Optimal Tax and Transfer Programs for Couples with Extensive Labor Supply Responses*†

Herwig Immervoll, OECD and ISER at University of Essex

Henrik Jacobsen Kleven, London School of Economics

Claus Thustrup Kreiner, University of Copenhagen

Nicolaj Verdelin, University of Copenhagen

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Abstract

This paper analyzes the optimal design of general nonlinear tax-transfer schedules for couples under unitary and collective approaches to family decision making. We consider a double-extensive model of labor supply where each spouse makes a labor force participation choice for given hours of work. We present simple and intuitive optimal tax rules that generalize existing findings on the optimal taxation of single-person households with extensive responses (Saez, 2002) to the case of two-person households with double-extensive responses. Without income effects on labor supply, optimal tax rules as a function of sufficient statistics are the same under the unitary and collective approaches. With income effects on labor supply, optimal tax rules under the two approaches continue to depend on the same sufficient statistics, but the collective model features an additional Pigouvian term arising from a within-family participation externality. Finally, we present microsimulations of tax reform for 15 European countries suggesting that a reduction of tax rates on secondary earners relative to primary earners is associated with strong welfare gains in all countries.

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†Any remaining errors and views expressed in this article are the authors responsibility. In particular, the paper does not necessarily represent the views of the OECD, the governments of OECD member countries or the EUROMOD consortium. The version of EUROMOD used in this paper relies on micro-data from 11 different sources for 15 countries. These are the European Community Household Panel (ECHP) made available by Eurostat; the Austrian version of the ECHP made available by the Interdisciplinary Centre for Comparative Research in the Social Sciences; the Living in Ireland Survey made available by the Economic and Social Research Institute; the Panel Survey on Belgian Households (PSBH) made available by the University of Liège and the University of Antwerp; the Income Distribution Survey made available by Statistics Finland; the Enquête sur les Budgets Familiaux (EBF) made available by INSEE; the public use version of the German Socio Economic Panel Study (GSOEP) made available by the German Institute for Economic Research (DIW), Berlin; the Survey of Household Income and Wealth (SHIW95) made available by the Bank of Italy; the Socio-Economic Panel for Luxembourg (PSELL-2) made available by CEPS/INSTEAD; the Socio-Economic Panel Survey (SEP) made available by Statistics Netherlands through the mediation of the Netherlands Organisation for Scientific Research - Scientific Statistical Agency; the Income Distribution Survey made available by Statistics Sweden; and the Family Expenditure Survey (FES), made available by the UK Office for National Statistics (ONS) through the Data Archive. Material from the FES is Crown Copyright and is used by permission. Neither the ONS nor the Data Archive bear any responsibility for the analysis or interpretation of the data reported here.

1 Introduction

The large literature on optimal income redistribution focuses almost exclusively on models of single-person households. These models fit poorly with real-world tax and transfer schemes, which redistribute income across families that are formed around couples. This has triggered a recent interest in generalizing the theory of optimal income redistribution to deal with couples. This can be seen as a multi-dimensional screening problem where agents (couples) are characterized by a multi-dimensional parameter (ability and taste-for-work parameters of each spouse) that are unobserved by the principal (the government which maximizes social welfare). Due to the technical difficulties associated with multi-dimensional screening problems, very few studies have tried to tackle the general problem and there are few general results regarding the optimal shape of tax schedules.[1] To sidestep these issues, most papers eliminate the multi-dimensional screening aspect of the problem by assuming that the tax treatment of spouses is separable and therefore individual-based (albeit gender specific).[2] However, this assumption is inconsistent with actual redistribution schemes, which are never fully separable due to the existence of family-based transfers and elements of jointness in the tax code (Immervoll et al., 2009).

Besides these issues, a key tension in the literature is that no consensus exists on what is the most suitable model of family decision making in the analysis of optimal taxation. The literature is divided into two main strands. One set of papers adopts the unitary approach in which each couple is modeled as a single decision-making unit.[3] While this approach provides a simple tool of analysis, it ignores intra-household distribution issues and is empirically unrealistic.[4] A second set of papers adopts an individualistic approach in which the family consists of members with conflicting interests bargaining over household resources. The dominating framework within this tradition is the collective labor supply model (Chiappori, 1988, 1992), which does not restrict itself to a particular bargaining process but assumes only that family allocations lie on the Pareto frontier.[5] Because the existing optimal tax papers in these two traditions differ in a number of other key dimensions (tax instruments, labor supply responses, dimensions of heterogeneity,

[1] Recently, Kleven et al. (2007, 2009) analyze the optimal nonlinear taxation of couples as a multi-dimensional screening problem, and characterize the optimal form of jointness in the taxation of spouses. Papers by Brett (2007) and Cremer et al. (2007) also analyze the optimal taxation of couples as a multidimensional screening problem.

[2] The first paper in this tradition is Boskin and Sheshinski (1983), who considered the optimal linear taxation of couples allowing for the possibility of selective tax rates on husband and wife. The linearity assumption implies fully separable tax treatment. A large set of subsequent papers have considered linear separable taxation of spouses, including Apps and Rees (1988, 1999, 2007) and Alesina et al. (2011). A paper by Schroyen (2003) extends the analysis to nonlinear taxation, but keeps the assumption of separable tax treatment.

[3] Papers in this tradition include Boskin and Sheshinski (1983), Schroyen (2003), Brett (2007), Cremer et al. (2007), Kleven and Kreiner (2007), and Kleven et al. (2007, 2009).

[4] The two key empirical failures of the unitary model is the income pooling hypothesis (e.g., Thomas, 1990; Browning et al., 1994; Lundberg et al., 1997) and the Slutsky symmetry of spousal labor supplies (e.g., Browning and Chiappori, 1998).

[5] Papers in this tradition include Apps and Rees (1988, 1999), Brett (1998), and Alesina et al. (2011).

etc.), it is currently not clear what are the precise differences between the unitary and collective approaches in terms of normative tax implications.

This paper takes a step to resolve these technical and conceptual issues in the design of optimal tax-transfer schemes for couples. We characterize optimal redistribution schemes that allow for realistic policy instruments (nonlinear, non-separable taxes and transfers) and under multi-dimensional heterogeneity in ability and work costs of each spouse across families. Moreover, we solve this problem under both the unitary and collective approaches, allowing us to explore the precise role of the family decision making model for optimal taxation.

Since the general problem just described is extremely complex, we make two key simplifying assumptions. First, we consider an extensive model of labor supply where each spouse makes a labor force participation choice for given hours of work. This double-extensive model greatly simplifies the analysis while allowing us to capture the key empirical difference in labor supply behavior between married men and women: the fact that participation elasticities are much higher for married women than for married men. By contrast, the elasticity of hours worked conditional on working is much more similar for men and women and both tend to be small.[6] Second, we impose an assumption on the joint distribution of spousal work costs that make one spouse the "primary earner" and the other spouse the "secondary earner" in the following sense: the primary earner is always the working spouse in a one-earner household, while the secondary earner works only in a two-earner household. This implies that the household optimization problem can be solved *as if* it were sequential: first it is decided if the primary earner should enter the labor market and then, conditional on primary-earner participation, it is decided if the secondary earner should also enter. This primary-secondary earner model is consistent with much empirical work in this area (e.g., Eissa, 1995; Eissa and Hoynes, 2004) and greatly simplifies the optimal tax analysis.

Our paper offers the following main findings. First, starting from a unitary model with no income effects on labor supply, we present very simple optimal tax rules for the optimal taxation of primary and secondary earners. These rules show that the optimal participation tax on secondary earners at each income level is a simple function of the participation elasticity of secondary earners and the social welfare weight on two-earner couples at the given income level. The optimal participation tax on primary earners is a simple function of the participation elasticity of primary earners and the social welfare weight on both one-earner and two-earner couples. Generalizing the model to allow for income effects on labor supply, we show that income effects are associated with a minor modification of the results and have no substantive importance for optimal taxation.

This first set of results extends the influential work by Saez (2002) for the case of single-

[6] Surveys of the empirical labor supply literature are provided by, e.g., Heckman (1993), Blundell and MaCurdy (1999), and Meghir and Phillips (2010).

person households with extensive labor supply responses to the case of two-person households with double-extensive responses. The central result in Saez (2002) is that, if the social welfare weight on low-income working individuals is greater than the average social welfare weight in the population, then it is optimal to impose negative participation tax rates at the bottom of the distribution. While this has been interpreted as providing a normative underpinning of means-tested in-work benefit programs (such as the EITC in the United States), the link between theory and policy is in fact not straightforward as EITC-style programs provide participation subsidies to families based on the combined income of spouses. What we show is that, in a setting with couples, a negative participation tax on the secondary earner requires that the social welfare weight on low-income two-earner couples is greater than the average social welfare weight in the population. In our model, because two-earner couples are better off than one-earner couples (for given spousal abilities), it is harder to justify a negative tax rate on low-income secondary earners than on low-income singles. Moreover, given a positive tax on secondary earners, we show that it also becomes harder to justify a negative tax rate on low-income primary earners in couples. This is because a lower participation tax on primary earners (and by implication a lower tax on one-earner couples) induces some two-earner couples to become one-earner couples, which is associated with a negative fiscal externality if the second-earner tax is positive. For this reason, a negative participation tax on the primary earner requires that the social welfare weight on low-income one-earner couples is *sufficiently* greater than the average social welfare weight in the population. If this condition is satisfied, it is possible to get an optimum that combines negative participation taxes on primary earners at the bottom along with positive participation taxes on secondary earners everywhere. Interestingly, this is consistent with the EITC in the U.S., which subsidizes first-earner entry while taxing second-earner entry (e.g., Eissa and Hoynes, 2004).

Second, we explore the robustness of the above results to collective family bargaining and intra-family equity issues. In the collective model, the social welfare function is defined over individual utilities instead of family utilities, and in general the government may put different weights on spouses than the actual bargaining weights in the intra-family allocation problem. We analyze the collective model in situations with and without income effects on labor force participation. In the case without income effects, we show that the optimal tax rules are qualitatively unchanged compared to the unitary model, i.e., the tax rules are unchanged as a function of sufficient statistics: participation elasticities of the two spouses along with social welfare weights on one-earner and two-earner couples. If the government disagrees with the intra-family bargaining weights, this will affect the social welfare weights on one- and two-earner couples, but it remains the case that those welfare weights provide sufficient statistics for policy evaluation. The key insight behind this result is that, in a collective model with no income effects, each spouse receives the full economic gain of his/her labor market entry and hence the conditions governing entry choices in families are the same as in a unitary model with no income effects.

Third, in a collective model with income effects on labor supply, the optimal tax rules are the same as those just described except for one modification. This modification reflects an externality associated with spousal participation choice: if one spouse, say the secondary earner, enters the labor market, this increases consumption without reducing leisure for the primary earner. Hence, the primary earner always benefits from secondary-earner participation. Whenever the government disagrees with the intra-family bargaining weights, this effect creates a spousal externality that calls for a Pigouvian tax correction. The implication of this externality for optimal tax rates is *a priori* surprising. For example, if the social welfare function favors secondary earners over primary earners compared to the actual intra-family weights, the externality of secondary-earner participation implies that there is too much secondary-earner participation. Other things equal, this calls for a higher tax on secondary earners. At the same time, a symmetric externality of primary-earner participation implies that there is too little primary-earner participation. Other things equal, this calls for a lower tax on primary earners. Hence, a social welfare function that favors secondary earners over primary earners calls for a shift in relative participation taxes from primary earners to secondary earners.[7]

Except for this potential spousal externality effect, the overall message of our analysis is that the normative tax implications of the unitary and collective models are remarkably similar. The key reason is that the two approaches share the central feature that the within-family labor supply allocation is Pareto efficient. In this case, it is possible to exploit envelope conditions from family optimization to express optimal tax rules as the same functions of sufficient statistics under the two approaches. This finding lends support to optimal income tax papers based on the unitary model by showing that this approach, despite its conceptual and empirical problems, may still provide a useful abstraction for the analysis of questions in normative public finance.

Fourth and finally, we simulate the welfare effects of tax reforms that change relative participation tax rates on primary and secondary earners. We start by carefully mapping tax-transfer policies in a large set of European countries as of 1998, using the EUROMOD microsimulation model. EUROMOD is an EU-wide tax-benefit simulator combining country-specific, but partly harmonized, micro datasets with a detailed modeling of the full set of institutional features of tax and transfer systems in each country.[8] We show that participation tax rates on primary earners

[7] This result allows for intra-family bargaining weights to depend on *innate* spousal characteristics, but assumes that bargaining weights do not depend on endogenous choices by either households or the government (i.e., household labor supply choices and the design of the couple tax schedule). Empirical evidence suggests that intra-family allocation depends on relative earnings between spouses (e.g., Browning et al., 1994), but it is not clear if this effect is driven by innate earnings capacities or endogenous labor supply choices. The case where endogenous labor supply choices directly impact within-family bargaining weights represents a fundamental departure from the collective labor supply framework. We provide a brief discussion of such an extension in the concluding Section 4.

[8] Introductions to EUROMOD and detailed descriptions of taxes and transfers in EU countries have been provided by Immervoll et al. (2007, 2009).

are higher than on secondary earners in almost all countries due the fact that family-based and means-tested welfare benefits are affected more by the first than by the second entrant.[9] We then investigate if it is desirable to go further in this direction by considering revenue-neutral reforms that reduce the tax rate on secondary earners relative to primary earners. We show that under weak conditions on relative social welfare weights on one- and two earner couples, it is indeed desirable to lower the tax burden on secondary earners.[10] For example, this could be implemented by supplementing the current systems with a two-earner tax credit.

The rest of the paper is organized as follows. Section 2 sets out different models of family labor supply and characterizes the optimal tax-transfer system in each case. Section 3 maps out the existing tax-transfer treatment across countries and presents microsimulations of tax reform. Section 4 discusses a number of extensions and directions for future work.

2 Models of family labor supply and optimal taxation

2.1 A simple unitary model without income effects

We consider a double-extensive model of labor supply where each spouse makes a labor force participation choice for given hours of work. The model extends the work of Saez (2002) for single-person households to the case of two-person households. Labor force participation varies across couples due to heterogeneity in market abilities and work costs, and households can be grouped into three different categories: zero-earner, one-earner, and two-earner households. As explained below, we impose restrictions on the joint distribution of work costs that make one spouse the "primary earner" (always the working spouse in a one-earner household) and the other spouse the "secondary earner" (a working spouse only in a two-earner household).

Each spouse is endowed with a fixed earnings capacity (innate ability), which we denote by z_p^h, z_s^h for the primary and secondary earner, respectively, in a household of type h. We allow for heterogeneity in both z_p^h and z_s^h, but reduce the dimensionality of the problem by assuming that, for each level of primary earnings z_p^h, there is only one possible level of secondary earnings z_s^h. A similar type of simplifying assumption was made in Kleven et al. (2009). Denoting by z_i the actual earnings of spouse i ($i = p, s$), the participation choice of each spouse amounts to choosing between $z_i = 0$ and $z_i = z_i^h$. The number of households of type h is denoted n_h, $h = 1, ..., H$, and the total population of households is normalized to one, $\sum_{h=1}^{H} n_h = 1$.

[9] This finding goes against the standard argument that participation tax rates are higher on secondary earners due to elements of jointness in the tax system (e.g., Alesina et al., 2011). This argument does not account for the existence of family-based and means-tested transfers, which we show empirically tends to swamp the effects of jointness in the tax code.

[10] As existing participation tax rates on secondary earners are strongly positive in all countries, these simulation results are of course consistent with the theoretical finding that negative tax rates on low-income secondary earners are typically not optimal.

All households have a quasi-linear utility function given by

$$u = c - q_p \cdot 1\left(z_p > 0\right) - q_s \cdot 1\left(z_s > 0\right), \tag{1}$$

where c is household consumption and q_p, q_s denote work costs of the primary and secondary earner, respectively. These work cost parameters capture all costs of working such as standard disutility of working, child care expenses, and commuting. The indicator function $1\left(.\right)$ takes the value 1 when a given spouse works ($z_i > 0$, $i = p, s$) and zero otherwise.

The household faces a general income tax schedule $T\left(z_p, z_s\right)$, which may be non-linear and potentially non-separable. The function $T\left(\cdot\right)$ captures taxes net of transfers and may be negative at some income levels. The budget constraint of each household equals

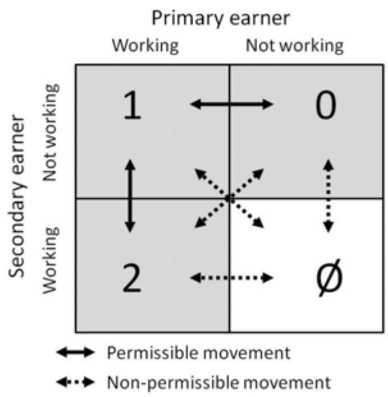
$$c \leq z_p + z_s - T\left(z_p, z_s\right). \tag{2}$$

Households choose earnings z_p and z_s so as to maximize utility (1) subject to the budget constraint (2). For households of type h (i.e., earnings pair z_p^h, z_s^h), there is a distribution of fixed costs described by a continuous joint density function $f_h\left(q_p, q_s\right)$ defined over $[0, \infty) \times [0, \infty)$. By defining the unconditional density and distribution functions of q_p as $f_h\left(q_p\right)$ and $F_h\left(q_p\right)$ and the conditional density and distribution functions of q_s as $p_h\left(q_s \left| q_p\right.\right)$ and $P_h\left(q_s \left| q_p\right.\right)$, we may write the joint density function as $f_h\left(q_p, q_s\right) = p_h\left(q_s \left| q_p\right.\right) \cdot f_h\left(q_p\right)$.

In general, households may choose one of four possible states: (i) none of the spouses participate (zero-earner couple), (ii) the primary earner—but not the secondary earner—participates (one-earner couple), (iii) the secondary earner—but not the primary earner—participates (reverse one-earner couple), and (iv) both spouses participate (two-earner couple). Notice that, in this general setting, the primary-secondary earner terminology is not very meaningful as the secondary earner is allowed to be the sole breadwinner in the reverse one-earner couple. To simplify the analysis, we consider a restricted problem that rules out the possibility of a reverse one-earner couple and makes the primary-secondary earner distinction clear-cut. Figure 1 illustrates the permissible participation choices of couples: the assumption is that couples can be observed only in the shaded areas (0, 1, and 2), never in region $\varnothing$. We have to ensure that this entry pattern is consistent with household optimization, which amounts to a restriction on the joint distribution of work costs $f_h\left(q_p, q_s\right)$. Appendix A shows how the distribution of work costs can be restricted to guarantee this.

This primary-secondary earner model simplifies the analysis in two ways. First, couples behave *as if* they were making a sequential participation choice. It is first decided if the primary earner should enter the labor market and then, conditional on primary-earner participation, it is decided if the secondary earner should also enter. Second, by ruling out movements between area 1 and area $\varnothing$ (the primary earner dropping out combined with the secondary earner entering) and between area 2 and area 0 (both spouses dropping out at the same time) in response to tax changes, the model avoids a *double deviation* that would pose considerable technical difficulty. The difficulties associated with such double deviations are well known from the literature on multi-dimensional screening (e.g., Mirrlees, 1976, 1986; Armstrong and Rochet, 1999; Kleven et al., 2007). The two simplifying aspects of the primary-secondary earner model allows us to derive simple and intuitive optimal tax rules, while keeping the most salient features of extensive labor supply responses in the empirical literature.

Figure 1: Participation choices of couples



Given the entry sequence implied by the primary-secondary earner model, a primary earner participates in the labor force if and only if the net household utility gain of doing so, conditional on spousal non-participation, is positive. For household h, this implies

$$q_p \leq z_p^h - \left(T_1^h - T_0\right) \equiv \bar{q}_p^h, \tag{3}$$

where $\bar{q}_p^h$ is the net-of-tax income gain of primary-earner entry, $T_1^h \equiv T\left(z_p^h, 0\right)$ is the tax liability of the couple if only the primary earner is working, and $T_0 \equiv T\left(0,0\right)$ is the net tax burden if none of the spouses are working. Primary earners with $q_p \leq \bar{q}_p^h$ enter the labor market at $z_p = z_p^h$, whereas primary earners with $q_p > \bar{q}_p^h$ stay outside the labor force. Conditional on primary-earner entry, the secondary earner in household h enters if and only if

$$q_s \leq z_s^h - \left(T_2^h - T_1^h\right) \equiv \bar{q}_s^h, \tag{4}$$

where $\bar{q}_s^h$ is the net-of-tax income gain of secondary-earner entry and $T_2^h \equiv T\left(z_p^h, z_s^h\right)$ is the tax liability of a two-earner couple.

Let $e_0^h \equiv n_h\left[1 - F_h\left(\bar{q}_p^h\right)\right]$, $e_1^h \equiv n_h F_h\left(\bar{q}_p^h\right) - e_2^h$ and $e_2^h \equiv n_h \int_0^{\bar{q}_p^h} P_h\left(\bar{q}_s^h \left| q_p\right.\right) f_h\left(q_p\right) dq_p$ denote, respectively, the number of zero-earner, one-earner, and two-earner couples of type h. Given the assumed sequence of labor market entry, we may define participation elasticities for primary and secondary earners as follows

$$\eta_p^h \equiv \frac{-\partial e_0^h}{\partial c_1^h}\frac{c_1^h - c_0}{e_1^h} = \frac{-\partial e_0^h}{\partial\left(1-\tau_p^h\right)}\frac{1-\tau_p^h}{e_1^h}, \ \eta_s^h \equiv \frac{\partial e_2^h}{\partial c_2^h}\frac{c_2^h - c_1^h}{e_2^h} = \frac{\partial e_2^h}{\partial\left(1-\tau_s^h\right)}\frac{1-\tau_s^h}{e_2^h}, \tag{5}$$

where $\tau_p^h \equiv \left(T_1^h - T_0\right)/z_p^h$ and $\tau_s^h \equiv \left(T_2^h - T_1^h\right)/z_s^h$ denote participation tax rates on primary and secondary earners, respectively. Two points are worth noting about these elasticity concepts. First, a change in the participation tax rate on primary earners (secondary earners, respectively) may come from a change in the tax burden on either zero-earner or one-earner couples (one-earner or two-earner couples, respectively). In a model without income effects, it does not matter for participation behavior where the variation in τ_p^h and τ_s^h is coming from, but it will matter in the models with income effects below. To be able to consider consistent elasticity concepts throughout the analysis, equation (5) defines the participation elasticity of primary (secondary) earners with respect to a change in the participation tax rate on primary (secondary) earners driven by a change in the tax burden on one-earner (two-earner) couples. Second, the elasticity of primary earners is defined by considering $-\partial e_0^h$ rather than ∂e_1^h, because the number of one-earner couples may change due to entry/exit of either primary or secondary earners. It is the reduction in the number of zero-earner couples $-\partial e_0^h$ that captures the participation increase of primary earners.

2.2 Government objective and optimal tax formulas

The government's preferences are described by a social welfare function of the form

$$S = \sum_h n_h \int_{\mathbf{q}} \omega_h(\mathbf{q})\, u_h(\mathbf{q})\, f_h(\mathbf{q})\, d\mathbf{q}, \tag{6}$$

where $\mathbf{q} = (q_p, q_s)$ denotes the pair of spousal work costs and $\omega_h(\mathbf{q}) \geq 0$ is a Pareto weight on couple $(h, \mathbf{q})$. This objective allows us to characterize the set of Pareto efficient tax schedules. The government maximizes S with respect to T_0, T_1^h, T_2^h for all h subject to incentive compatibility constraints (3)-(4) and a government budget constraint given by

$$\sum_h \left(T_2^h e_2^h + T_1^h e_1^h + T_0 e_0^h\right) \geq R. \tag{7}$$

We denote by λ the Lagrange multiplier associated with the government budget constraint, which represents the marginal value of public funds.

Following the convention in the literature (e.g., Kleven et al., 2007, 2009), we capture the redistributive tastes of the government by social welfare weights equal to the social marginal value of consumption for different couples expressed in terms of the marginal value of public funds. In particular, we denote by g_0^h, g_1^h, g_2^h the (average) social welfare weights on zero-earner, one-earner, and two-earner couples of type h. Given the social objective (6) and quasi-linear utility (1), the social welfare weight on two-earner couples of type h is defined as

$$g_2^h \equiv \frac{\int_{\mathbf{q}\in\mathbf{D}_2^h} \omega_h(\mathbf{q})\, f_h(\mathbf{q})\, d\mathbf{q}}{\lambda \cdot \int_{\mathbf{q}\in\mathbf{D}_2^h} f_h(\mathbf{q})\, d\mathbf{q}}, \tag{8}$$

where $\mathbf{D}_2^h$ denotes the set of $\mathbf{q}$s for these households. The social welfare weights on one-earner and zero-earner couples are defined symmetrically. Because of our assumption of no income effects, the average social welfare weight across the entire population of couples equals one (see Appendix B). We can state the following:

Proposition 1 *In the unitary model without income effects, the optimal nonlinear tax schedule $T(z_p, z_s)$ satisfies*

$$\frac{\tau_s^h}{1-\tau_s^h} = \frac{1-g_2^h}{\eta_s^h} \;\; \forall h, \tag{9}$$

$$\frac{\tau_p^h}{1-\tau_p^h} = \frac{1-g_1^h}{\eta_p^h} + \frac{1-g_2^h}{\eta_p^h}\frac{e_2^h}{e_1^h} \;\; \forall h, \tag{10}$$

where $\tau_p^h \equiv \left(T_1^h - T_0\right)/z_p^h$ and $\tau_s^h \equiv \left(T_2^h - T_1^h\right)/z_s^h$ denote participation tax rates on primary and secondary earners in a couple of type h.

Proof: See Appendix B. $\square$

The intuition behind this proposition can be understood by considering a small pertubation around the optimal schedule, an approach to optimal taxation developed by Piketty (1997) and Saez (2001). To understand formula (9), we consider a small tax cut on two-earner couples of type h, $dT_2^h = d\tau_s^h \cdot z_s^h < 0$. The reform has two mechanical effects: a mechanical loss of government revenue equal to $dM = d\tau_s^h \cdot z_s^h \cdot e_2^h < 0$ and a utility gain for two-earner couples which increases social welfare by $dW = -g_2^h \cdot d\tau_s^h \cdot z_s^h \cdot e_2^h > 0$. The reform has a behavioral effect as the tax-cut on two-earner couples increases the participation of secondary earners by $-\frac{\partial e_2^h}{\partial\left(1-\tau_s^h\right)} d\tau_s^h$. The increased participation leads to a behavioral revenue gain (corresponding to the efficiency effect of the reform) equal to $dB = -\tau_s^h z_s^h \frac{\partial e_2^h}{\partial\left(1-\tau_s^h\right)} d\tau_s^h = -\frac{\tau_s^h}{1-\tau_s^h} z_s^h \cdot \eta_s^h \cdot d\tau_s^h \cdot e_2^h > 0$. The reform is welfare improving iff $dW + dM + dB \geq 0$, which gives the condition

$$g_2^h \geq 1 - \frac{\tau_s^h}{1-\tau_s^h}\eta_s^h. \tag{11}$$

Hence, a tax cut of one Euro to two-earner couples is welfare improving as long as the social welfare weight on two-earner couples is larger than the loss of government revenue net of the positive behavioral revenue effect from increased secondary-earner participation. At the social optimum, a small tax pertubation cannot change social welfare in which case the condition (11) holds with equality for all h and becomes identical to equation (9).

By studying a similar tax cut for one-earner couples of type h, we obtain the following condition for the reform to be welfare improving

$$g_1^h \geq 1 - \frac{\tau_p^h}{1-\tau_p^h}\eta_p^h + \frac{e_2^h}{e_1^h}\frac{\tau_s^h}{1-\tau_s^h}\eta_s^h. \tag{12}$$

Analogous with the previous condition (11), this result reflects that a tax cut of one Euro to one-earner couples is welfare improving if the social welfare weight on one-earner couples is larger than the loss of government revenue net of behavioral effects. This reform has two behavioral effects. One is that a tax cut to one-earner couples—by lowering the participation tax rate on primary earners—leads to a positive labor supply effect for primary earners (second term on the right-hand side). The other is that a tax cut to one-earner couples—by increasing the participation tax rate on secondary earners—has a negative labor supply effect for secondary earners (third term on the right-hand side).

At the optimal tax system, conditions (11) and (12) both hold with equality. By using (11) to eliminate the secondary-earner tax rate in (12), we obtain equation (10).

Proposition 1 shows that optimal tax rates on primary and secondary earners can be written as simple and intuitive functions of social welfare weights on one-earner and two-earner couples along with participation elasticities of the two spouses.[11] Under standard assumptions that welfare weights are decreasing in earnings capacity while participation elasticities are largest at the bottom of the earnings distribution, the proposition calls for increasing participation tax rates. The simplicity of the formulas is surprising given the technical complexity normally encountered when studying the optimal non-linear and non-separable taxation of couples. This is feasible because of the assumption of sequential participation choices.

Proposition 1 extends in a simple way the results of Saez (2002) for singles to the case of couples. Indeed, our optimal tax rule for secondary earners would be the same as the Saez (2002) optimal tax rule for singles if we replace in equation (9) the welfare weight on two-earner couples by the welfare weight on singles and the participation elasticity of secondary earners by participation elasticity of singles. In Saez (2002), if the welfare weight on low-income working individuals is greater than the average welfare weight in the population, then participation tax rates are negative at the bottom of the distribution (as under an EITC). Proposition 1 shows that an analogous result applies to secondary earners in couples, but in this case a negative tax rate on secondary earners requires that the welfare weight on *two-earner* couples g_2^h is larger than one. While it is perhaps natural to assume that low-income *one-earner* couples carry a welfare weight above one, the assumption is less natural for two-earner couples due to the fact that secondary-earner participation is a signal of low spousal work costs and therefore being better off (for a given ability pair z_p^h, z_s^h). Other things equal, this makes it harder to justify a secondary-earner EITC. Moreover, the optimal tax rule for primary earners (10) shows that a social welfare weight on one-earner couples g_1^h above one is not sufficient to obtain an EITC for primary earners in low-income couples. The reason is, as explained above, that a reduction in

[11] The social welfare weights are exogenous in the current model (which simplifies derivations). Under a more standard concave social welfare function and hence endogenous welfare weights, the optimal tax rules can be formulated in exactly the same way as a function of (endogenous) welfare weights. The endogeneity of welfare weights would introduce simultaneity in the determination of optimal tax rates τ_p^h and τ_s^h.

the tax liability of one-earner couples induces some secondary earners to drop out of the labor market, thereby reducing economic efficiency if $\tau_2^h > 0$. For this reason, the optimality of an EITC for primary earners requires that g_1^h is sufficiently above one (provided that $g_2^h < 1$ and hence $\tau_2^h > 0$). If this condition is satisfied, it is possible to get an optimum that combines negative participation taxes on primary earners at the bottom of the earnings distribution with positive taxes on secondary earners everywhere. This would be consistent with the EITC in the U.S., which subsidizes first-earner entry while taxing second-earner entry (e.g., Eissa and Hoynes, 2004).[12]

In the following sections, we show that the basic spirit of these results survives a number of generalizations.

2.3 The unitary model with income effects

To allow for income effects on labor supply, we introduce imperfect substitutability between consumption and work costs. The simplest way to do this is by considering a household utility function

$$u = v(c) - q_p \cdot 1(z_p > 0) - q_s \cdot 1(z_s > 0),$$

where $v(.)$ is a concave function. The labor market entry decisions will in this case be characterized by

$$q_p \leq v\left(z_p^h - T_1^h\right) - v(-T_0) \equiv \bar{q}_p^h, \tag{13}$$

$$q_s \leq v\left(z_s^h + z_p^h - T_2^h\right) - v\left(z_p^h - T_1^h\right) \equiv \bar{q}_s^h. \tag{14}$$

For couples of a given type h, the marginal utility of income will be higher for zero-earner couples than for one-earner couples, and higher for one-earner couples than for two-earner couples. By implication, a lump-sum income transfer to the whole population would induce spouses with work costs around the thresholds $\bar{q}_p^h$ and $\bar{q}_s^h$ to drop out of the labor market, an effect that resembles the negative income effect on hours worked in standard intensive-margin models. Because of these income effects, Proposition 1 is replaced by

[12] As explained, these policy conclusions rely on the assumption that two-earner couples are better off than one-earner couples (at a given ability pair z_p^h, z_s^h). This is true in our model where secondary-earner participation is associated with a low *direct work cost* (low q_s), but it would not be true in a model where secondary-earner participation is instead driven by a low *opportunity costs of lost home production.* In the latter case, secondary-earner participation is a signal of low home production ability and therefore being worse off. This would create an equity argument for subsidizing the secondary earner. Both the work cost model and the home production model are analyzed in Kleven et al. (2009), who argue that the work cost model is more consonant with the literature on welfare/poverty measurement, and with the central assumption in the Mirrleesian optimal tax literature that higher income is a signal of higher well-being. It is this assumption that drives the result in Mirrleesian models that optimal tax rates are positive. If differences in market earnings were driven by home production ability rather than market production ability, then Mirrleesian models would generate negative income tax rates everywhere as the poor are better off than the rich.

Proposition 2 *In the unitary model with income effects, the optimal nonlinear tax schedule* $T(z_p, z_s)$ *satisfies*

$$\frac{\tau_s^h}{1-\tau_s^h} = \frac{1-g_2^h}{\eta_s^h} \;\; \forall h, \tag{15}$$

$$\frac{\tau_p^h}{1-\tau_p^h} = \frac{1-g_1^h}{\eta_p^h} + \frac{1-g_2^h}{\eta_p^h}\frac{e_2^h}{e_1^h}\theta_s^h \;\; \forall h, \tag{16}$$

where $\theta_s^h \geq 1$ *measures the strength of the income effect on secondary-earner participation.*

Proof: See Appendix B. □

These optimal tax rules take the exact same form as those in Proposition 1, except for the parameter $\theta_s^h \geq 1$ in equation (16). This parameter captures that, in a model with income effects, the secondary-earner participation effect of increasing the tax burden on one-earner couples (increasing τ_p^h) is no longer the same as the secondary-earner participation effect of reducing the tax burden on two-earner couples (reducing τ_s^h). Besides this trivial effect, optimal tax rates are unchanged as a function of sufficient statistics: social welfare weights on one-earner and two-earner couples, participation elasticities of primary and secondary earners, and the share of one-earner and two-earner couples in the population of couples.

2.4 The collective model without income effects

In the following two sections, we consider the collective model of family decision making (Chiappori, 1988, 1992; Apps and Rees, 1988) with and without income effects on labor supply. The collective framework is conceptually more appealing than the unitary model by modeling the couple, not as a single optimizing agent, but as two agents with conflicting interests bargaining over household resources. The defining feature of the collective approach is that it does not restrict itself to a particular bargaining process in the family, but assumes only that family allocations lie on the Pareto frontier.

Let the utility of each spouse i be given by

$$\tilde{u}_i = v_i\left(c_i - q_i \cdot 1\left(z_i > 0\right)\right), \;\; i = p, s, \tag{17}$$

where q_i is the fixed work cost of spouse i. Given the assumption of within-family Pareto efficiency, household decisions are made *as if* the couple maximizes the objective function

$$\left(1-\alpha^h\right)\tilde{u}_p + \alpha^h \tilde{u}_s, \tag{18}$$

where α^h is the intra-household Pareto weight capturing the relative strength of the two spouses in bargaining over household resources. We allow for the intra-household bargaining weight to depend on the innate earnings capacities of the two spouses z_p^h, z_s^h, enabling the model to be consistent with the empirical evidence showing that intra-family allocation depends on relative earnings between spouses (e.g. Browning et al., 1994). We assume that the intra-household bargaining weight does not depend on any endogenous outcomes of the model, i.e. the participation choices of the household and the tax schedule chosen by the government. We discuss the implications of relaxing these assumptions in section 4.

The objective function (18) is maximized with respect to c_p, c_s, z_p and z_s subject to the household budget constraint (2). The first-order conditions with respect to consumption levels imply that the intra-household distribution of consumption, for any given choice of z_p, z_s, is characterized by

$$\frac{\partial v_p}{\partial c_p} = \frac{\alpha^h}{1-\alpha^h}\frac{\partial v_s}{\partial c_s}. \tag{19}$$

Let c_i^1 and c_i^2 denote the consumption of spouse $i = p, s$ in a one-earner and two-earner couple, respectively (for ease of notation, we suppress the h superscript). Then the participation choices of primary and secondary earners are governed by the conditions

$$\begin{aligned} z_p &> 0 \text{ iff } v_p\left(c_p^1 - q_p\right) + \frac{\alpha}{1-\alpha}v_s\left(c_s^1\right) > v_p\left(c_p^0\right) + \frac{\alpha}{1-\alpha}v_s\left(c_s^0\right), & (20)\\ z_s &> 0 \text{ iff } v_p\left(c_p^2 - q_p\right) + \frac{\alpha}{1-\alpha}v_s\left(c_s^2 - q_s\right) > v_p\left(c_p^1 - q_p\right) + \frac{\alpha}{1-\alpha}v_s\left(c_s^1\right), & (21)\end{aligned}$$

where the consumption levels are determined by (19) and the budget constraint, and where we have made use of the assumption that a primary earner who is indifferent between working and not working will always be married to a non-working spouse, while a secondary earner who is indifferent between working and not working will always be married to a working spouse.

By combining the participation conditions (20) and (21) with the intra-household consumption condition (19) and the budget constraint (2), we may rewrite the participation conditions as

$$\begin{aligned} q_p &\leq z_p^h - \left(T_1^h - T_0\right) \equiv \bar{q}_p^h, & (22)\\ q_s &\leq z_s^h - \left(T_2^h - T_1^h\right) \equiv \bar{q}_s^h. & (23)\end{aligned}$$

These participation conditions are exactly identical to those in the unitary model (equations (3)-(4)). To understand the logic behind this result consider as an example a small increase in the earnings of the primary earner, dz_p, and note that the optimum, characterized by (19) and equality in conditions (22) and (23), will change according to $d\bar{q}_p = dc_p^2 = dc_p^1 = dz_p$ and $dc_s^2 = dc_s^1 = 0$, which keeps all arguments inside the utility functions unchanged. This shows that a marginal increase in the net-income of the primary earner (and likewise for the secondary earner) does not change the amount of resources transferred to the spouse, independent of the intra-household allocation parameter α. This also implies that the marginal entrants in the labor market (those with work costs around the thresholds $\bar{q}_p^h$ and $\bar{q}_s^h$) receive the entire consumption gain of their labor market entry, and the participation decisions therefore become identical to those in the unitary model. This important implication, which we come back to below, relies on the assumption that family labor supply choices lie on the Pareto frontier combined with the preference structure with no income effects on labor supply.

The social welfare function is again given by (6), but the function is now defined over individual utilities instead of family utilities according to

$$u = \left(1 - \beta^h\right) \tilde{u}_p + \beta^h \tilde{u}_s, \tag{24}$$

where β^h is allowed to be different from α^h to capture that the social planner may have different preferences over intra-household allocation than what is the outcome of the actual intra-household bargaining process. For this model, we can show the following:

Proposition 3 *In the collective model without income effects, the optimal nonlinear tax schedule $T(z_p, z_s)$ satisfies*

$$\frac{\tau_s^h}{1 - \tau_s^h} = \frac{1 - g_2^h}{\eta_s^h} \quad \forall h, \tag{25}$$

$$\frac{\tau_p^h}{1 - \tau_p^h} = \frac{1 - g_1^h}{\eta_p^h} + \frac{1 - g_2^h}{\eta_p^h} \frac{e_2^h}{e_1^h} \quad \forall h. \tag{26}$$

where $g_1^h \equiv g_1^h\left(\alpha^h, \beta^h\right)$ and $g_2^h \equiv g_2^h\left(\alpha^h, \beta^h\right)$.

Proof: See Appendix C. □

This proposition takes the exact same form as Proposition 1 for the unitary model, with the only twist being that the average social welfare weights on one-earner and two-earner couples in general depends on the social and private intra-household welfare weights $\left(\alpha^h, \beta^h\right)$. That is, the earnings abilities of spouses are no longer sufficient to determine the social welfare weight on a given couple, because in general the social planner may disagree with the intra-household distribution of consumption. The following two conclusions follow from Proposition 3:

Corollary 1 (i) *Social welfare weights $\left(g_1^h, g_2^h\right)$ and participation elasticities $\left(\eta_p^h, \eta_s^h\right)$ provide sufficient statistics for optimal tax rates. For given sufficient statistics, the tax rates are the same for the collective and unitary models without income effects.* (ii) *In the collective model, the intra-household distributional preference β^h has an indeterminate effect on social welfare weights $\left(g_1^h, g_2^h\right)$ and optimal tax rates $\left(\tau_p^h, \tau_s^h\right)$. The sign of this effect depends on third-order derivatives of the individual utility functions $v_p(.)$ and $v_s(.)$.*

Proof: Part (i) is immediate, part (ii) is proven in Appendix D. □

The first result establishes that social welfare weights on couples and participation elasticities provide sufficient statistics for policy evaluation in both the unitary and collective approaches (without income effects). Hence, there is no direct effect of intra-family equity concerns on optimal taxation, only an indirect effect captured by social welfare weights on couples. The key insight behind this result is that the marginal entrants in the labor market receive the full consumption gain of their labor market entry with no effect on their spouses. This implies that, at the margin, there is no externality of one family member's labor market entry on the utility of the spouse, and therefore no direct intra-family welfare effect from tax-induced changes in labor force participation. Social welfare weights on couples are then sufficient to evaluate tax policy even if the social planner has preferences for reallocation in favor of one spouse.

The second result implies that, even though welfare weights on couples in general is a function of intra-family welfare weights α^h, β^h (i.e., provided that $\beta^h \neq \alpha^h$), this does not carry any clear lessons for tax policy. In order to understand this result, consider a tax cut on two-earner couples financed by a higher tax on all other households. This reform increases the consumption level of both primary and secondary earners in two-earner couples, but reduces at the same time consumption levels of primary and secondary earners in all other couples. As an example, if the government cares more about the secondary earner than the couple does, it would have to balance the gain for secondary earners living in two-earner couples against the loss for secondary earners living in zero- and one-earner couples. Whether or not the reform is socially desirable is indeterminate without imposing more structure on preferences. We show in Appendix D that the answer depends on third-order derivatives of the individual utility functions, something we know very little about empirically.

The bottom line is that, if income effects on labor supply are small and in the absence of empirical evidence on third-order properties of utility functions, income taxation is not a useful instrument to deal with intra-household equity issues. In this case, the design of income taxation should focus on inter-household equity issues, a question that can be analyzed adequately based on the much simpler unitary approach.

2.5 The collective model with income effects

We now turn to a collective model with income effects that combines elements from the previous two sections. The utility of each spouse is given by

$$\tilde{u}_i = v_i\left(c_i\right) - q_i \cdot 1\left(z_i > 0\right), \quad i = p, s. \tag{27}$$

Everything else is unchanged compared to the collective model without income effects. Household decisions are again determined as if maximizing the objective function (18) subject to the household budget constraint (2), which gives

$$\frac{\partial v_p}{\partial c_p} = \frac{\alpha^h}{1-\alpha^h}\frac{\partial v_s}{\partial c_s}.$$

The labor market participation conditions are given by (for ease of notation, we suppress the h superscript):

$$
\begin{aligned}
z_p &> 0 \text{ iff } \left[v_p\left(c_p^1\right)-q_p\right]+\frac{\alpha}{1-\alpha}v_s\left(c_s^1\right)>v_p\left(c_p^0\right)+\frac{\alpha}{1-\alpha}v_s\left(c_s^0\right), \qquad (28)\\
z_s &> 0 \text{ iff } \left[v_p\left(c_p^2\right)-q_p\right]+\frac{\alpha}{1-\alpha}\left[v_s\left(c_s^2\right)-q_s\right]>\left[v_p\left(c_p^1\right)-q_p\right]+\frac{\alpha}{1-\alpha}v_s\left(c_s^1\right). \qquad (29)
\end{aligned}
$$

In contrast to the models without income effects, it is no longer the case that participation conditions are identical under the collective and unitary approaches. The above conditions imply that the marginal labor market entrant does not receive the full consumption gain of labor market entry. If one family member enters the labor market, this increases the consumption without reducing leisure for the spouse.

The optimal tax system is characterized by

Proposition 4 *In the collective model with income effects, the optimal nonlinear tax schedule* $T(z_p, z_s)$ *satisfies*

$$
\begin{aligned}
\frac{\tau_s^h}{1-\tau_s^h} &= \frac{1-g_2^h}{\eta_s^h}+\frac{\beta^h-\alpha^h}{\alpha^h}\sigma_p^h \;\; \forall h, \qquad (30)\\
\frac{\tau_p^h}{1-\tau_p^h} &= \frac{1-g_1^h}{\eta_p^h}+\frac{1-g_2^h}{\eta_p^h}\frac{e_2^h}{e_1^h}\theta_s^h-\frac{\beta^h-\alpha^h}{1-\alpha^h}\sigma_s^h \;\; \forall h, \qquad (31)
\end{aligned}
$$

where $\sigma_p^h, \sigma_s^h > 0$ *capture intra-household allocation effects.*

Proof: See Appendix E. □

The optimal tax formulas in this proposition are similar to the tax formulas for the unitary model with income effects (Proposition 2) except for the last terms in (30) and (31). These new terms reflect intra-family externalities associated with spousal participation responses: for example, if the secondary earner enters the labor market, this increases consumption without reducing leisure for the primary earner. Hence, the primary earner always obtains a surplus from secondary-earner participation (captured by σ_p^h). If social preferences favor secondary earners over primary earners compared to the actual intra-family bargaining weights ($\beta^h > \alpha^h$), this externality effect implies that there is *too much* secondary-earner participation. A symmetric argument implies that, in the case where $\beta^h > \alpha^h$, there is *too little* primary-earner participation.

From the above proposition, it follows

Corollary 2 (*i*) *If social preferences respect the actual intra-family welfare weights* ($\beta^h = \alpha^h$ *for all* h), *then social welfare weights* $\left(g_1^h, g_2^h\right)$ *and participation elasticities* $\left(\eta_p^h, \eta_s^h, \theta_s^h\right)$ *provide sufficient statistics for optimal tax rates and, given these statistics, the tax rates are the same for the collective and unitary models.* (*ii*) *If instead social preferences favor secondary earners compared to the actual intra-family welfare weights* $\left(\beta^h > \alpha^h\right)$, *then, for given statistics* $\left(g_1^h, g_2^h, \eta_p^h, \eta_s^h, \theta_s^h\right)$, *optimal participation tax rates will be higher on secondary earners and lower on primary earners* (*and vice versa*).

Proof: The proof is immediate. □

The first part is similar to a result by Apps and Rees (1988) in the context of the simple linear tax model. The second part is *a priori* surprising. If the government has preferences for redistribution towards secondary earners in couples, this calls for a *higher* participation tax rate on secondary earners and a *lower* participation tax rate on primary earners. These effects can be seen as Pigouvian tax corrections that arise from the within-family externality associated with spousal participation, which ceteris paribus makes secondary-earner participation too high and primary-earner participation too low compared to the social optimum.

A further discussion of these results and possible extensions/generalization is provided in section 4.

3 A microsimulation analysis of tax reform for couples in European countries

3.1 Existing tax-transfer schemes for couples in Europe

In this section, we apply our theoretical analysis to the taxation of couples in European countries, with special focus on the potential scope for reforms that cut taxes on secondary earners. We start with a brief description of the existing tax-transfer system. Our data source is EUROMOD, a microsimulation model for the EU built around partly homogenized micro datasets that include data on earnings, labor force participation and demographics. The version available for this study relates to 1998 and covers the 15 countries that constituted the EU at that time. Based on detailed algorithms capturing the full range of institutional features of tax and transfer systems in each country, the model is able to compute a wide range of taxes and benefits for each observation unit in representative samples for the various countries. The main policy instruments incorporated in EUROMOD are income taxes, social security contributions (or payroll taxes) paid by employees, benefit recipients, and employers as well as universal and means-tested social benefits including housing assistance.[13,14] The model fully accounts for the complicated interaction of different types of taxes and benefits with earnings, assets, employment status, marital status, housing situation and children, and its considerable level of detail makes it an ideal tool for comparative tax analysis. Despite the great level of detail, EUROMOD is unable to capture *in-kind* transfers such as publicly provided child care. Access to public child care represents a subsidy to labor force participation, in particular for the secondary earner, and

[13] In the sample of countries we consider, there is in fact no actuarial link between payroll taxes and future pension benefits. Hence, it makes most sense to include payroll taxes in the computations of effective distortionary tax rates.

[14] In the results reported here, we do not include unemployment insurance (UI) benefits in the calculation of effective participation tax rates. This is due in part to difficulties associated with accounting properly for the implications of limited UI duration in our static tax rate measures. At a more conceptual level, it is likely that UI schemes providing insurance against involuntary and temporary job loss have very different incentive implications than poverty alleviation programs offering permanent income guarantees to all non-workers.

a failure to include it leads us to overstate secondary-earner participation tax rates.[15] On the other hand, some in-kind transfers other than child care (such as means-tested housing and food programs) represent additional taxes on labor supply and therefore tend to offset somewhat the bias in secondary-earner tax rates.

We restrict the sample to married couples where both husband and wife are between 16 and 64 years of age, where the couple as a whole reports positive annual earnings, and where at least one member of the household has been working the entire year. We exclude those who are currently receiving pension, early retirement, or disability benefits.[16] In each couple, we define the primary earner (PE) as the highest-earning member and the secondary earner (SE) as the lowest-earning member of the household. Together with our sample restriction, this implies that, in one-earner couples, the primary earner works the entire year while the secondary earner is non-employed throughout the year. In two-earner couples, the secondary earner works either part of or the entire year but always has relatively low earnings.

As in section 2.1, we define the participation tax rate on a given spouse as the total change in family tax liability triggered by this spouse's labor market entry as a share of the earnings generated by the entry. Under the assumed sequence of labor market entries in the household, the participation tax rates on the primary and secondary earners are given by

$$\tau_p \equiv \frac{T(z_p, 0) - T(0, 0)}{z_p}, \qquad \tau_s \equiv \frac{T(z_p, z_s) - T(z_p, 0)}{z_s}. \tag{32}$$

These tax rates are simulated by EUROMOD in the following way. For the computation of τ_s, we consider the subsample of two-earner couples and start by computing actual taxes net of transfers $T(z_p, z_s)$ at each observed earnings pair, accounting for other relevant household information (place of residence, number of kids, etc.). We then recompute taxes and transfers in the alternative (hypothetical) situation where the secondary earner does not work, $T(z_p, 0)$, and calculate τ_s as in eq. (32). Analogously for τ_p, we use the sample of one-earner couples to simulate taxes net of transfers in the original situation, $T(z_p, 0)$, and in the alternative situation where the primary earner is not working, $T(0, 0)$, and then apply formula (32).[17]

Table 1 shows participation tax rates for primary and secondary earners in each country (averages for each country sample). As one would expect, Scandinavia and Northern-Continental Europe feature higher overall tax rate levels than Anglo-Saxon and Southern European countries.

[15] Blomquist et al. (2010) show theoretically that it may be important to account for in-kind transfers when measuring the distortionary effect of a tax-transfer system.

[16] We have not excluded self-employed individuals from the sample even though their behavioral responses to taxation tend to be different than for the rest of the population due to better evasion and avoidance opportunities. The self-employed constitute a fairly small fraction of the workforce in all the EU countries in our data.

[17] Our tax-rate estimates are therefore calculated for those currently working. As a result of sample selection, one would expect tax rates to be different for non-working individuals considering a transition into work. As we do not observe the earnings potential of non-working individuals, calculating their participation tax rates would require jointly estimating a wage and participation model for couples. In the microsimulation exercise in the next subsection, we deal with the selection issue indirectly by considering a decreasing profile of participation elasticities such that new labor market entrants tend to be located at the bottom end of the income distribution.

More interestingly, the tax rate on primary earners is higher than on secondary earners in all but the four Southern European countries (Greece, Italy, Portugal, and Spain). This is a result of the impact of family-based and means-tested welfare benefits, which are affected more by the first than by the second entrant. We do not observe the same effect in Southern Europe where welfare benefits are less generous.[18] Although most countries impose a higher participation tax rate on the primary earner, there are substantial differences in the relative rates across countries. In particular, the UK system stands out by being more favorable to second-earner participation than all other countries.

3.2 Reforming the tax-transfer system in Europe

The microsimulation analysis in this section is based on the unitary and collective models without income effects (presented in sections 2.1 and 2.4, respectively). The empirical labor supply literature has not reached a consensus on the size of income effects, and in any case the implications of these effects are rather trivial in the unitary framework. In the collective model with income effects, there may be intra-family externalities from spousal participation (in situations where the policy maker does not respect the actual intra-family welfare weights), but it is unclear how to identify these effects empirically.

Compared to the optimal tax analysis in section 2, the analysis below is different in two respects. First, we consider small reforms of the existing tax-transfer system rather than simulating the fully optimized tax-transfer system. In particular, we consider simple tax changes that depend on family participation status (zero-earner, one-earner, and two-earner) and aim to strengthen the incentives for secondary-earner participation. In particular, we consider revenue-neutral reforms that reduce the tax-burden uniformly on two-earner couples (for example, by introducing a secondary-earner tax credit without claw-back) financed either by zero-earner and one-earner couples together or by one-earner couples alone. These reforms do not affect marginal tax rates, and our conclusions therefore do not depend on the exclusion of intensive margin responses from the analysis.[19] Second, we use information about actual tax rates and participation elasticities to compute critical values for social welfare weights that make a reform welfare improving. The optimal tax theory in the previous section established that social welfare weights and participation elasticities are sufficient statistics to compute optimal tax rates. But

[18] In contrast to these findings, the conventional wisdom in the literature has been that participation tax rates are higher on secondary earners due to elements of jointness in the tax system (e.g., Alesina et al., 2010). The problem with the standard argument is that it ignores the existence of family-based and means-tested transfers, which we show empirically tend to dominate the effects of jointness in the tax code.

[19] Immervoll et al (2009) extend the analysis with intensive-margin responses and derive the effects of a reform that uniformly reduces the marginal tax rate on secondary earners financed by uniformly increasing the marginal tax rate on primary earners in one-earner couples. The conclusion is that the incorporation of hours-of-work responses into the analysis (assuming realistic elasticities) does not change the qualitative insights and has a fairly small quantitative impact. If anything, the conclusions regarding the welfare effects of cutting taxes for secondary earners are reinforced by this generalization.

because social welfare weights are subjective variables that would be difficult to estimate, it is useful to revert the problem by computing critical values for the subjective welfare weights from objective information about tax rates and elasticities.

To obtain critical values for social welfare weights, we consider the welfare effect of those who gain from a given reform relative to the welfare effect of those who lose from the reform (as in Browning and Johnson, 1984 and Immervoll et al., 2007). We denote by $dG \geq 0$ the average welfare gain of those who gain from the reform and by $dL \leq 0$ the average welfare change of those who lose from the reform. Notice that a Pareto-improving reform (no losers) implies $dL = 0$, whereas a Pareto-worsening reform (no gainers) implies $dG = 0$. A reform will be optimal to implement for the policy maker iff

$$\Psi \equiv -\frac{dL}{dG} \leq \frac{\bar{g}_G}{\bar{g}_L},$$

where Ψ is an inter-household utility trade-off and $\bar{g}_G, \bar{g}_L$ are the average social welfare weights assigned to the two groups by the policy maker. From information on tax rates and elasticities, we may estimate the trade-off Ψ, which measures the Euro-value of the welfare loss for those who lose from the reform (say, zero- and one-earner couples) per additional Euro transferred to those who gain (say, two-earner couples). This trade-off provides a critical value that may be used by the policy maker to compare to his subjective distributional preference for gainers versus losers $\bar{g}_G/\bar{g}_L$.

If the reform succeeds in increasing efficiency ($dL + dG > 0$), the value of Ψ is below 1, implying that it costs less than one Euro for zero-earner and one-earner couples to transfer an additional Euro to two-earner couples. However, to the extent that the social marginal welfare weight on two-earner couples relative to other couples $\bar{g}_G/\bar{g}_L$ is below one, an estimate of Ψ below one does not necessarily make the reform desirable. In general, the lower is Ψ, the more desirable is the reform, and if $\Psi = 0$ the reform represents a Pareto-improvement.

The first reform (Reform A) reduces tax rates on secondary earners by uniformly lowering the tax burden on two-earner couples financed by uniformly increasing the tax burden on zero- and one-earner couples. The size of the additional tax on zero- and one-earner couples is determined endogenously to balance the government budget taking into account the revenue implications of the behavioral responses. The reform increases second-earner participation, but has no effect on primary-earner incentives to enter the labor market as the tax increase is uniform across households with one earner and zero earners. The trade-off for Reform A may be derived as (see Appendix F)

$$\Psi_A \equiv \frac{1 - \sum_h \phi_2^h \frac{\tau_s^h}{1-\tau_s^h} \eta_s^h}{1 + \frac{e_2}{1-e_2} \sum_h \phi_2^h \frac{\tau_s^h}{1-\tau_s^h} \eta_s^h} \leq \frac{\bar{g}_2}{\bar{g}_{01}}, \tag{33}$$

where e_2 is the share of two-earner couples in the total population of couples, while ϕ_2^h is the fraction of two-earner couples who are of type h. The reform is optimal if the trade-off Ψ_A is smaller than the average welfare weight on two-earner couples relative to zero- and one-earner couples, $\bar{g}_2/\bar{g}_{01}$. This condition is closely related to the optimal tax formula (11) and shows that the key determinants of the inter-household trade-off are the participation tax rates and participation elasticities of secondary earners. This type of reform is always associated with an inter-household trade-off Ψ below 1: the increase in second-earner participation (at unchanged primary-earner participation) raises revenue, implying that the government can finance a welfare increase of one Euro to two-earner couples by imposing a welfare cost of less than one Euro on all other couples.

The second reform (Reform B) finances the tax cut on two-earner couples by taxing only one-earner couples, thereby avoiding a reduction in the welfare of zero-earner families. While reform B is associated with a better distributional profile than Reform A, the efficiency effects may be less desirable for Reform B because it increases participation tax rates on primary earners. The trade-off for Reform B may be derived as (see Appendix F)

$$\Psi_B \equiv \frac{1 - \sum_h \phi_2^h \frac{\tau_s^h}{1-\tau_s^h}\eta_s^h}{1 - \sum_h \phi_1^h \frac{\tau_p^h}{1-\tau_p^h}\eta_p^h + \frac{e_2}{e_1}\sum_h \phi_2^h \frac{\tau_s^h}{1-\tau_s^h}\eta_s^h} \leq \frac{\bar{g}_2}{\bar{g}_1}, \tag{34}$$

where e_1 is the share of one-earner households in the population and ϕ_1^h is the share of one-earner households that are of type h. As for the first reform, the trade-off associated with Reform B is decreasing in second-earner participation tax rates and participation elasticities. The trade-off Ψ_B additionally depends on primary-earner parameters: higher participation tax rates and higher participation elasticities for primary earners increase the trade-off. This reflects the negative efficiency effect associated with some one-earner couples falling back on the zero-earner schedule as the tax on one-earner couples increases. Although the negative participation responses of primary earners tend to worsen the trade-off of reform B compared to reform A, there is an offsetting effect that tends to make the reform more desirable. The impact on the second-earner participation incentive is larger for reform B, because it finances the tax cuts for two-earner families entirely by higher taxes on one-earner families and therefore has a larger effect on the utility difference between one-earner and two-earner couples. Thus, it is theoretically possible that reform B improves efficiency by more than reform A, and this is more likely to occur if the share of one-earner households e_1 is low, in which case reform B leads to a large tax increase for one-earner households.

We now turn to numerical simulations based on EUROMOD. As described, we identify the primary earner as the highest-earning member of the couple, and construct pre-tax earnings distributions for primary and secondary earners. Because the theoretical analysis is based on a discrete formulation dividing the population of couples into H earnings-groups, we have to define these subgroups in the empirical application. We divide the sample based on earnings quintiles (conditional on working) for primary and secondary earners, which yields 30 household groups

(5×5 two-earner families and 5 one-earner families). For each household group, we calculate a participation tax rate using the approach described in the previous section.

We calibrate participation elasticities based on the empirical labor supply literature. There is an extensive literature estimating participation responses for married couples based on data from the United States and European countries. This literature has been surveyed by Heckman (1993), Blundell (1995), Blundell and MaCurdy (1999), Meghir and Phillips (2010), and others. The literature finds that participation elasticities for married women (secondary earners) are substantial across a wide set of countries with values ranging from 0.5 to 1, whereas participation elasticities for prime-age males (primary earners) tend to be very small. Moreover, there is evidence that participation elasticities tend to be larger at the bottom of the earnings distribution than at the top of the earnings distribution, although some studies have found that elasticities for married women may still be substantial at the top (e.g. Eissa, 1995).[20]

The results of the simulations are presented in Table 2. We consider four different elasticity scenarios. The first three scenarios assume that the participation elasticities are constant across earnings groups, whereas the last scenario assumes that elasticities are higher at the bottom. Average elasticities for primary and secondary earners are shown in the table for each scenario.

We start by focusing on Reform A. Recall that the inter-household trade-off associated with this reform (eq. 33) does not depend on the participation elasticity for primary earners, only the elasticity for secondary earners matters. The first scenario assumes a participation elasticity of 0.5 for secondary earners. In this scenario, many countries show a quite favorable trade-off. In Germany, one- and zero-earner couples incur a loss of just 0.14 Euros for an additional Euro distributed to two-earner couples. In Belgium, Denmark, and France, second-earner tax rates are so high that a tax cut to two-earner families creates Laffer effects and therefore a Pareto improvement. In general, the favorable trade-offs for this reform and elasticity scenario reflect the high participation tax rates on secondary earners (compared to elasticities) that we saw in Table 1. In accordance with the pattern in Table 1, Reform A is less attractive in Greece, the UK, and Spain than in Northern-Continental European countries and Scandinavia.

Not surprisingly, Reform A becomes better (worse) as the participation elasticity of secondary earners increases (declines). In the second scenario where the second-earner elasticity is set equal to 0.7, the reform is costless or nearly costless to zero- and one-earner couples in half of the countries (Belgium, Denmark, Finland, France, Germany, Ireland, and Sweden). On the other hand, in the third scenario where the second-earner elasticity is set equal to 0.3, it is only

[20] The higher (average) participation elasticity of married women compared to married men is to a large extent driven by married women with (young) kids. This underlying heterogeneity is not important for our analysis because it deals with the optimal taxation of primary versus secondary earners in couples irrespective of kids. That is, our focus is on the design of a tax function $T(z_p, z_s)$ where z_p, z_s is the taxable income of the two spouses in the couple. This has been the central issue in the existing optimal tax literature. As a first-order approximation, the average elasticities for secondary and primary earners η_p, η_s can be seen as sufficient statistics for welfare analysis of this type of tax function.

Belgium that has no losers from the reform. Nevertheless, even in this scenario, nine countries have trade-offs at or below 1/2. Scenario 4 assumes the same average elasticity as in the first scenario but with a declining profile as a function of earnings.[21] The results do not change much compared to scenario 1, although there is a general tendency for the trade-off measure to increase. The reason is that the positive feedback effect on government revenue from higher participation is lower when the additional participation is generated at lower earnings levels where second-earner participation tax rates are typically lower.

The consequences of Reform B depend also on the primary-earner participation elasticity. In scenario 1, where the primary-earner elasticity is set equal to 0.1, we see that Ψ increases compared to Reform A but that the differences between the two reforms are small for all countries. Hence, the two counteracting effects on economic efficiency discussed above more or less cancel out in this elasticity scenario. When we look across the different scenarios, the effects of Reform A and B are roughly comparable except for Scenario 3 where we assume equal responsiveness for primary and secondary earners. This scenario is not realistic but highlights the importance of relative participation elasticities when evaluating reforms of type B that affect zero- and one-earner couples differently. In this scenario, ten countries would experience lower efficiency by implementing reform B (i.e., $\Psi > 1$), and in seven of those countries nobody gains from the reform (Pareto worsening). The explanation is that, for most countries, primary earners face higher participation tax rates than secondary earners. With identical elasticities, this implies that primary-earner labor supply is more distorted than secondary-earner labor supply, and in this case it is not desirable to induce additional entry of secondary earners at the expense of primary earners.

4 Discussion and Extensions

This paper analyzes the optimal design of general nonlinear tax-transfer schedules for couples under unitary and collective approaches to family decision making. We consider a double-extensive model of labor supply where each spouse makes a labor force participation choice for given hours of work. We present simple and intuitive optimal tax rules that generalize existing findings on the optimal taxation of single-person households with extensive responses (Saez, 2002) to the case of two-person households with double-extensive responses. Conditions are characterized under which the social optimum subsidizes the participation of primary earners at the bottom while taxing the participation of secondary earners as in the case of the EITC in the U.S. and the WFTC in the U.K. Finally, we present microsimulations of tax reform for

[21] The primary-earner elasticity is set equal to 0.3 at the lowest quintile of the primary earner income distribution (PEq1), 0.1 for PEq2 and PEq3, and 0 for PEq4 and PEq5. For secondary earners, the elasticity equals 0.8 for the lowest quintile of the secondary earner income distribution (SEq1), 0.6 for SEq2, 0.2 for SEq3, and 0 for SEq4 and SEq5.

15 European countries suggesting that a reduction of tax rates on secondary earners relative to primary earners is associated with strong welfare gains in all countries.

The paper shows that the effects of tax reform and optimal tax rules as a function of sufficient statistics are the same under unitary and collective approaches (at least in the absence of income effects on labor supply), because in both approaches the within-family labor supply allocation is efficient. This finding lends support to optimal income tax papers based on the unitary model (starting with Boskin and Sheshinski, 1983) by showing that this approach, despite its conceptual and empirical problems, may still provide a useful abstraction for the analysis of questions in normative public finance.

A couple of caveats to this "irrelevance result" should be mentioned. First, the argument is based on a sufficient statistics approach to policy evaluation in which the welfare consequences of tax policy and optimal taxation are expressed as functions of reduced-form elasticities that can be empirically estimated rather than structural primitives. This has become the leading approach in the modern public finance literature (see Chetty, 2009 for an appraisal of this approach). By contrast, under a structural approach to policy evaluation, the choice between the unitary and collective approaches obviously matters because they are associated with different utility functions and therefore different primitives.

Second, our result is based on the assumption that tax policy does not directly impact intra-family bargaining weights. One way in which tax policy may affect bargaining weights is that the tax schedule for singles versus couples may affect the outside opportunities of spouses (at different earnings levels) in different ways. This issue is orthogonal to our analysis as we do not consider the simultaneous design of tax schedules for couples and singles. Another way in which tax policy may affect bargaining weights is by specifying who is liable to remit family taxes and who is eligible to receive family transfers. For example, the study by Lundberg et al. (1997) showed that a policy reform which transferred a child allowance from the father to the mother significantly increased spending on the wife and children in the family. Our analysis does not consider this type of instrument as the couple tax function $T(z_p, z_s)$ is silent about who in the family remits taxes or receives transfers, but the finding of Lundberg et al. (1997) suggests that spousal remittance rules may be used to modify intra-family consumption allocation. As pointed out by Kleven et al. (2007), if such an instrument is available, it provides a *non-distortionary* way of restoring a fair allocation within the family, thereby ensuring that the private intra-family welfare weights are consistent with the social intra-family welfare weights. In this case, optimal spousal tax rates are identical under the collective and unitary approaches. More empirical research is needed to evaluate the robustness of the finding by Lundberg et al. (1997) and to gauge the scope for non-distortionary intra-family redistribution.

Finally, it would be potentially interesting to consider a deviation away from the unitary and collective approaches by allowing for non-cooperative aspects of family decision making.[22] As mentioned, the key ingredient shared by the unitary and collective models is that the within-family labor supply allocation is Pareto efficient, and this drives much of the analysis by allowing us to exploit envelope conditions from family optimization to express optimal tax rules as a function of behavioral elasticities and social welfare weights only. By contrast, under non-cooperative family decision making, Pareto efficient outcomes are no longer guaranteed (but of course still possible). Optimal tax rules will in general be affected by the presence of inefficiencies in intra-family labor supply choices as there may be a case for Pigouvian taxes to restore efficiency. As an example, in a model where intra-family bargaining weights depend on past and current education and labor supply choices (consistent with the empirical finding that intra-family allocation depends on the relative income between spouses), it is perceivable that both spouses work and earn too much in an attempt to improve their bargaining position in the household. This type of behavior creates an externality and calls for higher participation tax rates on both spouses. However, in the absence of a consensus in family economics on the potential importance and suitable way to model non-cooperative decision making within families, public finance economists currently have little guidance on how to study optimal tax systems that account for potential intra-household inefficiencies. We have therefore left this interesting question as a topic for future research.

A Foundations for the primary-secondary earner model

This appendix describes the restrictions on the joint distribution of work costs underlying the primary-secondary entry/exit pattern illustrated in Figure 1. Intuitively, we need to make sure that no couples have a high fixed cost of work for the primary earner q_p and at the same time a relatively low q_s for the secondary earner, in which case the secondary earner may be working while the primary earner is not working.

A primary earner with a non-working spouse will choose to work (not work) if q_p^h is below (above) $\bar{q}_p^h \equiv z_p^h - \left[T\left(z_p^h, 0\right) - T\left(0,0\right)\right]$ as described in eq. (3). On the other hand, with a working spouse, the fixed cost threshold of the primary earner becomes

$$\hat{q}_p^h \equiv z_p^h - \left[T\left(z_p^h, z_s^h\right) - T\left(0, z_s^h\right)\right].$$

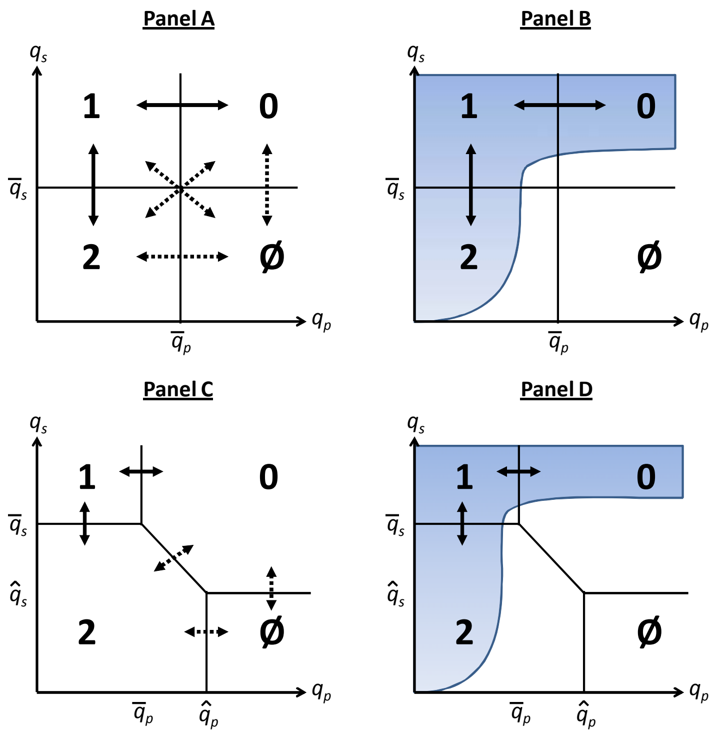
Correspondingly, we may define two fixed cost thresholds for the secondary earner. The threshold defined in eq. (4) describes the entry/exit decision of the secondary earner when the primary earner is working. If the primary earner is not working, the threshold is defined as

$$\hat{q}_s^h \equiv z_s^h - \left[T\left(0, z_s^h\right) - T\left(0,0\right)\right].$$

[22] See Lundberg and Pollak (1996) for a survey of models of family behavior, including non-cooperative bargaining models.

Consider first an initial equilibrium with individual taxation. In this case, the tax on labor market entry of one spouse does not depend on the decision of the other spouse implying that $\hat{q}_p^h = \bar{q}_p^h$ and $\hat{q}_s^h = \bar{q}_s^h$. This case is illustrated in Panel A in Figure A1, which displays the values of (q_p, q_s) for zero-, one- and two-earner couples. Without any restrictions on the joint distribution of fixed costs there may be couples in region Ø where the secondary earner is working while the primary earner is not working. Moreover, small tax reforms may move couples in all the directions indicated by the arrows and lead to double deviations where both spouses in a couple change behavior at the same time. To ensure the simple primary-secondary entry/exit behavior, we may restrict the joint distribution of fixed costs by assuming that the work costs of secondary earners are above a lower bound $\underline{q}_s^h\left(q_p^h\right)$, where $\underline{q}_s^h\left(q_p^h\right)$ is a weakly increasing function with $\underline{q}_s^h(0) = 0$ and $\underline{q}_s^h(\bar{q}_p) > \bar{q}_s$. This is illustrated in Panel B where the shaded area is the distribution of $\left(q_p^h, q_s^h\right)$ across the couples. In this case, no households are in region Ø and small tax changes will only lead to the entry/exit decisions indicated by the solid arrows.

Figure A1: Restriction on the joint distribution of work costs



The optimum in not necessarily characterized by individual taxation. Consider for example the case, where the tax on labor market entry of one spouse is *negatively* related to the earnings of the partner, i.e. $T\left(z_p^h, z_s^h\right) - T\left(0, z_s^h\right) < T\left(z_p^h, 0\right) - T(0,0)$ implying $\hat{q}_p^h > \bar{q}_p^h$ and $T\left(z_p^h, z_s^h\right) - T\left(z_p^h, 0\right) < T\left(0, z_s^h\right) - T(0,0)$ implying $\hat{q}_s^h < \bar{q}_s^h$. This case is illustrated in Panel C. The main change compared to Panel A is the line going from $(\bar{q}_p, \bar{q}_s)$ to $(\hat{q}_p, \hat{q}_s)$, which reflects couples with $\left(q_p^h, q_s^h\right)$ satisfying

$$q_p^h + q_s^h = z_p^h + z_s^h - \left[T\left(z_p^h, z_s^h\right) - T(0,0)\right],$$

who are indifferent between being zero-earner couples and two-earner couples, and where small tax reforms will trigger behavioral responses along this dimension as illustrated in Panel C. Note that an increase in q_p^h and a corresponding decrease in q_s^h leaves the condition above unchanged showing that the slope of the line separating two-earner and zero-earner couples is -1. To see that the line goes from $(\bar{q}_p, \bar{q}_s)$ to $(\hat{q}_p, \hat{q}_s)$ use the definitions of the fixed cost thresholds to compute $\bar{q}_p + \bar{q}_s$ and $\hat{q}_p^h + \hat{q}_s^h$, respectively. In both cases, we get $z_p^h + z_s^h - \left[T\left(z_p^h, z_s^h\right) - T(0,0)\right]$, which is identical to the RHS of the above condition.

Panel D shows how it is possible to ensure the simple primary-secondary entry/exit behavior by assuming a lower bound $\underline{q}_s^h\left(q_p^h\right)$ on the joint distribution of fixed costs with a similar shape as in panel B. Finally, if the tax on labor market entry of one spouse is *positively* related to the earnings of the partner, then $\hat{q}_p^h < \bar{q}_p^h$ and $\hat{q}_s^h > \bar{q}_s^h$. Also in this case, it is sufficient to restrict the fixed cost distribution to have the shape illustrated in panels B and D but with a lower bound on the distribution that lies above the point $\left(\hat{q}_p^h, \hat{q}_s^h\right)$.

A sufficient restriction on the joint distribution that works in all cases is to assume that $\underline{q}_s^h\left(q_p^h\right)$ is a weakly increasing function with $\underline{q}_s^h(0) = 0$ and $\underline{q}_s^h\left(q_p^h\right) > \max\left(\bar{q}_s^h, \hat{q}_s^h\right)$ for $q_p^h \geq \check{q}_p^h$ where $\check{q}_p^h \equiv \min\left(\bar{q}_p^h, \hat{q}_p^h\right)$. Note that this restriction is never inconsistent with the presence of zero-, one- and two-earner couples in the economy as long as the tax rates τ_p and τ_s are below 1, i.e., it does not exclude two-earner couples with low values of both q_p and q_s, one-earner couples with a low q_p and a high q_s and two-earner couples with high values of q_p and q_s.

To see how the restriction interact with the optimal tax problem, consider an initial equilibrium without taxes implying that $\bar{q}_p^h = \hat{q}_p^h = z_p^h$ and $\bar{q}_s^h = \hat{q}_s^h = z_s^h$. Next, assume a restriction on the joint distribution of couples corresponding to the gray area in Panel B. Now, consider a social planner that wishes to redistribute. If the social planner has only weak preferences for redistribution across couples then $\bar{q}_p^h$, $\hat{q}_p^h$, $\bar{q}_s^h$ and $\hat{q}_s^h$ will all be close to the values without taxation implying that the restriction imposed on the joint distribution still ensures that behavioral responses are only in the dimensions indicated by the solid arrows in Figure A1. On the other hand, if we wish to study the impact of strong preferences for redistribution then we need to first impose a more tight restriction on the possible distributions of fixed costs, i.e., a higher minimum value of $\underline{q}_s^h\left(q_p^h\right)$ starting at a lower value of q_p^h, in order for the optimal tax formulas to be valid.

B Proof of Propositions 1 and 2

This social planner objective (6) may be written as

$$
\begin{aligned}
S &= \sum_h n_h \left[\int_{\bar{q}_p^h}^{\infty} \int_{\underline{q_s^h}(q_p)}^{\infty} \omega_h(\mathbf{q}) u(\mathbf{q}) f_h(\mathbf{q}) d\mathbf{q} + \int_{\tilde{q}_p^h}^{\bar{q}_p^h} \int_{\underline{q_s^h}(q_p)}^{\infty} \omega_h(\mathbf{q}) u(\mathbf{q}) f_h(\mathbf{q}) d\mathbf{q} \right. \\
&\quad \left. + \int_0^{\tilde{q}_p^h} \int_{\bar{q}_s}^{\infty} \omega_h(\mathbf{q}) u(\mathbf{q}) f_h(\mathbf{q}) d\mathbf{q} + \int_0^{\tilde{q}_p^h} \int_{\underline{q_s^h}(q_p)}^{\bar{q}_s^h} \omega_h(\mathbf{q}) u(\mathbf{q}) f_h(\mathbf{q}) d\mathbf{q} \right], \qquad \text{(A-1)}
\end{aligned}
$$

where $\underline{q_s^h}(q_p)$ is the lower bound on fixed costs of secondary earners described above. The first term in the objective function is the contribution to social welfare from couples where both spouses are outside the labor market, i.e., q_p and q_s are higher than the thresholds (3) and (4). The second and third terms are contributions from one-earner couples. Note that none of the secondary earners are working in couples where the fixed cost of primary earners q_p is inside the interval $\left[\tilde{q}_p^h, \bar{q}_p^h\right]$, where $\tilde{q}_p^h$ is the solution to $\underline{q_s^h}\left(\tilde{q}_p^h\right) = \bar{q}_s^h$. These couples are captured by the second term. For couples where $q_p < \tilde{q}_p^h$, some secondary earners are working while others are not working, as reflected in the last two terms in the expression. By maximizing (A-1) with respect to $\left(T_0, T_1^h, T_2^h\right)$ and subject to (7), we obtain the first order conditions

$$
\begin{aligned}
0 &= L_{T_2^h} = -n_h \int_0^{\tilde{q}_p^h} \int_{\underline{q_s^h}(q_p)}^{\bar{q}_s^h} \omega_h(\mathbf{q}) \frac{du}{dc_2^h} f_h(\mathbf{q}) d\mathbf{q} + \lambda \left[e_2^h + \left(T_2^h - T_1^h\right) \frac{de_2^h}{dT_2^h} \right], \qquad \text{(A-2)} \\
0 &= L_{T_1^h} = -n_h \int_{\tilde{q}_p^h}^{\bar{q}_p^h} \int_{\underline{q_s^h}(q_p)}^{\infty} \omega_h(\mathbf{q}) \frac{du}{dc_1^h} f_h(\mathbf{q}) d\mathbf{q} - n_h \int_0^{\tilde{q}_p^h} \int_{\bar{q}_s}^{\infty} \omega_h(\mathbf{q}) \frac{du}{dc_1^h} f_h(\mathbf{q}) d\mathbf{q} \\
&\quad + \lambda \left[e_1^h + \left(T_2^h - T_1^h\right) \frac{de_2^h}{dT_1^h} - \left(T_1^h - T_0\right) \frac{de_0^h}{dT_1^h} \right], \qquad \text{(A-3)} \\
0 &= L_{T_0} = -\sum_h n_h \int_{\bar{q}_p^h}^{\infty} \int_{\underline{q_s^h}(q_p)}^{\infty} \omega_h(\mathbf{q}) \frac{du}{dc_0^h} f_h(\mathbf{q}) d\mathbf{q} + \lambda \sum_h \left[e_0^h - \left(T_1^h - T_0\right) \frac{de_0^h}{dT_0^h} \right], \text{(A-4)}
\end{aligned}
$$

where L denotes the Lagrangian function, λ is the Lagrangian multiplier, and subscripts 0, 1 and 2 denote zero-, one- and two-earner couples, respectively. In the derivations, we have used the envelope theorem implying that the effects of the reform on labor market entry/exit (changes in $\bar{q}_p^h$ and $\bar{q}_s^h$) have no first-order effects on social welfare. Using these first-order conditions, we calculate $\sum_h \left(L_{T_2^h} + L_{T_1^h}\right) + L_{T_0}$, from which we obtain

$$
\lambda = \frac{\sum_h n_h \int_{\mathbf{q}} \omega_h(\mathbf{q}) \frac{\partial u}{\partial c^h} f_h(\mathbf{q}) d\mathbf{q}}{1 + \sum_h \left[\left(T_2^h - T_1^h\right) \frac{de_2^h}{dT_2^h} + \left(T_2^h - T_1^h\right) \frac{de_2^h}{dT_1^h} - \left(T_1^h - T_0\right) \frac{de_0^h}{dT_1^h} - \left(T_1^h - T_0\right) \frac{de_0^h}{dT_0^h} \right]}. \qquad \text{(A-5)}
$$

From the first-order conditions (A-2) and (A-3) and the definitions of welfare weights, we obtain

$$
\begin{aligned}
-g_2^h + 1 + \left(T_2^h - T_1^h\right) \frac{de_2^h}{dT_2^h} \frac{1}{e_2^h} &= 0, \\
-g_1^h + 1 + \left(T_2^h - T_1^h\right) \frac{de_2^h}{dT_1^h} \frac{1}{e_1^h} - \left(T_1^h - T_0\right) \frac{de_0^h}{dT_1^h} \frac{1}{e_1^h} &= 0.
\end{aligned}
$$

After inserting the first equation in the second equation and using the relationship $dc/dT = -1$ as well as the definitions of participation tax rates, we obtain

$$
\begin{aligned}
-g_2^h + 1 - \frac{\tau_s^h}{1-\tau_s^h}\frac{\partial e_2^h}{\partial c_2^h}\frac{c_2^h - c_1^h}{e_2^h} &= 0, && \text{(A-6)}\\
-g_1^h + 1 - \frac{\partial e_2^h/\partial c_1^h}{\partial e_2^h/\partial c_2^h}\left(1-g_2^h\right)\frac{e_2^h}{e_1^h} - \frac{\tau_p^h}{1-\tau_p^h}\frac{-\partial e_0^h}{\partial c_1^h}\frac{c_1^h - c_0}{e_1^h} &= 0. && \text{(A-7)}
\end{aligned}
$$

With the quasi-linear preferences underlying Proposition 1, we have $\partial e_2^h/\partial c_1^h = -\partial e_2^h/\partial c_2^h$, which together with the definitions of labor supply elasticities in (5) imply that eqs (9) and (10) follow from the above two equations. In addition, we see from (3) and (4) that $de_2^h/dT_2^h = -de_2^h/dT_1^h$ and $de_0^h/dT_1^h = -de_0^h/dT_0$. This implies from (A-5) that $\lambda = \sum_h n_h \int_{\mathbf{q}} \omega_h(\mathbf{q}) \frac{\partial u}{\partial c^h} f_h(\mathbf{q})\, d\mathbf{q}$, such that the welfare weights sum to one, $\sum_h \left(e_0^h g_0^h + e_1^h g_1^h + e_2^h g_2^h\right) = 1$.

With the preference specification in section 2.3, λ is not necessarily equal to one and $\partial e_2^h/\partial c_2^h$ may differ from $-\partial e_2^h/\partial c_1^h$. We therefore define the elasticities

$$
\tilde{\eta}_s^h \equiv -\frac{\partial e_2^h}{\partial c_1^h}\frac{c_2^h - c_1^h}{e_2^h}, \quad \tilde{\eta}_p^h \equiv \frac{\partial e_0^h}{\partial c_0^h}\frac{c_1^h - c_0}{e_1^h}, \tag{A-8}
$$

which corresponds to the elasticities in (5) but where the change in the secondary earner participation incentive comes by changing c_1^h instead of c_2^h and the change in the primary earner participation incentive comes by changing c_0 instead of c_1^h. The optimal tax formulas in Proposition 2 may now be derived from (A-6) and (A-7) where $\theta_s^h \equiv \tilde{\eta}_s^h/\eta_s^h$. Moreover, it follows from (A-5) that

$$
\lambda = \frac{1}{1 + \sum_h \left[\frac{\tau_s^h}{1-\tau_s^h} e_2^h \left(\tilde{\eta}_s^h - \eta_s^h\right) + \frac{\tau_p^h}{1-\tau_p^h} e_1^h \left(\tilde{\eta}_p^h - \eta_p^h\right)\right]}, \tag{A-9}
$$

which is the marginal cost of funds of a lump sum tax. If $v(\cdot)$ is strictly concave then $\tilde{\eta}_s^h > \eta_s^h$ and $\tilde{\eta}_p^h > \eta_p^h$, implying that $\lambda < 1$ and $\theta_s^h > 1$. QED.

C Proof of Proposition 3

To ease the notation, we suppress h at some places. The social planner objective may be written as in (A-1) but with the utility ascribed to each household given by (24). By maximizing this objective with respect to $\left(T_0, T_1^h, T_2^h\right)$ and subject to (7), we obtain the first order conditions

$$
\begin{aligned}
0 &= L_{T_2^h} = -n_h \int_0^{\tilde{q}_p^h} \int_{\underline{q_s^h}(q_p)}^{\bar{q}_s^h} \omega_h(\mathbf{q}) \left[(1-\beta) \frac{\partial v_p}{\partial c_p^2} \frac{\partial c_p^2}{\partial T^2} + \beta \frac{\partial v_s}{\partial c_s^2} \frac{\partial c_s^2}{\partial T^2}\right] f_h(\mathbf{q})\, d\mathbf{q} \\
&\quad + \lambda \left[e_2^h + \left(T_2^h - T_1^h\right) \frac{de_2^h}{dT_2^h}\right], \\
0 &= L_{T_1^h} = -n_h \int_{\tilde{q}_p^h}^{\bar{q}_p^h} \int_{\underline{q_s^h}(q_p)}^{\infty} \omega_h(\mathbf{q}) \left[(1-\beta) \frac{\partial v_p}{\partial c_p^1} \frac{\partial c_p^1}{\partial T^1} + \beta \frac{\partial v_s}{\partial c_s^1} \frac{\partial c_s^1}{\partial T^1}\right] f_h(\mathbf{q})\, d\mathbf{q} \\
&\quad - n_h \int_0^{\tilde{q}_p^h} \int_{\bar{q}_s}^{\infty} \omega_h(\mathbf{q}) \left[(1-\beta) \frac{\partial v_p}{\partial c_p^1} \frac{\partial c_p^1}{\partial T^1} + \beta \frac{\partial v_s}{\partial c_s^1} \frac{\partial c_s^1}{\partial T^1}\right] f_h(\mathbf{q})\, d\mathbf{q} \\
&\quad + \lambda \left[e_1^h + \left(T_2^h - T_1^h\right) \frac{de_2^h}{dT_1^h} - \left(T_1^h - T_0\right) \frac{de_0^h}{dT_1^h}\right], \\
0 &= L_{T_0} = -\sum_h n_h \int_{\bar{q}_p^h}^{\infty} \int_{\underline{q_s^h}(q_p)}^{\infty} \omega_h(\mathbf{q}) \left[(1-\beta) \frac{\partial v_p}{\partial c_p^0} \frac{\partial c_p^0}{\partial T^0} + \beta \frac{\partial v_s}{\partial c_s^0} \frac{\partial c_s^0}{\partial T^0}\right] f_h(\mathbf{q})\, d\mathbf{q} \\
&\quad + \lambda \sum_h \left[e_0^h - \left(T_1^h - T_0\right) \frac{de_0^h}{dT_0^h}\right],
\end{aligned}
$$

where L denotes the Lagrangian function, λ is the Lagrangian multiplier, and subscripts 0, 1 and 2 denote zero-, one- and two-earner couples, respectively. In the derivation, we have used the envelope theorem implying that the effects of the reform on labor market entry/exit have no first-order effects on social welfare. Using these first-order conditions, we calculate $\sum_h \left(L_{T_2^h} + L_{T_1^h}\right) + L_{T_0}$, from which we obtain

$$
\lambda \equiv -\sum_h n_h \int_0^{\infty} \int_{\underline{q_s}\left(q_p^h\right)}^{\infty} \omega_h(\mathbf{q}) \left[(1-\beta) \frac{\partial v_p}{\partial c_p} \frac{\partial c_p}{\partial T} + \beta \frac{\partial v_s}{\partial c_s} \frac{\partial c_s}{\partial T}\right] f_h(\mathbf{q})\, d\mathbf{q}, \tag{A-10}
$$

which is the increase in social welfare of giving one Euro to the average couple in the population. The increase in social welfare of giving one Euro to a representative two-earner couple of type h relative to giving one Euro to an average couple in the population equals

$$
g_2^h(\alpha, \beta) \equiv \frac{-\int_0^{\tilde{q}_p^h} \int_{\underline{q_s}\left(q_p^h\right)}^{\bar{q}_s^h} \omega_h(\mathbf{q}) \left[\left(1-\beta^h\right) \frac{\partial v_p}{\partial c_p^2} \frac{\partial c_p^2}{\partial T^2} + \beta \frac{\partial v_s}{\partial c_s^2} \frac{\partial c_s^2}{\partial T^2}\right] f_h(\mathbf{q})\, d\mathbf{q}}{\lambda \cdot \int_0^{\tilde{q}_p^h} \int_{\underline{q_s}\left(q_p^h\right)}^{\bar{q}_s^h} f_h(\mathbf{q})\, d\mathbf{q}}, \tag{A-11}
$$

which defines the welfare weight on two-earner couples of type h. A corresponding definition exists for one-earner couples, g_1^h, and zero-earner couples, g_0^h, where $\sum_h \left(e_0^h g_0^h + e_1^h g_1^h + e_2^h g_2^h\right) = 1$. By using these definitions and repeating the computations in Appendix B, we again obtain eqs (A-6) and (A-7) from which Proposition 3 follows.

D Proof of Corollary 1

Property (i) follows directly from Propositions 1 and 3. In order to establish property (ii), we first insert eqs (19) and (A-10) into (A-11) and use the assumption $\alpha^h = \alpha$ and $\beta^h = \beta$. This gives (for ease of notation, we suppress the h superscript at some places):

$$g_2^h(\alpha,\beta) \equiv \frac{\int_0^{\tilde{q}_p}\int_{\underline{q_s}(q_p)}^{\bar{q}_s} \omega_h(\mathbf{q}) \left[(1-\beta)\frac{\partial c_p^2}{\partial T^2}+\beta\frac{1-\alpha}{\alpha}\frac{\partial c_s^2}{\partial T^2}\right]\frac{\partial v_p}{\partial c_p^2} f_h(\mathbf{q})\, d\mathbf{q}}{\lambda\cdot\int_0^{\tilde{q}_p}\int_{\underline{q_s}(q_p)}^{\bar{q}_s} f_h(\mathbf{q})\, d\mathbf{q}} * \frac{1}{\sum_h n_h \int_0^{\infty}\int_{\underline{q_s}(q_p)}^{\infty}\omega(\mathbf{q})\left[(1-\beta)\frac{\partial c_p}{\partial T}+\beta\frac{1-\alpha}{\alpha}\frac{\partial c_s}{\partial T}\right]\frac{\partial v_p}{\partial c_p} f_h(\mathbf{q})\, d\mathbf{q}}$$

Consider the quadratic individual utility function $v_i = \kappa_i c_i - \frac{\gamma_i}{2}(c_i)^2$ where $i = p, s$ and where κ_i and γ_i are positive constants. This utility function implies according to the household optimization condition (19) that the intra-household allocations in all couples satisfy

$$c_s = \frac{\kappa_s}{\gamma_s} - \frac{1-\alpha}{\alpha}\frac{\kappa_p}{\gamma_s} + \frac{1-\alpha}{\alpha}\frac{\gamma_p}{\gamma_s}c_p,$$

which implies that a given change in the tax burden of the household change the consumption pattern within the household according to

$$\frac{\partial c_s}{\partial T} = \frac{1-\alpha}{\alpha}\frac{\gamma_p}{\gamma_s}\frac{\partial c_p}{\partial T}.$$

By inserting this in the above expression for the welfare weight, we obtain

$$g_2^h(\alpha,\beta) \equiv \frac{\int_0^{q_p^*}\int_{\underline{q_s}(q_p)}^{\bar{q}_s}\omega(\mathbf{q})\frac{\partial v_p}{\partial c_p^2}\frac{\partial c_p^2}{\partial T^2} f(\mathbf{q})\, d\mathbf{q}}{\lambda\cdot\int_0^{q_p^*}\int_{\underline{q_s}(q_p)}^{\bar{q}_s} f(\mathbf{q})\, d\mathbf{q}} \frac{1}{\sum_h n_h\int_0^{\infty}\int_{\underline{q_s}(q_p)}^{\infty}\omega(\mathbf{q})\frac{\partial v_p}{\partial c_p}\frac{\partial c_p}{\partial T} f(\mathbf{q})\, d\mathbf{q}},$$

which is independent of β. With a third-order polynomial utility function, g_2^h would depend on β and the sign of the effect would depend on the sign of the third-order derivative. QED.

E Proof of Proposition 4

To ease the notation, we suppress h at some places. First, by imposing equality on conditions (28) and (29), we obtain the fixed cost thresholds

$$\bar{q}_p = v_p\left(c_p^1\right) - v_p\left(c_p^0\right) + \frac{\alpha}{1-\alpha}\left[v_s\left(c_s^1\right) - v_s\left(c_s^0\right)\right], \tag{A-12}$$

$$\bar{q}_s = \frac{1-\alpha}{\alpha}\left[v_p\left(c_p^2\right) - v_p\left(c_p^1\right)\right] + v_s\left(c_s^2\right) - v_s\left(c_s^1\right). \tag{A-13}$$

The social planner objective may be written as in (A-1) but with the utility ascribed to each household given by (24). By maximizing this objective with respect to $\left(T_0, T_1^h, T_2^h\right)$ and subject to (7), we obtain the first order conditions

$$\begin{aligned}
0 &= L_{T_2^h} - n_h \frac{\partial \bar{q}_s^h}{\partial T_2^h} \int_0^{\tilde{q}_p^h} \omega_h\left(q_p^h, \bar{q}_s^h\right) \left[u^1\left(q_p^h, \bar{q}_s^h\right) - u^2\left(q_p^h, \bar{q}_s^h\right)\right] f_h\left(q_p^h, \bar{q}_s^h\right) dq_p^h, \\
0 &= L_{T_1^h} - n_h \frac{\partial \bar{q}_s^h}{\partial T_1^h} \int_0^{\tilde{q}_p^h} \omega_h\left(q_p^h, \bar{q}_s^h\right) \left[u^1\left(q_p^h, \bar{q}_s^h\right) - u^2\left(q_p^h, \bar{q}_s^h\right)\right] f_h\left(q_p^h, \bar{q}_s^h\right) dq_p^h \\
&\quad - n_h \frac{\partial \bar{q}_p^h}{\partial T_1^h} \int_{\underline{q_s^h}(q_p)}^{\infty} \omega_h\left(\bar{q}_p^h, q_s^h\right) \left[u^0\left(\bar{q}_p^h, q_s^h\right) - u^1\left(\bar{q}_p^h, q_s^h\right)\right] f_h\left(\bar{q}_p^h, q_s^h\right) dq_s^h, \\
0 &= L_{T_0} - \sum_h n_h \frac{\partial \bar{q}_p^h}{\partial T_0} \int_{\underline{q_s^h}(q_p)}^{\infty} \omega_h\left(\bar{q}_p^h, q_s^h\right) \left[u^0\left(\bar{q}_p^h, q_s^h\right) - u^1\left(\bar{q}_p^h, q_s^h\right)\right] f_h\left(\bar{q}_p^h, q_s^h\right) dq_s^h
\end{aligned}$$

where $L_{T_2^h}$, $L_{T_1^h}$ and L_{T_0} are the expressions in Appendix C and $u^0\left(\bar{q}_p^h, q_s^h\right)$ denotes (with a slight abuse of notation) the social utility attributed to couples $\left(\bar{q}_p^h, q_s^h\right)$ if they choose to become zero-earner couples, while $u^1\left(\bar{q}_p^h, q_s^h\right)$ denotes the social utility if they decide to become a one-earner couple. From eqs (24) and (27), we obtain

$$\begin{aligned}
u^0\left(\bar{q}_p, q_s\right) - u^1\left(\bar{q}_p, q_s\right) &= (1-\beta) v_p\left(c_p^0\right) + \beta v_s\left(c_s^0\right) - (1-\beta)\left[v_p\left(c_p^1\right) - \bar{q}_p\right] - \beta v_s\left(c_s^1\right), \\
u^1\left(q_p, \bar{q}_s\right) - u^2\left(q_p, \bar{q}_s\right) &= (1-\beta)\left[v_p\left(c_p^1\right) - q_p\right] + \beta v_s\left(c_s^1\right) - \left[(1-\beta) v_p\left(c_p^2\right) - q_p\right] - \beta\left(v_s\left(c_s^2\right) - \bar{q}_s\right),
\end{aligned}$$

which, after using eqs (A-12) and (A-13), may be rewritten to

$$\begin{aligned}
u^0\left(\bar{q}_p, q_s\right) - u^1\left(\bar{q}_p, q_s\right) &= -\frac{\beta-\alpha}{1-\alpha}\left[v_s\left(c_s^1\right) - v_s\left(c_s^0\right)\right], \\
u^1\left(q_p, \bar{q}_s\right) - u^2\left(q_p, \bar{q}_s\right) &= \frac{\beta-\alpha}{\alpha}\left[v_p\left(c_p^2\right) - v_p\left(c_p^1\right)\right].
\end{aligned}$$

By inserting these expressions in the above first-order conditions for T_1^h and T_2^h, we obtain

$$\begin{aligned}
0 &= L_{T_2^h} - n_h \frac{\partial \bar{q}_s^h}{\partial T_2^h} \frac{\beta^h - \alpha^h}{\alpha^h}\left[v_p\left(c_p^2\right) - v_p\left(c_p^1\right)\right] \int_0^{\tilde{q}_p^h} \omega_h\left(q_p^h, \bar{q}_s^h\right) f_h\left(q_p^h, \bar{q}_s^h\right) dq_p^h, \\
0 &= L_{T_1^h} - n_h \frac{\partial \bar{q}_s^h}{\partial T_1^h} \frac{\beta^h - \alpha^h}{\alpha^h}\left[v_p\left(c_p^2\right) - v_p\left(c_p^1\right)\right] \int_0^{\tilde{q}_p^h} \omega_h\left(q_p^h, \bar{q}_s^h\right) f_h\left(q_p^h, \bar{q}_s^h\right) dq_p^h \\
&\quad + n_h \frac{\partial \bar{q}_p^h}{\partial T_1^h} \frac{\beta^h - \alpha^h}{1-\alpha^h}\left[v_s\left(c_s^1\right) - v_s\left(c_s^0\right)\right] \int_{\underline{q_s^h}(q_p)}^{\infty} \omega_h\left(\bar{q}_p^h, q_s^h\right) f_h\left(\bar{q}_p^h, q_s^h\right) dq_s^h,
\end{aligned}$$

By combining this with our previous results for $L_{T_1^h}$ and $L_{T_2^h}$, we obtain

$$g_2^h - \frac{\beta^h - \alpha^h}{\alpha^h} \eta_s^h \sigma_p^h = 1 - \frac{\tau_s^h}{1-\tau_s^h} \eta_s^h, \tag{A-14}$$

$$g_1^h + \frac{\beta^h - \alpha^h}{1-\alpha^h} \eta_p^h \sigma_s^h + \frac{\beta^h - \alpha^h}{\alpha^h} \frac{e_2^h}{e_1^h} \tilde{\eta}_s^h \sigma_p^h = 1 - \frac{\tau_p^h}{1-\tau_p^h} \eta_p^h + \frac{\tau_s^h}{1-\tau_s^h} \tilde{\eta}_s^h \frac{e_2^h}{e_1^h}, \tag{A-15}$$

where

$$\sigma_p^h \equiv \frac{c_p^2 - c_p^1}{z_s^h\left(1-\tau_s^h\right)} \frac{v_p\left(c_p^2\right) - v_p\left(c_p^1\right)}{c_p^2 - c_p^1} \frac{\int_0^{\tilde{q}_p^h} \omega_h\left(q_p^h, \bar{q}_s^h\right) f_h\left(q_p^h, \bar{q}_s^h\right) dq_p^h}{\lambda \cdot \int_0^{\tilde{q}_p^h} f_h\left(q_p^h, \bar{q}_s^h\right) dq_p^h}, \tag{A-16}$$

$$\sigma_s^h \equiv \frac{c_s^1 - c_s^0}{z_p^h\left(1-\tau_p^h\right)} \frac{v_s\left(c_s^1\right) - v_s\left(c_s^0\right)}{c_s^1 - c_s^0} \frac{\int_{\underline{q_s^h}(q_p)}^{\infty} \omega_h\left(\bar{q}_p^h, q_s^h\right) f_h\left(\bar{q}_p^h, \bar{q}_s^h\right) dq_s^h}{\lambda \cdot \int_{\underline{q_s^h}(q_p)}^{\infty} f_h\left(\bar{q}_p^h, \bar{q}_s^h\right) dq_s^h}, \tag{A-17}$$

and where the participation elasticities are defined in (5) and (A-8). The tax formula (30) comes directly from (A-14), while the tax formula (31) is obtained by inserting (A-14) into (A-15), and using the definition $\theta_s^h \equiv \tilde{\eta}_s^h / \eta_s^h$.

F Derivation of inequalities (33) and (34)

The impact of a general change in the tax system $(dT_0, dT_1^h, dT_2^h)_{h=1}^H$ on social welfare is obtained from (A-1)

$$\begin{aligned} dS &= \sum_h n_h \left[\int_{\bar{q}_p^h}^{\infty} \int_{\underline{q_s^h}(q_p)}^{\infty} \omega_h(\mathbf{q}) \frac{\partial u}{\partial c_0^h} \frac{\partial c_0^h}{\partial T_0} dT_0 \cdot f_h(\mathbf{q})\, d\mathbf{q} + \int_{\tilde{q}_p^h}^{\bar{q}_p^h} \int_{\underline{q_s^h}(q_p)}^{\infty} \omega_h(\mathbf{q}) \frac{\partial u}{\partial c_1^h} \frac{\partial c_1^h}{\partial T_1^h} dT_1^h \cdot f_h(\mathbf{q})\, d\mathbf{q} \right. \\ &\left. + \int_0^{\tilde{q}_p^h} \int_{\bar{q}_s^h}^{\infty} \omega_h(\mathbf{q}) \frac{\partial u}{\partial c_0^h} \frac{\partial c_1^h}{\partial T_1^h} dT_1^h \cdot f_h(\mathbf{q})\, d\mathbf{q} + \int_0^{\tilde{q}_p^h} \int_{\underline{q_s^h}(q_p)}^{\bar{q}_s^h} \omega_h(\mathbf{q}) \frac{\partial u}{\partial c_2^h} \frac{\partial c_2^h}{\partial T_2^h} dT_2^h \cdot f_h(\mathbf{q})\, d\mathbf{q}_s \right] \end{aligned} \quad \text{(A-18)}$$

where subscripts 0, 1 and 2 denote zero-, one- and two-earner couples, respectively, and where we have used the envelope theorem implying that the effects of the reform on labor market entry/exit (changes in $\bar{q}_p^h$ and $\bar{q}_s^h$) have no first-order effects on social welfare. The impact of the tax change on government revenue equals

$$\begin{aligned} dR &= \sum_h \left(e_2^h \cdot dT_2^h + e_1^h \cdot dT_1^h + e_0^h \cdot dT_0 \right) \\ &- \sum_h \left(\frac{\tau_s^h}{1-\tau_s^h} \left(dT_2^h - dT_1^h \right) \eta_s^h e_2^h + \frac{\tau_p^h}{1-\tau_p^h} \left(dT_1^h - dT_0 \right) \eta_p^h e_1^h \right). \end{aligned} \quad \text{(A-19)}$$

Reform A: We consider a budget-neutral tax change where $dT_1^h = dT_0 \equiv dy$ and $dT_2^h \equiv -dx$. By inserting this in (A-18), we see that this reform increases social welfare, $dS \geq 0$, iff

$$\frac{\sum_h g_2^h e_2^h}{\sum_h \left[g_0^h e_0^h + g_1^h e_1^h \right]} \geq \frac{dy}{dx}$$

From eq. (A-19) and the requirement of budget neutrality, $dR = 0$, we obtain

$$\frac{dy}{dx} = \frac{\sum_h e_2^h - \sum_h \frac{\tau_s^h}{1-\tau_s^h} \eta_s^h e_2^h}{1 - \sum_h e_2^h + \sum_h \frac{\tau_s^h}{1-\tau_s^h} \eta_s^h e_2^h}.$$

By combining the two above expressions and using the definitions

$$\begin{aligned} e_i &\equiv \sum_h e_i^h, \;\; \phi_i^h \equiv e_i^h / e_i, \;\; \bar{g}_i \equiv \frac{1}{e_i} \sum_h g_i^h e_i^h \;\text{ for } i = 0, 1, 2, \quad \text{(A-20)} \\ \bar{g}_{01} &\equiv \frac{1}{e_1 + e_0} \sum_h \left(e_1^h g_1^h + e_0^h g_0^h \right), \end{aligned}$$

we obtain condition (33).

Reform B: We consider a budget-neutral tax change where $dT_1^h \equiv dy$ and $dT_2^h \equiv -dx$ and $dT_0 = 0$. By inserting this in (A-18), we see that this reform increases social welfare, $dS \geq 0$, if

$$\frac{\sum_h e_2^h g_2^h}{\sum_h e_1^h g_1^h} \geq \frac{dy}{dx}$$

From eq. (A-19) and the requirement of budget neutrality, $dR = 0$, we obtain

$$\frac{dy}{dx} = \frac{\sum_h e_2^h - \sum_h \frac{\tau_s^h}{1-\tau_s^h}\eta_s^h e_2^h}{\sum_h e_1^h - \sum_h \frac{\tau_p^h}{1-\tau_p^h}\eta_p^h e_1^h + \sum_h \frac{\tau_s^h}{1-\tau_s^h}\eta_s^h e_2^h}.$$

By combining the two above expressions and the definitions (A-20), we obtain condition (34).

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Table 1. Participation tax rates

Country	Primary Earners	Secondary Earners
Austria	0.63	0.36
Belgium	0.73	0.74
Denmark	0.73	0.53
Finland	0.60	0.36
France	0.85	0.63
Germany	0.63	0.51
Greece	0.27	0.28
Ireland	0.54	0.44
Italy	0.35	0.46
Luxembourg	0.50	0.32
Netherlands	0.56	0.44
Portugal	0.37	0.41
Spain	0.34	0.41
Sweden	0.66	0.51
United Kingdom	0.56	0.20

Note: The two columns list the average effective participation tax rates for primary earners in one-earner couples and secondary earners in two-earner families, respectively. The calculation of the tax rates is descibed in the text.
Source: EUROMOD Microsimulation Model.

Table 2. Inter-household utility trade-off for reforms A and B

	Constant Elasticity						*Elasticity Profile*	
	Scenario 1		**Scenario 2**		**Scenario 3**		**Scenario 4**	
	η_p = 0.1	**η_s = 0.5**	**η_p = 0.1**	**η_s = 0.7**	**η_p = 0.3**	**η_s = 0.3**	**η_p = 0.1**	**η_s = 0.5**
Country	A	B	A	B	A	B	A	B
Austria	0.32	0.48	0.18	0.26	0.51	*No Gainers*	0.38	0.67
Belgium	*No Losers*		*No Losers*		*No Losers*		*No Losers*	
Denmark	*0.01*	*0.01*	*No Losers*		0.12	*No Gainers*	*0.01*	*0.02*
Finland	0.13	0.07	0.05	0.02	0.26	*No Gainers*	0.18	0.10
France	*No Losers*		*No Losers*		0.16	*No Gainers*	*No Losers*	
Germany	0.14	0.16	*No Losers*		0.35	*No Gainers*	0.21	0.27
Greece	0.61	0.65	0.48	0.50	0.76	0.99	0.60	0.63
Ireland	0.27	0.31	0.06	0.07	0.52	1.73	0.30	0.39
Italy	0.33	0.32	0.14	0.13	0.55	0.80	0.34	0.34
Luxembourg	0.43	0.53	0.27	0.32	0.62	1.66	0.54	0.69
Netherlands	0.25	0.31	0.11	0.12	0.46	3.21	0.28	0.37
Portugal	0.28	0.29	0.12	0.12	0.50	0.85	0.38	0.39
Spain	0.46	0.48	0.28	0.29	0.66	0.89	0.45	0.47
Sweden	0.07	0.03	*No Losers*		0.20	*No Gainers*	0.07	0.04
United Kingdom	0.58	0.77	0.46	0.56	0.72	*No Gainers*	0.65	1.03

Note: The trade-off is calculated using formula (6) in the text for reform A and formula (7) for reform B. η_p is the participation elasticity of primary earners (PE) and η_s is the participation elasticity of secondary earners (SE). Note that the primary earner elasticity does not affect the trade-off in reform A. In scenarios 1-3, the elasticities are the same for all income groups. In scenario 4, earnings responses are concentrated at the lower end of the income distribution. Specifically, η_p is 0.3 for primary earners in the lowest quintile of the PE earnings distribution (PEq1), 0.1 for PEq2 and PEq3, and 0 for PEq4 and PEq5. For secondary earners, the elasticity scenario is 1 for the lowest quintile of the SE earnings distribution (SEq1), 0.8 for SEq2, 0.5 for SEq3, 0.2 for SEq4 and 0 for SEq5. The average elasticities are listed above the results. Source: Authors' own calculations based on the EUROMOD microsimulation model.