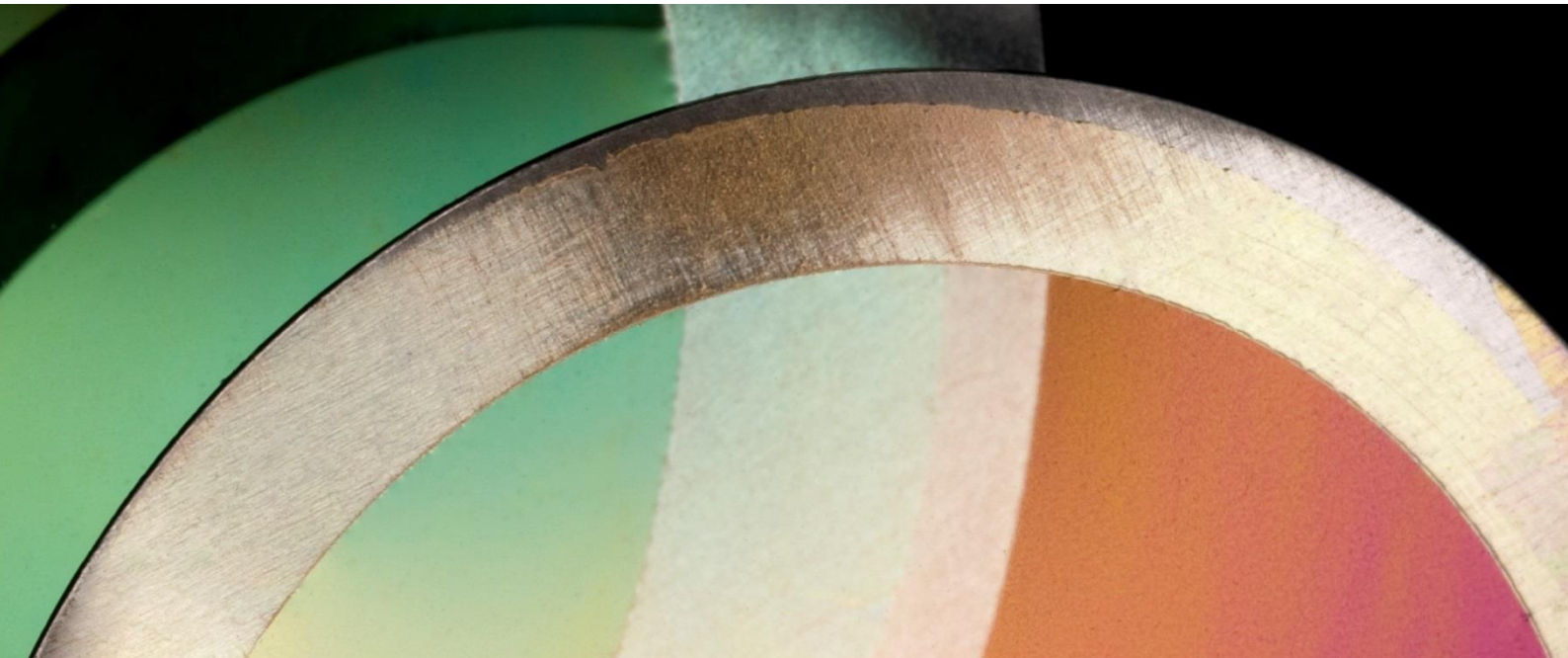
European Commission

JRC TECHNICAL REPORT

The impact of alternative childcare policies on mothers' employment for selected EU countries

JRC Working Papers on Taxation and Structural Reforms No 08/2022

E. Narazani, A. Agúndez García, M. Christl and F.Figari



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JRC130477

Seville: European Commission, 2022

How to cite this report: Narazani, E., Agúndez García, A., Christl, M., Figari, F., 2022. Impact of alternative childcare policies on mothers' employment for selected EU countries, JRC Working Papers on Taxation and Structural Reforms No 08/2022, European Commission, Joint Research Centre, Seville. JRC130477

Executive Summary

- The Barcelona targets on childcare were first adopted by the European Council in 2002 with the aim of increasing female participation in labour markets by enhancing the provision of early childhood education and care (ECEC). The European Council set two targets i.e. a participation rate of 90 % of children from age three until mandatory school age and a rate of 33 % of children under 3. Although the Barcelona targets are reached at EU-level, some Member States are significantly lagging behind. The initiative to revise the targets helps further promoting the equal sharing of care responsibilities between women and men and women's economic empowerment.
- To support the discussion on the revision of the targets, this paper assesses the impact on labour market participation and employment of mothers of alternative scenarios of formal childcare policies for a number of countries. The selected countries represent currently different female participation in the labour market and childcare systems (IT, EE, IE, AT, HU, FI, PT, PL).
- We use EUROLAB, the EU labour supply-demand microsimulation model that is based on EUROMOD, to simulate female labour supply reactions of formal childcare reforms. We use the representative sample of women with children under 3 years of age extracted from EU-SILC 2016. For the purpose of this specific analysis on formal childcare, we exploit the multi-dimensionality feature of EUROLAB and model childcare as an additional dimension of the choice set that mothers would face when deciding to work. Furthermore, in order to construct the counterfactual interacted choices and derive corresponding budget sets, we extend EUROMOD with information on childcare fees for subsidised and unsubsidised childcare services. Drawing on these parameters, increases in the formal childcare usage is simulated for different targets of childcare provision.
- Our results show that providing formal childcare to 40%, 50%, 60% and 65% of children under 3 would lead to significant increases in the labour supply of mothers, especially in countries where the current labour participation of women and the share of formal childcare is low. For example, an increase in early childhood education and care participation to 50% for children under the age of 3 would lead to increases in female labour supply ranging from 4% (Portugal) to 48% (Hungary), depending on how close the country is to the 50% target and the female employment at the starting point.
- Final employment effects, however, will be less pronounced when taking into account the demand side of the labour market. The general increase in labour market participation in the case of an early childhood education and care participation to 50% for children under the age of 3 range from 2% (Portugal) to 32% (Hungary).
- Finally, we assess the effectiveness of cost reducing policies by simulating a childcare-free policy. Our estimations indicate that such a policy would be less efficient to enhance labour participation of mothers especially in countries where formal childcare fees are low, even though it has to be taken into account that the budgetary implications of both policies are not comparable.

The impact of alternative childcare policies on mothers' employment for selected EU countries

Edlira Narazani[a,1], Ana Agúndez García[a], Michael Christl[a], Francesco Figari[b]

[a]*European Commission, Joint Research Centre (JRC-Seville)*
Edificio Expo, Calle Inca Garcilaso, 3
41092 Sevilla, SPAIN
[b]*University of Insubria*
Via Ravasi, 2,
21100 Varese VA, ITALY

Abstract

The Barcelona targets on childcare help increase women's labour-market participation and close the gender employment gap by enhancing the provision of early childhood education and care. To contribute to the debate on the revision of the targets, this paper estimates the impact on labour participation of mothers of alternative scenarios of formal childcare policies for a number of countries. The selected countries (IT, EE, IE, AT, HU, FI, PT, PL) represent different female participation in the labour market and childcare systems. The analysis makes use of the EUROLAB and EUROMOD models, based on EU-SILC data, to estimate female labour supply reactions to childcare reforms. Furthermore, EUROLAB allows us to also account for the labour demand side. The first reforms analyzed consist in providing formal childcare to 40%, 50%, 60% and 65% of children under 3. Our results show that the achievement of these levels of childcare (through increases in childcare availability and usage) would lead to significant increases in the labour supply of mothers (at the extensive and intensive margins), especially in countries where the current labour participation of women and the share of formal childcare is low. Accounting for labour demand, we show that the expected final employment effects in the new labour market equilibrium will be less pronounced, but still positive. Additionally, we analyse a pricing policy consisting in free childcare, showing that this policy would be most effective to support mothers´ labour market participation in countries where childcare fees are relatively high.

JEL-Code: J20, J22, J23, J13
Keywords: Labour market equilibrium, labour supply, labour demand, behavioural models, discrete choice, childcare

*Corresponding author. Email: edlira.narazani@ec.europa.eu
The findings, interpretations and conclusions expressed in this paper are entirely those of the authors. They should not be attributed to the European Commission. Any mistakes and all interpretations are the authors and theirs only.

1. Introduction

In March 2002, the European Council decided in Barcelona to set targets for providing childcare in the EU, with a view to increase female labour participation. Member States agreed to provide childcare by 2010 to at least 33% of children under 3 years of age and to at least 90% of children between 3 years old and the mandatory school age.[1] In a 2018 report[2], the European Commission assessed the progress towards the Barcelona targets. The report found that the targets had been only partially achieved. Specifically, the target of 33% of children under 3 years of age, although met for the EU as a whole, was reached by only 12 Member States (Belgium, Denmark, Finland, France, Germany, Italy, Luxembourg, Netherlands, Portugal, Slovenia, Spain and Sweden) individually in 2016. As for the second target, again, only 12 Member States had met it (Belgium, Denmark, Estonia, France, Germany, Ireland, Italy, Netherlands, Portugal, Slovenia, Spain and Sweden).

A European Parliament resolution on "care services in the EU for improved gender equality" adopted in November 2018[3], invited the European Commission "to revise upwards, in consultation with the relevant actors including the Member States, the Barcelona targets and targets on early childhood education." In her 2021 State of the Union speech, President Von der Leyen announced a European care strategy in order to support men and women in receiving the best care in different life stages and finding the best work-life balance for them. The initiative consists of a Commission Communication on a European care strategy accompanied by two proposals for Council Recommendations, one on the revision of the Barcelona targets on early childhood education and care (ECEC), and the other on long-term care (LTC). This analysis supports the identification of the most appropriate design for the new Barcelona targets by simulating a set of hypothetical scenarios of formal childcare policies[4] and their impact on female employment. For this analysis, we use the EUROLAB model[5] to simulate female labour supply reactions to different formal childcare policies, as well as the final employment effect of such reforms, after taking account of the labour demand side. The simulations are based on a sample of women with children under 3 years of age extracted from the micro-data of the ad hoc module on access to services of EU-SILC 2016.

EUROLAB is a labour supply-demand microsimulation model for the EU. It is based on EURO-

The authors are grateful for the helpful comments from Emanuela Tassa and the expert group for the revision of the Barcelona targets. We are indebted to the many people who have contributed to the development of EUROMOD, especially the EUROMOD team at JRC Seville.

[1] See the Presidentcy Conlusions of the Barcelona European Council in 2002.

[2] See the Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, on the development of childcare facilities for young children with a view to increase female labour participation, strike a work life balance for working parents and bring about sustainable and inclusive growth in Europe (the "Barcelona objectives") in 2018.

[3] See *European Parliament resolution on care services in the EU for improved gender equality* (2018)

[4] The definition of formal childcare used in this paper follows the definition of formal childcare in the EU survey on Income and living conditions (EU-SILC), which are the reference data for the computation of the indicators used for the Barcelona targets, i.e. childcare services that cover preschool or equivalent education, as well as professional childminders and centre-based childcare services.

[5] See Narazani et al. (2021)

MOD, the non-behavioural tax-benefit microsimulation model of the EU countries.[6] EUROLAB relies on a discrete choice labour supply model based on the random utility maximisation approach. The model is based on a multi-dimensional choice set that covers not only the alternatives of number of working hours but also other job peculiarities such as employment/self-employment statuses and occupational sectors. In addition, EUROLAB takes into account the labour demand side and the labour market adjustment towards the new equilibrium following the policy reforms under consideration.

The analysis covers eight EU countries representing different childcare systems and different initial female participation rates: Estonia, Hungary, Austria, Finland, Italy, Ireland, Poland and Portugal. Two types of formal childcare policies are simulated: 1) increasing the number of childcare slots to reach different levels of revised Barcelona targets (and assuming they are taken by families at unchanged childcare fees); 2) Pricing policy consisting in free childcare.

The first type of formal childcare policy consists in providing formal childcare to 40%, 50%, 60% and 65% of children under 3 (i.e. new Barcelona targets) keeping unchanged the existing structure of childcare fees for the countries involved in the analysis. Simulation results show that achieving these targets would lead to significantly increased labour supply of mothers especially in countries where the current share of formal childcare and/or female labour participation is low (like Hungary and Poland). In countries like Portugal, that are far beyond the existing childcare target, changes in labour supply incentives are instead expected to be moderate. Overall, employment effects will be less pronounced when a new labour market equilibrium is achieved (ie taking into account the demand side). For the second type of policy simulated, simulations results indicate that decreasing childcare fees is less effective in enhancing female labour market participation (although it has to be taken into account that the budgetary impacts of both types of reforms are not comparable).

These findings should be viewed with some caution given the limitations of our modelling approach with regard to the non-simulation of parental leave benefits, the availability of grandparents and relatives in providing informal childcare and other unobserved factors discussed in the note.

The note is organised as follows. Section 2 provides a literature review and gives an overview of the methodological approach and the extension of EUROLAB developed to carry out this analysis while Section 3 describes the extension of EUROMOD and the EU-SILC data. In Section 4, results for the policy options analysed are discussed. The last section concludes.

2. Literature review and empirical modelling approach

There is an extensive literature examining the effects of childcare reforms on the participation of mothers in the labour market in Europe.[7] The main factors that this literature identifies to

[6]The model is maintained and developed by the European Commission´s Joint Research Centre. For more details, see Sutherland and Figari (2013) and https://euromod-web.jrc.ec.europa.eu/

[7]See Nieuwenhuis (2022) for a focus review of reform impact studies on early childhood education and care. The effects of childcare reforms on labour supply of fathers are examined in a few studies which show no significant impact on fathers' employment rate (Andresen and Havnes, 2019; Ravazzini, 2018; Vikman, 2013)

explain households' preference for childcare are the availability and quality of childcare services and the related costs for the families. For example, the assessment of reforms to increase the availability of formal childcare services (Carta and Rizzica, 2018) has shown a positive impact on the participation of mothers in the labour market in Italy. Similarly, a strong association between childcare coverage and access and the participation of mothers in the labour market is shown for Norway ((Andresen and Havnes, 2019; Kunze and Liu, 2019; Stahl and Schober, 2018)), Belgium ((Dujardin et al., 2018)) and Germany ((Bick, 2016; Müller and Wrohlich, 2016)). Other papers ((de Muizon, 2020; Müller and Wrohlich, 2020)) examine the impact of childcare targeted subsidies.

The European Commission in its analyses of Member States´ economic and social situation in the European Semester framework, which also monitors progress towards the Barcelona targets, has dealt with childcare policies and their role to enhance female labour market participation. For example, the 2018 European Semester Country Report for Italy highlights that "The proportion of women participating in the labour market remains in fact one of the lowest in the EU. The main reasons include the difficulty of reconciling work with family care due to the limited availability of affordable childcare". Based on the EUROMOD model, we a budget neutral replacement of the fragmentised childcare related welfare system with a single permanent in-work benefit only for low-income working mothers. Results show that this reform would result in a substantial increase in mothers' labour supply and an increase in aggregate labour supply by around 2.3%, corresponding to an impact of 0.4% of GDP over five years compared to the baseline[8]. In 2022, childcare issues were mentioned in the recitals of five countries (CZ, HU, PL, RO and SK) and Austria received a Country Specific Recommendation to "boost labour market participation of women, including by enhancing quality childcare services".

EUROMOD has also been used to simulate different scenarios of availability and affordability of childcare services in the EU, both from a country-specific and cross-country perspective. For example, Hufkens et al. (2020) simulate different scenarios of increasing subsidized childcare slots and mothers´ employment for a set of EU countries using EUROMOD. From a national perspective, Figari and Narazani (2020) use the model to analyse the effects of relaxing existing constraints in terms of childcare availability and costs in Italy. The results show that, overall, the increase in childcare coverage is estimated to be more effective in improving incentives to work than reducing existing childcare costs, at the same budgetary cost.

Similarly to Figari and Narazani (2020), we follow a discrete choice model of labour supply and childcare that relies on Aaberge et al. (1995) and Van Soest (1995) to estimate the labour supply responses of mothers to changes in the childcare availability.[9] Discrete choice models belong to the family of random utility maximisation models ((McFadden, 1974)), which allow the utility function to be random. A convenient specification of the random component (the extreme value distribution) is used to determine the optimal alternative in terms of utility level associated with each choice. To account for the possible interaction between labour supply and childcare choices,

[8] See the Box 4.1.1 on "Effects on labour supply from rationalising childcare benefit", Commission Staff Working Document, Country Report Italy 2018.

[9] See Aaberge and Colombino (2018).

Figari and Narazani (2020) extend the framework initiated by Aaberge et al. (1999) who focus only on the labour supply decisions of couples, rendering endogenous the choice of childcare usage. In this framework, each woman faces an individual-specific opportunity set where each alternative does not refer only to the labour supply choices, characterised by a fixed quantity of hours, a wage rate and other non-pecuniary attributes, but also to the childcare options like subsidized and unsubsidized childcare, informal childcare and mother care.

For the purpose of this specific analysis on formal childcare, we exploit the multi-dimensionality feature of EUROLAB and model the type of childcare as an additional dimension of the choice set that mothers would face when deciding to work. In this way we treat childcare usage as an endogenous variable, so that each mother can choose from an individual-specific opportunity set that combines childcare alternatives and labour supply choices. While the choice set of labour supply includes part-time and full time working arrangements, the choice set of childcare consists of formal, informal and mother childcare, without distinguishing between part-time and full-time arrangements. This is due to the low relative frequency when combining labour supply choices with time-dependent childcare choices (especially in countries where the sample of mothers is small).

Furthermore, in order to construct the counterfactual interacted choices and derive the corresponding budget sets, we extend EUROMOD with information on fees for subsidised and unsubsidised childcare services. The extended version of EUROMOD considers the earnings of the mother and any other source of family income such as partner's income as well as childcare expenditures to derive the household disposable income corresponding to each possible combination of labour market and childcare alternatives a woman can opt for. It is important to note that the set of choices does not include the choice to opt for parental leave schemes, which in some countries are quite generous. After building the counterfactual choice set, we estimate the parameters capturing women's preferences on childcare and labour supply in this setting. Drawing on these parameters, increases in the formal childcare slots (assumed to be fully taken) are simulated in order to achieve different targets of childcare provision (i.e. Barcelona targets on childcare) keeping unchanged existing childcare fees. Changes in labour supply triggered by the achievement of the new targets of formal childcare coverage are then estimated. These changes in labour supply as a reaction to the childcare policy are often referred to in the literature as "second-order effects". These refer to pure changes in the desired participation in the labour market and working hours, disregarding the demand side of the labour market. But depending on the labour demand elasticity, the final interaction of supply and demand would determine the final employment effect when the market reaches its new equilibrium. We account for labour demand side adopting a partial labour market equilibrium in line with Colombino (2013).

The analysis covers eight EU countries representing different childcare systems and different initial female participation rates: Estonia, Hungary, Austria, Finland, Italy, Ireland, Poland and Portugal. The tax systems simulated refer to 2015, the same reference period as monetary variables included in the underlying data which come from the EU-SILC 2016. Furthermore, information related to the type and affordability of childcare services from the ad-hoc module "Access to services" are used to distinguish subsidised or free formal childcare from unsubsidised care.

2.1. Discrete choice of labour supply-childcare

We assume that mothers face a finite set of feasible discrete alternatives Ω that is the Cartesian product of a finite set of job alternatives (H) characterised by a given number of elements h (working hours) and a finite set of feasible childcare arrangements (S) characterised by a given number of elements s (childcare types). The choice set of working hours (H) includes non-market "jobs" (with H and earnings w_h equal to zero) and market jobs (with positive H and positive earnings w_h). The set of childcare arrangements (S) includes formal childcare alternatives (subsidised and unsubsidised) with respective childcare fees, informal and mother care alternatives without fee. The Cartesian product $\Omega = (H, S) = HxS$ contain hxs elements.

More specifically, the choice set based on two dimensions – four hours of work and four childcare alternatives – would have a size of 4 x 4. However, we assume a "fixed link" between labour supply and childcare (Ilmakunnas, 1997) in the sense that formal or informal childcare is needed in the case a mother works, excluding in this way three combinations of alternatives from the choice set Ω (short part-time job/maternal care, long part-time job/ maternal care and full-time job/ maternal care). Ideally, the assumption of "fixed link" should also be made between full-time employment and full time childcare, in the sense that full-time care is needed when a mother works full-time. In order to do so, it would be necessary to distinguish between part-time and full-time childcare arrangements, but we do not take this into account in our analysis because of the relative low frequency when it comes to combine labour supply choices with childcare choices based on time (especially in countries where the sample of mothers is small).

If we further define D_n^* as the set of all elements of the Cartesian product D that are not feasible for all individuals then the final choice set for mothers is equal to $D_n = DxS - D_n^*$ which includes 13 possible alternatives.

Given a policy regime τ (a vector of tax-benefit rule parameters) that transforms an endowment with earned (w_h) and unearned income (I) and a vector of childcare fees for formal childcare arrangements (xcc) into a net income C, a rational mother characterised by a vector of attributes Z selects the alternative that yields greatest utility $U(h, C, Z)$. In addition, we assume utility as a random variable that can be expressed as the sum of a systematic component $V(.)$ and a random component ϵ_t.

$$U = V(w^i_{(h,s)}, H, S, X, Z, \tau; \gamma_i) + \epsilon_i \tag{1}$$

Where H (hours of work required by the job) and S (childcare arrangements) are scalars and their opportunity density is a function $g(H, S)$. z_t and γ_t are a vector of attributes and parameters that characterise the preferences of mother i. It might include observed attributes that affect choice j like disposable income and leisure. X_t is a vector of attributes that characterises the mother i. Ω defines the set of all opportunities available to the household (including non-market and market opportunities).

Assuming an extreme value distribution for the random component we can obtain the probability that mother i is willing to accept a job and take up a childcare arrangement (h, s) and estimate the

utility parameters through a straightforward analytical solution following McFadden (1974).

$$P(w_i, h, s, \tau, \gamma_i, \delta_i) = \frac{e^{V(w_i,h,s,\tau,\gamma_i)}}{\sum_S \sum_H e^{V(w_i,h,s,\tau;\gamma_i)}} \tag{2}$$

Probabilistic choice (Equation 2) ignores the density or demand of certain types of jobs or availability of childcare types and this can lead to an over-prediction of some alternatives. To correct for this bias in prediction, we follow Van Soest (1995) and Aaberge et al. (1995, 1999) and include alternative specific dummies for different types of jobs (part-time and full-time) and childcare types (subsidised and unsubsidised). The idea behind this is that women can face different availability of job types because some labour markets are able to provide more jobs with market hours in a certain interval. At the same time they can face different availability of a specific childcare arrangement depending on country-specific childcare policies. We adopt a convenient specification of the probability density function $g(H, S)$ and obtain the probability that mother i is willing to accept a choice (h, s):

$$P(w_i, h, s, \tau; \gamma_i, \delta_i) = \frac{e^{V(w_i,h,s,\tau;\gamma_i)+D_i(h,s)\delta_i}}{\sum_S \sum_H e^{V(w_i,h,s,\tau;\gamma_i)+D_i(h,s)\delta_i}} \tag{3}$$

The vector $D_t(h, s)$ with 1[.] denoting the indicator function contains two sets of variables that capture: 1) the hour ranges [5≤h<25] and [30≤h<42] corresponding to part-time and full-time jobs, respectively and 2) subsidised and unsubsidised childcare choices.

The systematic part of the utility function is specified as a quadratic functional form on net household income and leisure where leisure is defined as total weekly hours minus working hours. The main arguments of the utility function are household disposable income (C) and individual leisure of the mother ($T - h_F$):

$$\mathrm{V(j,h}_i j) = \alpha_C * C + \alpha_{CC} * C^2 + \alpha_F * (T - h_F) + \alpha_{FF} * (T - h_F)^2$$

where $\alpha_C = \beta_C * (1 + HH_{size})$,

and $\alpha_F = \beta_{F1} * NChild + \beta_{F2} * Age + \beta_{F3} * Age^2 + \beta_{F4} * HighEdu + \beta_{F5} * Mortgage +$

$\beta_{F6} * Migrant + \beta_{F7} * Couple + \beta_{F8} * C$

The preference parameters assigned to linear terms of leisure are allowed to differ by the range of individual characteristics such as age and age squared of mother, dummy of tertiary education (*HighEdu*), dummy of being in couple (*Couple*) and number of children (*NChild*). Additionally, we interact leisure with two dummy variables indicating respectively a) whether the mother is a migrant (*Migrant*) in order to account for labour market integration constraints, and b) holds a mortgage liability (*Mortgage*) to control for other economic constraints like financial ones. Income is interacted with leisure and household size.

The choice set in the modified version of EUROLAB can be defined by selecting between the available working hours alternatives (3, 4 or 5) and childcare options (subsidised, unsubsidised, informal and mother).

It is possible to choose a distribution of counterfactual hours that can be derived as a fixed number of hours, random number of hours sampled from fixed intervals or number of hours sampled from observed distribution within fixed intervals. We choose to generate counterfactual working hours based on the observed distribution of hours because in this way the distribution of the potential alternatives respects the proportion of women observed to work a specific number of hours within each interval. As such, the working hours per week of mothers are divided into four intervals (0, 5–17, 17-29, 29–41) and their choice set of work (H) is made up of four alternatives: the actual choice (i.e. observed number of worked hours) plus other three potential alternatives.

The choice set of childcare options is built based on the SILC information on the number of hours per week spent at formal childcare (i.e. centre-based services or day-care centre), with informal arrangements (grand-parents, others household members, friends, etc...) or with the mother (maternal care). Although informal childcare is part of the choice set that mothers are supposed to face, the preference for this choice is not taken into account in our modelling approach observed sets of variables (e.g. proximity of grandparents or their employment status) due to the lack of specific information in SILC data. Taking account of mothers´ preferences for informal childcare can be important in southern European countries, such as Italy, where many parents are still reluctant to use formal childcare services, as they can account for more reliance services that grandparents are expected to provide (Del Boca 2015).

Furthermore, the formal childcare type is split into two choices – subsidised and unsubsidised one. We assign each child to the childcare arrangement prevailing in terms of number of hours per week. Whenever the hours are equal across different childcare types, the formal childcare (subsidised or unsubsidised) is defined as the prevailing childcare arrangement. As such, the choice set of childcare (S) of each woman is made of four alternatives: the actual choice (i.e. observed childcare arrangement) plus the other three potential alternatives.

We start selecting mothers in working age (i.e. 18-60 years old), not receiving pension or disability benefits and with at least one child under 3 years at the time of interview. The final sample consists of mothers living or not with a partner and they can be employed, self-employed, unemployed or inactive.

2.2. Labour demand

Policies that affect the provision of childcare services may trigger behavioural changes in labour supply of affected individuals. These effects, often called as "second-round" effects, represent pure changes in the desired number of working hours or activity/inactivity status, disregarding the demand side of the labour market. However, depending on how elastic the demand side is, the attainment of a new labour market equilibrium may lead to a different employment level and wage rate. In our analysis, we account for the demand side of labour market through a representation of a partial labour market equilibrium in line with Colombino (2013) approach. In discrete choice labour supply modelling, the common approach is using dummy variables (accounting for part-time and full-time jobs) when calculating the choice probabilities with the intention to improve the predictability of the choice, in particular for the choice of part-time work. This dummy, often interpreted as reflecting a number of factors (such as fixed and search costs, commuting costs etc)[10], can be also interpreted as reflecting availability or density of job types that are not represented by the systematic part of the utility function. As such, they can be used to link dummies' coefficients to the number of jobs available on the market (i.e. the demand side) and to develop a structural model that takes into account labour market equilibrium conditions (Colombino, 2013).

The method proposed by Colombino (2013) expresses the dummies coefficients or parameters δ_i of expression (2) as logarithmic functions of the number of jobs available in the market. Narazani and Colombino (2021) show that this method can be used also to model the effects of external sectoral labour demand shocks by considering behavioural reactions at the household level. In this paper we follow this later advancement to model the effects of positive shocks on childcare services accounting for labour market equilibrium. In case of a choice set consisting in working hour's alternatives and childcare types these dummies coefficients can reflect also availability or density of childcare options.

Let us consider a current childcare policy τ and denote as S the total number of formal childcare slots. Let express δ_s as a function of S.

$$\delta_s = \ln K * S \tag{4}$$

where K is constant. Assuming that households have identical γ and δ_s, we can write:

$$\delta_s = \ln K + \ln S \tag{5}$$

The introduction of a new childcare policy τ^*, for example an increase in formal childcare availability changes the choice probability (following equation 2) of taking up a childcare and working hour alternative. Let e^{ν} be the proportional change in S triggered by the new childcare policy, and $\delta_s(\nu)$ the changed value of δ_s:

$$\delta_s(\nu) = \ln (S * e^{\nu}) + \ln K = \ln S + \ln K + S = \delta_s + \nu \tag{6}$$

[10] See the survey by Blundell et al. (2007) for an example of modelling accounting for fixed costs of working.

Let the government set a new target of formal childcare equal S^*, possibly higher than the current usage of formal childcare. Under the assumption that the additional childcare slots will be fully taken by the households, then the value of v^* for which the total of formal childcare slots that the households are provided with reaches the new target of formal childcare can be given as:

$$\sum_i \sum_s P(w_i, h, s, \epsilon, \tau^*; \gamma, \delta_s(v^*)) = S(v^*) \tag{7}$$

The new value of $\delta_s(v)$ determines new choice probabilities and changes the probability of taking up a job. The new desired labour supply can be calculated as follows:

$$\sum_i \sum_h P(w_i, h, s, \epsilon, \tau^*; \gamma, \delta_s(v^*)) = E(v^*) \tag{8}$$

However a job must be available to allow for a new match in the labour market, entailing an equilibrium conditionality between available jobs and desired labour supply. Let us further assume that the data represent a labour market equilibrium status or in very simple terms that the total number of people working have chosen jobs available in the market. The equilibrium condition requires that the number of available jobs J is equal to the desired labour supply at the ongoing wage.

A similar logic as in the case of childcare dummies can be used to show that the desired labour supply is affected by the available jobs through the term working hour's dummies (δ_h) and representing the density of jobs as $\delta_h = \ln A * J$, where J denote total number of jobs and A is constant.

Let e^u be the proportional change in J following the shift in the desired labour supply, and $\delta_h(u)$ the changed value of δ_h:

$$\delta_h(u) = \ln(J * e^u) + A = \ln J + \ln A + v = \delta_h + u \tag{9}$$

We can also write the changed value of J as $J(u)$:

$$J(u) = J * e^u \tag{10}$$

By assuming $J = K * w^{-\eta}$ we get the wage rate corresponding to $J * e^u$:

$$w = K^{\frac{1}{\eta}}(J * e^u)^{-\frac{1}{\eta}} = w * e^{\frac{-u}{\eta}} w = K^{\frac{1}{\eta}}(J * e^u)^{-\frac{1}{\eta}} = w * e^{-\frac{u}{\eta}} \tag{11}$$

The new values of $\delta_h(u)$ and $w(u)$ determine new choice probabilities.

Let $\sum_i \sum_h P(w_i(u), h, s, \tau^*; \gamma, \delta_s(v^*), \delta_h(u^*)) = J(u^*)$ be the desired labour supply given the childcare policy τ^* and the adjustment u and v. Then the equilibrium value $u^* issuchthat$

$$\sum_i \sum_h P(w_i(u), h, s, \tau^*; \gamma, \delta_s(v^*), \delta_h(u^*)) = J(u^*) \tag{12}$$

The left-hand side represents the total desired labour supply in terms of number of jobs that the households are willing to accept. The right-hand side represents the available jobs, or labour demand. The equality determines the equilibrium employment level (number of jobs). Note that the adjustment in the number of jobs through a change in the level of the wage rates is a movement along the labour demand curve.

To find the value of u and v parameters we construct an algorithm that consists of the following steps:

1. Estimate the utility parameters (Appendix C) and the coefficients of in-work and formal childcare dummies. Compute the baseline labour supply as the total number of working hours predicted under the current system. Use this value to construct the baseline labour demand, assuming that the labour market is in equilibrium before the childcare reform takes place.
2. Run the optimisation procedure to find the value of the parameter v that correspond to the targeted formal childcare. The iterated changes in the parameter v affect the choice probabilities and consequently the aggregated formal childcare and desired labour supply (equations 4, 5 and 6).
3. Run the optimisation procedure given the new formal childcare and the new desired labour supply to find the value of u that corresponds to a labour market equilibrium status under the childcare targeted policy. The new equilibrium is attained when the total number of jobs matches the total number of individuals willing to work at a given wage. The iterated changes in the parameter u affect in-work dummies' coefficients (equation 7), wages (equation 9), choice probabilities and aggregated labour demand (equation 10).

The adjustment of the labour market is based on a single elasticity of labour demand (-0.5), which may not reflect the specific situation of the labour market. Moreover, this unique value may ignore regional differences within countries that seem important in some countries, including Italy.

3. Microsimulation model and data description

3.1. EUROLAB and EUROMOD

To run the discrete choice model explained in Section 2, we make use of EUROLAB and EUROMOD. EUROLAB is a behavioural microsimulation model that is based on discrete choice labour supply modelling. The discrete choice labour supply model (Aaberge et al., 1995; Van Soest, 1995) used in EUROLAB is based on the Random Utility Maximisation approach (McFadden, 1974) and is capable of simulating household choices and income components given any simulated fiscal rule. Specifically, the model is based on a multi-dimensional choice set that covers not only the alternatives of working hours (one-dimensional choice set) but also other job peculiarities such as employment arrangement (employment versus self-employment status) or occupational

sectors. However, for the purpose of this specific childcare related analysis, we exploit the multi-dimensionality feature of EUROLAB and model childcare arrangement as an additional dimension of the choice set that mothers would face when deciding to work.

EUROLAB uses EUROMOD to construct the budget constraints for each choice. EUROMOD simulates cash benefit entitlements, direct tax, social insurance contribution on the basis of the tax-benefit rules in place in each country. Non-simulated benefits (mainly contributory pensions), as well as market incomes, are taken directly from the input datasets.[11] However, in order to construct the counterfactual choices of childcare and derive corresponding budget sets, we extend EUROMOD with information on childcare fees for subsidised and unsubsidised childcare services. A detailed description of the imputation method of childcare fees is given in Appendix B. It is important to note that parental leave benefits are not simulated in EUROMOD and therefore they are not taken into account while imputing childcare fees. This limitation of our modelling approach can lead to upward bias in expected labour supply effects especially in Eastern European countries (like Hungary) characterized by high parental leave benefits and duration. The extended version of EUROMOD considers the earnings of the mother and any other source of family income as well as childcare expenditures to derive the household disposable income corresponding to each possible combination of labour supply and childcare alternatives the woman can opt for.

The computation of earnings available on any particular job (h) requires information on the wage rate of that type of job. This information is available only for the observed chosen job and therefore we have to estimate the wage rate for the other types of jobs. We specify the wage equation as a logarithmic function of observed wage rates that depends linearly on a set of conventional explanatory variables such as education, work experience, work experience squared and some regional dummies. To estimate the wage rates of employed and self-employed we follow Dagsvik and Strøm (2006) that assume a correlation between the random variables in the wage and selection equation to a common latent ability factor. Under the assumption, they show how the parameters of the wage equation for sector j can be estimated consistently and asymptotically efficient by OLS on the sub-sample of women that work in sector j by means of the regression equation where selection bias is controlled by including logPj as an additional explanatory variable in the wage equation. Pj is the probability of being in sector j, j = 0, 1, 2 (where j = 0 means not working, 1 means working as an employee and 2 working as self-employed) and is calculated running a multinomial logit model where the dependent variable is the type of sector and employment status.[12]

The analysis covers eight EU countries representing different childcare systems. These countries are Estonia, Hungary, Austria, Finland, Italy, Ireland, Poland and Portugal. The tax systems simulated refer to 2015, the same reference period as monetary variables included in the underlying data which come from the EU-SILC 2016.

3.2. Description of data

EUROLAB runs on the underlying simulation results from EUROMOD on the budget sets, which in turn rely on the European Statistics on Income and Living Conditions (EU-SILC) surveys. EU-

[11] For further information on EUROMOD, see Sutherland and Figari (2013).

[12] The details of this approach are given in Appendix D of Dagsvik and Strøm (2006).

Table 1: Formal care shares (over the total number of children under 3 years of age) based on SILC and formal enrolment based on UNECE, 2016

	EU-SILC*	Own calculation (EU-SILC)	UNECE	Total observations	Paid fees	Full fees	Subsidised care
Italy	34.4%	38%	23.0%	866	n/a	n/a	n/a
Estonia	30.2%	27%	30.0%	445	n/a	n/a	n/a
Ireland	28.6%	31%	0.3%	320	0.55	0.45	0.11
Austria	20.6%	21%	24.0%	374	0.97	0.43	0.53
Hungary	15.6%	16%		394	0.33	0.33	0.62
Finland	32.7%	33%	25.0%	723	0.9	0.03	0.96
Portugal	49.9%	43%	39.8%	454	0.83	0.6	0.26
Poland	7.9%	8%	5.9%	850	0.93	0.36	0.55

Note: Own elaborations are based on the sample of children under 3 years of age. Few observations for Italy and Estonia. "Paid fees" means that families pay for childcare. "Full fees" means that families pay full fees for childcare. "Subsidized care" means that childcare is subsidized by the Government. The shares of paid fees, full fees and subsidised care are calculated with reference to the formal care.

SILC surveys are representative samples of EU populations and collect comparable detailed information on socio-demographic characteristics and income from different sources at the individual and household levels. For the purpose of this analysis we use SILC 2016 mainly because the ad hoc module "Access to services" implemented in this wave provides information related to the affordability of childcare services needed to distinguish subsidised or free formal childcare from unsubsidised care. However, these data have several shortcomings. First, the lack of distinction between private and public provision of childcare does not allow us to simulate direct increases in the availability of public provisions. Second, the sample size of families with children under 3 using formal childcare is small and data might be statistically unreliable (Meroni et al., 2016). Third, in some cases, the number of children in formal childcare care based on SILC data does not correspond to formal enrolment of children reported by official statistics based on administrative data. As noted by Sirén et al. (2020), the difference is remarkable and might be explained by the misunderstanding of questions by the respondents. Furthermore, formal childcare calculations based on SILC data consider children under 3 at the time of the interview while United Nations Economic Commission for Europe (UNECE) statistics on enrolment of children are based on administrative data.

4. Simulation methodology and results

After running EUROMOD and simulating the budget constraints for each counterfactual choice set, we estimate the parameters characterising women's preferences on childcare and labour supply as described in Section 3. The estimated utility parameters are shown in Appendix C together with statistics of the model fit.

We draw on these parameters to first simulate the effect of the increase in formal childcare availability (i.e. achieving higher Barcelona targets) on the labour supply of mothers assuming that additional childcare slots are fully taken and keeping unchanged the rules for determining childcare fees. We follow the methodology described in Section 3 and make use of the estimated coefficients assigned to childcare dummies to capture the availability of subsidised and unsubsi-

dized childcare choices. These dummies are interpreted to reflect availability of childcare types that is not captured by the systematic part of the utility function. Based on this interpretation we modify the coefficients assigned to these dummies to increase the availability of formal childcare for children under 3 years according to four alternative Barcelona targets, such as 40%, 50%, 60% and 65%.

First we simulate the labour supply effects based on the sample of mothers with children under 3. Next, to identify the causal effects of maternal leave generosity on labour market attachment of mothers, we restrict the sample to children under 3 years of age but older than the number of months in post-natal paid maternal leave or older than 6 months (Appendix C). The length of maternity leave doesn't vary significantly across countries, with Ireland as an exception offering the longest period of paid maternity leave of 10 months (Table B.4). The restriction to children between 7 and 36 months is made to reflect the Directive 2019/1158 on work-life balance that establishes a minimum number of months of parental leave to all workers who exercise parental responsibilities in accordance with national legal systems.[13]

These estimated labour supply effects, called in the literature as "second-round" effects, represent pure changes in the desired number of working hours or activity/inactivity status and disregard the demand side of labour market or the possibility of a match between desired labour supply and available jobs. However, this match or the attainment of a new labour market equilibrium may lead to a different employment level, depending on how elastic the labour demand side is. We account for the demand side of labour market following the methodology described in Section 3 and estimate employment effects under a new labour market equilibrium.

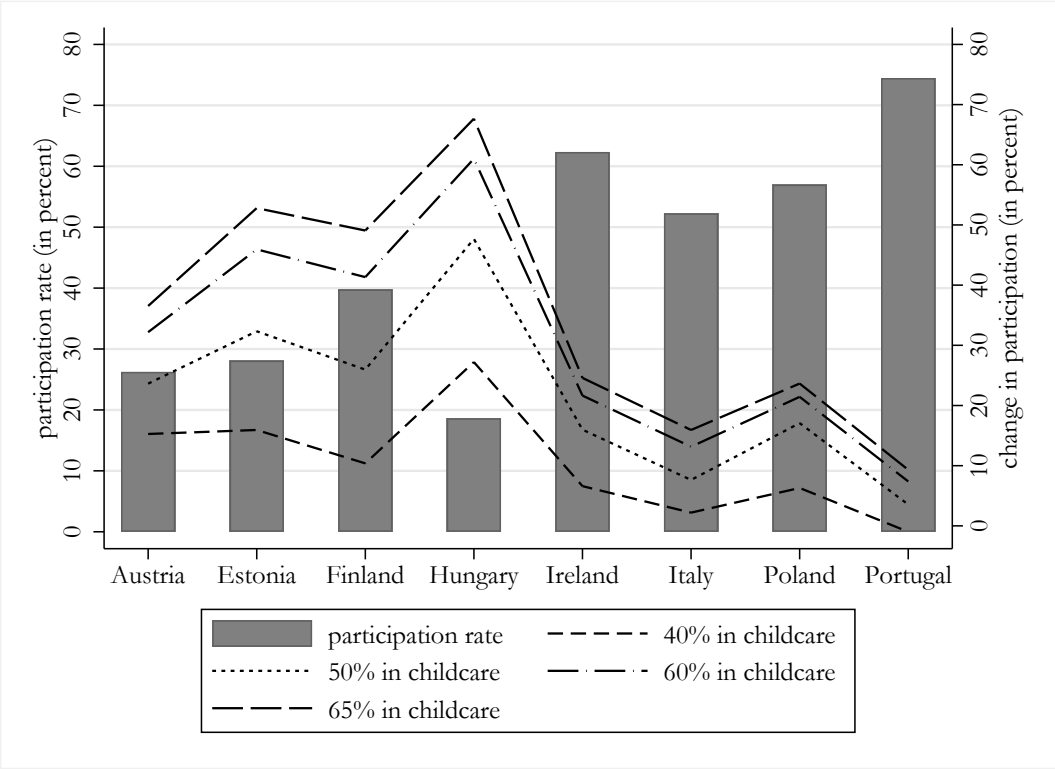
Lastly, we consider an indirect channel of potentially increasing childcare usage through the reduction of childcare fees and simulate labour supply effects of this policy. The potential effect of childcare fees reduction on labour supply of mothers depends on the prevalence of income effect versus substitution effect and therefore is not necessarily positive. This pricing reform cannot be comparable to the previous reforms on the availability/use of formal childcare, because while the level of childcare fees may depend on the availability of formal childcare services, the reforms on childcare availability (described above) can be considered exogenous. These reforms are not comparable either with regard to the budgetary impacts, both from the revenue side, due to the increase in labour provided by mothers, and from the spending of governments to provide more childcare slots or a reduction in childcare fees.

4.1. Increase in formal childcare availability and usage: pure labour supply effects

Figure 1 (Table B.5) reports the predicted percentage changes in labour participation rates (at the vertical axis) of mothers when increasing the coverage rate of formal childcare to 40%, 50%, 60% and 65% of children below 3. The dotted lines show the expected changes in labour participation of mothers for each childcare target over countries indicating an almost linear positive association between increased labour supply and increase in the childcare coverage rate.

[13] See Directive (EU) 2019/1158 of the European Parliament and of the Council of 20 June 2019 on work-life balance for parents and carers and repealing Council Directive 2010/18/EU.

Figure 1: Participation rates of mothers' and percentage changes for different levels of childcare provision

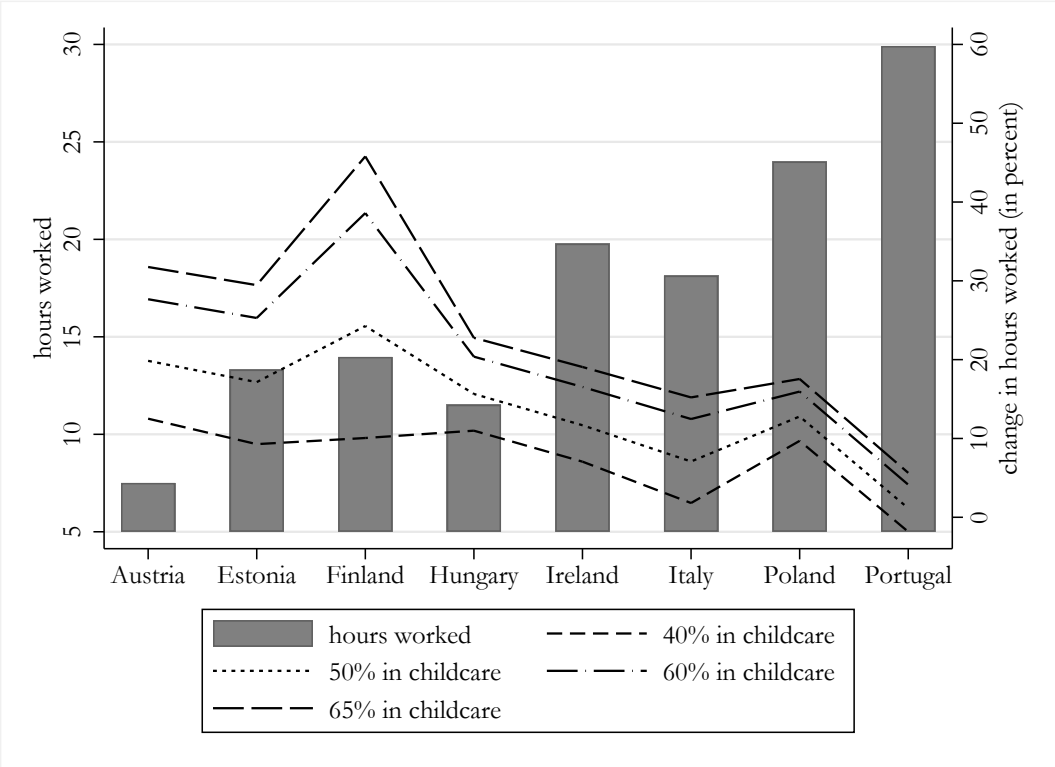


Source: Own calculations based on the EUROMOD and EUROLAB models.

In particular, an increase in formal childcare provision to 50% of the children below 3 is expected to increase participation of mothers in the labour market from 4% in Portugal to 48% in Hungary. The impact on labour supply is small in Portugal because the formal childcare and labour participation of mothers are already relatively high in this country. On the contrary, the impact of childcare increase is highest in Hungary because current participation rates of mothers is very low there. Reaching a more ambitious target of 60% would lead to increases in labour market participation ranging from 7% in Portugal to 61% in Hungary. Substantial increases are also found in Finland (41%) and Estonia (46%).

Responses in the intensive margin of labour are shown in Figure 2 (Tables B.6) that reports the predicted percentage changes in weekly working hours (at the vertical axis) of mothers when increasing the coverage rate of formal childcare to 40%, 50%, 60% and 65% of children below 3. Similar to the participation rates, the dotted lines indicate again an almost linear positive association between increased working hours and increase in the childcare coverage rate. Finland stands out as the country with the highest percentage increases in working hours for almost all scenarios, followed by Estonia and Austria.

Figure 2: Weekly working hours of mothers and percentage changes for different levels of childcare provision



Source: Own calculations based on the EUROMOD and EUROLAB models.

Restricting the sample to mothers with children under 3 years and over the number of months in maternity leave (Tables B.7 and B.8, Appendix C) the effect of the childcare provision increases is expected to be smaller for this sample of kids mainly because the current share of formal care is higher and mothers have higher labour market participation. Applying another selection criterion -children between 6 and 36 months – (Tables B.9 and B.10) and comparing the predicted changes in labour supply with those reported here, we notice that the effects of formal childcare increase on labour supply are expected to be slightly smaller for most of the countries except for Ireland, Finland and Poland (selection of kids is made on months in paid post-natal maternity leave).

4.2. Increase in formal childcare availability and usage: employment effect accounting for labour demand side

Assuming an elasticity of labour demand of -0.5, the equilibrium model applies running an optimisation procedure to search in a first step the value of the change in the dummy coefficient related to the new childcare target (parameter v, Section 3) and in a second step the average wage (parameter u, Section 3) that corresponds to a new labour market equilibrium status under the new childcare target. The optimization procedure related to the attainment of a new labour market equilibrium is explained in details in Narazani and Colombino (2021). If equilibrium conditions are not taken into account, the increase in childcare target should boost the time available for work and shift the desired labour supply curve to the right. This shift to the right implies an increase in

Table 2: Predicted percentage changes in labour participation accounting for Labour Demand

	No Equilibrium				Equilibrium			
	40%	**50%**	**60%**	**65%**	**40%**	**50%**	**60%**	**65%**
Austria	15%	24%	32%	37%	11%	18%	24%	27%
Estonia	16%	32%	46%	53%	11%	20%	28%	32%
Finland	10%	26%	41%	49%	4%	10%	18%	22%
Hungary	27%	48%	61%	68%	23%	32%	41%	45%
Ireland	7%	16%	22%	25%	5%	8%	11%	13%
Italy	2%	8%	13%	16%	0%	3%	7%	9%
Poland	6%	17%	21%	24%	7%	10%	13%	14%
Portugal	-1%	4%	7%	9%	0%	2%	5%	6%

Note: The columns "Equilibrium" ("No Equilibrium)" refer to % changes in labour participation when labour market equilibrium is (not) considered.

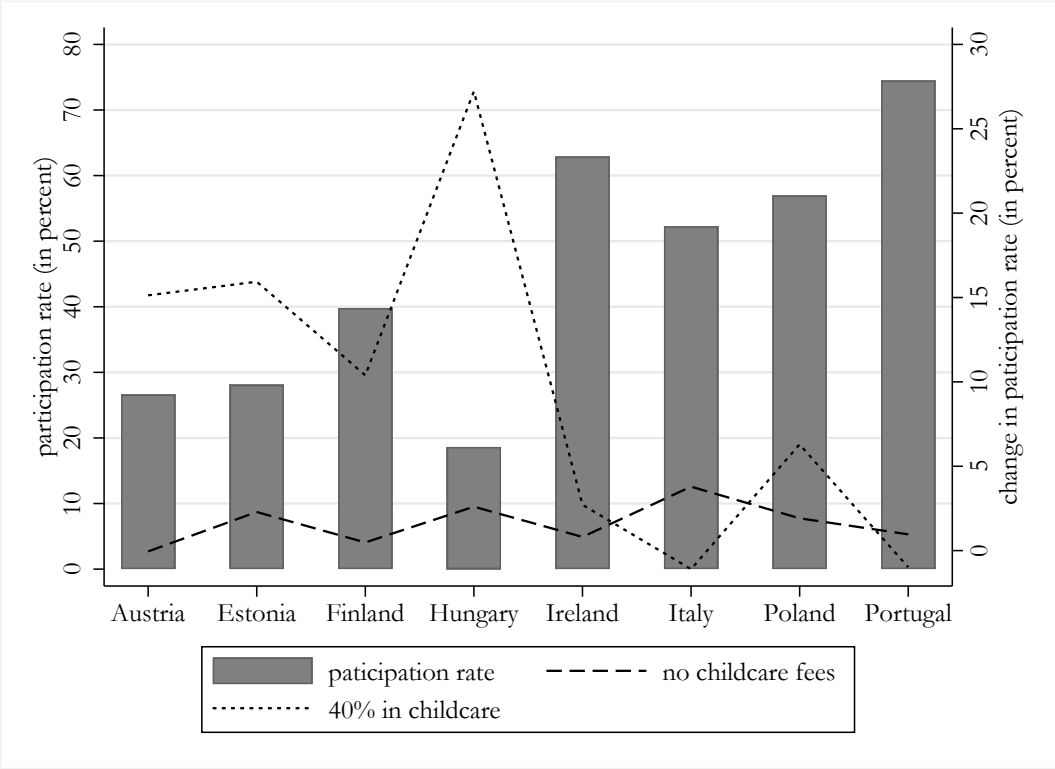
Source: Own calculations based on the EUROMOD and EUROLAB models.

total employment of mothers. A new market equilibrium condition that requires consistency between the number of jobs available and the desired labour supply is achieved through a movement along the demand curve and an adjustment of the wage rate leading to a decrease in employment. In particular, as Table 2 shows, an increase in formal childcare to 60% would shift the desired labour supply to the right and increase total employment of mothers by 60% (Hungary) and 41% (Finland) if equilibrium conditions are not taken into account. However this increase will drop to 41% (Hungary) and 18% (Finland) once the labour market reaches a new equilibrium through a movement along the demand curve and an adjustment of wage rate. The offsetting effect of labour market adjustment is smaller in Portugal, Austria and Italy and higher in Hungary, Finland and Estonia.

4.3. Labour supply effects of abolishing childcare fees

Lastly, we assess the effectiveness of childcare policies through a relaxation of cost constraints simulating an abolishment of childcare fees for the families. Simulation results show that this cost related reform would be less efficient to trigger increases in labour supply of mothers, at least compared to those generated by increases in childcare availability. To illustrate this finding, Figure 3 compares the increases in labour participation rates (in percentage points) when abolishing childcare fees and increasing the provision of childcare to 40% (keeping price of childcare constant).

Figure 3: Changes in participation rate of mothers for childcare fees abolishment, labour demand not considered



Source: Own calculations based on the EUROMOD and EUROLAB models

In making such comparisons, it is important to note, that the budgetary costs of each reform are not considered, although they might be quite different. As Figure3 shows, abolishing childcare fees would affect to some extent Italy (1.98 pp) and lesser Portugal (1.09 pp) where these fees are relatively high. In other countries the impact is almost zero because of the insignificance of these costs when compared to household income, the variable through which the effect of the policy is transmitted to labour supply. Detailed results are reported in Table B.11 and Table B.12 in the Appendix B.

5. Conclusion

This paper analyses labour supply effects for mothers of hypothetical scenarios of childcare policies. The analysis covers eight EU countries representing different childcare systems like Estonia, Hungary, Austria, Finland, Italy, Ireland, Poland and Portugal.

We use EUROLAB, the EU labour supply-demand microsimulation model that is based on EUROMOD, to simulate female labour supply reactions of formal childcare reforms based on a sample of women with children under 3 years of age extracted from EU-SILC 2016. For the purpose of this specific analysis on formal childcare, we exploit the multi-dimensionality feature of EUROLAB and model childcare as an additional dimension of the choice set that mothers would

face when deciding to work. To account for the possible interaction between labour supply and childcare choices we follow Figari and Narazani (2020). Furthermore, in order to construct the counterfactual interacted choices and derive corresponding budget sets, we extend EUROMOD with information on childcare fees for subsidised and unsubsidised childcare services. Drawing on these parameters, increases in the formal childcare usage is simulated for different targets of childcare provision.

The hypothetical scenarios of childcare reforms analysed consist in providing formal childcare to 40%, 50%, 60% and 65% of children under 3 for the countries involved in the analysis by increasing the number of childcare slots and assuming that these are taken by families at unchanged childcare fees. Simulation results show that achieving these targets would lead to significantly increased labour supply of mothers especially in countries where the current share of formal childcare and/or female labour participation is low, like Hungary and Poland. In countries like Portugal that are far beyond the existing target, changes in labour supply are expected to be moderate. Accounting for labour market adjustment mechanism following the increase in desired labour supply would make these employment effects of mothers less pronounced but still they remain sizable.

These incentive effects may be even lower when looking at the whole sample of women, depending on the share of mothers affected and the employment rates of the rest of the female population. Indeed, the overall participation of women in the labour market would go up very little by increasing the use of childcare services in countries such as Italy and Austria (less than 10% of women are mothers with children under the age of 3). However, it is important to note that our modelling approach is static and does not take into account the life cycle impact of childcare reforms. Besides the direct effect of the reform on mothers´ labour supply when their children are entitled for childcare services, an additional cumulative effect can be envisaged due to an increased attachment of these women to the labour market, which would also have an impact on their lifetime earnings and future pension entitlements.

After summarising the main findings of our analysis, several caveats deserve to be addressed. One limitation concerns the fact that parental leave benefits are not simulated in EUROMOD and are therefore not taken into account in the imputation of childcare costs. As discussed in the note, this limitation of our modelling approach may lead to upward estimates of the expected female labour supply effects of the childcare reform scenarios compared to the baseline, especially in countries (including Hungary) where such benefits are substantial and can be provided for more than 12 months. Another caveat of our analysis is that the difference between part-time and full-time types of formal childcare is not taken into account. Although micro data make it possible to distinguish between them in theory, the small frequency of the final combinations of childcare and labour supply (especially in countries where the sample of mothers is small) requires us to merge part-time and full-time childcare into one category. Another limitation of our analysis is that it does not consider modelling preferences for informal care in some countries, due for example, to mistrust in formal services or greater chances of grandparents to contribute to childcare.

Finally, we assess the effectiveness of cost reducing policies by simulating a childcare-free policy and simulations results indicate that such a policy would be less efficient to enhance labour participation of mothers especially in countries where formal childcare fees are low, even though it has

to be taken into account that the budgetary implications of both policies are not comparable).

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Appendix A. Imputation of childcare fees

At each alternative of the choice set where a mother can choose a formal childcare arrangement (public or private childcare services), we have to impute in EUROMOD the childcare fees paid by the family and then subtract such fees from the disposable income that enters the utility function as an argument. We assume a full time attendance and simulate the fees based on the rules in place in the scholastic year 2014-15 (or the closest year with information available) considering the regional variability whenever the data allows us to do so.

For each country included in the analysis we create a new "system" in EUROMOD (i.e. CC_2015cc where CC is the country acronym and cc means childcare) where we include a new "policy" (i.e. xcc_CC) where we simulate the childcare fees for public and private childcare services saved in the variables $xcc01\_s$ and $xcc02\_s$ respectively. We impute the monthly fee for childcare services to the relevant families considering a usual pattern of childcare use (i.e. based on a regular week outside holidays) and hence assume an attendance of 10 months per year. We do not include holiday care and childcare before and after school hours.

Appendix A.1. Austria

Childcare systems vary substantially across the 9 regions in Austria. While for example public (and private) childcare is for free in the region of Vienna, fees according to the disposable income of the households have to be paid in Styria, Lower Austria and Upper Austria. In other regions, such as Salzburg, childcare fees are paid at a standard rate (in Salzburg, 255 Euro), where only in exceptional cases the fees can be waived. Therefore, the imputation of childcare fees for children between 0 and 3 years is done on a regional level in Austria. We use data from the Chambor of labour with detailed information on the type of fees paid, and the specific amount. In case private childcare fees differ from the public ones (as e.g. in Salzburg), we use information provided by the regional government on the amounts to be paid for private childcare (e.g. 320 Euro in Salzburg).

Appendix A.2. Italy

In Italy, childcare services are managed by the local councils (i.e. more than 8.000 in the country) with a lot of variation in terms of coverage and fees which are relatively high and have to be paid by the families. Since 2016 (i.e. the year subsequent to the one considered in the analysis) a new "childcare bonus" (bonus Asili nido) was introduced, recognizing up to 1.000 euro (extended up to 3.000 euro from 2020) per year to cover part of the childcare costs based on income and assets of the family.

Fees in public childcare are means-tested with the tariff structure differing between municipalities and depending on family characteristics and an indicator that considers income, assets and family composition (i.e. ISEE, Indicator of the equivalised economic situation). The average out-of-pocket monthly fee, for a family with an ISEE of around 20.000 euro per year, is around 300€, with huge differences across regions determined by fees ranging from 80€ in Calabria to around 400€ in most of the Northern regions (Toscana, Piemonte, Bolzano, Friuli, Trento and Valle d'Aosta). Fees are simulated according to the income-asset dependent tariff structure in place in the capital city of each of the 21 regions. The cost of private childcare is entirely paid

by the families. The parental fees to be paid for a full-time slot in the private sector can be approximated using available information aggregated at macro regional area showing that the private childcare costs around 10% more than the maximum public fee in the North, 35% in the Center and 21% in the South (Attiva, 2011). See Figari and Narazani (2020) and Hufkens et al. (2016) for more details.

Appendix A.3. Finland

In Finland parents can choose whether they want to care for the child at home, put the child in municipal day-care or in a private day-care arrangement. If they opt for caring for the child at home they are entitled to the child home care allowance which consists of a basic allowance and a supplement. The basic allowance is a lump sum, the supplement is means tested and depends on the monthly income of the family and on family size. The fees in municipal childcare facilities are income based and depend on the size of the family and the requested hours of childcare. The maximum day-care fee is 283 euros per month. The fee percentages and minimum and maximum gross income limits are as follows:

The fee is calculated by subtracting the minimum income limit (according to family size) from average gross monthly income; the fee percentage is applied on this amount to calculate the fee for full day-care of the youngest child. There is an upper bound for the fees, defined by the maximum threshold. For low-income families (i.e. those below the minimum threshold) day-care is free of charge. The fee in private day-care is determined by the service provider but cannot be more than 30 euros larger than the fee in municipal day-care. See tHufkens and Verbist (2017) for more details

Appendix A.4. Estonia

In Estonia there is a system of pre-school childcare institutions provided mainly by local municipalities and less than 10% by private institutions. Municipal pre-school institutions are largely publicly funded Management costs of the preschool institutions shall be covered out of the rural municipality or city budget funds and, on the resolution of the rural municipality or city council, partially by parents. The amount covered by parents per child shall not exceed 20 per cent of the minimum wage rate established by the Government of the Republic. The cost of catering for children at a preschool institution shall be covered by the parents.

Across local municipalities the parental fees varied from 0 to around €60 per month and the average catering cost per child was around €20 per month. Childcare fees are generally not income dependent but poor families can ask for a full exemption but the share of such families is rather small. See Hufkens et al. (2016) for more details.

Appendix A.5. Poland

In Poland, all childcare facilities, either provided by public or private institutions, have to be registered by the local authority and inspected annually. Childcare fees are regulated at the local level and are differentiated between care and meal costs but mainly they are not income dependent and some discounts are only provided for low-income families with income below a certain threshold. The fee in a public creche for up to 10 hours a day is 10% of the average wage in the whole

economy at the end of previous year (in EUROMOD set at 3854.88PLN per month in 2015). In addition, the expenses for the meals are around 6.5 PLN per day.

In the private structure the costs are simulated at 1200 PLN per month plus about 16 PLN per day for the meals.

Appendix A.6. Portugal

In Portugal, there has been an increase of childcare participation rates over the last decades, mainly through full-time formal facilities. Most childcare services in Portugal are public services and services organised by NGO's. Children under 3 year olds are partly in facilities fully subsidised by the government, partly in semi-subsidised childcare (flat rate state support) and partly in private childcare.

childcare fees are determined as a percentage of household income, which increases with family resources. The maximum fee cannot be higher than the real average cost (including administration expenses) per user of the service.

Parents with children in semi-subsidised childcare facilities pay an income-dependent childcare fee. Low-income families or a family with an income below 30% of the guaranteed monthly minimum income (RMMG, i.e. 505€ per month) pay a fee that is 15% of their per capita income. The progressive percentage of per capita income goes from 15% to 35% when income is above 1.5 times the monthly minimum income. The household income per capita is calculated subtracting from the gross household income a measure of fixed costs of the household.

Private fees are simulated at an average of 455€ per month. See hufkens2017adding for more details.

Appendix A.7. Ireland

In Ireland childcare costs vary by income level and household structure. In order to simulate childcare fees, due to lack of available detailed data, we make use of estimated childcare costs by Doorley et al. (2021) before the introduction of the The National Childcare Scheme (NCS) which is fully operational only since 2019 and replaces four pre-existing targeted childcare subsidies which greatly affect the net parental fees.

Using national SILC 2017 data, Doorley et al. (2021) derived a measure of childcare costs faced by parents net of the childcare subsidies which existed before 2019: Early Childhood Care and Education (ECCE), Training and Employment Childcare (TEC) and Community Childcare Subvention (CCS) schemes. We deflated the values from 2017 to 2015 and simulated an average parental fee from 154€ to 493€ per month depending on family incomes. Private childcare fees are assumed to be 15% higher than the maximum subsidised fee. See Doorley et al. (2021) for more details.

Appendix A.8. Hungary

In Hungary childcare services are provided by both formal subsidised and unsubsidised institutions. The price paid by parents for the childcare institutions is generally not income related.

Formal childcare services are free of charge but parents pay for the meals and make minor material contributions. Approximate contribution is € 20 per month or 300 to 600 HUF.

Some of the nurseries owned by schools, churches, foundations or private owners also offer their services for free, others charge a fee (approximately 100 to 150 euros a month). According to the Public Education Law CXC/2011, from 2012 on also public institutions can charge a parental fee. The monthly fees are regulated: in day care centres fees and meals cannot exceed 25% of net family income per child. In home-based ECEC, the limit is drawn at 50% of net family income per child.

In EUROMOD we simulate meals cost per day at a rate of 580 HUF. Families with more than 3 children, lone parents and families with monthly income below 39.900HUF per adult are exempt from paying fees.

The parental fees in private childcare institutions can be very high but due to lack of info in the data we cannot simulate fees for private childcare facilities. See Hufkens et al. (2016) for more details.

Appendix B. Additional tables

Appendix B.1. Utility parameters

Table B.3: Conditional Logit results

	Austria	Estonia	Finland	Hungary	Ireland	Italy	Poland	Portugal
Voluntary Part-time	5.703***	5.521***	4.490***	19.07	3.732***	5.326***	2.952***	16.79
	(9.11)	(6.52)	(6.43)	(0.02)	(9.59)	(11.10)	(6.26)	(0.04)
Public childcare	-2.124***	-1.534***	-2.130***	-2.327***	-5.440***	-1.662***	-3.005***	-2.882***
	(-10.24)	(-10.96)	(-13.72)	(-11.47)	(-12.03)	(-12.57)	(-14.35)	(-12.22)
Private childcare	-2.308***		-5.295***	-3.092***	-3.561***	-1.526***	-2.071***	-1.147***
	(-10.39)		(-13.95)	(-12.14)	(-12.81)	(-10.02)	(-7.26)	(-4.78)
Informal childcare	-1.109***	-1.810***	-3.133***	-1.397***	-2.526***	-1.505***	-1.112***	-1.909***
	(-7.43)	(-12.17)	(-17.89)	(-10.00)	(-9.75)	(-12.33)	(-9.14)	(-9.17)
In-work dummy	-3.304**	-5.474**	-1.689	-6.198*	-2.354*	-6.910***	-5.021**	-1.461
	(-2.89)	(-3.23)	(-1.63)	(-2.18)	(-2.08)	(-5.00)	(-3.17)	(-1.05)
Part-time dummy	-2.247*	-0.122	-0.991*	-0.308	-0.160	-0.0546	-0.688	-1.001
	(-2.56)	(-0.11)	(-2.22)	(-0.27)	(-0.20)	(-0.14)	(-0.99)	(-1.39)
Full-time dummy	1.281	3.633**	1.893***	3.994***	1.502	1.562***	2.139**	2.355**
	(1.52)	(3.17)	(4.61)	(3.78)	(1.80)	(4.63)	(2.89)	(3.05)
Leisure	0.656***	0.666***	0.277*	1.057***	0.251	0.460***	0.573**	0.242
	(3.51)	(3.31)	(1.96)	(3.54)	(1.49)	(3.40)	(3.12)	(1.36)
Leisure square	-0.00651***	-0.00542**	-0.00258*	-0.00768**	-0.00289*	-0.00477***	-0.00471**	-0.00221
	(-4.37)	(-3.17)	(-2.25)	(-2.79)	(-2.17)	(-3.63)	(-2.82)	(-1.46)
Leisure x age	0.00354	-0.00248	0.00404	-0.00590	0.00356	0.00122	-0.00186	-0.000559
	(0.97)	(-1.04)	(1.39)	(-1.71)	(1.26)	(0.86)	(-1.32)	(-0.32)
Leisure x age square	-0.00004	0.00003	-0.00007	0.00006	-0.00004	-0.00002	0.00001	0.000006
	(-1.09)	(0.97)	(-1.64)	(1.57)	(-1.35)	(-1.12)	(0.84)	(0.35)
High educ x Leisure	-0.0345*	-0.000582	-0.0165**	0.00504	-0.0466***	-0.0216***	-0.0315***	-0.0121
	(-2.54)	(-0.07)	(-2.72)	(0.42)	(-4.76)	(-3.82)	(-5.43)	(-1.35)
Couple x Leisure	-0.00714	0.00371	-0.0642*	-0.0252	-0.0151	-0.00753	-0.0271*	-0.00797
	(-0.26)	(0.17)	(-2.39)	(-1.11)	(-1.04)	(-0.76)	(-2.55)	(-0.74)
Leisure x #children	0.00142	0.000155	-0.00651	-0.00635	0.0100	-0.00428	0.00220	0.0137**
	(0.13)	(0.03)	(-1.46)	(-1.10)	(1.43)	(-0.86)	(0.70)	(2.94)
Leisure x Migrant	0.0155	-0.0111	0.00698	0.763	0.0199	0.0306**	1.316	0.0106
	(0.84)	(-0.72)	(0.46)	(0.01)	(1.67)	(3.20)	(0.01)	(0.72)
Leisure x Mortgage	-0.000959	0.000287	-0.00118***	-0.000641	-0.00195***	-0.000946***	-0.000769*	-0.000980**
	(-1.16)	(0.71)	(-4.48)	(-1.52)	(-4.77)	(-3.44)	(-2.57)	(-2.66)
Net income	-0.0117	0.00840	0.00255	0.000237**	0.00718*	0.0171***	0.00760***	0.00738
	(-1.43)	(0.88)	(0.73)	(3.27)	(1.99)	(5.35)	(4.52)	(1.54)
Net income square	0.000002	0.000003	0.000002	5.77e-10	-0.0000008	0.0000005	-9.16e-08	0.00000190
	(0.73)	(0.61)	(1.30)	(1.64)	(-1.18)	(0.35)	(-0.27)	(0.78)
Net income x hh size	0.000525	-0.00115	-0.00118*	-0.0000510***	-0.0000646	-0.00267***	-0.000303	0.000797
	(0.29)	(-0.68)	(-2.08)	(-3.86)	(-0.11)	(-4.92)	(-1.12)	(0.88)
Net income x Leisure	0.00006	0.00003	0.00008***	0.0000003	-0.000008	-0.000009	0.000005	0.00003
	(1.67)	(1.04)	(3.72)	(1.00)	(-0.40)	(-0.39)	(0.63)	(1.09)
Observations	4043	3672	8034	4576	4966	9737	8918	5720
ll	-467.5	-569.8	-825.3	-471.0	-507.6	-1323.7	-883.2	-702.7
r2_p	0.414	0.364	0.479	0.478	0.482	0.311	0.498	0.377
aic	975.1	1177.6	1690.6	980.0	1055.3	2687.3	1806.3	1445.5
bic	1101.2	1295.6	1830.4	1102.2	1185.5	2831.0	1948.3	1578.5

Appendix B.2. Maternity leave

Table B.4: Maternity leave (in months, post natal)

	months
Austria	2
Estonia	4
Finland	2
Hungary	5
Ireland	10
Italy	4
Poland	3.5
Portugal	1.5

Appendix B.3. Additional LS results

Appendix B.3.1. Children under 3 years

Table B.5: Predicted labour participation probabilities, Labour demand not considered, unrestricted sample

	Target			
	40%	50%	60%	65%
Austria	0.307	0.329	0.352	0.364
Estonia	0.326	0.372	0.410	0.429
Finland	0.439	0.501	0.562	0.593
Hungary	0.237	0.275	0.300	0.312
Ireland	0.665	0.723	0.758	0.777
Italy	0.518	0.5626	0.591	0.606
Poland	0.606	0.667	0.692	0.705
Portugal	0.738	0.771	0.800	0.814

Table B.6: Predicted labour participation probabilities, Labour demand considered, unrestricted sample

		Target			
	Observed	40%	50%	60%	65%
Austria	0.266	0.297	0.313	0.329	0.337
Estonia	0.281	0.313	0.336	0.359	0.371
Finland	0.398	0.413	0.438	0.468	0.485
Hungary	0.186	0.230	0.246	0.263	0.271
Ireland	0.623	0.653	0.670	0.690	0.702
Italy	0.523	0.526	0.535	0.545	0.550
Poland	0.570	0.613	0.627	0.642	0.650
Portugal	0.745	0.744	0.761	0.780	0.789

Appendix B.3.2. Children under 3 years and over the number of months in paid maternal leave

Tables B.7 and B.8 report the predicted changes in labour market participation and working hours for the sample of mothers with children under 3 years and older than the number of months in maternity leave. The effect of the childcare availability increases is expected to be smaller for this sample of kids mainly because the current share of formal care is higher and mothers have higher labour market participation.

Table B.7: Predicted changes in labour participation rates, Labour demand not considered

		Target			
	Observed	40%	50%	60%	65%
Austria	0.259	13.37%	20.92%	28.77%	32.81%
Estonia	0.282	15.25%	27.81%	40.51%	46.91%
Finland	0.393	10.78%	26.02%	41.40%	49.14%
Hungary	0.181	31.76%	44.94%	58.15%	64.76%
Ireland	0.627	7.30%	12.05%	17.03%	19.61%
Italy	0.529	1.46%	6.95%	12.53%	15.36%
Poland	0.553	12.96%	17.46%	22.04%	24.35%
Portugal	0.738	-2.41%	1.51%	5.47%	7.45%

Table B.8: Predicted changes in weekly working hours, Labour demand not considered

		Target			
	Observed	40%	50%	60%	65%
Austria	7.507	12.51%	19.85%	27.67%	31.76%
Estonia	13.321	9.28%	17.15%	25.29%	29.46%
Finland	13.971	10.06%	24.27%	38.60%	45.79%
Hungary	11.517	10.99%	15.65%	20.38%	22.77%
Ireland	19.780	7.06%	11.68%	16.54%	19.07%
Italy	18.140	1.81%	7.08%	12.47%	15.21%
Poland	23.994	9.70%	12.79%	15.95%	17.55%
Portugal	29.918	-1.84%	1.15%	4.14%	5.64%

Appendix B.3.3. Children between 6 and 36 months of age

Table B.9: Predicted changes in labour participation rate, Labour demand not considered

		Target			
	Observed	40%	50%	60%	65%
Austria	0.27	12.79%	20.23%	27.98%	31.99%
Estonia	0.29	12.63%	24.69%	36.87%	43.01%
Finland	0.39	8.33%	24.12%	40.05%	48.05%
Hungary	0.18	30.15%	43.32%	56.57%	63.22%
Ireland	0.63	7.30%	12.05%	17.03%	19.61%
Italy	0.53	0.68%	5.96%	11.34%	14.06%
Poland	0.54	13.20%	17.92%	22.70%	25.12%
Portugal	0.74	-3.01%	0.23%	4.36%	6.44%

Table B.10: Predicted changes in weekly working hours, Labour demand not considered

		Target			
	Observed	40%	50%	60%	65%
Austria	7.7	11.95%	19.19%	26.91%	30.96%
Estonia	14.0	7.50%	14.85%	22.44%	26.33%
Finland	13.6	7.88%	22.83%	37.92%	45.51%
Hungary	11.7	10.20%	14.73%	19.33%	21.65%
Ireland	19.8	7.06%	11.68%	16.54%	19.07%
Italy	18.2	1.09%	6.23%	11.50%	14.17%
Poland	23.6	10.04%	13.30%	16.65%	18.34%
Portugal	29.8	-2.31%	0.18%	3.33%	4.90%

Appendix B.3.4. Abolishing public childcare fees

Table B.11: Predicted labour participation probabilities, public fees abolished

	Observed	Reform	% Change
Austria	0.266	0.266	-0.05%
Estonia	0.281	0.287	2.29%
Finland	0.398	0.400	0.49%
Hungary	0.186	0.191	2.61%
Ireland	0.623	0.626	0.49%
Italy	0.523	0.540	3.34%
Poland	0.570	0.581	1.92%
Portugal	0.745	0.752	0.96%

Table B.12: Predicted working hours, public fees abolished

	Observed	Reform	% Change
Austria	7.38	7.37	-0.05%
Estonia	12.97	13.15	1.36%
Finland	13.74	13.81	0.47%
Hungary	11.35	11.48	1.10%
Ireland	19.75	19.90	0.79%
Italy	17.85	18.62	4.32%
Poland	24.24	24.76	2.19%
Portugal	29.53	29.78	0.85%

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