on overall hours worked and the effect on labour supply in persons is again negative as in T3. The effect on men in couples with children 0 to 17 years of age is slightly lower than under T3, however the effect on women is more negative. These women are still faced with an income effect coming from their partner, but since virtually none of them has any income in the fourth tax bracket, they hardly face a lower marginal tax rate. Again, the same is true for men and women in couples without children. The effect on single parents and singles under T4 is less pronounced than under T3, most of them do not have income in the fourth tax bracket. Labour supply in persons again goes down due to some men and

women in couples leaving the labour market. The overall increase in hours worked is much smaller under T4 than under T3, but labour productivity, measured as the change in labour costs minus the change in hours worked, increases more under T4. The composition effect under T4 is more pronounced, with more productive men in couples increasing their hours, and less productive women in couples decreasing their hours, increasing average productivity.

Summarizing the results for the different tax bracket rate simulations, we find that in terms of overall hours worked, lowering the tax rate in the second and third tax bracket leads to the biggest increase. The effect of lowering the first and fourth tax bracket hardly affects overall hours worked. However, the increase in labour productivity is higher for higher tax brackets which is due to a composition effect where more productive men raise their hours while less productive women decrease their hours. Lowering the first and second tax bracket rate slightly increases labour supply in persons, whereas lowering the third and fourth tax bracket rate slightly lowers labour supply in persons (i.e. reverse added worker effect). A lower tax rate in the first tax bracket decreases income inequality (as measured by the lower Gini coefficient), while a lower tax rate in the second, third or fourth tax bracket increases income inequality.

6.3 Changes in welfare benefits and in-work tax credits

Next, we consider policy reforms targeted more at the extensive margin. We consider changes in the so-called participation tax rate.[2] Specifically, Table 6.2 gives the simulation results for changes in welfare benefits ('Bijstand' in Dutch) and the general in-work tax credit ('Arbeidskorting' in Dutch). In the first simulation we lower welfare benefits by 14% for a total amount of 500 million euro. In the second and third simulation we increase the general in-work tax credit, for all workers, for a total amount of 1.5 billion euro. In 2014 the general in-work tax credit rises up to an income of €19,253 (somewhat above the minimum wage), where the maximum credit is €2,097. The tax credit is phased-out with 4%, over an income of €40,720 and €83,970.[3] In the second

[2] The participation tax rate is the sum of the tax paid on earnings when taking up a job plus the associated loss in (welfare) benefits.

[3] The tax credit remains constant over an income of €19,253–€40,720. The minimum level of the in-work tax credit for all workers is €367 in 2014.

simulation, we increase the maximum level of the tax credit by €245, such that the maximum tax credit (€2,342) is reached at the same income of €19,253. In the third simulation, we target the in-work tax credit more strongly at low income individuals by raising the maximum tax credit even further (€2,538). In order to keep the budgetary impulse identical to the second scenario, the phase out of the tax credit (-4%) already starts at an income of €30,000.

First, consider the results for a decrease in welfare benefits. This leads to a substantial increase in overall labour supply in hours and persons of 0.62%. The effects are much bigger than for the decreases in tax bracket rates considered above. Indeed, welfare benefits operate on the extensive margin, which is the main margin of adjustment for labour supply (see Section 4). All groups raise their labour supply, where the response is particularly large for single parents. 28% of single parents are on welfare benefits in the base while the corresponding percentages are much smaller for the other groups. Hence, a substantial part of the additional spending goes to single parents. The effect on labour productivity per hour is negative, as the labour productivity of the additional workers is below average. The knock-on effects for the government are high because there are large budgetary savings on social welfare (e.g. transition from social welfare to the labour market). Finally, it is important to note that lowering welfare benefits has an adverse effect on income inequality.

The second column gives the results of the increase of the in-work tax credit. The effects are much smaller compared to the first simulation because the share of employed individuals is much larger than the share of individuals (in households) on welfare benefits. This makes the increase in disposable income per working person much smaller than the reduction in disposable income of non-working individuals in the welfare benefits simulation (in absolute terms). Even after accounting for the bigger impulse we consider (1.5 billion euro for the in-work tax credit compared to 0.5 billion euro for welfare benefits). Labour supply in hours and persons increases for all groups. The effect is larger for groups with a more substantial labour supply elasticity, such as women in couples with children and single parents.

The third column shows that targeting the in-work tax credit more on low income individuals, leads to a larger effect on total hours worked because the tax credit is more targeted at the extensive margin. The higher tax credit now

Table 6.2: Changes in welfare benefits and in-work tax credits

	(1)	(2)	(3)
Simulation	Welfare benefits[a]	In-work tax credit, across-the-board[c]	In-work tax credit, targeted[d]
Ex ante impulse (in €bln)	–0.5	1.5	1.5
		Percentage changes	
Gini coefficient[e]	0.56	–0.02	–0.29
Hours worked per week	0.62	0.11	0.14
– Men in couples young. child 0–17	0.76	0.02	-0.04
– Women in couples young. child 0–17	0.51	0.34	0.56
– Men in other couples	0.45	0.04	0.00
– Women in other couples	0.64	0.14	0.21
– Single parents young. child 0–17	2.81	0.29	0.34
– Singles	0.49	0.13	0.16
Participation rate	0.58	0.10	0.17
– Men in couples young. child 0–17	0.76	0.08	0.12
– Women in couples young. child 0–17	0.47	0.19	0.44
– Men in other couples	0.42	0.05	0.04
– Women in other couples	0.58	0.13	0.25
– Single parents young. child 0–17	2.46	0.24	0.33
– Singles	0.44	0.07	0.09
Labour costs	0.52	0.07	0.05
Labour productivity per hour	–0.10	–0.04	-0.09
Knock-on effects (in %)[f]	132	4	10

[a] Reduction in welfare benefits by 14%.
[c] An increase in the (maximum) general in-work tax credit (*Arbeidskorting*) of €245, by increasing the phase-in rate from 18.7 to 21.1%.
[d] An increase in the (maximum) general in-work tax credit (*Arbeidskorting*) of €440, by increasing the phase-in rate from 18.7 to 23.0%. The higher in-work tax credit is phased out from €30,000 onwards at 4%. The phase-out rate is the same as in the current system, but the new phase-out starts at an income of €30,000 instead of €40,000 in the current system. The level of the general in-work tax credit for incomes above €40,000 remains the same as in the current system.
[e] See Table 6.1.
[f] Knock-on effect for individuals in the labour supply sample.

increases labour supply more for women in couples, singles and single parents, compared to the second simulation. By contrast, men in couples with dependent children slightly lower their labour supply. Some men, with a high income, now receive a lower tax credit due to the earlier phase out of the tax credit (i.e. negative substitution effect). Furthermore, some men only face an income effect and also an income effect coming from the partners. Labour productivity now decreases further as men in couples are a group whose productivity is relatively high. This policy simulation has also a mitigating effect on income inequality.

Finally, it is important to note that for the same budgetary impulse, the impact of the targeted in-work tax credit on hours worked is bigger than the impact of changes in marginal tax rates considered above. However, the effect on labour productivity is negative because the in-work tax credit mostly affects workers with below average productivity, whereas the third and fourth tax bracket mostly affect workers with above average productivity.

6.4 Changes in policies targeted at parents with small children

Table 6.3 gives the results for policies targeted at parents with small children. The ex ante budgetary impulses are somewhat smaller for these simulations than for the simulation considered before, in line with the smaller tax or subsidy base.

We present 5 simulations. First, we simulate the reintroduction of an in-work tax credit for working parents with a youngest child up to 12 years of age ('Combinatiekorting' (COM) in Dutch).[4] The COM is a fixed amount of €270 for individuals earning at least €4,814. Second, we raise the income independent part of the tax credit for secondary earners and single parents with a youngest child up to 12 years of age ('Aanvullende Combinatiekorting' (AVCOM) in Dutch). We increase the fixed amount of the AVCOM by €600.[5] Third, we increase the income dependent part of the income dependent tax credit for secondary earners and single parents with a youngest child up to 12 years of age ('Inkomensafhankelijke Combinatiekorting' (ICK) in Dutch). The ICK depends on income, with a phase-in rate of 4% for income above the threshold of €4,814, and reaches its maximum of €1,109 at a personal income of

[4] The COM was abolished in 2009.
[5] The level of the AVCOM is €1,024 in 2014.

Table 6.3: Changes in policies for parents with small children

Simulation	(1) Combination credit[a]	(2) Additional combination credit[b]	(3) Income dependent combination credit[c]	(4) Chidcare subsidies[d]	(5) Income dependent child benefit[e]
Ex ante impulse (in €bln)	0.5	0.5	0.5	0.5	–0.5
			Percentage changes		
Gini coefficient[f]	–0.10	–0.08	–0.01	–0.01	0.47
Hours worked per week	0.04	0.09	0.16	0.20	0.29
– Men in couples young. child 0–17	0.02	0.04	0.01	0.09	0.58
– Women in couples young. child 0–17	0.23	0.69	1.30	1.86	1.07
– Men in other couples	0.01	0.00	0.00	0.00	0.06
– Women in other couples	0.05	0.05	0.06	0.00	0.25
– Single parents young. child 0–17	0.24	0.51	0.82	0.23	0.94
– Singles	0.00	0.00	0.00	0.00	0.00
Participation rate	0.08	0.17	0.13	0.14	0.26
– Men in couples young. child 0–17	0.10	0.13	0.11	0.12	0.50
– Women in couples young. child 0–17	0.37	0.90	0.63	0.86	0.85
– Men in other couples	0.01	0.00	0.00	0.00	0.05
– Women in other couples	0.06	0.08	0.06	0.00	0.20
– Single parents young. child 0–17	0.19	0.39	0.60	0.19	0.64
– Singles	0.00	0.00	0.00	0.00	0.00
Labour costs	0.02	0.06	0.12	0.17	0.24
Labour productivity per hour	-0.02	-0.04	-0.04	-0.03	–0.04
Hours formal childcare	1.02	1.74	2.82	22.88	1.43
Knock-on effects (in %)[g]	12	11	11	–60	50

[a] The combination credit (*Combinatiekorting*) is a flat tax credit for working parents, with gross income above €4,814, with a youngest child up to 12 years of age. We set the credit at €270 per person.
[b] The additional combination credit (*Aanvullende Combinatiekorting*) is a flat tax credit for working secondary earners and working single parents, with gross income above €4,814, with a youngest child up to 12 years of age. We set the credit at €600 per person.
[c] The income dependent combination credit (*Inkomensafhankelijke Combinatiekorting*) is a tax credit for working secondary earners and working single parents with a youngest child up to 12 years of age. The tax credit is income dependent, we increase the phase-in rate from 4 to 8%. The phase-in range runs from €4,814 to €32,539, at which the maximum credit increases by €1,109. The tax credit is not phased out.
[d] An increase in childcare subsidies (*Kinderopvangtoeslag*). Families only qualify for childcare subsidies when both parents work. The change in childcare subsidies is set in such a way that there is a proportional decline in the parental contribution rate. Because higher incomes have a higher parental contribution rate, this benefits more the parents with a higher income.
[e] A decrease in the income dependent child benefit (*Kindgebonden Budget*), an income dependent subsidy for parents with a youngest child up to 18 years of age. The subsidy is phased-out from €26,147 euro at a rate of 7.6%. We decrease the subsidy by 55%, and keep the phase-out rate the same. Hence, we extend the phase-out range of the subsidy.
[f] See Table 6.1.
[g] Knock-on effect for individuals in the labour supply sample.

€32,539. We simulate an increase in the level of the ICK by €1,100 and the phase-in rate by 4 percentage points. Fourth, we consider the effect of increasing childcare subsidies. We consider a proportional decrease across incomes in the parental fee that results after deducting the subsidy from the full hourly price. In the simulation results we now also report the effects on the use of formal childcare, measured in hours per week. Finally, we decrease the income dependent subsidy for parents with small children ('Kindgebonden Budget' (KGB) in Dutch). The KGB is a fixed amount up to a gross household income of €26,147 (close to the modal wage), after which it is phased out at a rate of 7.6%. The amount per family depends on the number and the ages of the children. We decrease the maximum amount for all families by 55%, lowering total expenditures by 500 million euro.[6]

First, consider the results for the change in the COM, the in-work tax credit for working parents with a youngest child up to 12 years of age. Reintroducing the COM raises aggregate labour supply by 0.04%. The effect on labour supply is limited because primary earners in couples, most likely men who are relatively inelastic with respect to labour supply, receive a substantial part of the impulse.

The second column gives the results for the increase in the income independent tax credit (AVCOM) for secondary earners and single parents. Primary earners do not receive the AVCOM. The increase in labour supply is much higher now (0.09%) and the AVCOM is more effective in stimulating labour supply than the COM. The reason for this is that the AVCOM is targeted at secondary earners (most likely women) and single parents (most likely women). Both groups are relatively elastic with respect to labour supply.

Third, consider the results of the increase in the income dependent tax credit (ICK) for secondary earners and single parents with a youngest child up to 12 years of age. The number of hours worked now increases more than in the second simulation. Raising the level and income dependency of the ICK not only makes working more attractive (i.e. extensive margin), but also encourages particularly secondary earners and single parents to work more days per week (i.e intensive margin). When we compare the results of this simulation with the general in-work tax credit for all workers in Table 6.2, we also find that the effect is more positive, given the smaller budgetary impulse in the ICK

[6] We keep the phase out rate at 7.6%.

simulation (0.5 billion euro instead of 1.5 billion euro). Indeed, secondary earners with dependent children and single parents are the groups that show the biggest response to changes in financial incentives.

In the fourth column we show the results of increasing childcare subsidies. This reform not only targets secondary earners and single parents with a youngest child up to 12 years of age, but also primary earners with children. Again, there is a substantial increase in hours worked, both due to an increase in persons employed, but also due to an increase in hours worked by the employed. The effects on labour supply in hours and persons, and on labour costs, are also somewhat bigger than for the ICK simulation. However, since the childcare reform also affects the effective hourly price relevant for parents, there is a substantial increase in the use of formal childcare, which leads to substantial additional budgetary costs ex post. Consequently, the knock-on effect for the government is negative and substantial.

Finally, consider the results for the change in the KGB, the income dependent subsidy for parents phased out after a household income close to the individual modal wage. We lower the budget for the KGB. This increases overall labour supply in hours, in persons and labour costs. In this reform, the income effect and the substitution effect work in the same direction, stimulating parents to start working and to work more hours per week. The effect is strong for single parents.[7] Non-working single parents experience the full decrease in KGB whereas the level of KGB is phased out (partly of completely) for working single parents. Women in couples with dependent children also strongly increase labour supply. The increase in labour costs is smaller than the increase in hours worked, as mostly mothers in couples and single parents work more hours, so that average productivity per hour worked decreases. We now also report the effects on the use of formal childcare, and we see that formal childcare follows the response in labour supply.[8] The KGB is targeted at low income households and lowering its budget raises income inequality much more compared to the other simulations.

[7] Note that there is a small effect on men and women in other couples, these are the men and women in couples with a partner whose labour supply is fixed, but have a dependent child.

[8] This does not mean that hours in formal childcare increases by approximately the same amount of hours as the hours worked of the parents, there is not a 1-to-1 relation between the use of formal childcare hours and the hours worked by parents.

7 Discussion and conclusion

In this paper we have provided a detailed overview of the heterogeneous labour supply responses to changes in financial incentives in the Netherlands. We find substantial differences between men and women in couples, in particular when children are present. Furthermore, the age of the youngest child seems to play an important role in labour supply responses, mothers with young children being particularly responsive. We have also shown that the decision whether or not to participate is more responsive to financial incentives than the hours per week decision. Simulation results show that the impact of marginal tax rates on total hours worked is limited, whereas increases in the participation tax rate have a larger negative effect on total hours worked, in particular when targeted at parents with young children.

The focus of the model is a detailed modelling of labour supply responses. However, various mechanisms are not present in the model which are potentially relevant for tax-benefit reform, and the empirical relevance of these mechanisms for the Dutch case. We discuss these mechanism below.

We assume that individuals are free to choose whether or not to participate, and how many hours or days to work per week. However, individuals can be involuntary unemployed, or they may not be able to work the number of hours or days per week that they would prefer (given the budget constraint). Previous studies have shown that accounting for involuntary unemployment, or the difference between preferred and actual working hours, can make quite a difference in terms of employment responses (Euwals and Van Soest, 1999; Bargain et al., 2010). We have put considerable effort in investigating the issue of involuntary unemployment, estimating a double-hurdle model (Cragg, 1971). However, for all household types we find that accounting for involuntary unemployment makes little difference to the employment responses to changes in financial incentives (De Boer, 2014). Very few individuals in the data are classified as involuntary unemployed. Note however that we use data for the period 2006–2009. Since then, unemployment has gone up considerably in the Netherlands and involuntary unemployment might be an issue at this point in time. However, recall that we are simulating the structural effects of tax-benefit reform. The structural level of (involuntary) unemployment is probably not that

different from the period 2006–2009. Regarding the difference between actual and preferred hours of work, we do not have data on preferred hours of work in our dataset. However, this seems to be a much smaller problem in the Netherlands than in many other OECD countries. For example, OECD (2013) reports that just 5% of part-time working women would like to work more hours, compared to e.g. 13% in Germany, 28% in France and 55% in Spain.

In the model we focus on the labour supply responses of changes in the tax-benefit system. Part of the modern public finance literature looks at a broader range of behavioural responses, by considering the so-called elasticity of taxable income, see Saez et al. (2012) for an excellent overview. The elasticity of taxable income also captures e.g. changes in effort more generally, occupational choice, and tax avoidance.[1] For the majority of workers, changes in taxable income mainly reflect changes in labour supply. Indeed, in a recent study for the Netherlands, Jongen and Stoel (2013) find that for the average worker the elasticity of taxable (labour) income is not that different from the labour supply elasticity. However, for high incomes they find that the labour supply elasticity is lower, whereas the elasticity of taxable income is higher, consistent with the literature, see again Saez et al. (2012). Hence, for high incomes, the labour supply response only captures part of the response in the tax base. Therefore, to determine e.g. the budgetary consequences of an increase in the top tax rate, one needs to consider the other behavioural responses next to the labour supply response.

We ignore general equilibrium effects on prices and wages. However, this may not be a bad approximation for the long run with a perfectly elastic labour demand (Aaberge and Colombino, 2014), which seems particularly relevant for a small open economy like the Netherlands.[2]

Perhaps more problematic is that we ignore the lifecycle. A number of studies have shown that accounting for lifecycle effects can be important for the analysis of tax-benefit reform, see e.g. Imai and Keane (2004) and Keane (2011). However, we do not have the data (e.g. on consumption or savings) to model lifecycle responses to tax-benefit reforms. Furthermore, there is often a trade-off

[1] Furthermore, for top incomes, the contractual hours that we observe in our dataset may not be a good indicator of actual hours.

[2] Interesting exercises with finite demand elasticities can be found in Peichl and Siegloch (2012) and Colombino (2013).

in modelling different parts of economic behaviour, due to the numerical complexities that arise.

Finally, we assume that all people are fully aware of their full budget constraint. However, the recent work by Chetty et al. (2009) shows that information or the lack thereof can play an important role in the behavioural responses to financial incentives. This is an important new research area. However, note that we are using policies and changes therein in the past to estimate preferences. So, to the extent that informational frictions play a role in behavioural responses to changes in financial incentives, our estimated preferences implicitly incorporate these informational frictions (if existed) in this period. Also, note that the model does rather well in predicting behavioural responses to past reforms.

To conclude, we believe that we have made a big step in modelling the heterogeneous responses to tax-benefit reform. However, interesting topics for future research remain.

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A Wage equations: Labour Market Panel

For the employed we use observed wages. For the non-employed we impute wages. To this end, we run wage regressions by sex and then by level of education, where education is split into three levels (lower, middle and higher).

We use panel data techniques to account for unobserved individual specific effects. We performed a Hausman test in order to test whether random effects or fixed effect is appropriate. For all groups, we reject the null hypothesis that the individual specific effects are uncorrelated with regressor and therefore we prefer fixed effects over random effects estimation. However, we lose information on time-invariant regressors with fixed effects and therefore opt for the quasi-fixed effects model (Mundlak, 1978).

To account for the possibility of selection we first estimate the probability of participation using a pooled probit regression

$$p_{it} = x'_{it}\gamma + z'_{it}\theta + \nu_{it}, \tag{A.1}$$

where vector z_{it} contains variables that are expected to have an effect on the probability of participation but not on wages (an exclusion restriction). From this regression we determine the inverse Mills' ratio

$$invmills_{it} = \phi(p_{it})/\Phi(p_{it}). \tag{A.2}$$

The inverse Mills' ratio is then included in the quasi-fixed effects model

$$ln(w_{it}) = x'_{it}\beta + \omega_i + \bar{x_i}'\pi + \lambda_t invmills_{it} + \epsilon_{it} \tag{A.3}$$

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

Table A.1 shows estimation results for all subgroups. We use age splines since we expect that the relationship between wage and age is nonlinear. Table A.1 shows that age increases with age but at a diminishing rate. This is in line with other studies (Vella and Verbeek, 1998, 1999). For both singles and couples we see that the age profile is steeper for higher educated individuals. We also

Table A.1: Wage equations couples

	Men			Women		
	Lower educated	Middle educated	Higher educated	Lower educated	Middle educated	Higher educated
Age						
18–30	0.045***	0.047***	0.076***	0.037***	0.037***	0.047***
31–40	0.020***	0.029***	0.045***	0.022***	0.024***	0.035***
41–50	0.013***	0.020***	0.028***	0.024***	0.021***	0.023***
51–63	0.010***	0.008***	0.011***	0.020***	0.017***	0.013***
Cohort[a]						
1980–1989	0.085***	0.147***	0.173***	0.146***	0.126***	0.158***
1975–1980	0.025	0.074***	0.129***	0.063***	0.080***	0.118***
1970–1975	0.019*	0.034***	0.093***	0.030***	0.048***	0.077***
1960–1965	0.010	–0.017***	–0.012	–0.008	–0.019***	–0.044***
1955–1960	–0.002	–0.031***	–0.043***	0.009	–0.027**	–0.064***
<1955	0.007	0.002	–0.012	0.010	–0.019*	–0.046***
Ethnicitity[a]						
Western immigrant	0.003	–0.068***	–0.055***	0.001	–0.026***	–0.032***
Non-western immigrant	–0.062***	–0.231***	–0.291***	–0.051***	–0.074***	–0.114***
Partner						
Married	0.015***	0.017***	0.015***	–0.011**	–0.015***	–0.025***
Year						
2006	0.005	0.005	0.004	0.006	0.004	0.002
2007	–0.006	–0.006	–0.003	–0.007	–0.005	–0.002
2008	–0.002***	–0.003***	–0.007***	–0.004***	–0.003***	–0.003***
2009	0.004***	0.004***	0.005***	0.005***	0.004***	0.002***
Mundlak averages age						
18–30	–0.008*	0.000	–0.005	–0.003	–0.002	0.001
31–40	–0.006**	–0.003**	0.000	–0.012***	–0.008***	–0.004***
41–50	–0.008***	–0.007***	–0.014***	–0.022***	–0.016***	–0.017***
51–63	–0.008***	–0.015***	–0.019***	–0.018***	–0.020***	–0.019***
Inverse Mills' ratio	–0.329***	0.452***	0.674***	–0.008	0.026**	0.098***
Attrition indicator	–0.004	–0.001	–0.001	–0.004	–0.004	0.000
Constant	1.446***	1.162***	0.618***	1.298***	1.430***	1.273***
Observations	88,997	168,316	129,663	60,824	146,294	89,859

*** p<0.01, ** p<0.05, * p<0.1.

[a] Reference group: born in 1965–1970 and autochtonous.

Table A.2: Wage equations singles

	Men			Women		
	Lower educated	Middle educated	Higher educated	Lower educated	Middle educated	Higher educated
Age						
18-30	0.035***	0.050***	0.073***	0.035***	0.043***	0.053***
31-40	0.016***	0.028***	0.046***	0.022***	0.027***	0.040***
41-50	0.009***	0.016***	0.027***	0.026***	0.020***	0.022***
51-63	0.008***	0.016***	0.015***	0.021***	0.021***	0.016***
Cohort[a]						
1980-1989	0.056	0.152***	0.245***	0.070	0.146***	0.210***
1975-1980	-0.009	0.068**	0.100***	0.026	0.078***	0.149***
1970-1975	0.004	0.032**	0.068***	0.017	0.046***	0.080***
1960-1965	0.006	0.012	-0.034	0.019	-0.025*	-0.056***
1955-1960	0.014	0.026	-0.075**	0.011	-0.027	-0.107***
<1955	-0.007	-0.006	-0.039	-0.004	-0.020	-0.048**
Etnicitity[a]						
Western immigrant	-0.029	0.012	0.018	-0.011	0.008	0.001
Non-western immigrant	-0.080*	-0.038	-0.135***	-0.025*	-0.020	-0.052**
Year						
2006	0.005	0.004	0.004	0.005	0.005	0.002
2007	-0.005	-0.005	-0.006	-0.008	-0.006	-0.002
2008	-0.004***	-0.002**	-0.001	0.000	-0.003***	-0.001
2009	0.005***	0.003***	0.003***	0.003**	0.004***	0.001*
Mundlak averages age						
18-30	0.000	0.000	0.006	-0.002	0.004	-0.001
31-40	-0.010**	-0.006*	-0.009**	-0.018***	-0.010***	-0.002
41-50	-0.007	-0.010***	-0.012***	-0.023***	-0.012***	-0.010***
51-63	-0.005	-0.010***	-0.014***	-0.015***	-0.023***	-0.019***
Inverse Mills' ratio	0.004	-0.219**	-0.177***	-0.028*	-0.097***	-0.191***
Attrition indicator	-0.003	0.006	0.004	-0.008	-0.006	-0.001
Constant	1.462***	1.058***	0.380	1.431***	1.084***	1.097***
Observations	14,055	26,511	19,534	11,947	27,783	21,358

*** p<0.01, ** p<0.05, * p<0.1.

[a] Reference group: born in 1965–1970 and autochtonous.

include cohort and year dummies in the regression. Because of perfect collinearity between age, cohort and period we use transformed time dummies following Deaton and Paxson (1994). The time dummies for 2006 and 2007 depend on the dummies for later years and are calculated manually.[1] Year dummies are significant in most specifications while the cohort variables are jointly significant for most subgroups. Wages are lower on average for non-Western immigrants. The coefficients for the Mundlak age averages are jointly significant in all specifications, but have no economic interpretation.

The lower part of Table A.1 shows that the inverse Mills' ratio is significant for most groups. Hence, we have evidence that selection bias is present for most groups. We also include an attrition indicator in order to test for the presence of attrition bias.[2] The attrition indicator is not significant for all subgroups.

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

[2] The attrition indicator is a dummy which equals 1 if an individual leaves the sample in our data period 2006-2009.

B Childcare price equations: Labour Market Panel

For non-users of formal childcare we have to impute a price for childcare. We have information on the use of formal childcare in the Netherlands for the period 2006–2009. Here, a distinction is made between daycare (children 0–3 years of age) and out-of-school care (children 4–11 years of age).

Again, we estimate a quasi-fixed effects model for the prices of daycare and out-of-school care.[1] Here, we follow the same procedure as for the wage estimations and estimate the following price equation:

$$p_{it} = x'_{it}\beta + \omega_i + \bar{x_i}'\pi + \lambda_t invmills_{it} + \epsilon_{it} \tag{B.1}$$

where the individual specific effect consists of a random part, ω_i with $\sim IID(0, \sigma^2_\omega)$, and a part which is allowed to be correlated with regressors $\bar{x_i}'\pi$. Here, $\bar{x_i}$ is the average of age which does not vary over time. Our dependent variable is the natural logarithm of the hourly real price.

We focus on households since childcare is consumed at the household level. As it turns out, characteristics of females are more important in predicting use and price of childcare than characteristics of men. Hence, we only include females characteristics in the regressions.

Table **??** shows estimation results for daycare and out-of-school care.[2] Estimation results show that year dummies are significantly increasing for daycare. However, time effects are less important in the price equation for out-of-school care. Households with higher educated women or younger women pay a higher price on average. We do not find evidence that selection bias and attrition bias is present.

[1] We conduct a Hausman test in order to test whether fixed or random effects is appropriate. In all cases, the Hausman test favours the fixed effects model.

[2] Including a squared term for age, age splines, ethnicity, a dummy for age of the youngest child or a dummy for multiple children, leads to insignificant coefficients.

Table B.1: Price equations childcare

	Daycare	Out-of-school care
Year		
2007	0.058***	0.015
2008	0.123***	0.025
2009	0.153***	0.035
Higher educated women	0.000	0.020*
Age women	–0.017***	-0.031***
Single parent	0.033**	-0.047***
Mundlak age average	0.014**	0.026**
Inverse Mills' ratio	–0.032	-0.008
Attrition indicator	–0.001	0.005
Constant	5.507***	5.741***
Observations	35,675	28,938

*** p<0.01, ** p<0.05, * p<0.1.

C Estimated preferences: Labour Market Panel

Table C.1: Estimated preferences couples without children, or with a youngest child 12–17 or 18+

Parameters	Couples without children	Couples youngest child 12-17	Couples youngest child 18+
Income	1.450***	2.154***	2.155***
Income^2	0.073***	0.248***	-0.063***
Leisure man	59.170***	-40.544***	81.540***
X (age man-38)/10	1.426***	-3.593***	-1.588***
X (age man-38)^2/100	1.231***	3.260***	1.869***
Leisure man^2	489.593***	-50.860***	631.332***
Leisure man^3	885.046***		1173.110***
Leisure woman	0.425	-31.320***	-18.664***
X (age woman-38)/10	5.146***	1.445***	0.977***
X (age woman-38)^2/100	0.885***	0.363***	1.578***
Leisure woman^2	178.746***	-103.165***	1.685
Leisure woman^3	543.435***		199.758***
Fixed costs of work man	0.566***	-6.339***	1.177***
X 1(low educated man)	0.122***	0.607***	0.327***
X 1(middle educated man)	0.242***	1.024***	0.010
X 1(non-West. immigrant man)	-1.814***	-1.963***	-1.707***
X 1(Western immigrant man)	-1.097***	-0.884***	-0.896***
Fixed costs of work woman	-1.152***	-1.734***	-1.306***
X 1(low educated woman)	-1.040***	-1.587***	-1.655***
X 1(middle educated woman)	-0.143***	-0.758***	-0.819***
X 1(non-West. immigrant woman)	-1.585***	-0.406***	-0.680***
X 1(Western immigrant woman)	-0.566***	0.102***	0.077***
Leisure man X leisure woman		-8.708***	
Observations	6,533	5,875	5,456

*** p<0.01, ** p<0.05, * p<0.1. Income and leisure are in logs.

Table C.2: Estimated preferences couples with a youngest child 0–3 or 4–11, by latent classes

Parameters	Couples young. child 0-3, LC 1	Couples young. child 0-3, LC 2	Couples young. child 4-11, LC 1	Couples young. child 4-11, LC 2
Class probability	48%	52%	42%	58%
Income	6.164**	15.810***	3.216	3.187***
Income^2	2.249**	-3.646	1.115	1.323***
Leisure man	-66.022***	-74.155***	13.879	14.486***
X (age man-38)/10	0.367	0.663	2.782	1.866***
X (age man-38)^2/100	0.260	-1.393	1.246**	1.216***
Leisure man^2	-48.270	-140.755***	28.321	29.344***
Leisure woman	-21.914***	-19.810**	7.477	7.318***
X (age woman-38)/10	2.936	1.038	1.362	1.428*
X (age woman-38)^2/100	2.348	2.087	1.722	1.518***
Leisure woman^2	-126.255***	-167.628***	12.140***	12.445***
Fixed costs of work man	-8.885***	-11.758***	1.475***	1.464***
X 1(low educated man)	1.539**	0.522	0.527	0.463
X 1(middle educated man)	1.483***	1.012	0.630*	0.417
X 1(non-west. immigrant man)	-0.830	-0.557	0.622	0.484***
X 1(western immigrant man)	-1.682***	-1.125*	0.622*	0.636***
Fixed costs of work woman	-2.502***	-2.540***	0.279***	0.287***
X 1(low educated woman)	0.084	-0.674**	0.271**	0.269
X 1(middle educated woman)	0.484*	0.162	0.232	0.235
X 1(non-west. immigrant woman)	-1.144***	-1.412***	0.282	0.287***
X 1(western immigrant woman)	-0.284	-0.868**	0.298	0.284
Hours of formal childcare	-2.895***	-1.600**	1.780**	1.150***
X 1(non-west. immigrant man)	-0.006	-0.135	1.183*	8.534
X 1(western immigrant man)	0.084	0.587	0.860	1.366
X 1(non-west. immigrant woman)	0.999	0.979	0.725	0.640
X 1(western immigrant woman)	0.365	0.164	0.556***	0.823
X 1(>=150,000 inhabitants)	0.643**	0.992**	0.435*	0.591
Hours of formal childcare^2	0.087	-0.135	0.299	0.346***
Fixed costs of childcare	0.609	0.365	0.469***	0.455***
X 1(low educated man)	-0.428	-0.287	0.378	0.357
X 1(middle educated man)	-0.207	-0.477**	0.276*	0.287
X 1(non-west. immigrant man)	-0.205	-0.466	1.863	178.637
X 1(western immigrant man)	0.099	-0.664	1.226	2.655
X 1(low educated woman)	-1.070***	-0.761**	0.564***	0.399*
X 1(middle educated woman)	-0.406**	-0.652***	0.266	0.279
X 1(non-west. immigrant woman)	-1.598	-1.261	0.873	0.869
X 1(western immigrant woman)	-0.100	-0.147	0.696**	0.751
X 1(>=150,000 inhabitants)	-0.859	-1.619**	0.544	0.569*
Income X leisure man	21.444	-2.710	5.684	6.258***
Income X leisure woman	5.391	-8.189	4.855	5.615***
Income X hours of formal childcare	0.942***	0.408*	0.385	0.417***
Leisure man X leisure woman	-0.392	-11.813	15.919	16.436
Leisure man X hrs of formal childcare	0.854	1.159	2.713***	2.860*
Leisure woman X hrs of formal childcare	-5.781***	-7.935***	1.495***	1.639***
Observations	4,166	4,166	5,017	5,017

*** p<0.01, ** p<0.05, * p<0.1. Income, leisure and childcare are in logs.

Table C.3: Estimated preferences singles and single parents

Parameters	Singles	Single parents youngest child 0-3	Single parents youngest child 4-11	Single parents youngest child 12-17	Single parents youngest child 18+
Income	0.719***	6.848***	0.929***	1.289***	1.123***
Income^2		-1.344***	0.345***		
Leisure	46.276***	-40.513***	-49.165***	9.571***	37.108***
X (age-38)/10	1.990***	-0.812***	-0.236***	-1.676***	-1.838***
X (age-38)^2/100	0.688***	-0.128***	1.080***	1.784***	1.789***
Leisure^2	411.672***	-126.760***	-141.990***	208.836***	373.026***
Leisure^3	808.944***			563.492***	825.408***
Fixed costs of work	0.189***	-4.262***	-3.742***	-0.860***	0.198***
X 1(low educated)	-0.728***	-1.321***	-1.447***	-1.340***	-1.261***
X 1(middle educated)	-0.064***	-0.171***	-0.435***	-0.319***	-0.385***
X 1(non-western immigr.)	-1.312***	-0.728***	-1.213***	-1.152***	-1.086***
X 1(western immigrant)	-0.637***	-0.367***	-0.565***	-0.675***	
X 1(>=150,000 inhab.)		-0.167***	-0.306***		
Hours of formal childcare		1.364***	-0.540***		
X 1(non-western immigr.)		1.448***	1.003***		
X 1(western immigrant)		0.406***	-0.031***		
X 1(>=150,000 inhab.)		0.070***	0.255***		
Hours of formal childcare^2		-0.376***	-0.231***		
Fixed costs of childcare		-2.771***	-2.436***		
X 1(low educated)		-1.099***	-0.998***		
X 1(middle educated)		-0.535***	-0.429***		
X 1(non-western immigr.)		-3.144***	-1.142***		
X 1(western immigr.)		-0.838***	-0.124***		
Income X hrs of form. childc.		-0.094***	0.077***		
Leisure X hrs of form. childc.		-2.920***	-5.454***		
Observations	30,383	4,171	14,793	20,767	9,171

*** p<0.01, ** p<0.05, * p<0.1. Income, leisure and childcare are in logs.

Table C.4: Estimated preferences couples with only one flexible partner, and adult children living at home

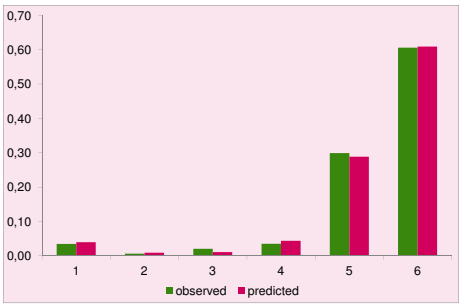
Parameters	Couples w/o children, man flexible	Couples w/o children, woman flex.	Couples with children, man flexible	Couples with children, woman flex.	Adult child
Income	7.303***	1.468***	3.225***	0.834***	4.593***
Income^2	-1.579***	0.141***	-0.385***	0.625***	-2.648***
Leisure	43.650***	-36.918***	51.200***	-23.913***	64.726***
X (age-38)/10	1.501***	2.908***	1.890***	-2.168***	-0.646***
X (age-38)^2/100	1.026***	1.915***	0.725***	1.766***	2.053***
Leisure^2	341.588***	-75.258***	426.721***	-52.317***	283.500***
Leisure^3	635.393***		761.591***	64.699***	518.039***
Fixed costs of work	-1.275***	-2.637***	-0.774***	-1.808***	6.027***
X 1(low educated)	1.091***	-1.259***	-0.049***	-1.451***	-0.638***
X 1(middle educated)	0.969***	-0.521***	0.068***	-0.650***	-0.375***
X 1(non-western immigrant)	-1.888***	-1.431***	-1.248***	-0.895***	-2.117***
X 1(western immigrant)	0.827***	-0.052***	-0.794***	-0.330***	-0.628***
X 1 (young. child 4-11)			0.064***	-0.110***	
X 1 (young. child 12-17)			0.384***	0.110***	
X1 (young. child 18+)			0.818***	-0.337***	
Income X leisure	-3.763***	1.850***		3.488***	-22.310***
Observations	3,550	3,281	7,715	12,517	25,088

*** p<0.01, ** p<0.05, * p<0.1. Income and leisure are in logs.

D Fit hours distribution: Labour Market Panel

Figure D.1: Couples without children

(a) Men



(b) Women

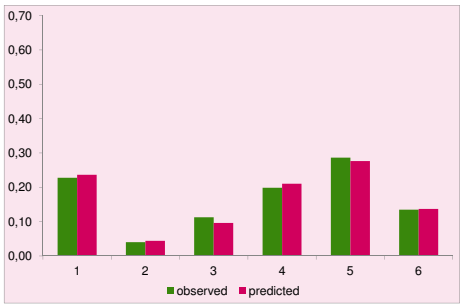
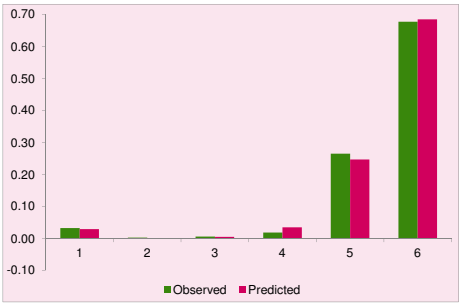


Figure D.2: Couples with youngest child 0–3

(a) Men



(b) Women

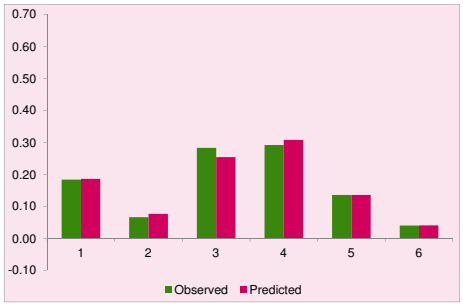
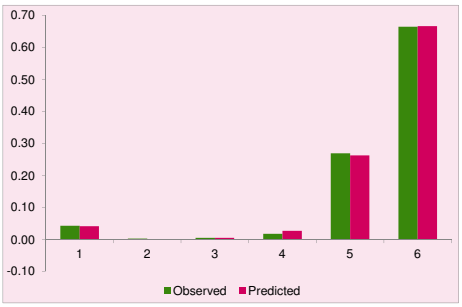


Figure D.3: Couples with youngest child 4–11

(a) Men



(b) Women

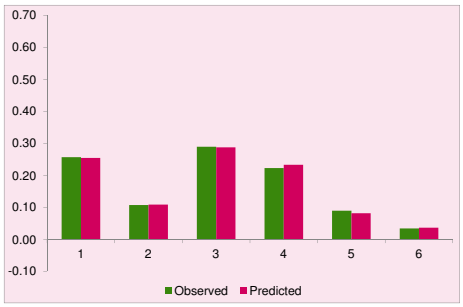
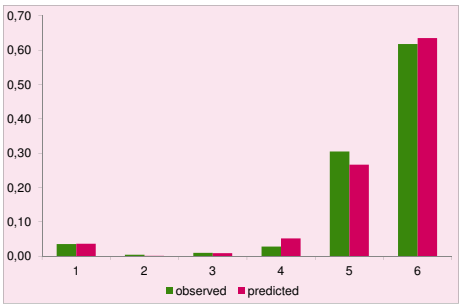


Figure D.4: Couples with youngest child 12–17

(a) Men



(b) Women

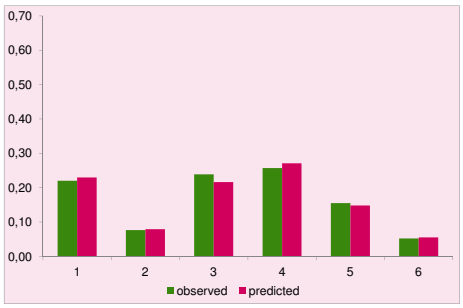
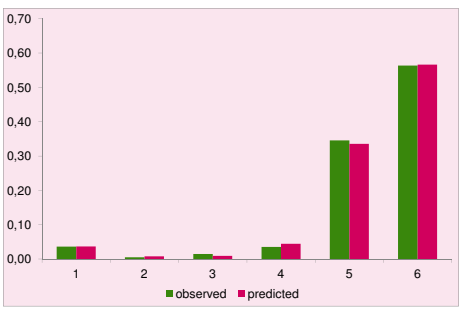


Figure D.5: Couples with youngest child 18+

(a) Men



(b) Women

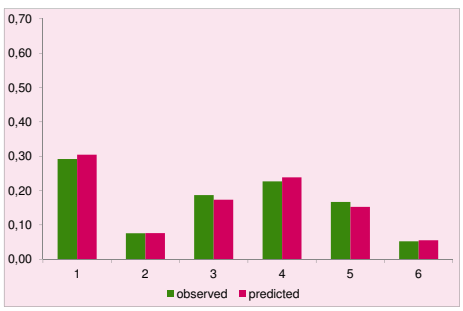
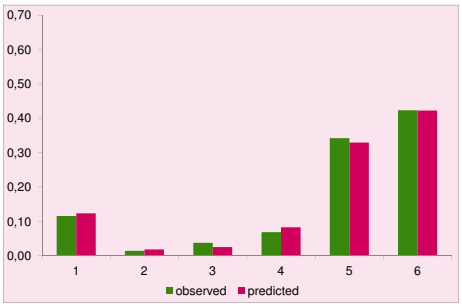


Figure D.6: Singles and single parents young. child 0–3

(a) Singles



(b) Single parents young. child 0–3

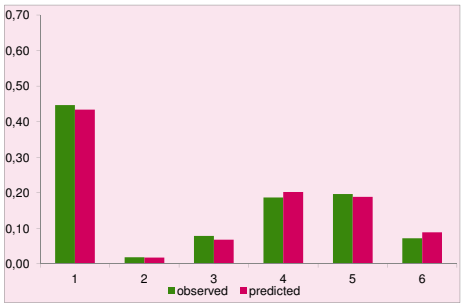
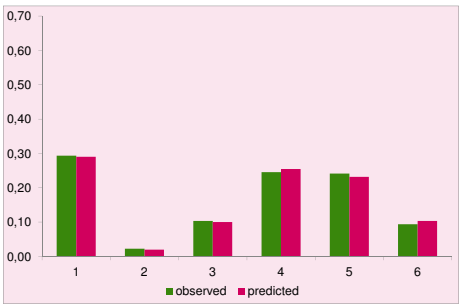


Figure D.7: Single parents young. child 4–11 and 12–17

(a) Single parents young. child 4–11



(b) Single parents young. child 12–17

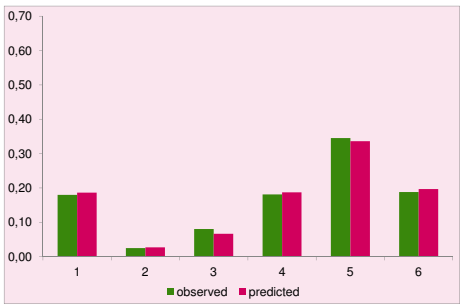
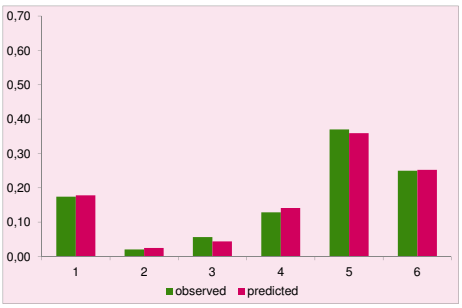


Figure D.8: Single parents young. child 18+ and adult children

(a) Single parents young. child 18+



(b) Adult child living at home

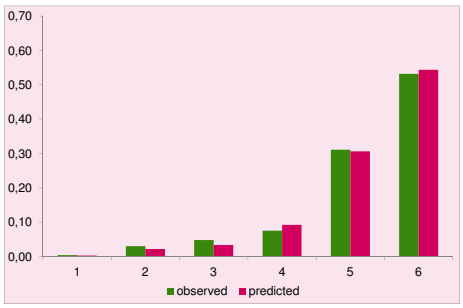
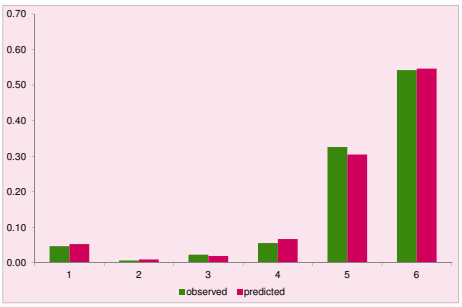


Figure D.9: Couples without children: inflexible partner

(a) Men



(b) Women

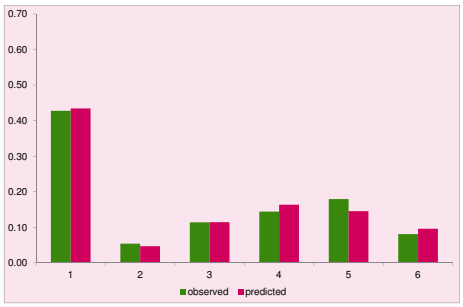
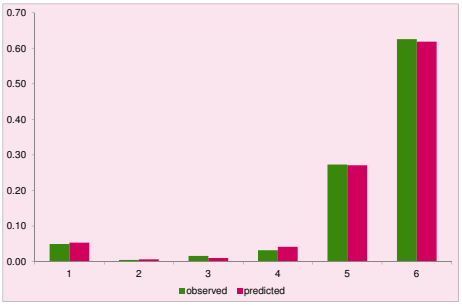
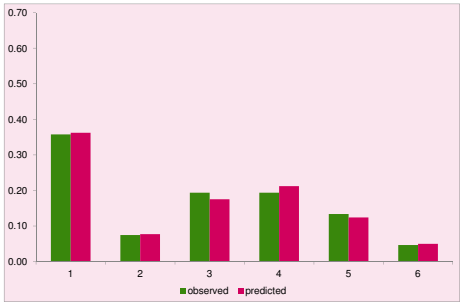


Figure D.10: Couples with children: inflexible partner

(a) Men



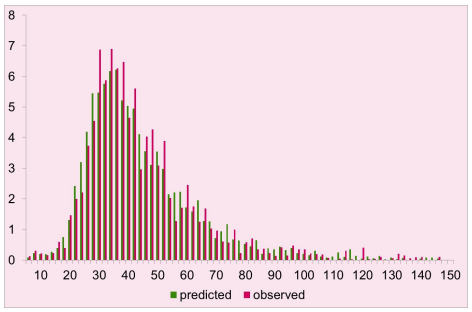
(b) Women



E Fit wage distribution: Labour Market Panel

Figure E.1: Couples without children

(a) Men



(b) Women

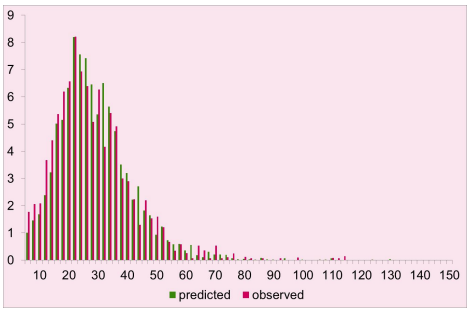
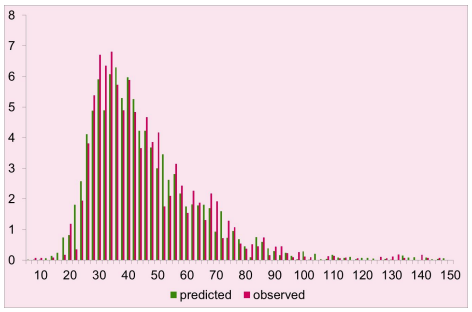


Figure E.2: Couples with youngest child 0–3

(a) Men



(b) Women

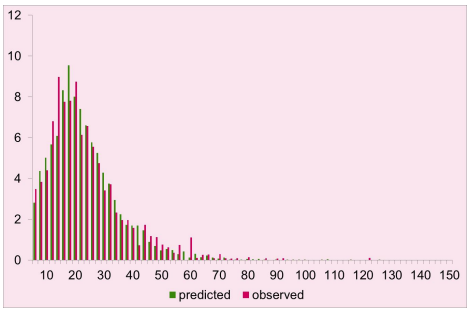
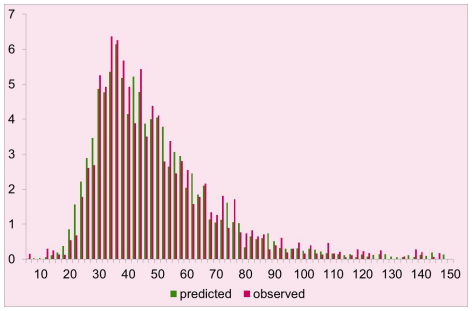


Figure E.3: Couples with youngest child 4–11

(a) Men



(b) Women

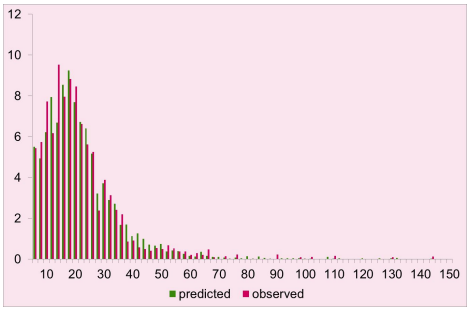
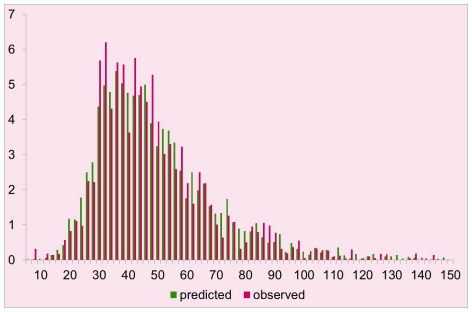


Figure E.4: Couples with youngest child 12–17

(a) Men



(b) Women

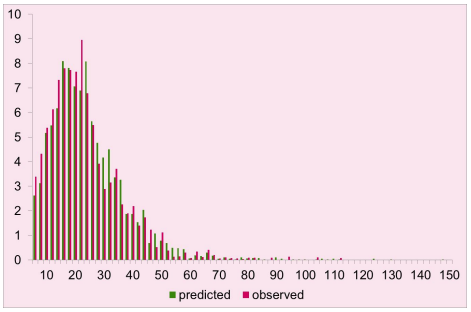
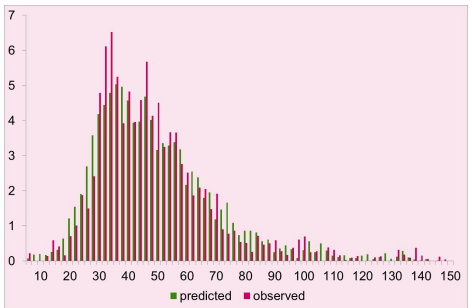


Figure E.5: Couples with youngest child 18+

(a) Men



(b) Women

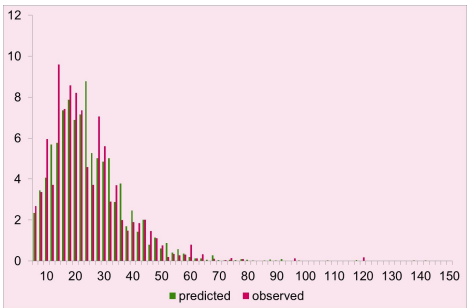
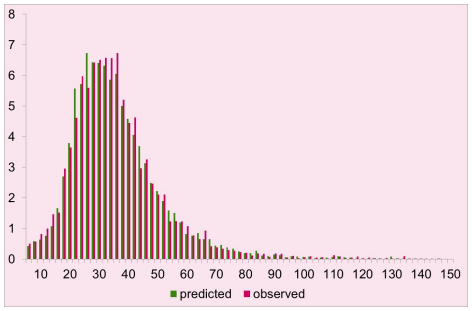


Figure E.6: Singles and single parents young. child 0–3

(a) Singles



(b) Single parents young. child 0–3

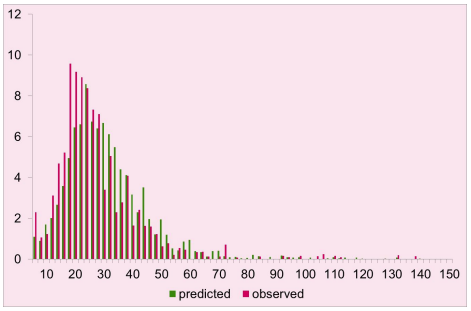
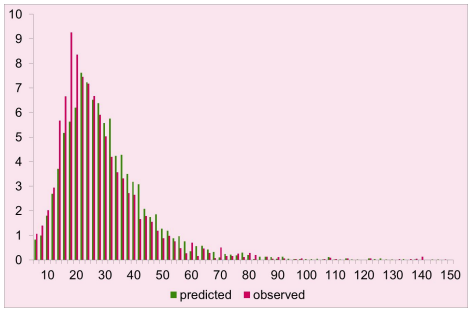


Figure E.7: Single parents young. child 4–11 and 12–17

(a) Single parents young. child 4–11



(b) Single parents young. child 12–17

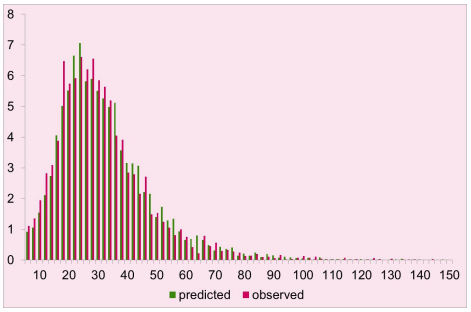
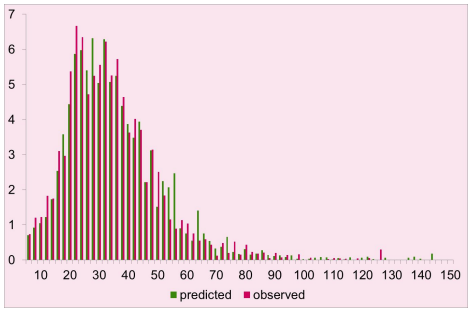


Figure E.8: Single parents young. child 18+ and adult children

(a) Single parents young. child 18+



(b) Adult child living at home

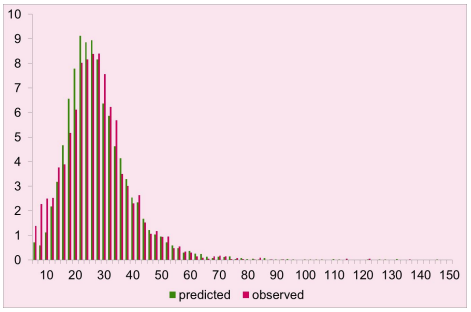
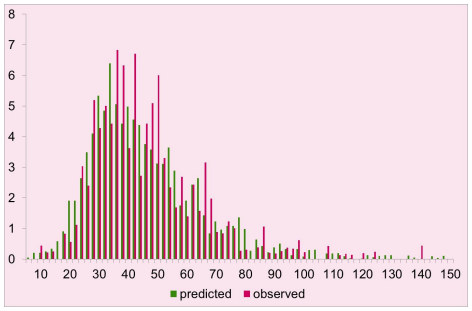


Figure E.9: Couples without children: inflexible partner

(a) Men



(b) Women

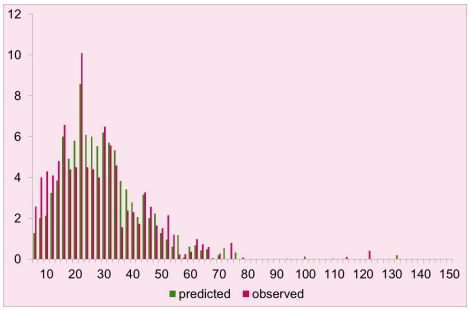
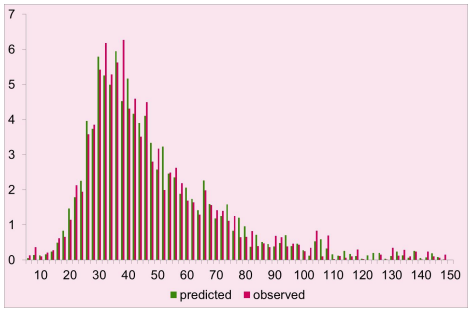
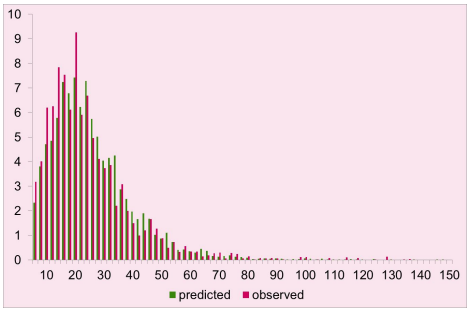


Figure E.10: Couples with children: inflexible partner

(a) Men



(b) Women



F Imputation of education in Income Panel

We impute education in the Income Panel 2010. We classify education as follows (using the Dutch abbreviations): i) lower educated = BO and VMBO, ii) middle educated = MBO, HAVO and VWO, iii) higher educated = HBO and WO. We estimate ordered logit models to predict education using data from the Labour Market Panel for 2009 (the last year included in the Labour Market Panel). As explanatory variables we use characteristics observed in both datasets, see Table F.1 for descriptive statistics. For employed we also use the hourly gross wage, which is observed in both datasets. We estimate ordered logit models separately for each household type (both sexes in couples), and separately for workers and non-workers. We then predict the level of education for each individual in the Income Panel using the estimated ordered logit results from the Labour Market Panel.

Table F.1: Individual and household characteristics: IPO 2010 versus LMP 2009

	Total	Men in couples w/o child	Women in couples w/o child	Men in couples with child	Women in couples with child	Singles	Single parents	Adult child
Labour Market Panel								
Female	0.513	0.000	1.000	0.000	1.000	0.417	0.842	0.342
Age	41.285	43.580	45.041	43.665	41.670	39.706	43.660	24.703
Native	0.811	0.850	0.850	0.820	0.807	0.776	0.662	0.813
Non-Western immigrant	0.096	0.056	0.052	0.097	0.103	0.115	0.226	0.111
Western immigrant	0.093	0.093	0.099	0.083	0.090	0.109	0.112	0.076
0-49 inhabitants[b]	0.494	0.481	0.514	0.538	0.541	0.336	0.375	0.561
50-149 inhabitants	0.294	0.297	0.293	0.292	0.288	0.307	0.319	0.275
>149 inhabitants	0.213	0.222	0.193	0.171	0.171	0.357	0.307	0.164
Northern region	0.101	0.103	0.111	0.099	0.103	0.098	0.093	0.087
Eastern region	0.213	0.210	0.211	0.227	0.227	0.175	0.179	0.226
Western region	0.469	0.461	0.448	0.452	0.452	0.542	0.537	0.455
Southern region	0.217	0.225	0.230	0.222	0.219	0.184	0.192	0.232
Gross hourly wage[a]	18.596	20.998	16.523	22.863	16.892	17.611	17.184	11.920
Income Panel								
Female	0.504	0.000	1.000	0.000	1.000	0.422	0.846	0.321
Age	41.098	44.397	44.184	43.626	41.234	39.903	43.302	26.062
Native	0.788	0.840	0.830	0.816	0.799	0.709	0.648	0.793
Non-Western immigrant	0.111	0.065	0.061	0.103	0.110	0.150	0.239	0.131
Western immigrant	0.101	0.095	0.108	0.081	0.091	0.141	0.114	0.076
0-49 inhabitants[b]	0.467	0.468	0.485	0.516	0.522	0.317	0.369	0.530
50-149 inhabitants	0.296	0.308	0.300	0.295	0.291	0.298	0.318	0.273
>149 inhabitants	0.237	0.224	0.215	0.189	0.187	0.385	0.313	0.197
Northern region	0.100	0.104	0.107	0.101	0.103	0.095	0.095	0.085
Eastern region	0.210	0.210	0.210	0.225	0.223	0.177	0.183	0.218
Western region	0.479	0.459	0.453	0.458	0.460	0.551	0.537	0.473
Southern region	0.211	0.227	0.230	0.216	0.215	0.177	0.186	0.225
Gross hourly wage[a]	17.736	20.002	15.968	21.662	16.594	16.560	16.696	11.520

[a] In 2009 prices.
[b] Degree of urbanisation (x1000 inhabitants).

Table F.2: Education: predicted IPO 2010 versus observed LMP 2009[a]

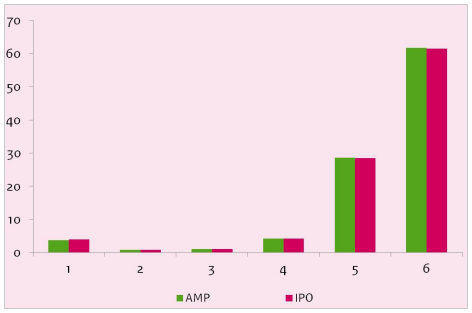
	Total	Men in couples w/o child	Women in couples w/o child	Men in couples with child	Women in couples with child	Singles	Single parents	Adult child
Labour Market Panel								
Lower educated	0.307	0.254	0.359	0.240	0.275	0.283	0.360	0.597
Medium educated	0.427	0.437	0.401	0.431	0.467	0.425	0.421	0.337
Higher educated	0.265	0.309	0.240	0.329	0.258	0.292	0.218	0.065
Income Panel								
Lower educated	0.318	0.274	0.356	0.251	0.268	0.312	0.369	0.606
Medium educated	0.427	0.439	0.413	0.436	0.464	0.420	0.422	0.330
Higher educated	0.255	0.288	0.232	0.313	0.267	0.268	0.209	0.064

[a] Education is classified as follows (using the Dutch abbreviations): i) lower educated = BO and VMBO, ii) middle educated = MBO, HAVO and VWO, iii) higher educated = HBO and WO.

G Predicted hours distr.: IPO 2014 vs. LMP 2007

Figure G.1: Couples without children

(a) Men



(b) Women

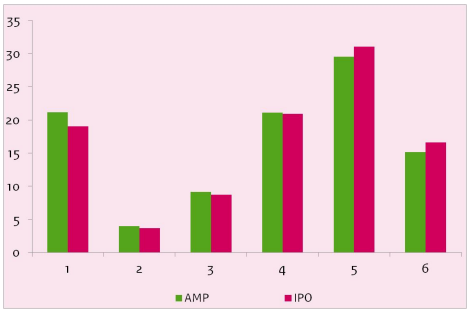
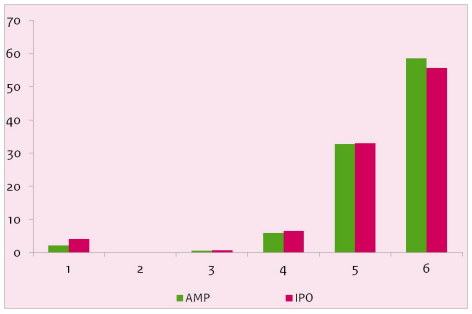


Figure G.2: Couples with youngest child 0–3

(a) Men



(b) Women

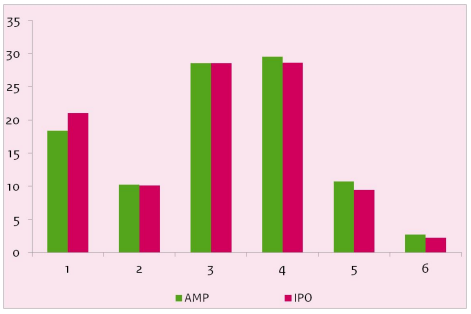
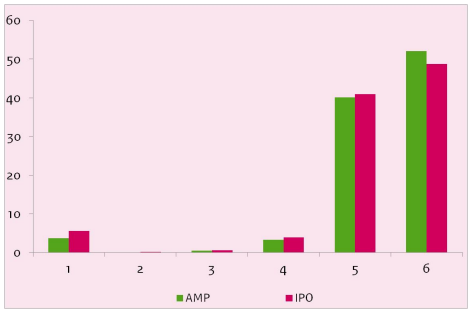


Figure G.3: Couples with youngest child 4–11

(a) Men



(b) Women

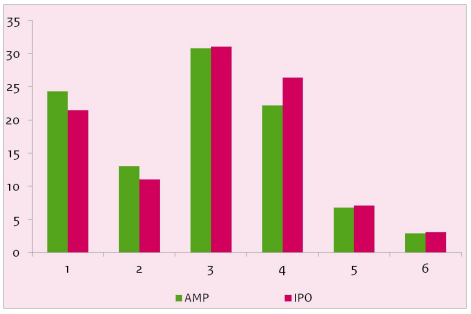
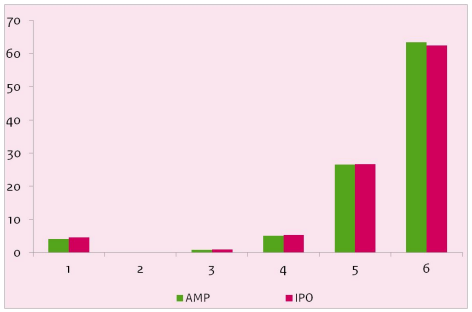


Figure G.4: Couples with youngest child 12–17

(a) Men



(b) Women

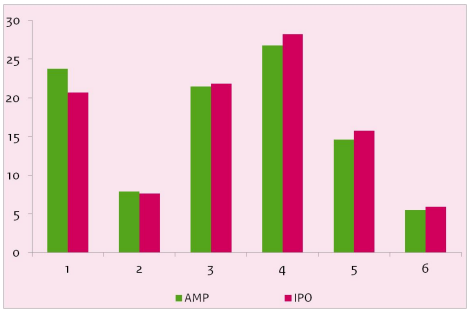
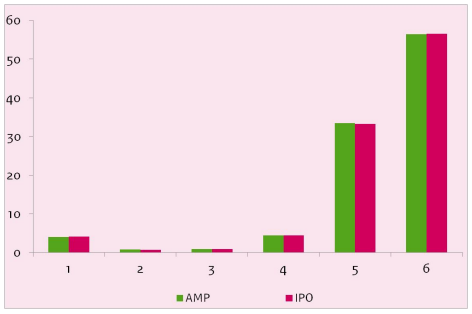


Figure G.5: Couples with youngest child 18+

(a) Men



(b) Women

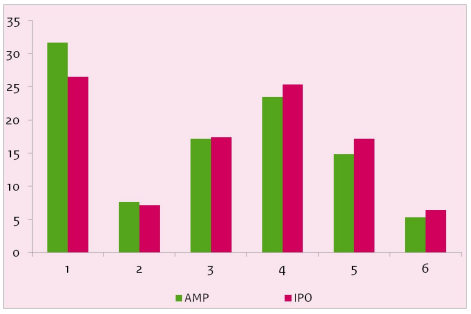
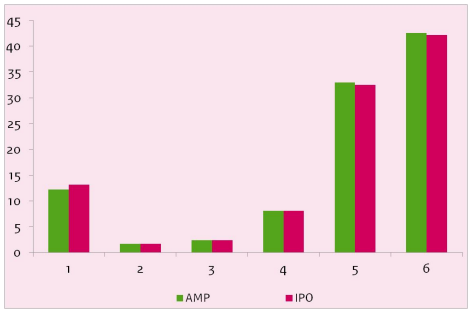


Figure G.6: Singles and single parents young. child 0–3

(a) Singles



(b) Single parents young. child 0–3

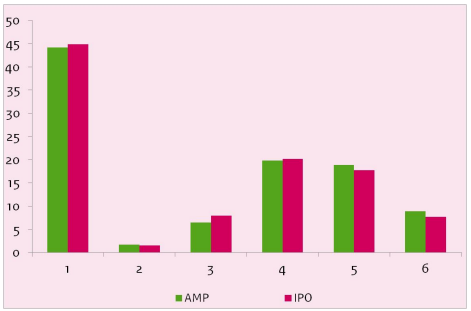
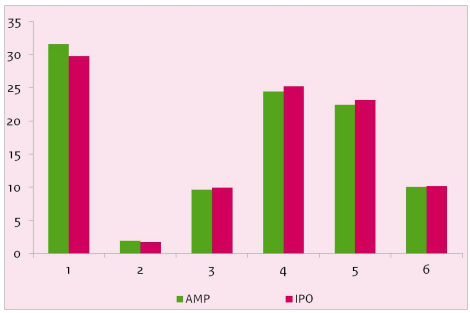


Figure G.7: Single parents young. child 4–11 and 12–17

(a) Single parents young. child 4–11



(b) Single parents young. child 12–17

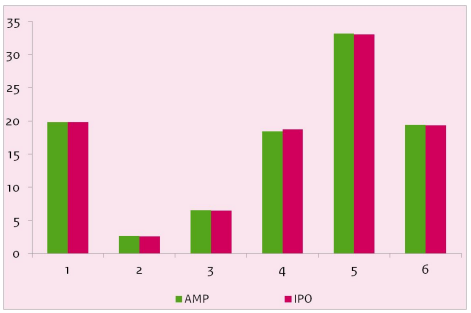
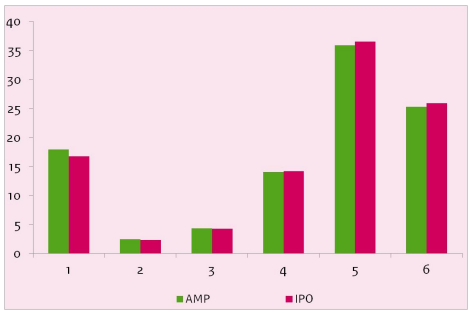


Figure G.8: Single parents young. child 18+ and adult children

(a) Single parents young. child 18+



(b) Adult child living at home

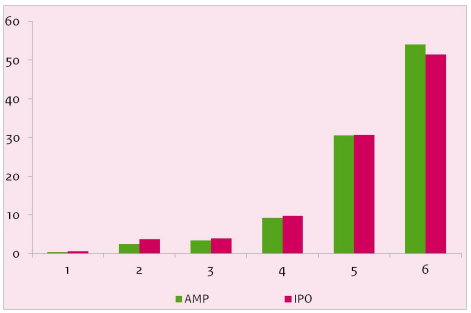
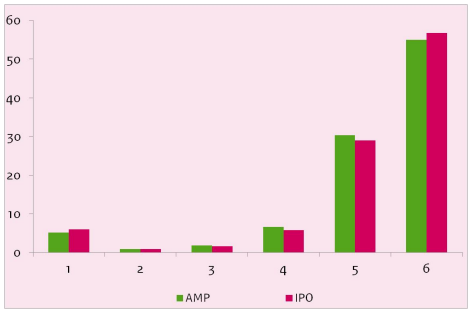


Figure G.9: Couples without children: inflexible partner

(a) Men



(b) Women

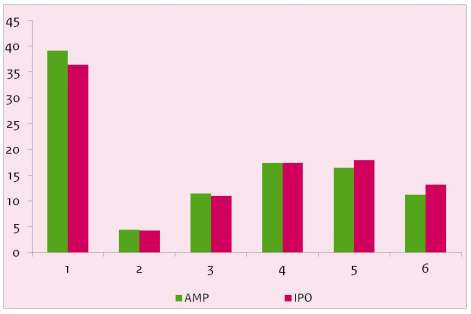
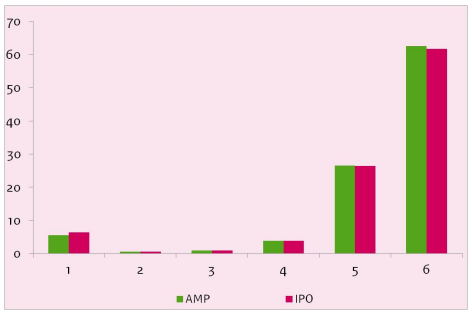
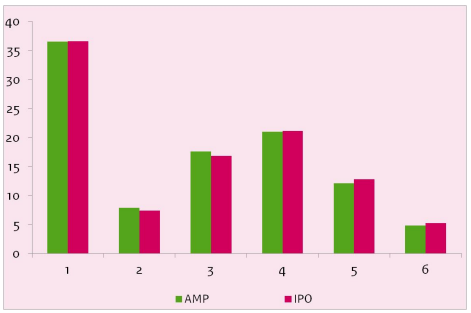


Figure G.10: Couples with children: inflexible partner

(a) Men



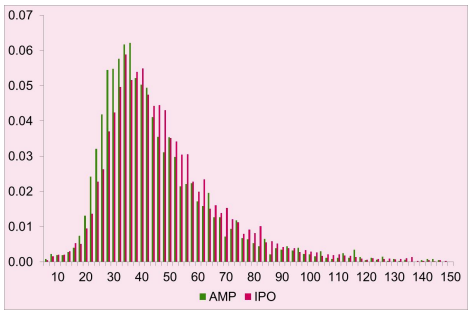
(b) Women



H Predicted wage distr.: IPO 2014 vs. LMP 2007

Figure H.1: Couples without children

(a) Men



(b) Women

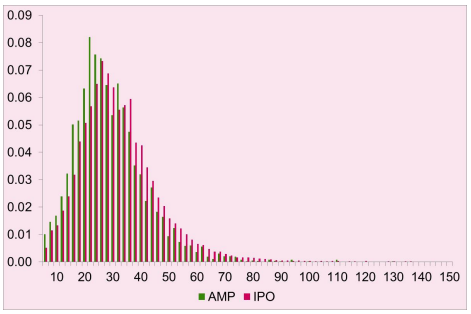
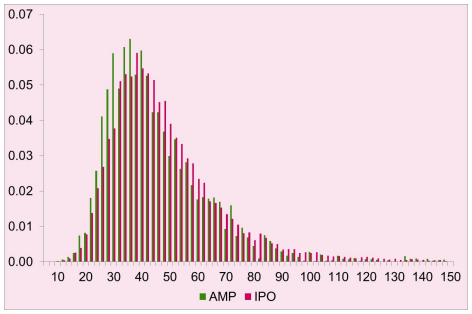


Figure H.2: Couples with youngest child 0–3

(a) Men



(b) Women

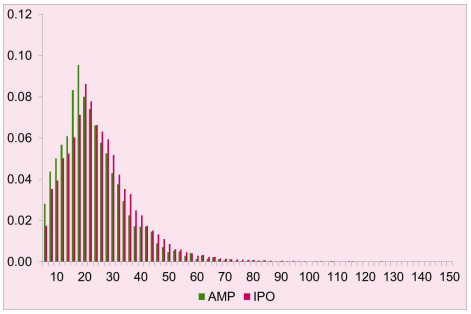
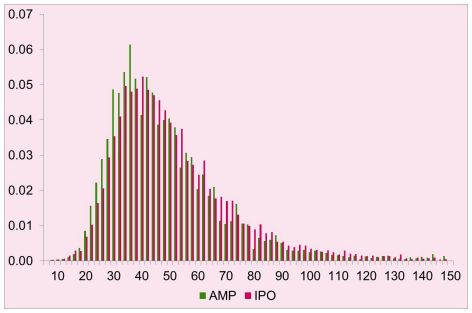


Figure H.3: Couples with youngest child 4–11

(a) Men



(b) Women

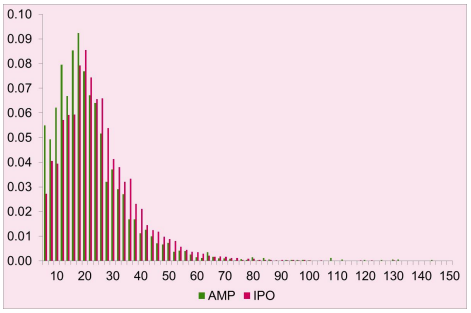
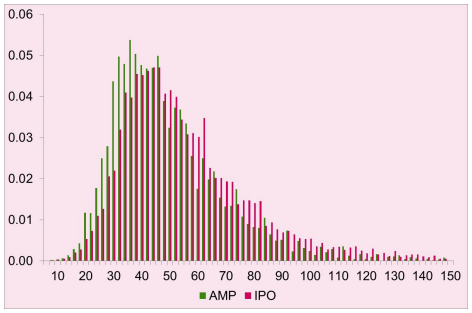


Figure H.4: Couples with youngest child 12–17

(a) Men



(b) Women

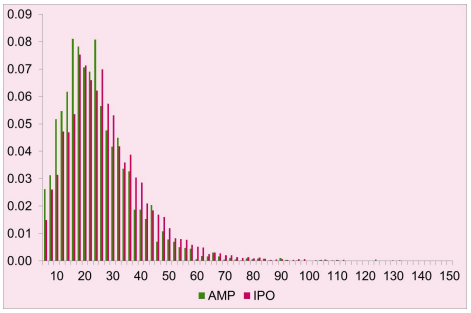
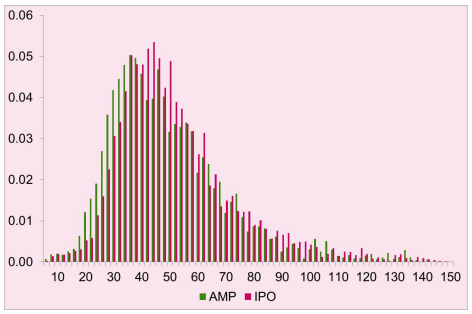


Figure H.5: Couples with youngest child 18+

(a) Men



(b) Women

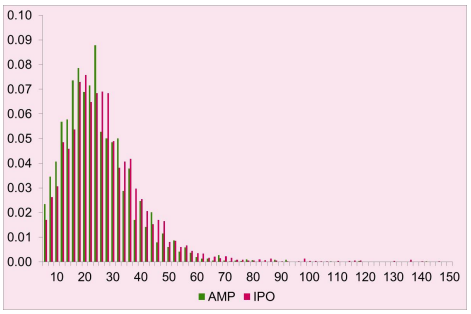
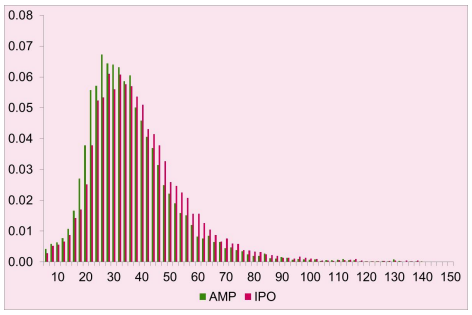


Figure H.6: Singles and single parents young. child 0–3

(a) Singles



(b) Single parents young. child 0–3

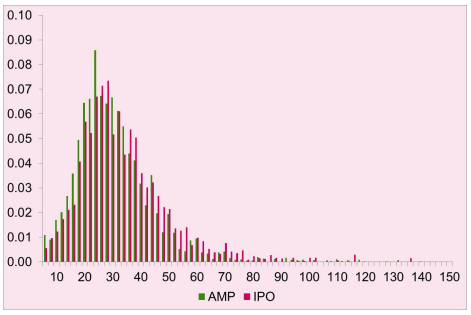
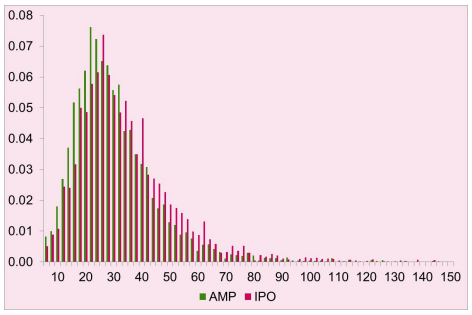


Figure H.7: Single parents young. child 4–11 and 12–17

(a) Single parents young. child 4–11



(b) Single parents young. child 12–17

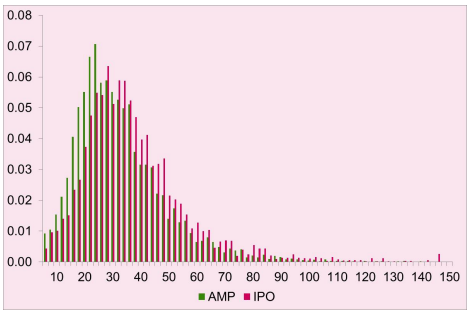
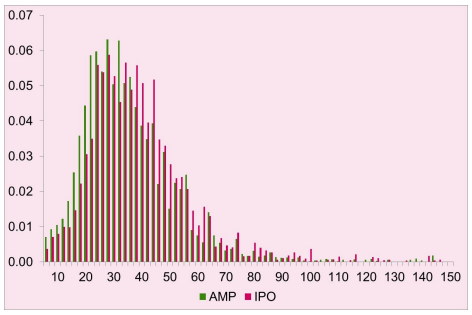


Figure H.8: Single parents young. child 18+ and adult children

(a) Single parents young. child 18+



(b) Adult child living at home

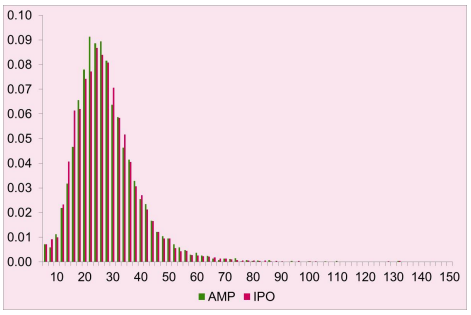
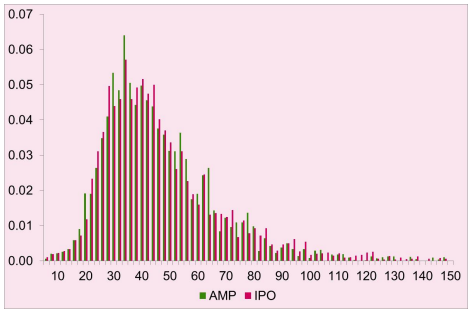


Figure H.9: Couples without children: inflexible partner

(a) Men



(b) Women

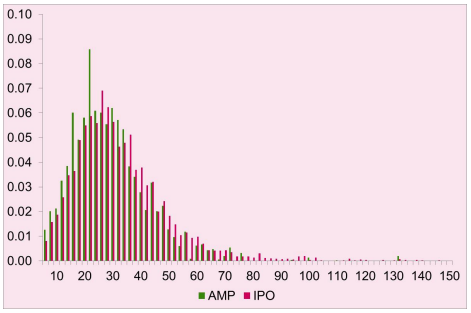
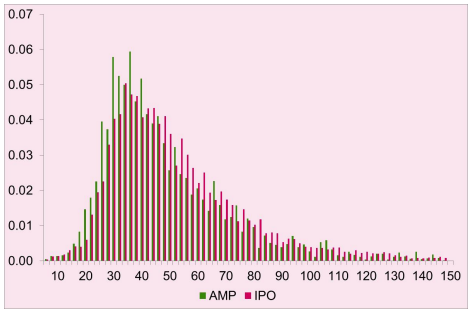
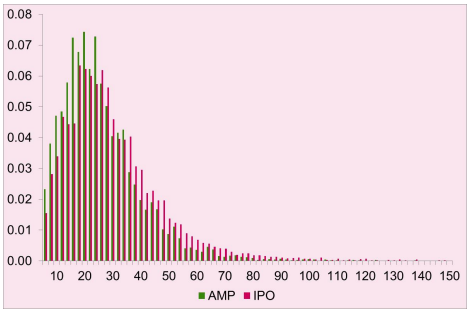


Figure H.10: Couples with children: inflexible partner

(a) Men



(b) Women



Publisher:

CPB Netherlands Bureau for Economic Policy Analysis
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November 2014