# MODELLING LABOUR SUPPLY AND POLICY REFORM IN THE BELGIAN TAX BENEFIT MODEL MIMOSIS

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november 2010

# TAXES ON LABOUR AND MODELLING LABOUR SUPPLY
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This report was written as part of the project "Belasting op arbeid en mogelijke arbeidsaanbodreacties", funded by FPS Social Security. The project exploited results produced with the microsimulation model MIMOSIS. For more information on the model see: http://www.socialsecurity.fgov.be/nl/nieuws-publicaties/publicaties/mimosis/mimosis.htm. The conclusions expressed in the text are the sole responsability of the authors.

# MODELLING LABOUR SUPPLY AND POLICY REFORM IN THE BELGIAN TAX BENEFIT MODEL MIMOSIS

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**Abstract:** Labour market policies with high budgetary cost are often advocated with the argument that the reform will partly or even largely be self-financing. The reform is assumed to induce currently inactive individuals to enter the labour market and to induce the currently active population to increase the number of hours worked. This would result in a positive effect on government revenue through higher personal income taxes and social security contributions and hence partly or largely cover the cost of the policy.

In this report we estimate a labour supply model to incorporate labour supply reactions in an evaluation of three policy reforms. We analyse to what extent integration of labour supply in the microsimulation model MIMOSIS adds to the overall evaluation of these policy reforms. The analysed are a reduction in social security contributions for the lower-skilled (workbonus), a general reduction of personal income taxes for the working population, and a reduction in personal income taxes which is targeted at the same lower-skilled population as the workbonus.

We find that, for the policies we analysed, incorporating labour supply reactions does hardly affect the initial cost of the different programs. We thus find that the cost recovery potential of the reforms is limited using the model specification and methodology used in this report.

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# 1 INTRODUCTION

When labour market policies with high initial budgetary cost are criticized, proponents of the proposal often counter with the argument that the reform will partly or even largely be self-financing. The reform is assumed to induce currently inactive individuals to enter the labour market and it will also induce the currently active to increase the number of hours worked. The self-financing of the reform stems mainly from an increase in personal income tax revenue and of an increase in social security contributions.

Traditional arithmetic microsimulation models confine themselves to an estimation of the initial budgetary cost of a proposal and the redistributive impact thereof. Potential cost recovery effects in the form of increased labour market participation are normally not integrated in standard microsimulation models. The same holds for the microsimulation model MIMOSIS of the Ministry of Social Security in Belgium, a model running on administrative data.

Yet, the MIMOSIS -model has a built-in capability to calculate budget constraints according to combinations of hours worked and disposable income.[1] The choice of number of hour points is at the user's discretion and for each of the chosen hour points the model calculates disposable income (and other income and tax concepts) for each of the chosen hour points. This information on the budget constraint, together with the observed choices of labour supply in the underlying data, enables a researcher to estimate a labour supply model. The estimation of such labour supply models then allows the evaluation of policy proposal on their cost recovery potential by taking into account effects on labour market participation.

Until about fifteen years ago, traditional approaches to labour supply modelling were based on the estimation of continuous labor supply functions. Apart from starting from unrealistic assumptions in most cases —that one can change one's labour supply in a continuous fashion— they also have proven to be cumbersome due to non linearities and non convexities of the real world budget constraints. The modelling of labour supply behaviour has subsequently been greatly simplified by the discrete choice approach proposed by van Soest (1995). The latter, in particular, builds on the observation that institutional constraints result in a limited set of working time alternatives (inactivity, some part-time categories, full-time and over-time), significantly reducing the computational burden of the estimation.

[1] See Decoster, De Swerdt and Van Camp (2010) for a description of effective average and marginal tax rates, using this tool.

In this report we apply this methodology to evaluate policy reforms in the realm of labour market policies as far as their impact on employment and cost recovery effects is concerned. More specifically we will evaluate an existing policy, to wit, a reduction of social security contributions for low skilled worker: the so called workbonus. We will compare the effects of the Workbonus with the effects of a more general reform: a reduction of personal income taxes for the entire working population. The latter is a hypothetical reform in the sense that it does not exist on the federal level. In the Flemish region, though, a similar policy has been in place in 2009 for all labour market participants (the so called Jobkorting).

While definitely an improvement over standard microsimulation models, it should be noted that the incorporation of labour supply responses does not take into account the demand side of the labour market. The models we use and the results we present are based on the premise that every individual who chooses to do so, can increase his or her labour time and/or enter the labour market. Our model certainly not yet accounts for the entire complexity of options and institutional constraints that often confront (potential) labour market participants.

The rest of the report is structured as follows. The next section presents the labour supply model in detail. Section 3 describes the sample that is used in the estimation of the model. The estimation results are then presented and described in section 4. Section 5 introduces the simulations and their effects on employment and government revenue. Finally section 0 concludes.

## 2 THE LABOUR SUPPLY MODEL

Suppose that each partner in a couple can potentially supply a finite number of working hours; each combination $j$ of working hours of the partners $j = 0, ..., J$ corresponds to a given level of gross labour market income. After adding non labour income and applying the microsimulation model, we derive the set of disposable incomes $C_{ij}$ (we suppose here that choice $j = 0$ corresponds to non-participation) and each discrete bundle of leisure and income provides a different level of utility.[2]

We assume that each partner may work from 0 to 55 hours in 5 hour increments which implies that a couple can choose among 144 alternative working hour combinations. Each alternative is characterized by a triplet of disposable income, leisure of the female partner and leisure of the male partner.

[2] Leisure is the time available minus hours worked. In the practical application time available is put equal to 80 hours per week, i.e. 16 hours of available 'active' time per day and 8 hours of sleep and other necessary activities.

The model is based on random utility: the utility household $i$ derives from making choice $j$, $V_{ij}$, is composed of two parts: the first part is the deterministic part of utility $U_{ij}$, which is assumed to depend on spouses' leisure $Lf_j$ , $Lm_j$, disposable income $C_{ij}$ and household characteristics $\mathbf{X}_i$, and for which a functional form has to be chosen; the second part consists of a random term $\varepsilon_{ij}$, unknown to the econometrician, but possibly known by the agents:

$$V_{ij} = U\left(Lf_{ij}, Lm_{ij}, C_{ij}, \mathbf{X}_i\right) + \varepsilon_{ij}. \tag{1}$$

If the error term $\varepsilon_{ij}$ is assumed to be identically and independently distributed across alternatives and households according to a type I extreme value distribution, McFadden (1974) proves that the probability that alternative $k$ is chosen by household $i$ is given by:

$$P_{ik} = \Pr\left(V_{ik} \geq V_{ij}, \forall j = 0,..., J\right) = \frac{\exp U\left(Lf_{ik}, Lm_{ik}, C_{ik}, \mathbf{X}_i\right)}{\sum_{j=0}^{J} \exp U\left(Lf_{ij}, Lm_{ij}, C_{ij}, \mathbf{X}_i\right)}. \tag{2}$$

Conditional on a functional specification of the utility function, it is possible to estimate the preference parameters of the deterministic part of utility given the assumption of theoretical distribution of the random error term. Although the error term cannot be observed or recovered easily from the estimation as in a simple OLS regression, it should be noted that it is the error term and more specifically the assumed theoretical distribution of the error term that makes the model estimable.

In the following, we follow Blundell et al. (2000) and assume a quadratic specification of the deterministic part of the utility function:

$$\begin{aligned} U_{ij} &= \alpha_c C_{ij} + \alpha_{cc} C_{ij}^2 + \alpha_{lf} Lf_{ij} + \alpha_{llf} Lf_{ij}^2 + \alpha_{lm} Lm_{ij} + \alpha_{llm} Lm_{ij}^2 \\ &\quad + \alpha_{clf} C_{ij} Lf_{ij} + \alpha_{clm} C_{ij} Lm_{ij} + \alpha_{lmlf} Lf_{ij} Lm_{ij} - \boldsymbol{\beta}'_{im} \mathbf{d}_{im} - \boldsymbol{\beta}'_{jf} \mathbf{d}_{jf}. \end{aligned} \tag{3}$$

We allow preferences to vary across households through taste-shifters on the income and leisure coefficients:

$$\begin{aligned} \alpha_c &= \alpha_{c0} + \boldsymbol{\alpha}'_{c1} \mathbf{X}_c \\ \alpha_{lf} &= \alpha_{lf0} + \boldsymbol{\alpha}'_{lf1} \mathbf{X}_{lf} \\ \alpha_{lm} &= \alpha_{lm0} + \boldsymbol{\alpha}'_{lm1} \mathbf{X}_{lm}, \end{aligned} \tag{4}$$

where $\mathbf{X}_c$, $\mathbf{X}_{lf}$, and $\mathbf{X}_{lm}$ are vectors of observed heterogeneity including age of the male or the female, number of children in different age groups (under 3, 3 to 5, 6 to 11 and 12 to 17), whether the individual lives in a medium sized or big city and the region of residence. In the case of single males and females the above expressions are simplified as they do not include cross effects between partners and there is only one set of dummy variables. In the next section we further describe the characteristics of the estimation sample.

The last two terms in (3) are introduced to capture the peaks in part-time and full-time work that is observed in labour market participation data in many countries. Often the peaks correspond to the standard working hour options including zero or non-participation. One of the main arguments is that other alternative and non-standard working hours often require more search and/or have higher fixed costs.[3] These conjectures and factual observations are captured in a rather ad-hoc way by introducing dummy variables which capture the search costs and fixed costs related to working opportunities with standard and non-standard working hours as a disutility term. The reference for these dummy variables is 0 hours and then there are 5 other dummy variables per spouse corresponding to 1) 5, 10 or 15 hours a week; 2) 20 hours a week; 3) 25, 30 or 35 hours a week; 4) 40 hours a week; and finally 5) more than 40 hours per week, i.e. $d_{1s} = 1$ ($s = f, m$) if hours worked is either 5, 10 or 15 etc.

## 3 SAMPLE SELECTION

The estimation sample consists of all individuals that are available for the labour market, including those that are currently not working. The general criteria to be met for inclusion in the sample are as follows:

- 18 or older and less than 65
- not pre-retired
- not retired
- not self-employed
- not a student
- not sick or disabled

We do include older individuals in our sample, though one might argue that this is a particular subgroup as to the options available. More particularly, now, when we simulate individuals as non-participating we assume that they enter unemployment. For individuals older than 55 for example this may not be realistic as they may choose to enter early retirement and stop working altogether. But the instantaneous effect will not be that different between unemployment and early retirement or even full retirement. The unemployment benefits granted are the most generous ones, i.e. the

[3] In the discussion of the estimation results we will also present the results of a model that does not include the dummy variables.

benefits applicable when in the first months of unemployment, and should not be that different from pension benefits or early retirement benefits. The difference occurs when individuals are in a certain state for a longer period of time. Pension benefits do not decrease over time; whereas unemployment benefits may decrease the longer one stays in unemployment. Modeling such considerations would require a dynamic labour supply model and is out of the scope of this report.

As Table 1 shows the group of individuals of 55 years and older represents a small part of the sample population, generally less than 10%. The group of over 60 does not represent more than 2% of the sample population. More than 80% of the sample population is in the age group of 20 to 49 and the average age is in the early 30's for singles and in the late 30's and early 40's for males and females in couples. There are more lone parents among single females than there are among single males. The presence of children, especially young children, has a potentially large effect on the fixed costs of participating in the labour market.

Females in couples clearly work less hours than any of the other subgroups. Males in couples work the most hours, followed by single males and single females. Hourly wages for singles are considerable less than for males in couples and also less than for females in couples, probably due to the difference in average age between the two subgroups. Females in general earn less per hour than their male counterparts.

The first 12 rows under the heading of demographics in Table 1 are the variables that are taken up as taste shifters in (4). As the region of residence is a dummy variable one of the regions acts as reference region and is left out of the estimation. In our case that is the Brussels region. We now turn to a description of the estimation procedure and results.

TABLE 1 DESCRIPTIVE STATISTICS FOR MODELED SUBSAMPLES

| | Singles | | Couples | |
|---|---|---|---|---|
| | Males | Females | Males | Females |
| Demographics | | | | |
| Household size | 1.07 | 1.55 | 3.43 | |
| Children under 3 | 0.01 | 0.07 | 0.24 | |
| Children from 3 to 6 | 0.01 | 0.09 | 0.27 | |
| Children from 6 to 12 | 0.02 | 0.20 | 0.53 | |
| Children from 12 to 18 | 0.02 | 0.18 | 0.38 | |
| Age of male | 31.39 | | 40.38 | |
| Age of female | | 34.00 | 38.13 | |
| Living in Flanders (share in sample) | 0.58 | 0.53 | 0.61 | |
| Living in Wallonia (share in sample) | 0.32 | 0.35 | 0.31 | |
| Living in Brussels (share in sample) | 0.10 | 0.13 | 0.08 | |
| Living in medium sized city (10000-49999) (share in sample) | 0.57 | 0.55 | 0.60 | |
| Living in big sized city (>=50000) (share in sample) | 0.29 | 0.33 | 0.25 | |
| Population with flexible labour supply in age bracket (shares in sample): | | | | |
| 20 to 49 | 0.90 | 0.87 | 0.81 | 0.86 |
| 50 to 54 | 0.05 | 0.06 | 0.10 | 0.09 |
| 55 to 59 | 0.03 | 0.05 | 0.07 | 0.05 |
| 60 and over | 0.01 | 0.02 | 0.02 | 0.01 |
| Labour supply | | | | |
| Hours worked (all) | 28.20 | 22.08 | 31.14 | 18.48 |
| Hours worked (population in employment) | 34.94 | 33.23 | 36.67 | 30.02 |
| Hourly wages (in €2001) | | | | |
| Hourly wage (all) | 11.56 | 10.44 | 14.30 | 10.90 |
| Hourly wage (population in employment) | 12.17 | 11.59 | 15.14 | 12.51 |
| Number of observations | 15413 | 13444 | 30279 | |

## 4 ESTIMATION OF THE LABOUR SUPPLY MODEL

In order to estimate the model we need to discretize the observed labour supply in the data. We do this in 5 hour increments and take a band of 2.5 hours in either end of the discrete point to assign individuals to a discrete point. Individuals working less than 2.5 hours are indicated as working 0 hours, individuals working from 2.5 to 7.5 hours are indicated as working 5 hours in the model and so forth until 55 hours.

In MIMOSIS we then simulate disposable income for each individual in his or her assigned discrete labour supply. Since there are potentially 144 combinations of hours worked for couples the model is run 144 times, each time changing the number of hours per week. Remark that this way we also simulate hours worked and combinations of hours worked that are not the actual (discretized) hours worked for that individual and that are technically not needed to estimate the model. We will need them, however, when we want to derive probabilities for each of the discrete choice options. Once we input the number of hours worked MIMOSIS uses these as input and calculates gross labour income using hourly wages. This gross labour income is then subsequently used in all the calculations in the other domains of the tax-benefit system that are modeled in MIMOSIS. The result of each run is an output file containing disposable income and other income concepts for each individual corresponding to that particular combination of hours worked. In total we have 144 output files.

For further processing we combine these 144 output files into one single file that will contain, for each income concept in the output file, 144 variables. For example *inc*_20_40 will be the amount of income concept *inc* if the male partner works 20 hours and the female partner 40 hours per week. In the case of singles the concept used will be *inc*_*x*_0 where *inc* is the income concept and *x* the amount of hours worked by the single individual. This income file is then combined with a basic file that contains other information such as demographics and other socio-economic variables. This enables distilling the proper datasets for the different subsamples on which the model will be estimated, i.e. single males, single females and couples. The disposable income concepts used in the estimation are those that correspond to the actual (discretized) hours worked.

Given the stochastic nature of the model where the probabilities are given by expression (2), what we aim to achieve in estimation is a probability distribution that is as close as possible to the actual distribution. We want to maximize the likelihood that the observed distribution of hours worked corresponds as closely as possible to the joint probability as given in (2). We use maximum log-likelihood estimation to estimate the parameters of the deterministic part of the utility function.

The estimation is done using the 2001 tax-benefit legislation, the year of legislation that corresponds to the year of data collection. In the following sections we will describe the results of the maximum likelihood estimation for the different subsamples.

### 4.1 PARAMETER ESTIMATES

The parameter estimates of the labour supply model for couples, single females, and single males, corresponding to equations (3) and (4), are shown in Table 2, Table 3 and Table 4 respectively. We show results for two specifications of the model, one that does not include dummy variables for different discrete hour points and one that does include such dummy variables.

For couples the intercepts of the coefficients on income and leisure (i.e. $\alpha_{c0}$, $\alpha_{lf0}$ and $\alpha_{lm0}$) are positive, contrary to the estimation for single males and females. This might suggest that for couples, marginal utility of consumption and leisure have the expected sign too. However, income interacts with several other variables and with leisure and to determine the sign of marginal utility of consumption and leisure we need to plug in the values of these other variables.[4] In general, working has a negative effect on utility as witnessed by the overall positive and highly significant coefficient on the dummy variables. Remember that the dummy variables enter as disutility terms in the deterministic part of the utility function. Only females in couples seem to have a clear preference for working full-time as their utility increases significantly when they work 40 hours, ceteris paribus.

The model with dummy variable seems to perform better as the model without as shown by the log-likelihood value. A value of 0 would imply that we can perfectly replicate the observed distribution of hours worked so a value closer to 0 for the log-likelihood means a better 'fit' of the model. Another way to look at the fit of the model is to look at the observed and predicted aggregate probabilities which we will now turn to in the next section.

[4] A more intuitive representation of the estimated coefficients of the utility function would be by using marginal rates of substitution between income and leisure (see Decoster and Haan 2010 for an example). However, the calculation (and interpretation) of this concept is not straightforward when the alternative specific dummies are present in the model. This reveals the problematic nature of this 'ad hoc' way in which these dummies, which essentially capture elements from the budget constraint, are introduced directly into the preferences.

TABLE 2 ESTIMATES OF PREFERENCE STRUCTURE: COUPLES

| | Model without dummy variables | | | Model with dummy variables | | |
|---|---|---|---|---|---|---|
| | Coeff. | Std. Err. | | Coeff. | Std. Err. | |
| Income | 0.355 | 0.052 | *** | 0.365 | 0.056 | *** |
| x Age male | -0.239 | 0.094 | ** | -0.136 | 0.102 | |
| x Age male squared | 0.162 | 0.045 | *** | 0.071 | 0.048 | |
| x Age female | 0.545 | 0.085 | *** | 0.743 | 0.092 | *** |
| x Age female squared | -0.136 | 0.042 | *** | -0.244 | 0.046 | *** |
| x Number of children under 3 years | 0.047 | 0.005 | *** | 0.021 | 0.005 | *** |
| x Number of children aged 3 to 5 | 0.048 | 0.005 | *** | 0.027 | 0.005 | *** |
| x Number of children aged 6 to 11 | 0.038 | 0.003 | *** | 0.021 | 0.003 | *** |
| x Number of children aged 12 to 17 | 0.019 | 0.004 | *** | 0.009 | 0.004 | ** |
| x medium sized city (>=10K and <50K) | 0.009 | 0.007 | | 0.011 | 0.007 | |
| x big sized city (>=50K) | 0.007 | 0.008 | | 0.005 | 0.008 | |
| x Walloon region | -0.022 | 0.009 | ** | -0.009 | 0.010 | |
| x flanders region | -0.074 | 0.009 | *** | -0.058 | 0.009 | *** |
| Income squared | -0.005 | 0.000 | *** | -0.005 | 0.000 | *** |
| Leisure male | 0.232 | 0.016 | *** | 0.265 | 0.022 | *** |
| x Age male | -0.202 | 0.026 | *** | -0.158 | 0.024 | *** |
| x Age male squared | 0.152 | 0.013 | *** | 0.113 | 0.011 | *** |
| x Number of children under 3 years | 0.002 | 0.002 | | 0.010 | 0.001 | *** |
| x Number of children aged 3 to 5 | 0.007 | 0.001 | *** | 0.012 | 0.001 | *** |
| x Number of children aged 6 to 11 | 0.005 | 0.001 | *** | 0.013 | 0.001 | *** |
| x Number of children aged 12 to 17 | -0.003 | 0.001 | *** | 0.008 | 0.001 | *** |
| x medium sized city (>=10K and <50K) | 0.004 | 0.002 | * | 0.004 | 0.002 | ** |
| x big sized city (>=50K) | 0.006 | 0.002 | *** | 0.006 | 0.002 | *** |
| x Walloon region | -0.014 | 0.003 | *** | -0.010 | 0.002 | *** |
| x flanders region | -0.037 | -0.002 | *** | -0.032 | 0.002 | *** |
| Leisure male squared | -0.002 | 0.000 | *** | -0.001 | 0.000 | *** |
| Leisure female | 0.128 | 0.013 | *** | 0.245 | 0.021 | *** |
| x Age female | -0.238 | -0.023 | *** | -0.209 | 0.021 | *** |
| x Age female squared | 0.206 | 0.012 | *** | 0.177 | 0.011 | *** |
| x Number of children under 3 years | 0.037 | 0.001 | *** | 0.035 | 0.001 | *** |
| x Number of children aged 3 to 5 | 0.022 | 0.001 | *** | 0.021 | 0.001 | *** |
| x Number of children aged 6 to 11 | 0.018 | 0.001 | *** | 0.019 | 0.001 | *** |
| x Number of children aged 12 to 17 | 0.011 | 0.001 | *** | 0.014 | 0.001 | *** |
| x medium sized city (>=10K and <50K) | 0.004 | 0.002 | ** | 0.004 | 0.002 | *** |
| x big sized city (>=50K) | 0.006 | 0.002 | *** | 0.006 | 0.002 | *** |
| x Walloon region | -0.001 | 0.002 | | 0.000 | 0.002 | |
| x flanders region | -0.017 | 0.002 | *** | -0.013 | 0.002 | *** |
| Leisure female squared | -0.001 | 0.000 | *** | -0.001 | 0.000 | *** |
| Income x Leisure male | 0.001 | 0.000 | *** | -0.004 | 0.000 | *** |
| Income x Leisure female | 0.000 | 0.000 | ** | -0.001 | 0.000 | *** |
| Leisure male x Leisure female | 0.002 | 0.000 | *** | 0.000 | 0.000 | *** |
| Male | | | | | | |
| xWorking 5 to 15 hours per week | | | | 3.022 | 0.108 | *** |
| xWorking 20 hours per week | | | | 2.919 | 0.148 | *** |
| xWorking 25 to 35 hours per week | | | | 2.698 | 0.173 | *** |
| xWorking 40 hours per week | | | | 1.229 | 0.180 | *** |
| xWorking more than 40 hours per week | | | | 5.862 | 0.176 | *** |
| Female | | | | | | |
| xWorking 5 to 15 hours per week | | | | 2.154 | 0.080 | *** |
| xWorking 20 hours per week | | | | 0.605 | 0.115 | *** |
| xWorking 25 to 35 hours per week | | | | 0.814 | 0.130 | *** |
| xWorking 40 hours per week | | | | -0.929 | 0.134 | *** |
| xWorking more than 40 hours per week | | | | 3.664 | 0.164 | *** |
| Log-lokelihood | -124288.97 | | | -89308.43 | | |
| Wald Chi2(12) | 1244.86 | | | 692.38 | | |
| Observations | 30278 | | | 30278 | | |

* significant at 10%; ** significant at 5%; significant at 1%

TABLE 3 ESTIMATES OF PREFERENCE STRUCTURE: SINGLE FEMALES

| | Model without dummy variables | | | Model with dummy variables | | |
|---|---|---|---|---|---|---|
| | Coeff. | Std. Err. | | Coeff. | Std. Err. | |
| Income | -0.357 | 0.076 | *** | -0.156 | 0.082 | *** |
| x Age female | 0.451 | 0.147 | *** | 0.851 | 0.162 | *** |
| x Age female squared | -0.035 | 0.077 | | -0.271 | 0.083 | *** |
| x Number of children under 3 years | -0.056 | 0.020 | *** | 0.022 | 0.022 | |
| x Number of children aged 3 to 5 | 0.009 | 0.018 | | 0.056 | 0.019 | *** |
| x Number of children aged 6 to 11 | -0.037 | 0.011 | *** | 0.015 | 0.011 | |
| x Number of children aged 12 to 17 | -0.088 | 0.011 | *** | -0.023 | 0.011 | ** |
| x medium sized city (>=10K and <50K) | 0.047 | 0.016 | *** | 0.048 | 0.018 | *** |
| x big sized city (>=50K) | 0.070 | 0.017 | *** | 0.065 | 0.019 | *** |
| x Walloon region | -0.006 | 0.017 | | 0.009 | 0.017 | |
| x flanders region | -0.071 | 0.016 | *** | -0.041 | 0.017 | ** |
| Income squared | -0.004 | 0.001 | *** | -0.006 | 0.001 | *** |
| Leisure female | -0.042 | 0.016 | *** | 0.158 | 0.030 | *** |
| x Age female | -0.200 | 0.026 | *** | -0.074 | 0.025 | *** |
| x Age female squared | 0.151 | 0.014 | *** | 0.083 | 0.013 | *** |
| x Number of children <=3 years | 0.040 | 0.004 | *** | 0.051 | 0.004 | *** |
| x Number of children >3 and <=6 years | 0.019 | 0.004 | *** | 0.035 | 0.003 | *** |
| x Number of children >6 and <=12 years | 0.005 | 0.002 | ** | 0.024 | 0.002 | *** |
| x Number of children >12 years | -0.014 | 0.002 | *** | 0.011 | 0.002 | *** |
| x medium sized city (>=10K and <50K) | 0.010 | 0.003 | *** | 0.010 | 0.003 | *** |
| x big sized city (>=50K) | 0.021 | 0.003 | *** | 0.021 | 0.003 | *** |
| x Walloon region | 0.003 | 0.003 | | 0.006 | 0.003 | ** |
| x flanders region | -0.029 | 0.003 | *** | -0.024 | 0.003 | *** |
| Leisure female squared | 0.000 | 0.000 | *** | -0.001 | 0.000 | *** |
| Income x Leisure female | 0.007 | 0.000 | *** | -0.001 | 0.000 | *** |
| Female | | | | | | |
| xWorking 5 to 15 hours per week | | | | 3.207 | 0.134 | *** |
| xWorking 20 hours per week | | | | 2.176 | 0.192 | *** |
| xWorking 25 to 35 hours per week | | | | 2.624 | 0.221 | *** |
| xWorking 40 hours per week | | | | 0.650 | 0.230 | *** |
| xWorking more than 40 hours per week | | | | 5.264 | 0.255 | *** |
| Log-lokelihood | -28002.61 | | | -19380.90 | | |
| Wald Chi2(10) | 548.45 | | | 292.35 | | |
| Observations | 13014 | | | 13014 | | |

* significant at 10%; ** significant at 5%; significant at 1%

TABLE 4 ESTIMATES OF PREFERENCE STRUCTURE: SINGLE MALES

| | Model without dummy variables | | | Model with dummy varibales | | |
|---|---|---|---|---|---|---|
| | Coeff. | Std. Err. | | Coeff. | Std. Err. | |
| Income | -0.468 | 0.071 | *** | 0.000 | 0.072 | *** |
| x Age male | 0.343 | 0.127 | *** | 0.791 | 0.131 | *** |
| x Age male squared | 0.057 | 0.067 | | -0.208 | 0.068 | *** |
| x Number of children under 3 years | -0.059 | 0.059 | | 0.021 | 0.055 | |
| x Number of children aged 3 to 5 | -0.150 | 0.043 | *** | -0.038 | 0.038 | |
| x Number of children aged 6 to 11 | 0.036 | 0.027 | | 0.084 | 0.026 | *** |
| x Number of children aged 12 to 17 | -0.065 | 0.025 | *** | 0.018 | 0.024 | |
| x medium sized city (>=10K and <50K) | 0.040 | 0.015 | *** | 0.029 | 0.016 | * |
| x big sized city (>=50K) | 0.069 | 0.017 | *** | 0.053 | 0.017 | *** |
| x Walloon region | -0.064 | 0.018 | *** | -0.042 | 0.018 | ** |
| x flanders region | -0.090 | 0.017 | *** | -0.072 | 0.017 | *** |
| Income squared | -0.002 | 0.001 | *** | -0.009 | 0.001 | *** |
| Leisure male | -0.030 | 0.016 | *** | 0.090 | 0.029 | *** |
| x Age male | -0.212 | 0.025 | *** | -0.079 | 0.023 | *** |
| x Age male squared | 0.165 | 0.013 | *** | 0.090 | 0.012 | *** |
| x Number of children under 3 years | -0.004 | 0.011 | | 0.023 | 0.009 | ** |
| x Number of children aged 3 to 5 | -0.011 | 0.009 | | 0.015 | 0.008 | * |
| x Number of children aged 6 to 11 | -0.016 | 0.006 | *** | 0.018 | 0.006 | *** |
| x Number of children aged 12 to 17 | -0.036 | 0.006 | *** | 0.006 | 0.005 | |
| x medium sized city (>=10K and <50K) | 0.013 | 0.003 | *** | 0.010 | 0.003 | *** |
| x big sized city (>=50K) | 0.030 | 0.003 | *** | 0.026 | 0.003 | *** |
| x Walloon region | -0.016 | 0.003 | *** | -0.010 | 0.003 | *** |
| x flanders region | -0.045 | 0.003 | *** | -0.039 | 0.003 | *** |
| Leisure male squared | 0.000 | 0.000 | ** | -0.001 | 0.000 | *** |
| Income x Leisure male | 0.010 | 0.000 | *** | -0.002 | 0.000 | *** |
| Male | | | | | | |
| xWorking 5 to 15 hours per week | | | | 3.272 | 0.151 | *** |
| xWorking 20 hours per week | | | | 2.985 | 0.205 | *** |
| xWorking 25 to 35 hours per week | | | | 3.046 | 0.235 | *** |
| xWorking 40 hours per week | | | | 1.827 | 0.237 | *** |
| xWorking more than 40 hours per week | | | | 6.700 | 0.230 | *** |
| Log-lokelihood | -33958.03 | | | -24051.88 | | |
| Wald Chi2(10) | 618.73 | | | 477.40 | | |
| Observations | 15384 | | | 15384 | | |

* significant at 10%; ** significant at 5%; significant at 1%

#### 4.2 MODEL 'FIT': OBSERVED VERSUS PREDICTED VALUES

In the tables below we show the observed and predicted percentages for each of the 12 hour options and for the two model specifications. For the observed values this means the percentage of the population observed in a certain hours range. Here we would expect to find the largest masses at zero, part-time and full-time work. The predicted values are averages of the probabilities of observing the individual in a certain hours range. That is, we summarize the probability of observing an individual in a certain discrete point over all individuals. The probabilities themselves are calculated using the estimated coefficients shown in Table 2, Table 3 and Table 4 and the disposable incomes for each of the possible hours worked combinations as calculated by MIMOSIS and plugging them in (2).

In Table 5 we show the results for the model without dummy variables. As can be seen the peaks that are observed around the traditional points of hours worked are not very well captured in this specification of the model. Non participation and especially full-time work are seriously underestimated and part-time work —in the range of 15 to 35 hours— is in general overestimated. Remember that the inclusion of dummy variables is an option to attenuate this generally observed result. In Table 6 we show the aggregate prediction for the model specification that includes dummy variables for different (clusters of) discrete hour choices. As can be seen from this table the aggregate 'fit' for this model specification is indeed very good for all subsamples — couples, single males and females— especially around the traditional points, i.e. inactivity, part-time work and full-time work. In fact, the traditional hour choices are perfectly predicted up to one decimal. Of course, this is partly an artifact of the model, as those are the options where the dummy variable takes on a value of one *only* if that level is observed, i.e. zero, 20 or 40. The other options are clustered, e.g. the options 5, 10 or 15 hours of work are captured in a single dummy variable. Nonetheless, also the other —non-standard— hour options are quite close to the aggregate observed values. For this reason and because the use of labour supply models is especially useful to estimate aggregate budgetary effects and cost recovery effects of policy proposals and reforms as well as the aggregate effects on labour force participation in the simulations we will only work with the model specification including dummy variables.

First, we will look at one other way to judge the performance of the model and that is by calculating elasticities which we do in the next section.

TABLE 5 OBSERVED VERSUS PREDICTED PERCENTAGES FOR MODEL WITHOUT DUMMY VARIABLES AND FOR DIFFERENT SUBSAMPLES (COUPLES, SINGLE MALES AND SINGLE FEMALES)

| | males in couples | | females in couples | |
|---|---|---|---|---|
| | observed (%) | predicted (%) | observed (%) | predicted (%) |
| 0 | 15.4 | 7.6 | 39.2 | 31.1 |
| 5 | 0.6 | 1.2 | 1.6 | 4.2 |
| 10 | 1.1 | 1.7 | 1.9 | 4.5 |
| 15 | 1.3 | 9.4 | 2.6 | 13.2 |
| 20 | 2.6 | 8.1 | 10.9 | 9.3 |
| 25 | 3.1 | 9.2 | 5.4 | 7.6 |
| 30 | 6.9 | 11.2 | 9.3 | 6.8 |
| 35 | 9.4 | 13.0 | 3.8 | 6.3 |
| 40 | 56.4 | 13.1 | 24.9 | 5.7 |
| 45 | 1.3 | 11.4 | 0.2 | 4.8 |
| 50 | 0.8 | 8.6 | 0.1 | 3.8 |
| 55 | 1.2 | 5.5 | 0.1 | 2.8 |
| | single males | | single females | |
| | observed (%) | predicted (%) | observed (%) | predicted (%) |
| 0 | 19.8 | 11.9 | 32.6 | 20.9 |
| 5 | 0.8 | 1.8 | 1.1 | 6.4 |
| 10 | 1.3 | 2.3 | 1.5 | 5.4 |
| 15 | 1.9 | 10.4 | 2.4 | 11.2 |
| 20 | 4.2 | 9.0 | 7.3 | 8.5 |
| 25 | 4.6 | 9.7 | 4.4 | 7.7 |
| 30 | 8.3 | 11.2 | 6.5 | 7.6 |
| 35 | 10.6 | 11.8 | 4.7 | 7.5 |
| 40 | 46.9 | 11.1 | 38.7 | 7.4 |
| 45 | 0.8 | 9.2 | 0.4 | 6.7 |
| 50 | 0.4 | 6.9 | 0.2 | 5.8 |
| 55 | 0.5 | 4.7 | 0.4 | 4.9 |

TABLE 6 OBSERVED VERSUS PREDICTED PERCENTAGES FOR MODEL WITH DUMMY VARIABLES AND FOR DIFFERENT SUBSAMPLES (COUPLES, SINGLE MALES AND SINGLE FEMALES)

| | males in couples | | females in couples | |
|---|---|---|---|---|
| | observed (%) | predicted (%) | observed (%) | predicted (%) |
| 0 | 15.4 | 15.4 | 39.2 | 39.2 |
| 5 | 0.6 | 0.4 | 1.6 | 1.5 |
| 10 | 1.1 | 0.7 | 1.9 | 1.6 |
| 15 | 1.3 | 1.9 | 2.6 | 3.0 |
| 20 | 2.6 | 2.6 | 10.9 | 10.9 |
| 25 | 3.1 | 4.3 | 5.4 | 7.2 |
| 30 | 6.9 | 6.1 | 9.3 | 6.1 |
| 35 | 9.4 | 9.0 | 3.8 | 5.2 |
| 40 | 56.4 | 56.4 | 24.9 | 24.9 |
| 45 | 1.3 | 0.8 | 0.2 | 0.2 |
| 50 | 0.8 | 1.1 | 0.1 | 0.1 |
| 55 | 1.2 | 1.4 | 0.1 | 0.1 |
| | **single males** | | **single females** | |
| | observed (%) | predicted (%) | observed (%) | predicted (%) |
| 0 | 19.8 | 19.8 | 32.6 | 32.6 |
| 5 | 0.8 | 0.6 | 1.1 | 1.1 |
| 10 | 1.3 | 1.0 | 1.5 | 1.4 |
| 15 | 1.9 | 2.3 | 2.4 | 2.5 |
| 20 | 4.2 | 4.2 | 7.3 | 7.3 |
| 25 | 4.6 | 5.4 | 4.4 | 4.9 |
| 30 | 8.3 | 7.6 | 6.5 | 5.2 |
| 35 | 10.6 | 10.4 | 4.7 | 5.3 |
| 40 | 46.9 | 46.9 | 38.7 | 38.7 |
| 45 | 0.8 | 0.5 | 0.4 | 0.4 |
| 50 | 0.4 | 0.6 | 0.2 | 0.3 |
| 55 | 0.5 | 0.7 | 0.4 | 0.3 |

### 4.3 ELASTICITY ESTIMATES

In the tables that follow we show estimates of the elasticities, both at the intensive and extensive margins. Elasticities at the intensive margin are obtained by increasing the wage by 1% and recalculating the number of hours worked given the parameter estimates of the utility function. At the extensive margin a similar procedure is followed but now with respect to the probability of entering the labour market, i.e. the change in participation probability following a 1% wage increase. The results are shown for men and women in couples, single males and single females.

Simulating an increase of 1% in gross wages implies that we have to run MIMOSIS again 144 times to simulate disposable incomes in each of the hours worked choices for this new situation, i.e. a 1% increase in gross wages. Actually this is done two times, once for an increase of 1% in the gross wage of males and once for an increase of 1% in the gross wage of females.

Extensive elasticities are calculated as the expected percentage change in labour market participation due to a 1% increase in gross wages. It is a measure of the responsiveness of non-participants to an increase in their (potential) gross wage, i.e. how many will be activated by a 1% increase in their gross wage.[5] The probability of participation is given by one minus the probability of not working. Intensive elasticities are calculated by estimating the change in expected hours worked due to an increase of 1% in gross wages (including the participation effect). The reported elasticities are aggregate elasticities, meaning that we sum the total amount of hours worked before and after the increase of 1% for the entire population or the entire decile and that we then subtract these totals and divide the difference by 1%.

The elasticities reported in Table 7 through Table 9 are relatively high especially at the intensive margin for males in couples. Female elasticities are generally found to be higher than those for males, especially for females in couples. The magnitude reported here is not exceptionally high compared with some findings in other countries (see e.g. chapter 1 in Orsini, 2008 and references therein). The higher general elasticity for females, however, is not consistently confirmed throughout the wage distribution: female elasticities are higher only for the upper half of the wage distribution, whereas in the lower half of the distribution males are shown to have higher elasticities than females. This pattern is especially strong in the case of couples.

Across model specifications elasticities at the intensive margin are similar. At the extensive margin, on the other hand, elasticities are generally estimated to be lower in the specification without dummy variables and this difference is especially outspoken in the case of both males and females in couples. We will refer back to the elasticities when we discuss the simulation results in the next section.

[5] Gross wages for individuals currently not performing any labour market activity are typically imputed from an estimated wage equation. In MIMOSIS, however, we have information on observed and former wages from administrative data. For those currently inactive we assume they can resume activity at their former wage (indexed to reflect changes in living standards).

TABLE 7 ELASTICITY ESTIMATES FOR MALES AND FEMALES IN COUPLES

| | Model specification without dummy variables | | | | Model specification with dummy variables | | | |
|---|---|---|---|---|---|---|---|---|
| | intensive | | extensive | | intensive | | extensive | |
| | males | females | males | females | males | females | males | females |
| | aggregate elasticity | | | | aggregate elasticity | | | |
| | 0.439 | 0.699 | 0.127 | 0.287 | 0.384 | 0.538 | 0.275 | 0.357 |
| | aggregate elasticity per decile of gross wage | | | | aggregate elasticity per decile of gross wage | | | |
| 1 | 0.519 | 0.468 | 0.134 | 0.191 | 0.621 | 0.408 | 0.415 | 0.242 |
| 2 | 0.789 | 0.670 | 0.184 | 0.265 | 0.696 | 0.512 | 0.495 | 0.299 |
| 3 | 0.751 | 0.743 | 0.182 | 0.313 | 0.607 | 0.563 | 0.442 | 0.343 |
| 4 | 0.700 | 0.816 | 0.154 | 0.330 | 0.546 | 0.620 | 0.398 | 0.391 |
| 5 | 0.565 | 0.831 | 0.151 | 0.339 | 0.467 | 0.626 | 0.339 | 0.387 |
| 6 | 0.470 | 0.826 | 0.146 | 0.326 | 0.393 | 0.634 | 0.276 | 0.429 |
| 7 | 0.376 | 0.753 | 0.129 | 0.293 | 0.329 | 0.597 | 0.230 | 0.409 |
| 8 | 0.291 | 0.704 | 0.104 | 0.303 | 0.265 | 0.569 | 0.180 | 0.404 |
| 9 | 0.177 | 0.610 | 0.072 | 0.265 | 0.171 | 0.493 | 0.107 | 0.355 |
| 10 | 0.054 | 0.494 | 0.039 | 0.230 | 0.070 | 0.341 | 0.039 | 0.263 |

TABLE 8 ELASTICITY ESTIMATES FOR SINGLE MALES

| | Model specification without dummy variables | | Model specification with dummy variables | |
|---|---|---|---|---|
| | intensive | extensive | intensive | extensive |
| | aggregate elasticity | | aggregate elasticity | |
| | 0.138 | 0.096 | 0.239 | 0.184 |
| | aggregate elasticity per decile of gross wage | | aggregate elasticity per decile of gross wage | |
| 1 | 0.137 | 0.045 | 0.287 | 0.186 |
| 2 | 0.131 | 0.071 | 0.275 | 0.191 |
| 3 | 0.130 | 0.069 | 0.271 | 0.188 |
| 4 | 0.136 | 0.068 | 0.281 | 0.193 |
| 5 | 0.132 | 0.079 | 0.275 | 0.194 |
| 6 | 0.132 | 0.087 | 0.261 | 0.191 |
| 7 | 0.154 | 0.102 | 0.251 | 0.191 |
| 8 | 0.173 | 0.127 | 0.253 | 0.201 |
| 9 | 0.196 | 0.162 | 0.242 | 0.209 |
| 10 | 0.066 | 0.133 | 0.075 | 0.116 |

TABLE 9 ELASTICITY ESTIMATES FOR SINGLE FEMALES

| | Model specification without dummy variables | | Model specification with dummy variables | |
|---|---|---|---|---|
| | intensive | extensive | intensive | extensive |
| | aggregate elasticity | | aggregate elasticity | |
| | 0.221 | 0.201 | 0.336 | 0.237 |
| | aggregate elasticity per decile of gross wage | | aggregate elasticity per decile of gross wage | |
| 1 | 0.248 | 0.123 | 0.297 | 0.178 |
| 2 | 0.070 | 0.046 | 0.230 | 0.120 |
| 3 | 0.263 | 0.173 | 0.262 | 0.148 |
| 4 | 0.440 | 0.348 | 0.332 | 0.193 |
| 5 | 0.192 | 0.160 | 0.355 | 0.225 |
| 6 | 0.182 | 0.174 | 0.387 | 0.262 |
| 7 | 0.280 | 0.263 | 0.360 | 0.261 |
| 8 | 0.240 | 0.209 | 0.346 | 0.269 |
| 9 | 0.152 | 0.206 | 0.420 | 0.341 |
| 10 | 0.094 | 0.245 | 0.279 | 0.257 |

# 5 SIMULATIONS

In this section we look at three policy reforms, one actual and two hypothetical. The main objective is to look at the difference in labour supply effects between targeted reforms and more general reforms. A targeted reform is one where the proposed reform is designed to increase labour market participation among a certain subgroup of the population, e.g. low skilled, or low earners. Two of the reforms that we study are targeted and one is general in nature. The two targeted reforms are the workbonus - an existing policy for which the benefit varies with the level of earnings within a certain range - and a reduction of personal income taxes in the form of a fixed amount that is the same for everybody in the targeted population. The general reform is one where the above reduction in personal income taxes is applicable to all wage earners on the private labour market. We will describe each of the reforms in more detail in the next section but remark that with the hypothetical targeted reform we do not want to target another subpopulation. All we want to evaluate is whether there is a difference in labour market participation between the workbonus and this reduction in personal income taxes where everybody *within the same subpopulation*, i.e. the subpopulation targeted by the workbonus, is entitled to the same amount.

## 5.1 THE REFORMS

### 5.1.1 Reform 1: Workbonus

The workbonus is a measure instituted to increase labour market participation among the low skilled and comes in the form of a reduction in employee social security contributions. The amount of the reduction depends on the full time equivalent earnings of the worker and decreases as those earnings increase. The legislator makes a distinction between white and blue collar workers. Table 10 shows the structure, income boundaries and amounts of the workbonus as it was applicable in 2009.

TABLE 10 WORKBONUS FOR BLUE AND WHITE COLLAR WORKERS IN EURO PER MONTH

| Gross monthly full time equivalent earnings (FTEE) | Blue collar workers | White collar workers |
|---|---|---|
| <=1387.49 | 189 | 175 |
| >1387.49 and <=1693.50 | 189-0.3021*(FTEE-1387.49) | 175-0.2798*(FTEE-1387.49) |
| >1693.50 and <=2203.72 | 154.43-0.1892*(FTEE-1387.49) | 143-0.1752*(FTEE-1387.49) |
| >2203.72 | 0 | 0 |

The workbonus is determined in function of full time equivalent earnings and is adjusted afterwards to take into account working time. Take the example of a full time worker, working 21 days a month. In that case full time equivalent income for someone working less than full time in the same job is calculated as :

$$\text{FTEE} = \left( \frac{\text{number of days worked by a full time worker}}{\text{actual number of days worked}} \right) * \text{earnings.}$$

The amount of the workbonus calculated on this full time equivalent income is then multiplied by the inverse of the fraction between brackets to determine the actual amount of the workbonus to be applied to this worker.

Without taking into account potential labour supply effects, we obtain a first estimate of the gross cost of the workbonus in 2009 by a simple comparison of government revenue in the 2009 baseline (with workbonus) with a ‘reform’-situation where we have put the workbonus parameters at zero. The number of persons eligible for the workbonus in 2009 is estimated to be around 940 000 individuals. The resulting estimate is a gross cost of about €834 million and a net cost of €528 million. Part of the gross cost is recovered by an increase in the personal income tax revenue, since a reduction in social security contributions increases taxable income and hence personal income taxes.

Table 11 gives summary statistics of average, minimum, maximum and median yearly gross and net gain for the targeted population. The gross gain is calculated as the difference in employee social security contributions between the baseline situation and the reform situation and the net gain by comparing disposable incomes in both baseline and reform situation. The change in personal income taxes is also shown and a positive reading indicates higher personal income taxes in the baseline situation, i.e. with workbonus. The median net gain is €540 per year, but there also seem to be individuals that actually see their disposable income decrease. It is peculiar to find a maximum gross gain of more than €3000 if the gross maximum monthly amount is only €189. Remember that the only change is that the parameters applying to the workbonus were put to zero in the reform situation. There obviously seem to be other factors at play and that is also the strength of a comprehensive model as MIMOSIS but in this report we will not go into more detail on this matter.

TABLE 11 SUMMARY STATISTICS OF GAINS AND LOSSES AFTER INTRODUCTION OF THE WORKBONUS IN EURO PER YEAR

| | mean | minimum | median | maximum |
|---|---|---|---|---|
| Gross gain (loss) in social security contributions | 887 | 4 | 808 | 3287 |
| Net gain (loss) in disposable income | 597 | (5452) | 540 | 4973 |
| Gain (loss) in personal income taxes* | 252 | 1596 | (179) | (2956) |

*a gain in personal income taxes implies that the individual pays less personal income taxes after introduction of the workbonus than (s)he did before, i.e. the maximum loss is €2956 per year implying that this person pays €2956 per year more in personal income taxes than (s)he would in a situation without the workbonus. The maximum gain is €1596 per year or a loss of -€1596 per year.

#### 5.1.2 Reform 2: General reduction of personal income taxes

In this scenario every working individual is given a reduction in personal income taxes. The amount of the reduction is equal to the net cost of the workbonus, i.e. €528 million, divided by the number of eligible persons. The eligibility conditions of this general reduction are based on those of the Flemish "jobkorting" (but in this case implemented at the federal level). More specifically we take the minimum income threshold needed to be eligible for the Flemish "jobkorting" and apply it to our sample. The minimum threshold is €5500 net taxable income per year. In our simulation there are no further restrictions and we keep it as general as possible. Every working person with a net taxable income above the threshold receives a certain amount. Taking into account the net cost of the workbonus and the number of individuals that satisfy the eligibility conditions we arrive at an amount of €173.64 per year.

#### 5.1.3 Reform 3: Targeted reduction of personal income taxes

In this reform situation we only grant a reduction in personal income taxes to those who also receive the workbonus. The eligibility conditions are thus those of the workbonus and the amount received is €561 per year. This amount was obtained by dividing the net cost of the workbonus by the number of workbonus recipients in the 2009 system. In short, every individual with a gross full time equivalent montly labour income of less than €2203.72 (but higher than zero) receives a reduction of personal income taxes equal to €561 per year.

### 5.2 SIMULATIONS: CALCULATIONS AND RESULTS

As we mentioned in the section on the estimation of the labour supply model the latter is estimated on 2001 data, the year of data collection. The simulations, however, are on the legislation of 2009. Moreover, in 2001 there already was a workbonus. All this makes that we did not use 2001 as a baseline. The baseline we use is simulated as well and obtained by applying the estimated coefficients on the 2009 system with the workbonus turned off. In the next subsection we briefly explain the steps taken to arrive at the different datasets used for the analysis.

#### 5.2.1 Expected incomes and taxes

For each individual we calculate the probability of choosing a particular amount of hours worked according to:

$$P_{ik} = \Pr\left(V_{ik} \geq V_{ij}, \forall j = 0,..., J\right) = \frac{\exp U\left(Lf_{ik}, Lm_{ik}, C_{ik}, \mathbf{X}_i\right)}{\sum_{j=0}^{J} \exp U\left(Lf_{ij}, Lm_{ij}, C_{ij}, \mathbf{X}_i\right)}, \tag{5}$$

where $U(\ )$ is given by:

$$\begin{aligned} U_{ij} &= \alpha_c C_{ij} + \alpha_{cc} C_{ij}^2 + \alpha_{lf} Lf_{ij} + \alpha_{llf} Lf_{ij}^2 + \alpha_{lm} Lm_{ij} + \alpha_{llm} Lm_{ij}^2 \\ &\quad + \alpha_{clf} C_{ij} Lf_{ij} + \alpha_{clm} C_{ij} Lm_{ij} + \alpha_{lmlf} Lf_{ij} Lm_{ij} - \boldsymbol{\beta}'_{im} \mathbf{d}_{im} - \boldsymbol{\beta}'_{jf} \mathbf{d}_{jf}. \end{aligned} \tag{6}$$

The coefficients of $U(.)$, the $\alpha's$ and $\beta's$, are the ones estimated and reported in section 4.1. We obtain disposable income and leisure by running MIMOSIS once for each possible combination of hours worked and for each reform situation (including the 2009 'baseline'). The procedure is the same as the one described in the estimation of the labour supply model, i.e. we run MIMOSIS 144 times for each of the reform situations and combine the resulting income files in one file for further analysis.

For the baseline simulation, we used the 2009 tax-benefit legislation with the workbonus turned off. We thus start from expected incomes, revenues and hours worked in the situation where there is no workbonus. The expected incomes, taxes and revenues, hours worked and labour market participation are obtained by applying the calculated probabilities for the “no workbonus” situation on the incomes and revenue concepts as calculated by MIMOSIS in the same “no workbonus” situation. E.g. personal income taxes paid by a couple in the baseline is calculated as:

$$E\left[PIT_{base}\right]=\sum_{i=0}^{55}\sum_{j=0}^{55}p_{ij}PIT_{ij}, \tag{7}$$

where $p_{ij}$ is the probability of the male partner choosing $i$ hours of work and the female partner choosing $j$ hours of work and $PIT_{ij}$ is the amount of personal income taxes paid as calculated by MIMOSIS if the couple chooses that combination of hours worked. To get aggregate amounts, all individual amounts are weighed by the population weights and summed over all individuals.

The same applies to hours worked to estimate the effects on labour market participation. In the case of a couple for example the expected number of hours worked by the male is:

$$E\left[hour_{male}\right]=\sum_{i=0}^{55}\sum_{j=0}^{55}p_{ij}Hm_{ij}, \tag{8}$$

where $Hm_{ij}$ is hours worked and $p_{ij}$ is the probability of the male choosing state $i$ given that his partner chooses state $j$. Again, the aggregate total is obtained by a weighted sum over all (male) individuals.

In the next subsection we show the results of the simulations described in the previous section after application of the concepts and calculations described in this subsection.

#### 5.2.2 Labour market participation and revenue effects

In the following tables we show the effects on labour market participation and revenue of the different reforms and for the different subsamples, i.e. males and females in couples, single males, and single females. We also show the results for the targeted population. As we consider this as the evaluation of an existing measure, the targeted population here is the subgroup enjoying the workbonus in a normal single run of MIMOSIS, i.e. for the actually observed labour time. Given that we start from a situation without workbonus as the baseline we evaluate the participation effects on the targeted population as compared to a situation without workbonus. This way we evaluate whether the measure really has had an effect on the labour market participation of this group, i.e. whether they would work less or even not at all in the counter factual situation without workbonus.

In Table 12 and Table 13 we show labour market participation and their full time equivalents in the baseline and different reform scenarios for the different subsamples. The change in employment with respect to the baseline is also shown. As can be seen the employment effects are rather small and there is no considerable difference in overall job creation between the three reform scenarios. The biggest impact on employment is found in the male population and especially males in couples. The employment effect among males is more than twice that of females in almost all scenarios and for all subsamples. This is consistent with the pattern of elasticities in Table 7 where male elasticities were shown to be higher than female elasticities in the lower half of the wage distribution in this specification of the model, i.e. with dummy variables to capture the disutility of certain working hour choices and to capture the peaks in observed labour market participation and non-participation as explained in the first part of this report.

The effect on full time equivalent jobs is somewhat higher than the effect on mere participation. Full time equivalent jobs are calculated by dividing the total amount of hours worked per week by 40. The higher increase in full time equivalents implies that the reforms not only induce people to enter the labour market but also to increase the number of hours worked for those who are already working. Confirmation can be found in Table 14 and Table 15 where we show the distribution of estimated probabilities for the different reform scenarios and the baseline.

Overall the distributions are very similar and indicative of the rather small employment effects that we observe in Table 12 and Table 13. Increases in probabilities are especially found in the higher hour options especially around 40 hours, whereas for the lower options probabilities generally decline or remain unchanged. The effect is more pronounced among males than females as could be expected from the results of the employment effects and the estimated elasticities.

If we focus on the targeted population, i.e. those that currently enjoy the workbonus, we see that the effect of a targeted reform is much more effective than a more general one, but that there is much less difference between the more complex (to calculate) workbonus and a simpler scheme where all individuals of the targeted population get the same amount. Remember that the average reduction in personal income taxes was around €561 per year and the median net gain for the workbonus was €540. That is also why in most cases, except for single males and males in couples in the targeted population, we see slightly larger employment effects under the system of a reduction in personal income taxes than under the workbonus.

Remark also that he employment effects among the targeted population for both single males and females are higher than the overall effect for the entire population in the respective subsamples. Remember from Table 11 that there are individuals that actually have a lower disposable income in the situation with workbonus compared to the situation where the parameters for the workbonus are put equal to zero. Those individuals will either decrease their working hours or leave the labour market altogether which translates in lower participation and/or a lower level of full-time equivalent jobs.

As to the cost of the programs, Table 12 and Table 13 show that the cost is clearly higher for singles than it is for couples in all scenarios. Moreover, the cost for single females is considerably higher than that for males exceeding the latter by more than 60% at an average of around €155 000 per full time equivalent job. The cost for couples is considerably less but still amounts to a significant €40 000 per full time equivalent job. The targeted reforms are in general less costly than the more general one where the entire working population enjoys a reduction.

TABLE 12 LABOUR MARKET PARTICIPATION AND REVENUE EFFECTS FOR MALES AND FEMALES IN COUPLES

| | Males in couples | | | | Females in couples | | | |
|---|---|---|---|---|---|---|---|---|
| | base | Workbonus | PIT reduction general | PIT reduction targeted | base | workbonus | PIT reduction general | PIT reduction targeted |
| | Entire population of males in couples | | | | Entire population of females in couples | | | |
| Total labour force participation | 725396 | 728354 | 727989 | 728355 | 499988 | 501560 | 501815 | 501590 |
| Change with respect to base | | 2958 | 2593 | 2959 | | 1572 | 1827 | 1602 |
| Full time equivalents* | 619928 | 623341 | 623202 | 623346 | 323153 | 324620 | 324900 | 324647 |
| Change with respect to base | | 3413 | 3274 | 3417 | | 1467 | 1748 | 1494 |
| | Targeted population of males in couples** | | | | Targeted population of females in couples** | | | |
| Total labour force participation | 100771 | 102792 | 101359 | 102656 | 118508 | 119648 | 119007 | 119695 |
| Change with respect to base | | 2021 | 588 | 1885 | | 1140 | 500 | 1187 |
| Full time equivalents* | 81903 | 84133 | 82574 | 83996 | 78358 | 79449 | 78840 | 79488 |
| Change with respect to base | | 2230 | 671 | 2093 | | 1090 | 482 | 1130 |

| | Total revenue effects couples for the entire population of couples | | | |
|---|---|---|---|---|
| | base | workbonus | PIT reduction general | PIT reduction targeted |
| Government revenue (in million Euro) | 25611 | 25420 | 25377 | 25416 |
| Cost per job (in Euro) | | 42158 | 52936 | 42757 |
| Cost per full time equivalent (in Euro) | | 39141 | 46602 | 39704 |

*Full time equivalent jobs are calculated by dividing the total amount of hours worked per week in the different scenarios by 40.

**Targeted population is the subpopulation that enjoys the workbonus in its currently observed labour market position.

TABLE 13 LABOUR MARKET PARTICIPATION AND REVENUE EFFECTS FOR SINGLE MALES AND FEMALES

| | Single Males | | | | Single Females | | | |
|---|---|---|---|---|---|---|---|---|
| | base | Workbonus | PIT reduction general | PIT reduction targeted | base | workbonus | PIT reduction general | PIT reduction targeted |
| | Entire population of single males | | | | Entire population of single females | | | |
| Total labour force participation | 498965 | 500000 | 499802 | 499976 | 332169 | 332588 | 332534 | 332655 |
| Change with respect to base | | 1035 | 837 | 1011 | | 419 | 365 | 487 |
| Full time equivalents* | 417430 | 418595 | 418387 | 418560 | 259254 | 259705 | 259638 | 259764 |
| Change with respect to base | | 1166 | 958 | 1130 | | 451 | 384 | 510 |
| | Targeted population of single males** | | | | Targeted population of single females** | | | |
| Total labour force participation | 126877 | 127914 | 127152 | 127886 | 91527 | 91950 | 91652 | 92009 |
| Change with respect to base | | 1037 | 275 | 1009 | | 423 | 125 | 482 |
| Full time equivalents* | 106958 | 108125 | 107268 | 108086 | 73666 | 74121 | 73799 | 74172 |
| Change with respect to base | | 1167 | 310 | 1128 | | 455 | 133 | 506 |

| | Total revenue effects single males for the entire population of single males | | | | Total revenue effects single females for the entire population of single females | | | |
|---|---|---|---|---|---|---|---|---|
| | base | workbonus | PIT reduction general | PIT reduction targeted | base | workbonus | PIT reduction general | PIT reduction targeted |
| Government revenue (in million Euro) | 8792 | 8694 | 8705 | 8705 | 3316 | 3246 | 3254 | 3236 |
| Cost per job (in Euro) | | 94649 | 103980 | 86019 | | 167794 | 168873 | 164806 |
| Cost per full time equivalent (in Euro) | | 84067 | 90852 | 77002 | | 155833 | 160657 | 157087 |

*Full time equivalent jobs are calculated by dividing the total amount of hours worked per week in the different scenarios by 40.

**Targeted population is the subpopulation that enjoys the workbonus in its currently observed labour market position.

TABLE 14 DISTRIBUTION ESTIMATED PROBABILITIES IN % FOR MALES AND FEMALES IN COUPLES FOR DIFFERENT REFORM SCENARIOS

| | Males in couples | | | | Females in couples | | | |
|---|---|---|---|---|---|---|---|---|
| Hours worked | base | workbonus | PIT general reduction | PIT targeted reduction | base | workbonus | PIT general reduction | PIT targeted reduction |
| 0 | 23.42 | 23.11 | 23.15 | 23.11 | 49.08 | 48.92 | 48.89 | 48.92 |
| 5 | 1.55 | 1.54 | 1.54 | 1.54 | 4.75 | 4.74 | 4.74 | 4.74 |
| 10 | 2.07 | 2.05 | 2.05 | 2.05 | 3.87 | 3.87 | 3.86 | 3.87 |
| 15 | 2.69 | 2.67 | 2.66 | 2.67 | 3.07 | 3.07 | 3.07 | 3.07 |
| 20 | 3.79 | 3.77 | 3.76 | 3.77 | 11.10 | 11.12 | 11.12 | 11.12 |
| 25 | 5.88 | 5.87 | 5.85 | 5.87 | 6.72 | 6.74 | 6.74 | 6.74 |
| 30 | 7.15 | 7.16 | 7.14 | 7.16 | 4.84 | 4.87 | 4.87 | 4.87 |
| 35 | 8.51 | 8.55 | 8.54 | 8.55 | 3.38 | 3.40 | 3.40 | 3.40 |
| 40 | 43.17 | 43.48 | 43.49 | 43.48 | 13.01 | 13.10 | 13.13 | 13.11 |
| 45 | 0.48 | 0.49 | 0.49 | 0.49 | 0.09 | 0.09 | 0.09 | 0.09 |
| 50 | 0.56 | 0.57 | 0.57 | 0.57 | 0.05 | 0.06 | 0.06 | 0.06 |
| 55 | 0.73 | 0.74 | 0.75 | 0.74 | 0.04 | 0.04 | 0.04 | 0.04 |

TABLE 15 DISTRIBUTION OF ESTIMATED PROBABILITIES IN % FOR SINGLE MALES AND FEMALES FOR DIFFERENT REFORM SCENARIOS

| | Single males | | | | Single females | | | |
|---|---|---|---|---|---|---|---|---|
| Hours worked | base | workbonus | PIT general reduction | PIT targeted reduction | base | workbonus | PIT general reduction | PIT targeted reduction |
| 0 | 23.65 | 23.47 | 23.53 | 23.49 | 40.69 | 40.60 | 40.63 | 40.60 |
| 5 | 1.27 | 1.27 | 1.27 | 1.27 | 1.95 | 1.95 | 1.95 | 1.95 |
| 10 | 1.79 | 1.78 | 1.79 | 1.78 | 2.25 | 2.24 | 2.24 | 2.24 |
| 15 | 2.49 | 2.48 | 2.48 | 2.48 | 2.50 | 2.49 | 2.50 | 2.50 |
| 20 | 4.54 | 4.53 | 4.53 | 4.53 | 7.51 | 7.51 | 7.51 | 7.51 |
| 25 | 5.75 | 5.75 | 5.75 | 5.75 | 4.95 | 4.95 | 4.95 | 4.95 |
| 30 | 7.59 | 7.59 | 7.59 | 7.59 | 4.89 | 4.90 | 4.90 | 4.90 |
| 35 | 9.79 | 9.82 | 9.81 | 9.81 | 4.63 | 4.64 | 4.63 | 4.64 |
| 40 | 41.71 | 41.89 | 41.84 | 41.88 | 30.01 | 30.09 | 30.07 | 30.09 |
| 45 | 0.39 | 0.39 | 0.39 | 0.39 | 0.26 | 0.26 | 0.26 | 0.26 |
| 50 | 0.47 | 0.47 | 0.47 | 0.47 | 0.21 | 0.21 | 0.21 | 0.21 |
| 55 | 0.55 | 0.55 | 0.55 | 0.55 | 0.16 | 0.16 | 0.16 | 0.16 |

Another way to look at the effectiveness of the reforms is to evaluate the employment effects according to gross wage decile. We divide each subpopulation into ten equal groups according to the gross wage, where the group with the lowest number contains the 10% of the (sub)population with the lowest gross wage and the highest group contains the 10% of the (sub)population with the highest gross wage.

As the workbonus is wage related we expect to see larger effects in the lowest deciles. Table 16 and Table 17 indeed provide confirmation of this. The largest employment effects are found in the bottom half of the wage distribution. The first decile is less responsive to the reforms than the following deciles which is consistent with the pattern of elasticities where the lowest decile, in general, was estimated to have a lower elasticitiy than the subsequent deciles, especially along the extensive margin, i.e. influencing the decision whether or not to enter the labour market. For the general reduction we see that the effects are more evenly distributed among the wage deciles. In fact, more than 70% of the employment effects is concentrated in the first half of the wage distribution for the workbonus, with a low of around 70% for single females and a high of more than 80% for males in couples. The employment effects in the case of a general reduction in personal income taxes are much less concentrated in the lower half, with a low of less than 30% for single females and a high of 57% for males in couples.

TABLE 16 EMPLOYMENT EFFECTS PER DECILE OF GROSS WAGE FOR MALES AND FEMALES IN COUPLES

| | Males in couples | | | Females in couples | | |
|---|---|---|---|---|---|---|
| | workbonus | PIT general reduction | PIT targeted reduction | workbonus | PIT general reduction | PIT targeted reduction |
| Wage decile | | Participation | | | Participation | |
| 1 | 362 | 98 | 331 | 116 | 31 | 107 |
| 2 | 798 | 358 | 788 | 290 | 128 | 288 |
| 3 | 654 | 410 | 660 | 265 | 162 | 269 |
| 4 | 539 | 426 | 536 | 232 | 185 | 237 |
| 5 | 393 | 417 | 410 | 192 | 202 | 202 |
| 6 | 279 | 399 | 285 | 143 | 207 | 148 |
| 7 | 191 | 367 | 189 | 100 | 209 | 101 |
| 8 | 127 | 332 | 126 | 72 | 211 | 75 |
| 9 | 43 | 279 | 59 | 33 | 212 | 39 |
| 10 | 28 | 187 | 33 | 23 | 200 | 28 |
| | | Full time equivalents* | | | Full time equivalents* | |
| 1 | 358 | 98 | 337 | 134 | 37 | 127 |
| 2 | 737 | 330 | 732 | 320 | 143 | 319 |
| 3 | 574 | 360 | 578 | 286 | 177 | 289 |
| 4 | 460 | 360 | 452 | 247 | 197 | 251 |
| 5 | 316 | 334 | 329 | 200 | 211 | 209 |
| 6 | 220 | 311 | 224 | 149 | 216 | 154 |
| 7 | 149 | 276 | 147 | 105 | 215 | 105 |
| 8 | 96 | 237 | 94 | 76 | 218 | 78 |
| 9 | 30 | 184 | 43 | 33 | 217 | 41 |
| 10 | 18 | 103 | 23 | 24 | 196 | 29 |

*Full time equivalent jobs are calculated by dividing the total amount of hours worked per week in the different scenarios by 40.

TABLE 17 EMPLOYMENT EFFECTS PER DECILE OF GROSS WAGE FOR SINGLE MALES AND FEMALES

| | Single males | | | Single females | | |
|---|---|---|---|---|---|---|
| | workbonus | PIT general reduction | PIT targeted reduction | workbonus | PIT general reduction | PIT targeted reduction |
| Wage decile | | Participation | | | Participation | |
| 1 | 78 | 14 | 59 | 40 | 9 | 39 |
| 2 | 203 | 48 | 171 | 6 | 1 | 5 |
| 3 | 249 | 89 | 233 | 80 | 22 | 85 |
| 4 | 194 | 100 | 190 | 96 | 33 | 113 |
| 5 | 142 | 111 | 168 | 92 | 44 | 102 |
| 6 | 118 | 119 | 132 | 70 | 49 | 86 |
| 7 | 92 | 119 | 90 | 41 | 53 | 52 |
| 8 | 61 | 120 | 57 | 12 | 56 | 14 |
| 9 | 19 | 122 | 20 | 9 | 58 | 9 |
| 10 | 10 | 115 | 10 | 6 | 58 | 6 |
| | | Full time equivalents* | | | Full time equivalents* | |
| 1 | 71 | 13 | 55 | 36 | 9 | 37 |
| 2 | 186 | 44 | 160 | 6 | 1 | 5 |
| 3 | 222 | 80 | 211 | 74 | 21 | 82 |
| 4 | 169 | 88 | 167 | 90 | 32 | 108 |
| 5 | 122 | 96 | 146 | 85 | 42 | 97 |
| 6 | 102 | 102 | 115 | 66 | 46 | 82 |
| 7 | 82 | 104 | 79 | 37 | 50 | 48 |
| 8 | 55 | 104 | 51 | 12 | 52 | 14 |
| 9 | 17 | 107 | 19 | 8 | 56 | 9 |
| 10 | 9 | 100 | 9 | 6 | 57 | 6 |

*Full time equivalent jobs are calculated by dividing the total amount of hours worked per week in the different scenarios by 40.

## 6 CONCLUSION

In this report we used a labour supply model in conjunction with the microsimulation model MIMOSIS to assess three proposals of labour market policies. Often, these policy proposals are evaluated on the basis of budgetary cost without taking into account potential cost recovery effects through increased labour market participation and hence higher personal income tax revenue and social security contributions. In this report we have presented a methodology that incorporates labour market effects at the labour supply side, i.e. without explicitly accounting for demand side considerations. We have applied this methodology to the three reform situations, evaluating them from the perspective of employment and revenue effects.

In the first part of the report we have described the estimation of the labour supply model. The 'fit' of the model with quadratic utility was quite good, mainly by including dummy variables that capture disutility from working. These act as a sort of proxy for institutional and other constraints, such as fixed costs and search costs, that are or can be prominent in certain job options more than in others, e.g. jobs with non-standard working hours may be hard to find.

In the second part of the report we applied the estimated model coefficients to evaluate the policy reforms, both actual and hypothetical, on their merits as to employment creation and government revenue. We found that employment effects are limited, amounting to only a few thousand full time equivalent jobs. In a sense this may come as no surprise given the relatively small yearly net amounts gained and the considerable size of the targeted population. Further research could be done in which budget neutrality is sought and in which targeting is still further sharpened. The cost per job of the reforms created was shown to be correspondingly high, but with a large difference between males and females in couples, the most responsive groups, and single males and females.

Overall we tend to conclude that the inclusion of labour supply responses in this kind of evaluations did not add much to the analysis. The distributions of the probabilities in all scenarios were so close together that cost recovery effects are negligible.

For further research, it would certainly be worthwhile pursuing labour supply models with other functional specifications of the utility function. The quadratic specification used in this report, though very common in applied empirical research, is not guaranteed to be well behaved. A box-cox representation, for example, would not suffer from this drawback and could be used as an alternative to the quadratic specification.

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