

## Ensaio Econômico

EPGE

Escola

Brasileira de

Economia e

Finanças

Nº 825

ISSN 0104-8910

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Julho de 2021

Intrahousehold Inequality and the Joint  
Taxation of Household Earnings/ - Cassiano B. Alves,  
Carlos E. da Costa, Felipe Lobel, Humberto Moreira - Rio  
de Janeiro: FGV EPGE, 2021

40p. - (Ensaaios Econômicos; 825)

Inclui bibliografia.

CDD-330

# INTRAHOUSEHOLD INEQUALITY AND THE JOINT TAXATION OF HOUSEHOLD EARNINGS\*

Cassiano B. Alves<sup>★</sup>, Carlos E. da Costa<sup>☆</sup>, Felipe Lobel<sup>★</sup>, and Humberto Moreira<sup>☆</sup>

<sup>★</sup>*Northwestern University*

<sup>☆</sup>*FGV EPGE Brazilian School of Economics and Finance*

<sup>★</sup>*University of California, Berkeley*

July 1, 2021

## Abstract

We study the optimal design of nonlinear labor income tax for multiperson households. Each household consists of two workers with different productivity levels and unequal access to the family's economic resources. We show how intrahousehold inequality, together with individual-oriented utilitarianism, generally leads to a misalignment between the household's and government's objectives, a state known as dissonance. We handle the multidimensionality that plagues the [Mirrlees](#) model by restricting preferences to be identical and iso-elastic and by focusing on taxes characterized by income-splitting. This approach allows us to provide a complete solution for the screening problem, incorporate different degrees of assortative matching, and assess the role of dissonance in shaping the optimal tax schedule. We also investigate the welfare gains from gender-based policies.

**Keywords:** *Intrahousehold Inequality; Joint Taxation; Collective Household; Multidimensional Screening.* **JEL Classification:** H21, H31, D13.

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\*Corresponding author: Cassiano Alves. Address: Northwestern University, Department of Economics, 2211 Campus Dr, Evanston, IL 60208, USA. Telephone: (US) +1 (202) 374-1347, (BR) +55 (21) 99647-4009. Email: [cassianoalves@u.northwestern.edu](mailto:cassianoalves@u.northwestern.edu). We would like to thank Alan Auerbach, Bruno Barsanetti, João Guerreiro, Dirk Krueger, Guido Lorenzoni, João Monteiro, Wojciech Olszewski, Alessandro Pavan, Matthew Rognlie, Emmanuel Saez, Bernard Salanié, Bruno Strulovici, Christopher Udry, Danny Yagan, Gabriel Zucman and seminar participants at the NTA 113th Annual Conference on Taxation, IHS Graduate Conference, the 2020 ESWC in Milan, 2018 EEA-ESEM Meeting in Cologne, 2018 DSE Winter School, USP, the Theory and Macro workshops at FGV EPGE and the Graduate Student Seminar at Northwestern University for their invaluable comments. da Costa thanks CNPq project 301140/2017-0 for financial support. Moreira thanks CNPq and Faperj for financial support. This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001. All errors are our responsibility. Word Count: 16470.

UNTIL recently, economists have tried to understand household behavior on a common preference basis where all family members' resources were pooled to maximize a single objective function. Moreover, this "household welfare function" had a normative status when used in optimal tax theory (e.g., [Boskin and Sheshinski \(1983\)](#)). However, starting with the pioneering contributions of [Manser and Brown \(1980\)](#) and [McElroy and Horney \(1981\)](#) and the conceptual change promoted by [Chiappori \(1988, 1992\)](#); [Apps and Rees \(1988\)](#), family economics rapidly progressed toward the understanding of joint family decisions driven by divergent interests within the household.<sup>1</sup>

This new paradigm acknowledges that economic resources and well-being can be unequally distributed among family members. Since the primitive object of concern for economic policies is the well-being of individuals, tax policy analysis should be revised following the change in paradigm that took place in family economics. This paper contributes to this revision by deriving optimal labor income tax formulae for multiperson households.

Households in our model are composed of two spouses, each with a utility function and an individual level of labor market productivity. Households are also characterized by a relative Pareto weight of each spouse's utility in a Bergsonian household welfare function. We allow the Pareto weights to be heterogeneous across households.

We start our analysis by completely characterizing the optimal joint income tax system for the case of identical iso-elastic preferences. To do so, we must deal with the screening problem described by [Mirrlees \(1971\)](#), but in a multidimensional context. Indeed, household tax theory has always been limited by the multidimensional nature of the screening problem to which it gives rise. As a consequence, most contributions to the literature limit its scope by pre defining functional forms for taxes ([Boskin and Sheshinski \(1983\)](#)), precluding adjustments in all of the relevant decision margins ([Kleven et al. \(2009\)](#)), and restricting the amount of heterogeneity ([Cremer et al. \(2012\)](#)).

Our first contribution is to offer an aggregation result to reduce the dimensionality of the screening problem and enable the use of standard tools to solve the mechanism design problem. As it turns out, under the assumption of identical iso-elastic preferences, we are able to maintain full generality on skill distributions, the relative Pareto weight of spouses, and the correlation between spouses' skills while still solving the model. Here, the inherent multidimensionality that plagues optimal household taxation endogenously collapses into a single-dimensional problem in which single-crossing still holds. Since there is only one screening variable (household earnings) and three dimensions of characteristics (spouses' productiv-

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<sup>1</sup>[Lundberg and Pollak \(1996\)](#), for example, adopted a bargaining protocol to model the independent agency of men and women in marriage. Early contributions to the understanding of the internal workings of families can be found in many of Gary Becker's contributions.

ities and the spouses' relative weight parameter), at each earning level there is a bunching of different household types. However, because of the specification of preferences, these sets are identified by a common exogenous parameter.<sup>2</sup> This substantially simplifies the analysis and allows us to derive a formula for the optimal marginal tax rate under general distributions of household types. The optimal tax formula, which is written in terms of primitives of the model, is explicit about how family decision making affects the shape of the optimal tax system and can be successfully taken to the data.

Households' assessment of their own well-being is captured by a Bergsonian household utility function involving different Pareto weights applied to each spouse's utility. Our approach is, in contrast, individual-oriented utilitarianism, where the planner aggregates individuals' well-being as the sum of their utility.<sup>3</sup> As pointed out by Chavas et al. (2018), Chiappori and Meghir (2015), and Haddad and Kanbur (1990), ignoring intrahousehold inequality is a major drawback in the proper assessment of inequality and welfare distribution, the objects of concern for redistribution policies.

The misalignment between household and social objectives – *dissonance*, in the terminology of Apps and Rees (2011) – leads to an adjustment of the traditional Mirrlees (1971) formula. In the presence of dissonance, the traditional formula for optimal marginal taxes is augmented by a Pigouvian correction term that internalizes the impacts of taxes on the distribution of resources within the household. This new term comes into place due to the presence of dissonance and accounts for the intrahousehold inequality. Taken as a function of household Pareto weights, this Pigouvian correction term has a U-shaped format and is equal to zero when government and household objectives are perfectly aligned; which corresponds to equal Pareto weights for both spouses. Starting from equal weights, the Pigouvian term increases (becomes positive) as the Pareto weight is biased against the most productive spouse and decreases (becomes negative) in the opposite direction. The minimum occurs at zero only when spouses have the same productivity. In a sense, households for which the relative weight is biased toward the most productive spouse overestimate the cost of effort when compared to the planner's evaluation.

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<sup>2</sup>Exogeneity of this aggregated parameter with respect to policy is key, since this is what allows for an exogenous ordering of households willingness to make effort. For general preferences, the ordering becomes endogenous to the tax system and the screening problem is not tractable. Moreover, even if we settle for a local characterization via perturbation methods, the aggregation of preferences at the same income level introduces novel elements to the analysis.

<sup>3</sup>By neglecting the multiperson nature of households, the welfare evaluation typical of optimal taxation literature is devoid of any meaning if we are committed to methodological individualism, a central tenet in the economic analysis. In fact, when coining the term "methodological individualism", Schumpeter (1954) wrote: "the self-governing individual constitutes the ultimate unit of social sciences; and that all social phenomena resolve themselves into decisions and actions of individuals that need not or cannot be further analyzed in terms of superindividual factors."

We illustrate how intrahousehold inequality affects the shape and size of taxes with an empirical application that estimates the optimal joint income tax using data from the March 2016 supplement of the Current Population Survey (CPS). We control for the degree of intrahousehold inequality by postulating an equal Pareto weight for all families in the economy. By varying it, we see the impacts of dissonance on optimal taxes.

Our simulations suggest that a planner concerned with the intrahousehold distribution of welfare induces more intense redistribution. In our exercise, the planner only has joint taxes as an instrument for redistributing across households, which will be used to the extreme to achieve a more equitable outcome at the individual level. Compared to the benchmark case without dissonance, the planner induces in our baseline scenario an inequality level, measured by the Gini index, that is 53.8% lower. We envision this result as one of our main contributions. That is, if the social planner is concerned by the individuals' welfare and takes the household decision process seriously, then, even restricted to a joint taxation instrument, s/he can account for the intrahousehold inequality, which represents a significant share of the inequality manifested in the economy. Therefore, the measurement of inequality in the society and the policy prescriptions for overcoming it can be severely affected through the lens of the collective model.<sup>4</sup>

We restrict most of our analysis to the case of joint tax schedules. Despite a growing tendency toward individual taxes, joint tax schedules are still pervasive. The usual rationale for their use is based on horizontal equity principles: one should not treat couples with identical earnings differently. Although we do not necessarily side with this view, we acknowledge the compelling argument by [Gordon and Kopczuk \(2014\)](#), who show that, from an equity perspective, joint taxes are a better departure point for tax design than individual taxes.<sup>5</sup>

In Section 4, we go beyond joint taxation by investigating the welfare gains of gender-based taxation policies. We show that a small tax on the earnings of the least productive spouse redistributes utility toward this spouse. The logic behind this result is that a spouse-specific income tax is indeed a subsidy to the spouse's leisure. Under the assumption that Pareto weights are not affected by the new policy, the distribution of consumption is not altered and the relative utility of the taxed spouse is increased. This effect must, of course, be balanced by the overall decrease in welfare as perceived by the household. Still, when the least productive spouse is also the one with less power – the case emphasized by [Immervoll et al. \(2011\)](#) – optimal policy will typically introduce a small tax on

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<sup>4</sup>With dissonance, the actual interpersonal distribution of income is a mean preserving spread of the one measured under the assumption that household income is evenly split across spouses.

<sup>5</sup>Starting with a schedule that depends only on total household earnings (or on individual earnings in the case of individual taxation), [Gordon and Kopczuk \(2014\)](#) estimate the benefits of conditioning taxes on other observables. They show that departing from separate taxes requires more conditioning and accomplishes less in terms of promoting equity.

this agent.<sup>6</sup> This finding depends on the assumption adopted in almost all of the household taxation literature (Kleven et al. (2009); Immervoll et al. (2011); Cremer et al. (2016)) that household weights are invariant to perturbations to the policy. We make this explicit by considering a very stylized collective model in which household weights depend on the relative net marginal productivity of spouses. The intuitive result is recovered (i.e., taxing a spouse hurts him/her).

The restriction to identical iso-elastic preferences may leave one wondering how general our findings may be. To partially answer this question, we use a tax perturbation approach to derive optimal tax formulae in terms of sufficient statistics with no restrictions on preferences, as in Saez (2001). The presence of dissonance modifies the formula in two important ways. The first is the introduction of an additional sufficient statistic that should be taken into account: the wedge between social values of income and its market price. The second concerns the aggregation of elasticities across households with the same earnings. The multidimensionality of household types leads to heterogeneity in preferences at each earning level. This was already the case in Saez (2001) since he did not impose single-crossing. The novelty here that arises from dissonance is that there is not one but two different relevant aggregated elasticities: the usual average elasticities and a welfare-weighted elasticity.<sup>7</sup>

Government revenues depend on average elasticities in which the average at each level of earning is calculated using the empirical distribution. Yet, elasticities are also important statistics because dissonance makes behavioral responses relevant to welfare.<sup>8</sup> In this case, the average elasticity is obtained by aggregating across households at each earning level using a welfare-adjusted distribution, analogously to the risk adjustment typically used in finance.

For the types of preferences typically used in optimal taxation studies, our optimal tax formula has an ABC plus D representation, which makes it a natural extension of the ABCs formulas first derived by Diamond (1998).

The rest of the paper is organized as follows. After this introduction, we offer a brief literature review. Section 1 describes the economy. The policy objective is carefully discussed in Section 2. In Section 3, we show how the assumption of identical iso-elastic preferences allows us to reduce the dimensionality of the screening program to actually solve the model in terms of primitives. In Section 4, we explore a simple form of gender-dependent perturbation on the joint schedule. Section 5 generalizes the optimal formulae from Section 3 using a tax perturbation

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<sup>6</sup>This finding is also in line with Cremer et al. (2016).

<sup>7</sup>In Saez's words, "It is not necessary to assume that people earning the same income have the same elasticity; the relevant parameters are simply the average elasticities at given income levels" (Saez (2001), p. 210). The complexity introduced by dissonance is the aggregation issue mentioned in footnote 2.

<sup>8</sup>In particular, the envelope arguments used to restrict the welfare consequences of tax perturbations to the mechanical effect cannot be used if there is dissonance.



approach. These formulae are based on sufficient statistics that are not too easy to recover and that furthermore are endogenous to the policy. Our approach in this section highlights the type of assumptions that are needed if the approach is to be put into practice. Section 6 concludes. Proofs are relegated to Appendix C. In Appendix F, we discuss how allowing the extensive margin decisions of secondary earners could change the conclusions of the model.

## Related literature

[Boskin and Sheshinski \(1983\)](#) explore the sub optimality of tax schedules such as the one adopted in the US in which husbands and wives face equal marginal tax rates. They discuss the possibilities of taxing spouses equally or differently, or even subsidizing one of the spouses. They show that taxing the earnings of husbands and wives at the same rate is inefficient because it disproportionately reduces female labor market participation. [Boskin and Sheshinski \(1983\)](#) use a unitary approach and take household (revealed) preferences as the normative criterion to be used by the planner. Moreover, they restrict their analysis to linear taxes. [Bastani \(2013\)](#) extends the analysis of linear taxes to a collective setting in which spouses decide through bargaining.

Also under a unitary approach, [Kleven et al. \(2009\)](#) analyze the general non-linear optimal income tax for couples. In their model, the primary earner chooses labor supply as a continuum (intensive margin), while the secondary earner decides whether or not to participate in the labor market (extensive margin). If the secondary earner opts to participate in the job market, the labor supply is given, whereas in our environment, both spouses choose in the intensive margin.<sup>9</sup> They show conditions under which the optimal tax scheme displays a positive tax on secondary earnings and when those taxes on secondary earnings decrease with primary earnings. [Kleven et al.](#)'s analysis starts from individual taxes and asks whether introducing jointness is optimal. Our analysis in Section 4 takes the exact opposite starting point, (i.e., joint taxes), and asks whether introducing differentiation on marginal taxes can be welfare improving.

Closer to our work are the studies by [Immervoll et al. \(2011\)](#), [Cremer et al. \(2012\)](#), and [Cremer et al. \(2016\)](#). Dissonance, as defined by [Apps and Rees \(1988\)](#), plays a central role in all of these works. [Immervoll et al. \(2011\)](#) simplify their analysis by only considering extensive margin decisions and imposing strong restrictions on the choice sets. [Cremer et al. \(2012\)](#) handle multidimensionality by restricting couple types with the assumption of perfect assortative matching. Finally, [Cremer et al. \(2016\)](#) consider only a finite number of types. However, they consider fully general taxes and show how tax formulae change when compared

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<sup>9</sup>In Appendix F, we extend our analysis and allow for the secondary earner to adjust labor supply in both margins.



to a world without dissonance. The small number of types they consider allows them to focus on a world in which incentive constraints only bind in the usual direction.

[Guner et al. \(2012\)](#) quantify the effects of tax reforms taking carefully into account the labor supply of married women as well as the current demographic structure. Married women have a heterogeneous cost of participating. They analyze how the structure of taxation can affect the participation decision, which is empirically responsive to tax perturbations. In our setting, both men and women have a heterogeneous participation cost, and they do not have the option to file separately if both spouses are working.

Our model is static, so we refrain from discussing the important issues related to the interaction between risk sharing and spouses' labor supply analyzed in [Blundell et al. \(2016\)](#) and [Wu and Krueger \(2019\)](#). However, as in these works, joint labor supply decisions are the essence of our analysis.

## 1 Environment

The economy is inhabited by a continuum of households (or families) with measure normalized to one. Each household is composed of two spouses indexed by  $i \in \{a, b\}$ , where  $a$  identifies the female spouse and  $b$  the male spouse in the household. Each spouse is characterized by a type  $w_i \in [\underline{w}, \bar{w}] \subset \mathbb{R}_+$  denoting individual labor market productivity (or wage rate). Technology is linear as one efficient unit of labor produces one unit of consumption good. Agents are paid their marginal productivity, which implies that the labor income generated by spouse  $i \in \{a, b\}$  whose productivity is  $w_i$  when that spouse supplies  $l_i$  hours of work is given by  $z_i = w_i l_i$ .

Individuals derive utility from the consumption of a private good  $x_i \in \mathbb{R}_+$  and disutility from marketable labor supply  $l_i \in \mathbb{R}_+$  resulting in a total utility given by  $U(x_i, l_i)$ , common to all individuals. Utility  $U : \mathbb{R}_+^2 \rightarrow \mathbb{R}$  is assumed to be strictly quasi-concave, strictly increasing in consumption, strictly decreasing in labor supply, and of class  $\mathcal{C}^2$ .

**Household decision making** We take the multiperson nature of households seriously. We also assume that households are collective, in the sense that household consumption and labor supply choices always result in efficient outcomes, regardless of the bargain protocol they engage in. Therefore, without loss of generality, we can assume that a household whose members have productivities  $(w_a, w_b)$  make consumption and labor supply decisions  $(x_i, l_i)_{i \in \{a, b\}}$  to maximize a Bergso-

nian household utility function of the form

$$(1) \quad \alpha U(x_a, l_a) + (1 - \alpha)U(x_b, l_b),$$

for some Pareto weight  $\alpha \in [0, 1]$ , reflecting the relative contribution of the female spouse to household welfare. Following [Immervoll et al. \(2011\)](#) we assume that  $\alpha$  is exogenous and independent of policy. We impose no restrictions on the relationship between the Pareto weight,  $\alpha$ , and spouses' productivities,  $(w_a, w_b)$ .

Given the previous structure, each household can be parameterized by a triple  $(w_a, w_b, \alpha) \in \Lambda \equiv [\underline{w}, \overline{w}] \times [\underline{w}, \overline{w}] \times [0, 1]$ . This triple will henceforth be referred to as the family type, denoted by  $\iota \equiv (w_a, w_b, \alpha)$ .

**Informationally feasible allocations** We follow the household economics literature by assuming that only total household consumption  $x \equiv x_a + x_b$  is observable outside of the household; that is, consumption cannot be assigned to a specific spouse. Because of this assumption, goods cannot be conditioned on each spouse's consumption.<sup>10</sup> Given this informational structure, bundles that can be associated with a household in any mechanism are of the form  $(x, z_a, z_b) \in \mathbb{R}_+^3$ .<sup>11</sup>

Moreover, in most of this paper (with the exception of Section 4), we restrict our analysis to policies that cannot distinguish the income generated by each of the spouses. In this case, feasible bundles are of the form  $(x, z) \in \mathbb{R}_+^2$ , where  $z \equiv z_a + z_b$  is total income of the household. We call them *aggregate bundles*.

**Tax system** For most of what follows, we focus on joint taxation, which only uses information on total household income  $z = z_a + z_b$ , that is,  $\mathbb{T}(z_a, z_b) = T(z_a + z_b)$ .<sup>12</sup> Therefore, a government with a redistributive objective taxes households using a nonlinear joint income tax schedule,  $T : \mathbb{R}_+ \rightarrow \mathbb{R}$ , assigning a tax liability for each possible level of family income. Call  $\mathcal{T}_0$  the set of all such tax systems. The net of tax income is used in the family consumption  $x = z - T(z)$ .

Studying joint taxation is particularly important because of its empirical rele-

<sup>10</sup>A more general approach is to define assignable and non assignable goods. For the former, the spouse who is actually consuming each quantity can be determined, whereas for the latter, this is not possible. One could also include public goods consumed by both spouses in a nonrivalrous manner. For simplicity, there is only one non assignable private consumption good. This classification is independent of the relation between taxation and labor choices emphasized in this paper.

<sup>11</sup>Equivalently,  $(x, z_a, z_b)$  is such an allocation if and only if  $\phi(x, z_a, z_b) \leq 0$  for some function  $\phi : \mathbb{R}_+^3 \rightarrow \mathbb{R}$ . These are the only budget sets that can be designed to induce a desired allocation by a planner.

<sup>12</sup>The polar opposite is a separable tax schedule – a function  $\mathbb{T} : \mathbb{R}_+^2 \rightarrow \mathbb{R}$  that assigns to each vector of household incomes  $(z_a, z_b) \in \mathbb{R}_+^2$  a tax to be paid  $\mathbb{T}(z_a, z_b) = T(z_a) + T(z_b) \in \mathbb{R}$ , for some  $\mathcal{C}^2$  function  $T : \mathbb{R}_+ \rightarrow \mathbb{R}$ . Any deviation from this separable tax system is not neutral to marital status and may impose a marriage penalty or bonus.

vance.<sup>13</sup> For instance, in the US, couples have the choice of filing taxes individually or jointly. Under the joint tax option, the marginal tax rates depend exclusively on the aggregate income of the household. The overall progressivity of the labor income tax schedule means that filing individually is almost never optimal.<sup>14</sup> Although agnostic about the foundations of joint taxation, we view fairness as an appealing property for its use.

This restriction on the space of feasible mechanisms will be convenient in reducing the number of margins that a government has to take into account in order to align incentives in this multidimensional environment.<sup>15</sup>

**Family problem** As we have argued before, an important characteristic of the household consumption data is that most consumption is not assignable in the sense that only  $x$ , not  $x_a$  and  $x_b$ , is observed by outsiders. Moreover, under the restriction that policy instruments are based on total household earnings, the budget constraint is invariant to the source of labor income, and we can define for a type  $\iota = (w_a, w_b, \alpha)$  family a utility function  $V : \mathbb{R}_+^2 \times \Lambda \rightarrow \mathbb{R}$  as

$$(2) \quad V(x, z, \iota) \equiv \max_{(x_a, x_b), (z_a, z_b) \in \mathbb{R}_+^2} \left\{ \alpha U\left(x_a, \frac{z_a}{w_a}\right) + (1 - \alpha)U\left(x_b, \frac{z_b}{w_b}\right) \right. \\ \left. \text{s.t. } x_a + x_b = x \quad \text{and} \quad z_a + z_b = z \right\}.$$

The utility function  $V$  reflects the collective nature of family decisions and incorporates the intrahousehold allocation decisions of how much each spouse contributes to family income and how resources are distributed between family members.<sup>16</sup> It represents the ordering of  $(x, z)$  bundles by a household composed of spouses with productivities  $w_a$  and  $w_b$  and Pareto weight  $\alpha$ . From this formulation, it is easy to see that different spouses from families choosing the same  $(x, z)$  can achieve very different utility levels depending on their relative productiv-

<sup>13</sup>Cremer et al. (2012) provide conditions under which the government should tax couples jointly.

<sup>14</sup>Ireland and Germany are some other countries that use this type of joint taxation.

<sup>15</sup>Mirrlees (1971) addresses the problem of choosing a fully nonlinear tax system as a screening problem. It has long been recognized that screening problems in multidimensional environments are hard to handle because the absence of an exogenous ordering of willingness to pay or work precludes a simple characterization of the binding constraints. It is also well known that the optimum of these problems usually implies too much *pooling*; see Rochet and Choné (1998), and Rochet and Stole (1987).

<sup>16</sup>If we do not restrict the instruments beyond the informational restriction imposed by the non-assignability of consumption, the household utility for a type  $\iota$  family would be

$$\mathcal{V}(x, z_a, z_b, \iota) \equiv \max_{(x_a, x_b) \in \mathbb{R}_+^2} \left\{ \alpha U(x_a, z_a/w_a) + (1 - \alpha)U(x_b, z_b/w_b) \quad \text{s.t. } x = x_a + x_b \right\}.$$

This last definition will be useful when we consider gender-based policies in Section 4. Of course, we can always define  $V$  in (2) through  $V(x, z, \iota) \equiv \max_{z_b \in \mathbb{R}_+} \mathcal{V}(x, z - z_b, z_b, \iota)$ .

ities and Pareto weights.

Two important assumptions are embedded in this formulation:  $\alpha$  is exogenous to any policy, and the decision process within the family will always lead to an efficient outcome. This latter assumption places our approach in the realm of collective models (e.g., [Chiappori \(1988\)](#) and [Browning and Chiappori \(1998\)](#)). As for the former, we could hold Pareto weights fixed for two plausible reasons. First, Pareto weights could be determined at the marriage stage, as in [Gayle and Shephard \(2019\)](#).<sup>17</sup> Second, as in [da Costa and de Lima \(2019\)](#), the planner may have additional instruments to handle Pareto weights. In both cases, an interesting question we leave for future work is how policies influence the distribution of weights in the long run through marriage markets.

Since intrahousehold transfers are not observed, the allocation of consumption between spouses cannot be directly affected by any policy. Hence, for any feasible policy, household preferences ordering can be represented by the family utility function  $V$ .

## 2 The Planner's Problem

A utilitarian planner with fully flexible tax instruments would eliminate any intrahousehold inequality by setting effort and consumption across spouses accordingly. We take on the more realistic case in which the planner has access to imperfect instruments to influence intrahousehold inequality. In fact, we start with joint tax systems  $T \in \mathcal{T}_0$  that do not discriminate between the sources of income. This section presents an optimal tax calculation to answer the question of how a government can use redistribution between households to achieve redistribution within the family. Family characteristics  $\iota$  are heterogeneous in the population and assumed to be private information of the family. Denote  $F(\iota)$  as their joint distribution over the support  $\Lambda \equiv [\underline{w}, \bar{w}] \times [\underline{w}, \bar{w}] \times [0, 1]$ . The planner can use the tax policy  $T : \mathbb{R}_+ \rightarrow \mathbb{R}$  to influence couples' aggregate decisions and spouses' allocations indirectly. We assume that the planner is restricted to using joint tax schedules  $T \in \mathcal{T}_0$ .

### 2.1 The planner's objective

We have associated with each household  $\iota$  a utility function  $V(x, z, \iota)$  representing its preferences ordering on aggregate bundles. Whether any welfare meaning should be attached to it is a different matter.

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<sup>17</sup>We do not take into account the policy impact on household formation. That is, we assume that couples do not divorce in response to changes in policies, nor do we allow spouses to anticipate those changes at the moment of marriage. [Alm and Whittington \(1999\)](#) find that in the US, the impacts of the income tax on marriage decisions, even when statistically significant, are small.

As [Chiappori and Meghir \(2015\)](#) have pointed out, a welfare metric that does not take into account intrahousehold inequality is inconsistent with any welfare criteria based on individuals, as is the case for utilitarianism. Traditional principles of morals and ethics do not justify the planner taking into account households', instead of individuals', utilities for welfare evaluation. Moreover, intrahousehold inequality is central to the study of redistribution policies. The goal of this paper is exactly to derive the implications of this intrahousehold inequality to the optimal tax theory.

Therefore, even though the planner takes "household preferences" as given, its objective may depend arbitrarily on the utilities of all individuals. We shall focus on an anonymous individual-oriented utilitarian objective (i.e., the planner maximizes the average of all individuals' utilities).

**Dissonance** Under the individual-oriented utilitarian objective, the planner weights equally the utility of spouses in a given couple. Spouses, in contrast, decide using a different objective (1) captured by their Pareto weights  $\alpha$  and  $1 - \alpha$ . The solution to (2) defines consumption  $x_a(x, z, \iota)$  and income  $z_a(x, z, \iota)$  choices for the wife as a selection from the argmax correspondence. We can also directly define the analogous functions  $x_b(x, z, \iota) = x - x_a(x, z, \iota)$  and  $z_b(x, z, \iota) = z - z_a(x, z, \iota)$  for the husband.

Using the notation above household welfare as perceived by the planner is

$$(3) \quad W(x, z, \iota) \equiv \frac{1}{2}U\left(x_a(x, z, \iota), \frac{z_a(x, z, \iota)}{w_a}\right) + \frac{1}{2}U\left(x_b(x, z, \iota), \frac{z_b(x, z, \iota)}{w_b}\right).$$

The function  $W : \mathbb{R}_+^2 \times \Lambda \rightarrow \mathbb{R}$  represents the planner's assessment of individuals' welfare in a household  $\iota$  when consuming the aggregate bundle  $(x, z)$ . Note that  $\alpha$  only affects  $W$  indirectly through its effect on household choices.<sup>18</sup> We can re write (3) as

$$(4) \quad W(x, z, \iota) = V(x, z, \iota) + \left(\frac{1}{2} - \alpha\right) \left[ U\left(x_a(x, z, \iota), \frac{z_a(x, z, \iota)}{w_a}\right) - U\left(x_b(x, z, \iota), \frac{z_b(x, z, \iota)}{w_b}\right) \right].$$

This expression has a nice behavioral analogue. The first term on the right hand side of (4) is the spouses' aggregate utility under the household welfare met-

<sup>18</sup>An interesting parallel can be made between our model and the taxation of behavioral agents in [Farhi and Gabaix \(2020\)](#). From the government's perspective, the utility derived by the family is distorted, thus generating a discrepancy between the *decision utility*,  $V$ , and the *experience utility*,  $W$ . A couple in our model is analogous to a behavioral agent of [Farhi and Gabaix \(2020\)](#) and [Gerritsen \(2016\)](#).

ric (2). It is analogous to the *decision utility*, of some behavioral economics models – see Farhi and Gabaix (2020). The planner’s ordering of bundles,  $W$ , whose analogue is the *experience utility* of behavioral economics does not coincide with the household’s ordering (except when  $\alpha = 1/2$ ). The difference between the two – the second term on the right-hand side of (4) – determines the dissonance between the household and planner welfare metric in the assessment of the spouses’ well-being.

Clearly if  $\alpha = 1/2$ , there is no dissonance. Note that, even if the ordering represented by  $V(x, z, \iota)$  coincides with the one represented by  $W(x, z, \iota)$  (leading to the same choices  $(x, z)$ ), the value assigned by the planner to a unit of consumption good in the hand of each household may still depend on  $\alpha$ . Indeed, the way in which  $(x, z)$  is split between spouses matters and, in the case of equal preferences and productivity, unless household resources are equally divided between the spouses, that is,  $x_a(x, z, \iota) = x_b(x, z, \iota)$  and  $z_a(x, z, \iota) = z_b(x, z, \iota)$ , there would be dissonance even if the household chose  $(x, z)$  exactly as the planner would.<sup>19</sup>

Noting that dissonance will be more pronounced the larger the difference between the Pareto weight  $\alpha$  and  $1/2$  is, we shall formally define the distance between  $\alpha$  and  $1/2$  as our relevant measure of exogenous dissonance.

The existence of dissonance creates a role for public policies that affect household resources by bringing the level of intrahousehold inequality closer to the desired level. The last term in (4) internalizes how the collective decision process affects the decision margins of the individuals vis-à-vis the family’s decision, and it is the only term affected by a taxation policy.

### 3 Optimal Taxation

By the revelation principle, the planner’s problem can be restated in the space of direct mechanisms as

$$\max_{(x, z): \Lambda \rightarrow \mathbb{R}_+^2} \int_{\Lambda} W(x(\iota), z(\iota), \iota) dF(\iota),$$

subject to incentive compatibility constraints: for every  $\iota \in \Lambda$

$$\iota \in \arg \max_{\tilde{\iota} \in \Lambda} V(x(\tilde{\iota}), z(\tilde{\iota}), \iota),$$

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<sup>19</sup>This is the case when instead of using equal weights to both spouses in (3), the planner would follow the weights  $\alpha$  to the wife and  $1 - \alpha$  to the husband as in (1).

where we slightly abused notation in using  $x(\cdot)$  and  $z(\cdot)$  to denote the outcome function associated with the direct mechanism and the resource constraint:

$$\int_{\Lambda} [z(\iota) - x(\iota)] dF(\iota) \geq 0.$$

To circumvent the technical difficulties that arise from the multidimensional nature of the screening problem, we specialize our model in this section. We consider a class of preferences for which the household type collapses into a one-dimensional type with preferences that still possess the single-crossing property. Assume separable preferences of the form  $U(x_i, l_i) = u(x_i) - h(l_i)$  with  $u(x_i) = \ln x_i$  and  $h(l_i) = l_i^{1+\gamma}(1 + \gamma)^{-1}$ . The parameter  $\gamma > 0$  in the disutility of labor is the inverse of the Frisch elasticity of labor supply. Using  $l_i = z_i/w_i$ , we can reparameterize each agent's utility as

$$(5) \quad U(x_i, z_i, \theta_i) = \ln x_i - \theta_i \frac{z_i^{1+\gamma}}{1 + \gamma},$$

where  $\theta_i \equiv w_i^{-(1+\gamma)}$  is referred to as the individual's type. These preferences are in line with the empirical evidence reviewed in [Chetty \(2006\)](#) and are often used in the taxation literature.

Recall our assumptions regarding intrahousehold decision making: families' disposable income  $x = z - T(z)$  is used in the consumption of a private good allocated between spouses  $x = x_a + x_b$  in an efficient way; efficiency is equivalent to assuming that the family maximizes a weighted utilitarian program where  $\alpha \in (0, 1)$  is the Pareto weight assigned to the wife's utility and  $1 - \alpha$  to the husband's utility. This particular parameterization of preferences implies that both spouses always supply a positive quantity of labor. Hence, decisions are taken along the intensive margin. In Appendix F, we discuss participation decisions through the introduction of an additional discrete participation cost. Define  $\underline{\theta} = \overline{w}^{-(1+\gamma)}$  and  $\bar{\theta} = \underline{w}^{-(1+\gamma)}$  to write the family type space as  $[\underline{\theta}, \bar{\theta}] \times [\underline{\theta}, \bar{\theta}] \times (0, 1)$ .<sup>20</sup>

In this simple environment, the problem of a type  $(\theta_a, \theta_b, \alpha)$  family facing a tax schedule  $T : \mathbb{R}_+ \rightarrow \mathbb{R}$  is

$$\max_{\substack{(x_a, x_b) \in \mathbb{R}_{++}^2 \\ (z_a, z_b) \in \mathbb{R}_+^2}} \alpha \left[ \ln x_a - \theta_a \frac{z_a^{1+\gamma}}{1 + \gamma} \right] + (1 - \alpha) \left[ \ln x_b - \theta_b \frac{z_b^{1+\gamma}}{1 + \gamma} \right],$$

subject to

$$x_a + x_b \leq z_a + z_b - T(z_a + z_b).$$

We can split the household decision problem into two stages: (i) the allocation

<sup>20</sup>The choice of  $\ln$  parameterization implies that the utility is not defined under null consumption. This way, family utility will not be well defined when either  $\alpha = 0$  or  $\alpha = 1$ .



of consumption and effort across spouses and (ii) the optimal choice of total consumption and effort given the tax system. For stage (i), the efficient solution to the household consumption allocation problem is

$$\frac{x_a}{x} = \alpha \quad \text{and} \quad \frac{x_b}{x} = (1 - \alpha).$$

If we use this finding directly in the household objective, then household preferences in our model are a particular case of that in [Wu and Krueger \(2019\)](#), in which spouses' Frisch elasticities are identical.

Spouses' contribution to total household income can be expressed in terms of productivities,  $\theta_a, \theta_b$ , and the Pareto coefficient  $\alpha$  as

$$\frac{z_a}{z} = \frac{[(1 - \alpha)\theta_b]^{\frac{1}{\gamma}}}{[(1 - \alpha)\theta_b]^{\frac{1}{\gamma}} + [\alpha\theta_a]^{\frac{1}{\gamma}}} \quad \text{and} \quad \frac{z_b}{z} = \frac{[\alpha\theta_a]^{\frac{1}{\gamma}}}{[(1 - \alpha)\theta_b]^{\frac{1}{\gamma}} + [\alpha\theta_a]^{\frac{1}{\gamma}}}.$$

A spouse's contribution to household income varies negatively with the spouse's own individual Pareto weight; not only consumption but also leisure increases with one's Pareto weight. Individual earnings also vary positively with the spousal productivity gap, which means that more productive spouses work relatively more, holding all other primitives fixed.

Using the previous results, we can rewrite the household utility function for a type  $(\theta_a, \theta_b, \alpha)$  family (defined in (2)) as a function of total earned income,  $z$ , and disposable income  $x$ , as

$$(6) \quad V(x, z, \theta_a, \theta_b, \alpha) = \kappa(\alpha) + \ln x - \omega(\theta_a, \theta_b, \alpha) \frac{z^{1+\gamma}}{1 + \gamma},$$

where  $\kappa(\alpha) \equiv \alpha \ln(\alpha) + (1 - \alpha) \ln(1 - \alpha)$  and

$$(7) \quad \omega(\theta_a, \theta_b, \alpha) \equiv \frac{\alpha(1 - \alpha)\theta_a\theta_b}{\left[[(1 - \alpha)\theta_b]^{\frac{1}{\gamma}} + [\alpha\theta_a]^{\frac{1}{\gamma}}\right]^\gamma}.$$

Two features are worth noting in this household utility function. First, family types only enter the objective through  $\omega(\theta_a, \theta_b, \alpha)$ . Therefore, families whose combinations of  $(\theta_a, \theta_b, \alpha)$  generate the same  $\omega$  share the same objective.<sup>21</sup> We can think of  $\omega(\theta_a, \theta_b, \alpha)$  as a sufficient statistic for the family characteristics when computing the utility of a given aggregate bundle  $(x, z) \in \mathbb{R}_{++} \times \mathbb{R}_+$ . Second,  $\kappa(\alpha)$  is the utility term that depends on  $\alpha$  but not through  $\omega$ , separable from the allocation and, hence, not affected by a tax policy. Let us refer to  $\omega$  as the family unitary type.

Given our assumptions, the problem of a type  $\omega$  household facing a tax sched-

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<sup>21</sup>Total utility would vary if we allow  $\alpha$  to vary across households. It would not change choices, however.

ule  $T : \mathbb{R}_+ \rightarrow \mathbb{R}$  – i.e., stage (ii) – is given by

$$(8) \quad \max_{(x,z) \in \mathbb{R}_{++} \times \mathbb{R}_+} \left\{ \ln x - \omega \frac{z^{1+\gamma}}{1+\gamma}, \quad \text{s.t.} \quad x = z - T(z) \right\}.$$

Again, we want to stress that this problem is shared by all families whose combinations of  $(\theta_a, \theta_b, \alpha)$  generate the same  $\omega$ . This representation allows us to think about the planner's program as if it were a program involving a representative individual for the family whose type is the one-dimensional parameter  $\omega$  and derives utility from the aggregate bundle  $(x, z)$ . Aggregate preferences are well behaved and exogenously ordered with respect to the parameter  $\omega$  (i.e., the *Spence-Mirrlees condition* is satisfied). The first-order necessary condition for the type  $\omega$  family's problem (8) is

$$1 - T'(z) = x\omega z^\gamma.$$

### 3.1 Optimal tax formulae

In the rest of this section, let us consider a government that taxes households using a nonlinear joint income tax schedule  $T : \mathbb{R}_+ \rightarrow \mathbb{R}$  to maximize a utilitarian social welfare function.

**Without dissonance** Assume for the moment, as a benchmark, that the planner follows households' welfare metric respecting the Pareto weights,  $\alpha$  for the wife and  $1 - \alpha$  for the husband. There is no dissonance, and the household-oriented utilitarian planner adopts as a welfare criterion the maximization of households' average utility. As a consequence, families with the same type  $\omega$  should get the same treatment, and the planner's problem is equivalent to the standard [Mirrlees](#) problem, whose solution is given by equation (9) below.

Let  $\psi(\cdot)$  be the probability density function of the random variable  $\omega$  implied, through (7), by the joint distribution of the random vector  $(\theta_a, \theta_b, \alpha)$  and  $\Omega$  its support.<sup>22</sup> In an interval where  $z(\omega)$  is strictly increasing, the marginal tax rate for the optimal nonlinear income joint taxation will be exactly as in [Mirrlees'](#) model:

$$(9) \quad \frac{T'(z(\omega))}{1 - T'(z(\omega))} = \frac{1}{x(\omega)\psi(\omega)\omega} \int_{\omega}^{\bar{\omega}} [x(s) - \mathbb{E}^\psi[x]] \psi(s) ds.$$

This is the usual formula for the marginal tax rate faced by a type  $\omega$  family. In the case of log preferences, the labor wedge increases with the total earnings of families whose types are higher than  $\omega$ . Indeed, a slight increase in taxes raises more revenue the more earnings above  $z(\omega)$  are to be taxed. In particular, there is no distortion at the top because the mass of families above the highest type is null.

<sup>22</sup>The derivation of (9) is standard. We repeat it in Appendix A.1 – Lemma 8 – for completeness.

When the social welfare function is based on household utility, whatever this may mean, the social value of income measured by its shadow price (the Lagrange multiplier) of the resource constraint is equal to the inverse of mean consumption, which is equal to disposable income  $\lambda = \mathbb{E}^\psi[x]^{-1}$ .

Mechanically, all of these results are standard. However, it is noteworthy that the screening variable in this problem is the synthetic parameter  $\omega$ , which is a function of all of the family's characteristics (as in (7)). This fact already makes it clear that the multi-person nature of households should affect the optimal taxes.

**With dissonance** Now let's consider that the planner follows an individual-oriented utilitarian metric, as in (4). The indirect utility of spouses  $a, b$  in a family with total income  $z$ , disposable income  $x$ , type  $(\theta_a, \theta_b, \alpha)$  can be written as (see Lemma 7 in Appendix A.1 for the derivations):

$$V_a(x, z, \theta_a, \theta_b, \alpha) = \ln \alpha - \kappa(\alpha) + V(x, z, \theta_a, \theta_b, \alpha) + [\omega - \omega_a] \frac{z^{1+\gamma}}{1+\gamma}, \quad \text{and}$$

$$V_b(x, z, \theta_a, \theta_b, \alpha) = \ln(1 - \alpha) - \kappa(\alpha) + V(x, z, \theta_a, \theta_b, \alpha) + [\omega - \omega_b] \frac{z^{1+\gamma}}{1+\gamma},$$

where  $V(x, z, \theta_a, \theta_b, \alpha)$ ,  $\kappa(\alpha)$  and  $\omega(\theta_a, \theta_b, \alpha)$  are defined in (6) and (7),

$$(10) \quad \omega_a(\theta_a, \theta_b, \alpha) \equiv \theta_a \left( \frac{[(1 - \alpha)\theta_b]^{\frac{1}{\gamma}}}{[(1 - \alpha)\theta_b]^{\frac{1}{\gamma}} + [\alpha\theta_a]^{\frac{1}{\gamma}}} \right)^{1+\gamma}, \quad \text{and}$$

$$\omega_b(\theta_a, \theta_b, \alpha) \equiv \theta_b \left( \frac{[\alpha\theta_a]^{\frac{1}{\gamma}}}{[(1 - \alpha)\theta_b]^{\frac{1}{\gamma}} + [\alpha\theta_a]^{\frac{1}{\gamma}}} \right)^{1+\gamma}$$

are the *adjusted types* for spouses  $a$  and  $b$ . Adjusted types are synthetic parameters that capture individuals' productivities, the Frisch elasticity, and Pareto coefficients. It varies negatively with individuals' own productivity and Pareto weights. It also varies positively with the spouse's productivity. From now on, we suppress the dependency of  $\omega$ ,  $\omega_a$ , and  $\omega_b$  on  $(\theta_a, \theta_b, \alpha)$  whenever it is convenient.

**Lemma 1.** *The family unitary type  $\omega$  is a weighted average of spouses' adjusted types with weights given by their Pareto weights (i.e.,  $\omega = \alpha\omega_a + (1 - \alpha)\omega_b$ ).*

These adjusted types represent an effective type after considering the household dynamics in a reduced form utility derived from the consumption of the bundle  $(x, z)$ . From (10), we can see that the higher are the Pareto weight  $\alpha$  and the productivity gap  $\theta_a/\theta_b$ , the higher (lower) will be the adjusted type of spouse  $a$  (spouse  $b$ ).

Another important point made explicit by our example is that two households with the same unitary type may differ with regard to  $\kappa(\alpha)$ . This means that, al-

though they make the same decisions, the "total utility" they obtain may differ if we do not use a utilitarian (or weighted utilitarian) metric.<sup>23</sup>

When considering intrahousehold inequality, we need to keep track of all characteristics of the family. However, the preference specification we are working with depends directly on the adjusted types. Therefore, it will be convenient to work with the random vector  $(\omega, \omega_a, \alpha)$  whose density, denoted by  $\hat{\psi}(\omega, \omega_a, \alpha)$ , is implied by the distribution of family characteristics  $(\theta_a, \theta_b, \alpha)$ .<sup>24</sup> Notice that we can always make the following decomposition:  $\hat{\psi}(\omega, \omega_a, \alpha) = \hat{\psi}_c(\omega_a|\omega, \alpha)\hat{\psi}_m(\omega, \alpha)$ . Denote  $\Omega = [\underline{\omega}, \bar{\omega}]$  as the support of  $\omega$  and  $\Omega_a = [\underline{\omega}_a, \bar{\omega}_a]$  as the support of  $\omega_a$ .

In Appendix B, we show how to derive the social welfare criterion of an individual-oriented utilitarian social planner. We present the result in the following lemma.

**Lemma 2.** *The social welfare criterion of an individual-oriented utilitarian social planner (i.e., the planner that weights equally spouses' utility in the welfare metric) is*

$$\int_0^1 \int_{\underline{\omega}}^{\bar{\omega}} \int_{\underline{\omega}_a}^{\bar{\omega}_a} W(x, z, \omega, \omega_a, \alpha) \hat{\psi}(\omega, \omega_a, \alpha) d\omega_a d\omega d\alpha,$$

where

$$(11) \quad W(x, z, \omega, \omega_a, \alpha) = \left(\frac{1}{2} - \alpha\right) \ln \frac{\alpha}{1 - \alpha} + V(x, z, \omega) + \left(\alpha - \frac{1}{2}\right) \left(\frac{\omega_a - \omega}{1 - \alpha}\right) \frac{z^{1+\gamma}}{1 + \gamma},$$

for  $\omega = \alpha\omega_a + (1 - \alpha)\omega_b$ , and  $\omega_a$  and  $\omega_b$  defined in (10).

The function  $W : \mathbb{R}_+^2 \times \Omega \times \Omega_a \times (0, 1) \rightarrow \mathbb{R}$  represents the welfare derived by the planner from offering bundle  $(x, z)$  to a family with adjusted types  $\omega$  and  $\omega_a$  and Pareto weights  $\alpha$  for the wife. The last term in (11) internalizes how the collective decision process affects the decision margins of the individuals *vis-à-vis* the family's decision. The dissonance between the family's utility and the planner's welfare is exacerbated by the higher adjusted types discrepancy and the Pareto weight. As expected, if  $\alpha = 1/2$ , there is no tension between spouses in the household collective decision, and consequently the planner's welfare metric becomes the family's utility function. Note also that, for couples whose spouses have the same adjusted type, the household decision process only affects the planner's welfare in level.

It is convenient to write the problem as choosing a utility level for the family,  $v(\omega)$ , an income level,  $z(\omega, \omega_a, \alpha)$ , depending on both adjusted types, and letting consumption be implicitly defined by  $x(v(\omega), z(\omega, \omega_a, \alpha), \omega, \omega_a, \alpha)$ . The planner's

<sup>23</sup>Note also the role played by log preferences for consumption under the utilitarian metric. Were we to preserve an iso-elastic specification for preferences,  $u(c) = c^{1-\sigma}(1 - \sigma)^{-1}$ , but with a different value for  $\sigma$ , then  $\alpha$  would directly affect the social value of money in the hands of the households beyond its role in determining  $\omega$ .

<sup>24</sup>From  $\omega = \alpha\omega_a + (1 - \alpha)\omega_b$ , we can pin down the husband adjusted type  $\omega_b$ .

problem determines  $v : \Omega \rightarrow \mathbb{R}$  and  $z : \Omega \times \Omega_a \times (0, 1) \rightarrow \mathbb{R}$  to solve:

$$\max_{v(\cdot), z(\cdot)} \int_0^1 \int_{\underline{\omega}}^{\bar{\omega}} \int_{\underline{\omega}_a}^{\bar{\omega}_a} \left[ v(\omega) + \left( \alpha - \frac{1}{2} \right) \left( \frac{\omega_a - \omega}{1 - \alpha} \right) \frac{z(\omega, \omega_a, \alpha)^{1+\gamma}}{1 + \gamma} \right] \hat{\psi}(\omega, \omega_a, \alpha) d\omega_a d\omega d\alpha,$$

subject to incentive compatibility constraints:

$$(\omega, \omega_a, \alpha) \in \arg \max_{(\tilde{\omega}, \tilde{\omega}_a, \tilde{\alpha}) \in \Omega \times \Omega_a \times (0, 1)} \left[ \ln x(\tilde{\omega}, \tilde{\omega}_a, \tilde{\alpha}) - \omega \frac{z(\tilde{\omega}, \tilde{\omega}_a, \tilde{\alpha})^{1+\gamma}}{1 + \gamma} \right],$$

for every  $\omega \in \Omega$ ,  $\omega_a \in \Omega_a$ , and the budget constraint:

$$\int_0^1 \int_{\underline{\omega}}^{\bar{\omega}} \int_{\underline{\omega}_a}^{\bar{\omega}_a} [z(\omega, \omega_a, \alpha) - x(v(\omega), z(\omega, \omega_a, \alpha), \omega, \omega_a, \alpha)] \hat{\psi}(\omega, \omega_a, \alpha) d\omega_a d\omega d\alpha \geq 0.$$

The assumption of iso-elastic disutility of labor allows us to disentangle the dissonance between the collective behavior in the family and the individualistic preferences of the government. In fact, by (6) the family type  $\omega$  is a sufficient statistic for the preference of the family. By the revelation principle, all families with the same type choose the same allocation when facing a given tax schedule. Hence, despite dissonance, any incentive compatible allocation should give the same allocation to families with the same  $\omega$ . Without loss, we can therefore focus on a direct mechanisms of the form  $v : \Omega \rightarrow \mathbb{R}$  and  $z : \Omega \rightarrow \mathbb{R}$ . The following lemma states the necessary and sufficient conditions for an allocation to be implementable.

**Lemma 3.** *The set of implementable allocations is characterized by the local incentive conditions; that is,  $v : \Omega \rightarrow \mathbb{R}$  and  $z : \Omega \rightarrow \mathbb{R}$  are implementable if and only if*

- i) For each  $\omega \in \Omega$ ,  $\dot{v}(\omega) = z(\omega)^{1+\gamma}/(1 + \gamma)$ ;
- ii)  $z(\omega)$  is increasing in  $\omega$ .

The next proposition characterizes the optimal taxation.

**Proposition 1.** *Let the social welfare function be individual-oriented utilitarian. In all intervals where  $z(\omega)$  is strictly increasing, the marginal tax rate for the optimal (nonlinear) income joint taxation is*

$$(12) \quad \frac{T'(z(\omega))}{1 - T'(z(\omega))} = \frac{1}{\psi(\omega)x(\omega)\omega} \int_{\omega}^{\bar{\omega}} [x(s) - \mathbb{E}^{\psi}[x]] \psi(s) ds - \frac{\mathbb{E}^{\psi}[x]}{x(\omega)\omega} \left[ \int_0^1 \left( \alpha - \frac{1}{2} \right) \left( \frac{\mathbb{E}[\omega_a|\omega, \alpha] - \omega}{1 - \alpha} \right) \phi(\alpha|\omega) d\alpha \right],$$

where  $\psi(\omega)$  is the marginal density of the random variable  $\omega$  and  $\phi(\alpha|\omega)$  is the density of  $\alpha$  conditional on a given  $\omega$ .

*Proof.* See Appendix C. □

**Corollary 1.** *The social value of income measured by the shadow price (the Lagrange multiplier) of the government budget constraint is equal to the inverse of mean consumption (disposable income)  $\lambda = \mathbb{E}^\psi[x]^{-1}$ .*

The first term in the formula for the optimal joint taxation is analogous to the case in which there is no dissonance; let us refer to this as the standard term. The last term in the formula, which we will refer to as the dissonance term, represents the additional distortion that the government promotes because of the dissonance.<sup>25</sup>

For the next corollary, we postulate an equal  $\alpha$  for all families in the economy. This fixes the degree of intrahousehold inequality and allows us to see more clearly how the planner wants to distort marginal taxes to influence the decisions of consumption/labor supply within the family and ultimately influence the distribution of well-being of the individuals.

**Corollary 2.** *Let the social welfare function be individual-oriented utilitarian. Suppose additionally that the Pareto weight  $\alpha$  is constant across all households. Then, in all intervals where  $z(\omega)$  is strictly increasing, the marginal tax rate for the optimal (nonlinear) income joint taxation is*

$$(13) \quad \frac{T'(z(\omega))}{1 - T'(z(\omega))} = \frac{1}{x(\omega)\psi(\omega)\omega} \int_{\omega}^{\bar{\omega}} [x(s) - \mathbb{E}^\psi[x]] \psi(s) ds - \frac{\mathbb{E}^\psi[x]}{x(\omega)\omega} \left( \alpha - \frac{1}{2} \right) \left( \frac{\mathbb{E}[\omega_a|\omega] - \omega}{1 - \alpha} \right).$$

A smaller marginal tax provides a higher incentive for households to increase their income, and, as a consequence, it increases the incentives for productive types to work more. There is also a welfare redistribution from high-skilled to low-skilled workers within the household. In other words, household bargaining plays the redistributive role previously played by the taxation mechanism. On the other hand, when the most productive spouse has more weight, the family's

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<sup>25</sup>This dissonance term directly depends on the exogenous dissonance,  $\alpha - 1/2$ . It can be interpreted as a Pigouvian adjustment that we show in Section 5 to be a welfare-adjusted dissonance coefficient,  $\xi(z)$ , with an explicit expression given by (18). For the specification of preferences used in this section,  $\xi(z)$  takes a simple (independent of  $z$ ) form:

$$\xi(z) = \frac{0.5\omega_a + 0.5\omega_b}{\alpha\omega_a + (1 - \alpha)\omega_b}.$$

Note, however, that the adjustment term may still depend on the specific earnings level,  $z$ . The reason is twofold. First the welfare adjustment (social welfare weight) usually does depend on  $z$ . Second, as one can see from (19), to obtain the adjustment term, one must aggregate across all households  $(\theta_a, \theta_b, \alpha)$  that choose  $z$ , which may vary across different  $z$ 's.

income depends more on higher-skilled private interest. Therefore, more progressive tax schedules are redistributed from families with a more productive powerful spouse to families with a less productive powerful spouse. Thus, the optimal marginal tax increases when compared to the one derived in the standard case.

### 3.2 Numerical Simulations

We now compute the marginal tax rate derived in Proposition 1 and Corollary 2 using real data from the March 2016 extract of the CPS. This exercise will provide a quantitative assessment of how family decision making affects the size and shape of optimal joint income taxes. In Appendix E, we have a detailed exposition of the implementation based on a discrete grid of the income distribution adapted from [Mankiw et al. \(2009\)](#) to our model.

We restrict our sample to married spouses whose incomes are strictly positive. As in [Mankiw et al. \(2009\)](#), we use hourly wages as a proxy for productivity.<sup>26</sup> The parameter  $\gamma$  in the disutility of labor is set to be equal to  $\gamma = 1.5$ , implying a Frisch elasticity of labor supply of 0.66. It is important to note that the effects uncovered in our numeric assessment are heavily dependent on the degree of assortative matching. In these simulations, we implicitly use the degree inherent to our sample, which is equal to 0.2129 when measured by the correlation between spouses' hourly wages.

For this policy evaluation, we postulate that all families share the same Pareto weight  $\alpha$ . Although unrealistic, this simplification has two main advantages that help us in the implementation and interpretation of the forces behind the optimal taxes. The first main advantage is computational as the assumption simplifies the optimal taxation formula – Corollary 2 – thus reducing the need to do additional integration and to estimate the distribution of Pareto weights conditional on family unitary type  $\omega$ . The second and more important benefit of this simplifying assumption is that by fixing the degree of intrahousehold inequality, we are able to isolate its impact on tax prescriptions. The degree of household inequality is held fixed because in our model a constant share of the family's resources, entirely determined by  $\alpha$ , goes to each spouse. We highlight the importance of intrahousehold inequality by repeating our exercises in three different scenarios:  $\alpha = 0.3, 0.5, 0.7$ .

The  $\alpha = 0.3$  scenario corresponds to the situation in which the female spouse has a low weight on the family utility function and gets a small share of family resources for her private consumption. The  $\alpha = 0.7$  is the opposite scenario in which the male spouse has a low weight and a small share of family resources. In the  $\alpha = 0.5$  scenario, resources are equally distributed between the spouses, and

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<sup>26</sup>In Appendix F, we show how to consider families in which one of the spouses earns no income, which allows for participation decisions.



this is the implicit assumption made whenever a household-oriented approach is taken. Under this assumption, the marginal tax rate in Corollary 2 depends on the distributions of the family unitary type  $\omega$ , its distribution  $\psi(\omega)$ , as well as the distribution of the modified type  $\omega_a$  conditional on  $\omega$ ,  $\phi(\omega_a | \omega)$ . We calculate these distributions from the knowledge of the empirical wage distribution.

Figure 1 displays the relationship of female adjusted types  $\omega_a$  and the family unitary type  $\omega$ . It displays a scatter plot of the families in our sample along with the estimated conditional expectation  $\mathbb{E}[\omega_a | \omega]$  (dashed blue line) implemented non-parameterically using kernel regression.

[ FIGURE 1 ABOUT HERE ]

In Figure 1, we can see how the adjusted types change with  $\alpha$ . The intuition is that types are adjusted to compensate for the bargaining power within the family. For instance, adjusted types work as if we boost types for spouses with a smaller Pareto weight in the reduced-form utility.

Comparing the three panels in Figure 1, we see that the impact of collective decision making can be empirically relevant. As  $\alpha$  increases,  $\mathbb{E}[\omega_a | \omega]$  decreases. An interpretation is that the greater the woman's welfare weight for a given family type, the more her welfare relies on it and the less it relies on her original productivity: a greater fraction of household earnings is assigned to the husband. Hence, we expect that decreasing the woman's adjusted type will be needed.

Recall the formula for the optimal marginal tax rate in Corollary 2. The last term on the right-hand side of this formula is the additional distortion that the planner imposes to influence the intrahousehold decision process. It depends on the determinants of collective decision making  $\alpha$  and the conditional expectation  $\mathbb{E}[\omega_a | \omega]$  as well as the determinants of behavioral responses.

Figure 2 displays the optimal marginal tax rate as a function of the family unitary type  $\omega$ . Each graph displays four curves. In solid green is the optimal marginal tax rate, as in Corollary 2, where the planner maximizes individual-oriented utilitarian criteria. We decompose this optimal marginal tax in two terms. The first term on the right-hand side in (13), which we refer to as the standard term, is the dashed pink line with diamond markers, and the second term on the right-hand side in (13), which we refer to as the dissonance term, is the point-wise blue line with square markers. Lastly, the solid red line is the optimal marginal tax rate, as in (9), where the planner maximizes household-oriented utilitarian criteria. Note that it is the household marginal cost of effort  $\omega$  in the horizontal axis; rich families are the low types.

[ FIGURE 2 ABOUT HERE ]

By comparing these curves, we obtain a better insight into the contribution of each force. The first thing to notice is that even though the standard term

(dashed pink line with diamond markers) results from the same expression of optimal marginal tax without dissonance, its contribution to the optimal tax with dissonance is not the same. This happens because, in the case of dissonance, the planner chooses a different allocation to implement.

[ FIGURE 3 ABOUT HERE ]

Figure 3 highlights the difference between the standard Mirrless tax rates and the Pigouvian correction introduced by dissonance. Ignoring this correction can lead to significant distortions in the optimal policy.

The dissonance term is the additional distortion the planner wants to induce. As we see, this term can be negative, and its absolute value can be bigger than the standard term. When this happens, it leads to a marginal subsidy. This marginal subsidy is a new feature of optimal marginal tax rates, not possible in standard Mirrleesian models.

By placing the graphs for the different  $\alpha$ s side by side, one highlights the influence of collective decision making on optimal taxes. Naturally, when  $\alpha = 0.5$ , the dissonance term vanishes and both optimal marginal tax rates coincide.

[ FIGURE 4 ABOUT HERE ]

To facilitate the comparison between different  $\alpha$ s in the tax schedule, we plot in Figure 4 the optimal tax rates with dissonance for all the  $\alpha$ s in the same graph. When the distribution of resources is biased toward the most productive spouse (case  $\alpha = 0.7$ ), the planner implements more distortions than in the case in which the distribution of resources is biased toward the least productive spouse (case  $\alpha = 0.3$ ). In any of those cases, the planner will impose additional distortions on joint income through taxes or subsidies at the margin to influence intrahousehold inequality. We will return to this issue momentarily.

Typically, the modified term has a U-shaped format, starting high for low values of the family unitary type  $\omega$  and steadily decreasing up to a point where it becomes negative.

### **Inter and Intrahousehold Inequality**

A fruitful way of expressing the importance of taking individual welfare into account is obtained by contrasting the distribution of income across households with the distribution of income across individuals.

[ FIGURE 5 ABOUT HERE ]

Figure 5 displays the Lorenz curves implied by the optimal taxation for both households and individuals. Whenever preferences are separable, and the utility of consumption is identical for the two spouses, then interpersonal inequality

exceeds inter household inequality. Heuristically, under the former criterion, one takes into account that spouses with low power in poor households have incomes that are substantially smaller than spouses with high power in rich households. Under the latter, it is only the average consumption of spouses in these two households that matters.

[ Table 1 ABOUT HERE ]

Table 1 collects the inequality achieved in the scenarios in which the planner maximizes individual-oriented and household-oriented utilitarian criteria. This is the policy object that is relevant in the equity-efficiency trade-off that constitutes the core of the optimal taxation problem.

The planner with limited instruments uses redistribution across households to directly influence redistribution within households. This leads to a stronger preference for redistribution than one would observe if only household inequality were taken into account.

## 4 Gender-based Policies

The study of Kleven et al. (2009) is perhaps the main reference for the optimal taxation of couples under a mechanism design approach. The complexities related to the multidimensional nature of the problem are circumvented by assuming that primary earners make choices along the intensive margin and secondary earners along the extensive margin only, and by focusing on individual taxation. By introducing the notion of jointness in tax schedules, they explore the usefulness of making the marginal tax rates of one spouse dependent on the earnings of the other.

In this paper, we start from the opposite perspective: tax schedules characterized by income splitting, for which marginal tax rates are always equalized across spouses. In this Section we introduce a small linear marginal tax,  $t$ , on the gross income of spouse  $a$  at all income levels. The nonlinear income schedule then applies to total household income after this tax. Note how this reform has a heterogeneous impact on couples with identical  $z$  depending on how earnings are distributed across spouses.<sup>27</sup>

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<sup>27</sup>When the budget constraint distinguishes the source of income, one must make explicit the impact of a reform on each different source of taxable income (i.e.,  $z_a$  or  $z_b$ ). Yet, because the baseline schedule is of the form  $\mathcal{T}(z_a, z_b) = T(z_a + z_b)$ , the behavioral impact of any reform on tax revenues depends only on  $dz = dz_a + dz_b$ , but not on  $dz_a$  or  $dz_b$  separately. If we let  $1 = (1, 1)$ , then  $dz = 1 \cdot (dz_a, dz_b)$ . Revenue impacts are captured by the same general expressions derived in Section 5.

## 4.1 Combining joint and individual instruments

Let spouse  $a$  be subjected to an individual linear income tax with constant (positive or negative) rate  $t \in \mathbb{R}$ . Note that this tax is raised on spouse  $a$ 's gross income leading to a new value,  $z = z_a(1 - t) + z_b$ , for household taxable income. This type of taxation adds gender-based incentives to the tax system since the marginal tax rate faced by each spouse is not the same, as opposed to our baseline case. Note that the marginal tax rate on the income produced by spouse  $a$  is not  $T'(z) + t$ , but  $T'(z)(1 - t) + t$ .

Moreover, this tax shifts effort toward spouse  $b$ . Indeed, it is straightforward to check that

$$(14) \quad \frac{z_a}{z_b} = \left[ \frac{(1 - \alpha)\theta_b(1 - t)}{\alpha\theta_a} \right]^{\frac{1}{\gamma}}.$$

For small tax  $t$ , spouse  $b$  is "relatively more productive".

To understand the impact of  $t$  on household income, it is worth noting that household preferences can once again be represented by a utility function of the form

$$V(x, z, \theta_a, \theta_b, \alpha, t) = \kappa(\alpha) + \ln x - \omega(\theta_a, \theta_b, \alpha, t) \frac{z^{1+\gamma}}{1 + \gamma},$$

where  $\kappa(\alpha) \equiv \alpha \ln(\alpha) + (1 - \alpha) \ln(1 - \alpha)$  is fully determined by  $\alpha$  and

$$\begin{aligned} \omega(\theta_a, \theta_b, \alpha, t) \equiv & \alpha\theta_a \left[ \frac{[(1 - \alpha)\theta_b(1 - t)]^{\frac{1}{\gamma}}}{[(1 - \alpha)\theta_b(1 - t)]^{\frac{1}{\gamma}} + [\alpha\theta_a]^{\frac{1}{\gamma}}} \right]^{1+\gamma} + \\ & (1 - \alpha)\theta_b \left[ \frac{[\alpha\theta_a]^{\frac{1}{\gamma}}}{[(1 - \alpha)\theta_b(1 - t)]^{\frac{1}{\gamma}} + [\alpha\theta_a]^{\frac{1}{\gamma}}} \right]^{1+\gamma} \end{aligned}$$

is a family type unitary type and a function of spouses' types, the Pareto weight, and the tax rate.

The tax  $t$  on  $\omega$  affects household productivity by increasing the relative importance of spouse  $b$ 's productivity. Hence,  $\omega$  may increase with  $t$  or decrease with  $t$  depending on  $(1 - \alpha)\theta_b > \alpha\theta_a$  and on  $\gamma$ .

We can further simplify the expressions above if we define

$$\zeta_a(t) = \frac{[(1 - \alpha)\theta_b(1 - t)]^{\frac{1}{\gamma}}}{[(1 - \alpha)\theta_b(1 - t)]^{\frac{1}{\gamma}} + [\alpha\theta_a]^{\frac{1}{\gamma}}} \quad \text{and} \quad \zeta_b(t) = \frac{[\alpha\theta_a]^{\frac{1}{\gamma}}}{[(1 - \alpha)\theta_b(1 - t)]^{\frac{1}{\gamma}} + [\alpha\theta_a]^{\frac{1}{\gamma}}}.$$

In fact, we get  $z_a = \zeta_a z$ ,  $z_b = \zeta_b z$  and  $\omega(t) = \alpha\theta_a\zeta_a(t)^{1+\gamma} + [1 - \alpha]\theta_b\zeta_b(t)^{1+\gamma}$ . Note that the marginal tax rate faced by each household in the definition of the program is also changed by  $t$ . Indeed, we can use (14) to write the household

budget constraint as

$$x = z [1 - t\zeta_a(t)] - T(z [1 - t\zeta_a(t)]).$$

This shows that, although household productivity  $\omega$  may be increased by  $t$ , the marginal tax rate faced by the household is always increased by  $t$ . It is not hard to show, by simple envelope arguments, that the impact on the utility *as perceived by the household* is unambiguously negative. In the absence of dissonance, this negative impact is the one that must be compared with the positive revenue impact to assess the value of a small tax reform.

When dissonance is taken into account, however, the utility *as perceived by the planner* need not decrease. We have seen that  $t$  acts as a subsidy on spouse  $a$ 's leisure. Moreover,  $t$  has no impact on how total consumption is shared by spouses. Hence, a positive  $t$  produces a redistribution of utility from spouse  $b$  to spouse  $a$ , which is valued by the planner when  $\alpha < 1/2$ . This welfare gain must be, in general, compared with the overall loss associated with higher taxes.

Alternatively, note that a small tax  $t$  on  $z_a$  will increase tax revenues. To keep the balanced budget, one could simply reduce  $T(\cdot)$  by an amount  $H$  such that

$$tz\zeta_a(t) + T(z(1 - tz\zeta_a(t))) - H(z(1 - tz\zeta_a(t))) = T(z).$$

Recall that since  $\alpha$  is the same for all couples, a  $(\theta_a, \theta_b, \alpha)$  couple may be equally represented by  $(\omega, \omega_a)$ . Using this representation, the introduction of a small  $t$  must be accompanied by a decrease in marginal tax rates captured by

$$h(\omega, \omega_a) = \hat{\zeta}_a(\omega, \omega_a)z[1 - T'(z)],$$

where  $\hat{\zeta}_a(\omega, \omega_a) = \zeta_a(0)$  for a type  $(\omega, \omega_a)$  couple.

Two things about this expression are worth noting. First, the reduction in the marginal tax rate would have to differ for two couples with the same earnings if the share earned by  $a$  differs. Second, because  $z$  is a function of  $\omega$  only, all the dependency on  $\omega_a$  is through  $\hat{\zeta}_a(\omega, \omega_a)$ . This allows us to write the feasible reform in which

$$H(z(\omega)) = z(\omega)[1 - T'(z(\omega))]\mathbb{E}_{\omega_a} [\hat{\zeta}_a(\omega, \omega_a)|\omega].$$

Such reform distributes income from couples with a high participation of  $z_a$  on total income (high  $\hat{\zeta}_a(\omega, \omega_a)$ ) toward couples with low participation. Since we are holding  $\alpha$  fixed across households, this redistribution is toward couples with very asymmetric productivities between spouses. With log utility for consumption, the planner weights money in the hands of couples only by  $z$  and not by how it is distributed across spouses. Hence, the merits of this reform only depend on whether the redistribution of utility from  $b$  to  $a$  justifies the inefficiency generated

by the misallocation of effort across spouses. If the planner's metric puts more weight on spouse  $a$  than couples do, then, for a small enough  $t$ , the answer is yes.

### A parametric tax function

Assume that the initial joint tax schedule is of the form used by [Musgrave \(1959\)](#), [Bénabou \(2000\)](#), and [Heathcote et al. \(2017\)](#) (i.e.,  $T(z) = z - \chi z^{1-\kappa}$ ). Then, assume that a small tax  $t$  is introduced in the income earned by spouse  $a$ . The tax base is now  $\tilde{z} = z [1 - t\zeta_a(t)]$ . The household budget constraint becomes

$$x = z [1 - t\zeta_a(t)] - \{z [1 - t\zeta_a(t)] - \chi [z [1 - t\zeta_a(t)]]^{1-\kappa}\} = \chi [1 - t\zeta_a(t)]^{1-\kappa} z^{1-\kappa}.$$

The impact on the household constraint is to reduce  $\chi$  to  $\chi [1 - t\zeta_a(t)]^{1-\kappa}$ . Given the preferences we are using (log in consumption), this has no impact on household labor supply. Indeed,

$$z = \left[ \frac{1 - \kappa}{\omega(\theta_a, \theta_b, \alpha, t)} \right]^{\frac{1}{1+\gamma}}$$

is the same expression we would obtain without  $t$ , if  $\omega$  were held fixed. So, the effect of  $t$  on labor supply is completely captured by how taxes change  $\omega$ .

[ FIGURE 6 ABOUT HERE ]

Again, the impact is heterogeneous across households with identical earnings,  $z$ , depending on the fraction  $\zeta_a(t)$  of their income that is earned by spouse  $a$ . Figures 6 and 7 display the impact of introducing a small tax,  $t > 0$ , on spouse  $a$ 's earnings on the aggregate disutility of effort for couples which, absent this gender specific tax, would have the same  $\omega$  and hence the same earnings.

[ FIGURE 7 ABOUT HERE ]

Regarding utility,  $t$  also has a direct impact on utility since it reduces household consumption through  $\chi [1 - t\zeta_a(t)]^{1-\kappa}$ . If a revenue preserving reform is considered (i.e., if  $\chi$  is increased to compensate for the extra resources raised by  $t$ ), then for the couples for which consumption is increased, the welfare of spouse  $a$  necessarily increases.

[ FIGURE 8 ABOUT HERE ]

Figure 8, left panel, displays the impact on each spouse's utility and on  $V$ , the planner's assessment of household utility, of introducing a small tax  $\tau_a = 5\%$  on spouse  $a$ 's earnings. It is apparent that spouse  $a$  always benefits. Since  $\chi$  is adjusted to hold total government revenues fixed, there is also a redistribution from

households in which spouse  $a$ 's earnings are a higher proportion of household income to households in which it is a lower proportion. The right panel makes it clear that the "intuitive" policy of subsidizing  $a$  reduces her welfare.

[ FIGURE 9 ABOUT HERE ]

In Figure 9, we consider different values for spouse  $a$ 's productivity and show that the pattern remains. If there is no dissonance, as in the right panel of Figure 8, then the share of families that lose, according to the planner's metric, increases substantially.

### Policy-dependent threat points

The apparently paradoxical finding that taxing  $a$  leads to an increase in her utility crucially depends on the absence of household production and the assumption that power, as captured by  $\alpha$ , is unaffected by policy.<sup>28</sup> Immervoll et al. (2011), who make the same assumption regarding the Pareto weights, justify it by assuming that weights depend on the utilities attained by singles, which, they claim, are unaffected by the taxation of couples. Although this argument has merit, one must also recognize that, under a collective approach, changes in a household budget set may have an indirect impact on choices through changes in the household objective. In our model, this amounts to  $\alpha$  possibly being affected by policy.

We show how this collective feature may overturn the counter intuitive finding from the previous policy evaluations and restore the more commonsense view that taxing wives hurts them.

Let

$$z = z_a(1 - \tau) + z_b.$$

Note that the gross income produced by such household is  $\hat{z} = z_a + z_b = z + \tau z_a$ . Since  $y = z_a(1 - \tau) + z_b - T(z_a(1 - \tau) + z_b) = z - T(z)$ , we shall focus on this variable for the purpose of understanding household choices. To simplify the terminology we shall refer to  $z = z_a(1 - \tau) + z_b$  as earnings and  $\hat{z} = z_a + z_b$  as gross income.

Spouses generate earnings efficiently by solving

$$\mathcal{V}_\tau(z, \alpha, w_a, w_b) = \min_{z_a} \left\{ \alpha \left( \frac{z_a}{w_a} \right)^{1+\gamma} + (1 - \alpha) \left( \frac{z - z_a(1 - \tau)}{w_b} \right)^{1+\gamma} \right\},$$

which has, as a first-order condition,

$$\alpha \frac{z_a^\gamma}{w_a^{1+\gamma}} = (1 - \alpha) \frac{[z - z_a(1 - \tau)]^\gamma}{w_b^{1+\gamma}} (1 - \tau)$$

<sup>28</sup>With household production, income taxes are subsidies to household goods. If spouse  $b$  has a stronger taste for household goods, the findings may be reversed.



or

$$\frac{\alpha}{(1-\alpha)(1-\tau)} \frac{w_b^{1+\gamma}}{w_a^{1+\gamma}} z_a^\gamma = [z - z_a(1-\tau)]^\gamma.$$

Now, the crucial assumption we make in the spirit of the collective approach is that<sup>29</sup>

$$\alpha = \frac{w_a(1-\tau)}{w_a(1-\tau) + w_b}.$$

In this case, we find that the wife's earnings as a share of earnings,  $z$ , are

$$z_a = \frac{w_a}{w_b + w_a(1-\tau)} z,$$

which we could also have written as a function of the household's gross income,  $\hat{z}$ , as  $z_a = w_a \hat{z} / (w_b + w_a)$ .

A little bit of algebra allows us to write the household aggregated disutility of effort,  $\alpha n_a^{1+\gamma} / (1+\gamma) + (1-\alpha) n_b^{1+\gamma} / (1+\gamma)$ , as

$$\hat{\mathcal{V}}_\tau(w_a, w_b) = \frac{1}{1+\gamma} \left( \frac{z}{w_b + w_a(1-\tau)} \right)^{1+\gamma}.$$

Now, letting  $\omega_\tau(w_a, w_b) = (w_a(1-\tau) + w_b)^{-1-\gamma}$ , then the household optimal earnings decision problem can be written more simply as

$$\max_z \left\{ \ln(z - T(z)) - \omega_\tau(w_a, w_b) \frac{z^{1+\gamma}}{1+\gamma} \right\}.$$

Introducing a gender-dependent tax,  $\tau$ , involves three consequences for the gender being taxed. First, as before, the reward from this spouse's effort is less rewarded. This is a force toward increasing her leisure. However, the "collective" nature of couples means that as the spouse's ability to contribute to the couple reduces, so does her entitlement to the household surplus. Under the specific assumption we have made about  $\alpha$  as a function of  $(w_a(1-\tau), w_b)$ , the amount of effort (hence, leisure) per unit of gross income  $\hat{z} = z_a + z_b$  is not changed by taxes. Second, the tax is, for all purposes, making the household less productive from a private perspective since a unit of gross income  $\hat{z}$  is converted to  $z = \hat{z} - \tau z_a < \hat{z}$  units of taxable income. Finally, a lower  $\alpha$  implies that spouse  $a$  gets a smaller share of  $z - T(z)$ .

Hence, in contrast with the case most frequently explored in the literature, if one takes the collective nature of households seriously, the "intuitive" result reappears.

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<sup>29</sup>The collective approach allows the share of household income that is received by each spouse to affect the allocation. In empirical works, exogenous variables – usually unearned income – are used. Here, we use *net* productivity to affect weights.

## 5 Generalizing Preferences: The Tax Perturbation Approach

In the previous sections, we were able to fully characterize the optimal tax schedules when spouses share the same iso-elastic preferences. This section uses a tax perturbation approach to provide expressions for the optimal marginal tax rate for the case in which preferences are fully general.

When restricted to taxes in the class  $\mathcal{T}_0$  of tax schedules characterized by income splitting, as we learned from our aggregation result, the planner faces households who behave as if they were an individual with a single labor income  $z$  and consumption  $x$ . This result makes our environment similar to [Mirrlees'](#) original formulation, whose solution can be locally characterized using the perturbation methods in [Saez \(2001\)](#). The main advantage of this approach is the derivation of optimal tax formulae using a few empirically relevant sufficient statistics.

As in [Goloso et al. \(2014\)](#), the first step is to compute the welfare and revenue effects of perturbing the baseline schedule in the direction of an arbitrary reform  $H : \mathbb{R}_+ \rightarrow \mathbb{R}$ , which amounts to computing its Gateaux differential. That is, consider a reform whereby the current schedule is replaced by a new one,  $\tilde{T} = T + \mu H$ , for  $\mu \in \mathbb{R}$ . When the reform  $H$  is a  $\mathcal{C}^2$  function, for small values of  $\mu$  the resulting tax schedule is a *perturbed* version of the baseline tax and lies within its neighborhood. This section restricts taxes to the class of joint taxation  $\mathcal{T}_0$ . Given a baseline tax system  $T \in \mathcal{T}_0$ , we say that the perturbation  $H : \mathbb{R}_+ \rightarrow \mathbb{R}$  is *within the same class* if the perturbed tax schedule remains in the same class as  $T$ , that is,  $\tilde{T} = T + \mu H \in \mathcal{T}_0$  for small enough  $\mu$ . We will then say that the tax schedule is optimal within this class if there is no perturbation *within the same class*, which improves the planner's objective.<sup>30</sup>

Before we move on, a cautionary note is in order. [Alves et al. \(2019\)](#) showed that, in models in which the utility function is not ordered according to the unobserved heterogeneity, formulae derived using variational methods may fail to characterize the optimum. At issue is the implicit assumption that agents are never indifferent between two choices  $z$  and  $z'$  with  $z > z'$  and, hence, that perturbations induce no jumps. Endogenous ordering of types typically arises in models with multidimensional heterogeneity. Therefore, unless we impose more structure on agents' preferences, our model is susceptible to [Alves et al.'s \(2019\)](#) critique.

We start by deriving the behavioral response for the change in a baseline tax schedule  $T : \mathbb{R}_+ \rightarrow \mathbb{R}$  (a candidate for the optimal schedule) in the direction of the reform  $H : \mathbb{R}_+ \rightarrow \mathbb{R}$ . Consider the program of a type  $\iota$  household facing a

<sup>30</sup>There may still be  $H'$  for which  $\tilde{T}' = T + \mu H' \notin \mathcal{T}_0$ , which improves the planner's objective. In fact, in Section 4 we study reforms whose resulting perturbed classes are not within the class of joint taxation  $\mathcal{T}_0$ .

nonlinear tax schedule  $T : \mathbb{R}_+ \rightarrow \mathbb{R}$ :

$$(15) \quad \max_{(x,z) \in \mathbb{R}_+^2} \{V(x, z, \iota) \quad \text{s.t.} \quad x = z - T(z)\}.$$

The solution to this program defines the earnings supply functional  $z_\iota : \mathcal{T} \rightarrow \mathbb{R}$ , where  $\mathcal{T}$  is the class of tax schedules being considered. We measure *behavioral responses* to the reform in the direction of  $H$  by the Gateaux derivative of the earnings supply functional, denoted by  $dz_\iota(T; H)$  (see (C.3) for the formal definition).

The overall marginal effect on welfare after a reform in the direction of  $H$  is given by

$$(16) \quad dW(x, z, \iota) = \partial_x W(x, z, \iota) \left[ -H(z) + \left( 1 + \frac{\partial_z W(x, z, \iota)}{\partial_x W(x, z, \iota)} \frac{1}{1 - T'(z)} \right) [1 - T'(z)] dz_\iota(T; H) \right] d\mu.$$

Thus, to derive the optimal tax formulae, one decomposes the impact of a perturbation in the candidate optimal tax system into a mechanical effect (the first term in (16), representing the difference between a dollar in the hands of a household and a dollar in the hands of the government. The second term captures the consequences of behavioral responses for government revenues. Typically, this second term is eliminated because envelope theorem reasoning guarantees no first-order effects of behavioral responses on individuals' utilities. However, this is no longer true if there is dissonance because there will be first-order effects on the planner's assessment of individuals' utilities. Households respond to tax reforms according to their welfare assessment  $V$ , which is not aligned with the planner's welfare assessment  $W$  of the spouses' utilities. In fact, unless  $1 - T'(z) = -\frac{\partial_z W(x, z, \iota)}{\partial_x W(x, z, \iota)}$ , the second term in (16) is not null, and we explicitly see how behavioral responses have a first-order effect on the planner's welfare. Therefore, the envelope arguments normally used to capture the impact on welfare of these perturbations (e.g., [Saez \(2001\)](#)) must therefore be amended to include this term.<sup>31</sup>

Let us derive expressions for  $\frac{\partial_z W(x, z, \iota)}{\partial_x W(x, z, \iota)}$  and  $dz_\iota(T; h)$ . To make our point in as stark a manner as possible and to better communicate with the numerical example of Section 3, we restrict our attention to separable preferences of the form  $U(x_i, l_i) = u(x_i) - h(l_i)$  for functions  $u : \mathbb{R}_+ \rightarrow \mathbb{R}$  and  $h : \mathbb{R}_+ \rightarrow \mathbb{R}$ . We then define, with some abuse of notation and omitting parameters for shortness,  $x_a(x)$ ,  $x_b(x)$ ,  $z_a(z)$ , and  $z_b(z)$  as the solution to the family program in (2).<sup>32</sup> In this case, we can

<sup>31</sup>It is easy to see the source of these differences. The first-order necessary conditions for program (15) is  $1 - T'(z) = -\frac{\partial_z V(x, z, \iota)}{\partial_x V(x, z, \iota)}$ . In a standard Mirrleesian model,  $W(x, z, \iota) = V(x, z, \iota)$ , so that  $1 - T'(z) = -\frac{\partial_z W(x, z, \iota)}{\partial_x W(x, z, \iota)}$ .

<sup>32</sup>Notice that separability of the utility implies separability between consumption and labor decisions. That is why we write  $x_a(\cdot)$  and  $x_b(\cdot)$  as a function only of  $x$ , and  $z_a(\cdot)$  and  $z_b(\cdot)$  as function only of  $z$ .

show that

$$\frac{\partial_z W(x, z, \iota)}{\partial_x W(x, z, \iota)} \frac{1}{1 - T'(z)} = - \frac{(2\alpha - 1) z'_a(z) + (1 - \alpha)}{(2\alpha - 1) x'_a(x) + (1 - \alpha)}.$$

Of course, if  $\alpha = 1/2$ , there is no dissonance and the marginal rate of substitution from the planner's perspective is equal to the marginal retention rate  $1 - T'(z)$ . This is also true in the limiting case when  $x'_a(x) = z'_a(z)$ , but this result is unexpected.<sup>33</sup>

The behavioral response to a reform in the direction of  $H$ , measured by the Gateaux derivative, is given by

$$(17) \quad dz_\iota(T; H) = - \frac{\varepsilon^c(z, \iota) z H'(z) + \eta(z, \iota) H(z)}{1 - T'(z) + \varepsilon^c(z, \iota) z T''(z)},$$

where  $\varepsilon^c(z, \iota)$  is the compensated elasticity of household taxable earnings with respect to the retention rate  $1 - T'(z)$ , and  $\eta(z, \iota)$  is the income elasticity of taxable earnings of a type  $\iota$ , both of which are explicitly calculated in Appendix G.

**The relevant elasticities** For each household  $\iota$ , we follow [Jacquet et al. \(2013\)](#) and [Scheuer and Werning \(2017\)](#) in deriving the relevant elasticities of taxable income that take into account the endogeneity of marginal tax rates due to the local tax schedule curvature: uncompensated,  $\varepsilon(z, \iota)$ , income,  $\eta(z, \iota)$ , and compensated,  $\varepsilon^c(z, \iota)$  (see Appendix G).

All of these elasticities are defined at the household level. However, the tax schedule should necessarily treat all families with the same total income equally. Therefore, we need to aggregate across all families. For each  $z \in \mathbb{R}_+$ , let

$$\bar{\varphi}(\iota|z) = \int_{z_\iota(T)=z} dF(\iota)$$

be the distribution of household types  $\iota$  choosing  $z$  at the candidate optimal tax schedule  $T$ . We can aggregate across households choosing  $z$  using  $\bar{\varphi}(\iota|z)$  and define aggregate elasticities as follows:

$$\varepsilon(z) = \int_{\iota \in \Lambda} \varepsilon(z, \iota) d\bar{\varphi}(\iota|z), \quad \eta(z) = \int_{\iota \in \Lambda} \eta(z, \iota) d\bar{\varphi}(\iota|z), \quad \text{and} \quad \varepsilon(z)^c = \int_{\iota \in \Lambda} \varepsilon^c(z, \iota) d\bar{\varphi}(\iota|z).$$

Let us denote

$$\Phi(z) = \int_{\iota \in \Lambda} d\bar{\varphi}(\iota|z)$$

as the empirical income distribution induced by the tax system, and let's assume it admits a density, which we shall denote by  $\varphi(z)$ .

<sup>33</sup>While  $x'_a(x)$  depends on the local curvature of  $u(\cdot)$  at the optimal choice  $(x_a(x), x - x_a(x))$ ,  $z'_a(z)$  depends on the local curvature of  $h(\cdot)$  at the optimal choice  $(z_a(z), z - z_a(z))$ . Hence, they will differ for almost all parameterizations.

As it turns out, elasticities  $\varepsilon(z)$ ,  $\eta(z)$ , and  $\varepsilon^c(z)$  are important for understanding the consequences of behavioral responses to government revenues. However, a novelty we uncover is that we need alternative elasticities to assess the welfare consequence of behavioral responses. For this, let the average welfare weight at income  $z$ ,  $g(z)$ , be defined as

$$g(z) = \int_{\iota \in \Lambda} g(z, \iota) d\bar{\varphi}(\iota|z),$$

where  $g(z, \iota) = \partial_x W(z - T(z), z, \iota)$ , which is positive given our specification of the welfare function (3). Hence, we define the welfare-weighted elasticity by

$$\bar{\varepsilon}(z) = \int_{\iota \in \Lambda} \frac{g(z, \iota)}{g(z)} \varepsilon(z, \iota) d\bar{\varphi}(\iota|z),$$

with analogous definitions for  $\bar{\eta}(z)$ , the welfare-weighted income elasticity, and for  $\bar{\varepsilon}^c(z)$ , the welfare-weighted compensated elasticity of taxable earnings.<sup>34</sup>

In what follows, it is convenient to define the household  $\iota$  *behavioral wedge*:

$$(18) \quad \xi(z, \iota) \equiv \frac{\partial_z W(z - T(z), z, \iota)}{\partial_x W(z - T(z), z, \iota)} \frac{1}{1 - T'(z)}.$$

Analogously to what we have done with elasticities, we define

$$\bar{\xi}(z) = \int_{\iota} \frac{g(z, \iota)}{g(z)} \xi(z, \iota) d\bar{\varphi}(\iota|z),$$

the welfare-weighted average behavioral wedge.

## 5.1 Optimal tax formula

We have already shown how dissonance changes the direct impact of tax reforms on welfare measured by the planner. Unlike the standard case of single households, the welfare impact of a small reform is not negligible. This happens because the social marginal value of income does not coincide with the private one. Adding the mechanical and behavioral effects on tax revenues along the lines of [Saez \(2001\)](#), we arrive in Proposition 2 at the expression for optimal marginal tax rates.

**Proposition 2.** *The first-order necessary conditions for the optimal joint tax schedule at*

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<sup>34</sup>Of course, if for all  $z$ ,  $\varepsilon(z, \iota)$  is the same for all  $\iota$  (or if the co-variance between  $\partial W/\partial x$  and  $\varepsilon$  over the distribution of  $\iota$  is zero), then the two concepts coincide.

the total household income level  $z \in \mathbb{R}_+$  can be written as

$$(19) \quad \frac{T'(z)}{1 - T'(z)} = \frac{1}{\epsilon^c(z)} \frac{1 - \Phi(z)}{z\varphi(z)} \left\{ \int_z^{\bar{z}} \left[ 1 - g(\tilde{z}) + \frac{T'(\tilde{z})}{1 - T'(\tilde{z})} \eta(\tilde{z}) \right] \frac{\varphi(\tilde{z})}{1 - \Phi(z)} d\tilde{z} \right. \\ \left. + \int_z^{\bar{z}} g(\tilde{z}) \{ [1 - \bar{\xi}(\tilde{z})] \bar{\eta}(\tilde{z}) - \zeta^{\eta, \xi}(\tilde{z}) \} \frac{\varphi(\tilde{z})}{1 - \Phi(z)} d\tilde{z} \right\} \\ - \frac{g(z)}{\epsilon^c(z)} \{ [1 - \bar{\xi}(z)] \bar{\epsilon}^c(z) - \zeta^{\epsilon, \xi}(z) \},$$

where  $\Phi(z)$  is the empirical income distribution induced by the optimal tax system,  $\varphi(z)$  is its density,  $g(z)$  is the marginal social value of income in the hands of households with income  $z$ ,  $\bar{\xi}(z)$  is the behavioral wedge between the social values of income and its market price,  $\bar{\epsilon}^c(z)$  and  $\bar{\eta}^c(z)$  are welfare-adjusted average elasticities for households choosing  $z$ , and  $\zeta^{\epsilon, \xi}(z)$  and  $\zeta^{\eta, \xi}(z)$  are the welfare-adjusted covariances between these elasticities and the behavioral wedges for all households choosing  $z$ .

The first thing to note about (19) is that if  $\bar{\xi}(z) = 1$ , this is simply the [Piketty-Saez](#) intuitive expression for optimal taxes. The second important thing is that two types of aggregation are used to characterize optimal taxes: the regular empirical frequency-weighted elasticities ( $\epsilon(z)$ ,  $\epsilon^c(z)$ , and  $\eta(z)$ ) and the welfare-weighted elasticities ( $\bar{\epsilon}(z)$ ,  $\bar{\epsilon}^c(z)$ , and  $\bar{\eta}(z)$ ).

As pointed out by [Saez \(2001\)](#), using a perturbation approach allows us to write optimal tax formulae even when types are multidimensional, which is precisely our case here. However, with multidimensional heterogeneity, households of different types bunch at the same  $z$ , and we need to aggregate behavioral responses across these agents.<sup>35</sup> This is already in [Saez \(2001\)](#), as we can see if we assume  $\bar{\xi}(z) = 1$ . The novelty is that, whereas elasticities are only important in [Saez \(2001\)](#) because of their behavioral impact on revenues, they directly affect utility as perceived by the planner. In this case, averages must be welfare adjusted analogously to risk adjustments in asset pricing formulae.

Dissonance means that behavioral responses have first-order consequences on welfare, which vary across agents with the same earnings. The overall impact, which depends on the elasticities and the wedges, is weighted not by the relative empirical frequency of couples choosing  $z$  but by the welfare-adjusted frequencies. All elasticities pertaining to dissonance have a bar to denote this adjustment. The covariance terms that appear in the last two lines of (19) are also calculated under this welfare-adjusted measure.<sup>36</sup>

<sup>35</sup>According to [Saez \(2001\)](#) "The direct proof using elasticities shows that it is not necessary to introduce a uni-dimensional exogenous skill distribution to obtain formula (14) [our formula (19)]. Therefore, formula (14) might, in principle, be valid for any heterogeneous population as long as (...) are considered as average elasticities at income level  $z$ ."

<sup>36</sup>Co-variance terms also appear in the optimal tax formulae for behavioral agents derived by [Gerritsen \(2016\)](#). [Gerritsen's](#) representation slightly differs from ours since he does not work with

As it turns out, ridding the expression from these aggregation issues leads to a considerably more straightforward extension of optimal tax formulae. Toward this end, we assume that all elasticities are identical for agents choosing the same  $z$ . This will lead us to an ABC+D formula (Proposition 3) that is derived from (20) below.

**Corollary 3.** *Assume that for all  $z$ ,  $\varepsilon(z, \iota) = \varepsilon(z)$ ,  $\eta(z, \iota) = \eta(z)$ , and  $\varepsilon^c(z, \iota) = \varepsilon^c(z)$  for all  $\iota$  choosing  $z$ . Then, the first-order condition for the optimal joint tax schedule for couples at income level  $z$  in Proposition 2 can be rewritten as*

$$(20) \quad \frac{T'(z)}{1 - T'(z)} = \frac{1}{\varepsilon^c(z)} \frac{1 - \Phi(z)}{z\varphi(z)} \left\{ \int_z^{\bar{z}} \left[ 1 - g(\tilde{z}) + \frac{T'(\tilde{z})}{1 - T'(\tilde{z})} \eta(\tilde{z}) \right] \frac{\varphi(\tilde{z})}{1 - \Phi(\tilde{z})} d\tilde{z} \right. \\ \left. + \int_z^{\bar{z}} g(\tilde{z}) [1 - \bar{\xi}(\tilde{z})] \eta(\tilde{z}) \frac{\varphi(\tilde{z})}{1 - \Phi(\tilde{z})} d\tilde{z} \right\} - \bar{g}(z) [1 - \bar{\xi}(z)] .$$

Because we have assumed that elasticities are identical for all households choosing the same  $z$ , we can drop the bar from almost all statistics and eliminate the co-variance terms in (19). The only term for which we still make a distinction between the empirical distribution and the welfare-adjusted distribution concerns the behavioral wedge  $\bar{\xi}(z)$ .

Note how (20) identifies a new sufficient statistic that should be considered when evaluating optimal income taxes. It highlights that the planner may want to impose additional distortions to influence decisions taken within the household.

Equation (20) defines  $T'(z)/(1 - T'(z))$  implicitly. We can find an explicit solution by solving this integral equation.

**Proposition 3.** *Assume that  $\varepsilon(z, \iota) = \varepsilon(z)$ ,  $\eta(z, \iota) = \eta(z)$ , and  $\varepsilon^c(z, \iota) = \varepsilon^c(z)$  for all  $\iota$  choosing  $z$  and for all  $z$ . Then, the marginal tax rate for the optimal joint tax schedule for couples at income level  $z$  is given by*

$$(21) \quad \frac{T'(z)}{1 - T'(z)} = A(z)B(z)C(z) + D(z),$$

where

$$A(z) = \frac{1}{\varepsilon^c(z)}, \quad B(z) = \frac{1 - \Phi(z)}{\varphi(z)z}, \quad D(z) = -g(z) [1 - \xi(z)] \\ \text{and} \quad C(z) = \int_z^{\bar{z}} \{1 - g(\tilde{z})\} \exp \left\{ \int_{\tilde{z}}^{\bar{z}} \frac{\eta(\tilde{\tilde{z}})}{\varepsilon^c(\tilde{\tilde{z}})} \frac{d\tilde{\tilde{z}}}{\tilde{\tilde{z}}} \right\} \frac{\varphi(\tilde{\tilde{z}})}{1 - \Phi(\tilde{\tilde{z}})} d\tilde{\tilde{z}}.$$

Equation (21) has an ABC (and D) form similar to that in [Diamond \(1998\)](#), with an added D to account for a dissonance term. The term  $D(z)$  acts as a Pigouvian

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a change in the measure, considering extra co-variance terms in the empirical measure.



correction that raises marginal tax rates when  $\bar{\xi}(z) > 1$  and lowers it otherwise. Recalling that

$$\xi(z, \iota) \begin{matrix} \leq \\ \geq \end{matrix} 1 \Leftrightarrow \frac{\partial_z W(z - T(z), z, \iota)}{\partial_x W(z - T(z), z, \iota)} \begin{matrix} \leq \\ \geq \end{matrix} \frac{\partial_z V(z - T(z), z, \iota)}{\partial_x V(z - T(z), z, \iota)},$$

marginal tax rates are reduced when compared to the pure Mirrleesian optimum if, on average, family earnings  $z$  underestimate the disutility of effort as perceived by the planner and are increased otherwise.

For the case of iso-elastic preferences of Section 3,  $\xi(z, \iota)$  is independent of  $z$ .<sup>37</sup> We can therefore evaluate it separately from the rest of the program. Figure 11 shows how  $\xi$  varies with dissonance  $\alpha$  for different values of the relative productivity of spouses  $d = [w_a/w_b]^{1+\gamma}$ , where  $\gamma$  denotes the inverse of the Frisch elasticity of labor supply.

[ FIGURE 11 ABOUT HERE ]

Since the planner is utilitarian, for all values of  $d$ ,  $\xi = 1$  when  $\alpha = 1/2$ , and the Pigouvian term  $D$  vanishes. When  $\delta = 1$  (i.e., when both spouses are equally productive)  $\xi$  reaches a minimum exactly at  $\alpha = 1/2$ . This means that, for the special case in which spouses are equally productive, the Pigouvian term is always non-negative, and marginal tax rates are higher the greater the dissonance. Intuitively, the planner perceives a deviation from an equal split of effort as an inefficiency that leads to a underestimation of the welfare loss from work. It corrects it by discouraging work. For all other values of  $d$ ,  $\xi$  increases (respectively decreases) with  $\alpha$ , at  $\alpha = 1/2$ , if  $\delta < 1$  (respectively  $\delta > 1$ ). Starting from  $\alpha = 1/2$ , a slight increase in its value, leads the couple to perceive a cost of working that is lower than the planner's if it is  $b$  who is productive, but leads to an overestimation if it is  $a$  who is more productive. The Pigouvian term will, in this case, be negative and the marginal tax lower than when there is no dissonance. Eventually, as dissonance becomes too large, the inefficiency perceived by the planner will dominate, and the Pigouvian term will become positive.

**Relationship between the optimal taxation formulae** Optimal tax formulae (12) could be directly derived from (19). First, note that under identical ln preferences, the marginal social value of resources is equal for all households earning the same  $z$ , leading us to drop all of the covariance terms and equalizing the empirical and welfare-adjusted moments: the relevant expression for optimal taxes takes the explicit form (21). Second, separability greatly simplifies the  $C(z)$  term in (21) once

<sup>37</sup>Of course  $\iota$  will determine, along with the tax system, how much earnings,  $z$ , the family will generate. What is meant here is that knowledge about  $\iota$  is sufficient for determining  $\xi$ , for any tax system.

one notes that, under separability,  $\eta(z)/\varepsilon^c(z) = d \ln u'(z - T(z))/dz$ . A somewhat tedious algebra is needed to show that the dissonance term,  $D(z)$ , becomes the term in the second line of (12). As in Saez (2001), it is comforting to check that the same formulae, albeit written in terms of primitives only, are reached using a mechanism design approach.

## 6 Conclusion

In this paper, we obtain optimal tax schedules for multiperson households under the restriction that taxes entail income-splitting. Intrahousehold inequality, a policy goal often ignored in the study of redistribution policies following the Mirrlees tradition, takes center stage.

The use of a common specification for preferences allows us to handle the multidimensional screening problem that plagues optimal household taxation and to actually compute the optimal tax schedule. Our results highlight the quantitative impact of dissonance, the misalignment between the household's and planner's objectives for household income taxes: an instrument that can only indirectly affect intrahousehold inequality. Optimal marginal tax rates need no longer be non-negative which is in contrast with a well-known property derived for single-person households in the Mirrlees tradition.

Departing from a joint schedule, we explore the consequences of introducing some form of differentiation in the marginal tax rates faced by the two spouses. We show that it is typically optimal to introduce a *small* tax on the spouse that society tries to promote, since income taxes subsidize spouse's leisure. This crucially depends on the assumption that power is unaffected by choices or the tax system (or both). It is clear that if earnings – a policy-dependent variable – instead of innate productivity – a policy-independent variable – determine power, these results may be reversed.

Finally, to take into account the potential heterogeneity of preferences across agents, we derive optimal tax formulae preferences using tax perturbation methods. Optimal tax formulae have an ABC+D expression that extends the ABC formula made popular by Diamond (1998) by introducing an additive D term: a Pigouvian correction for dissonance. This Pigouvian term, which adjusts the marginal tax rate, has an analytical expression for the special case of logarithmic preferences for consumption. We find that, for small values of dissonance, it decreases from a value of zero as more power is given to the most productive spouse. This suggests that if bargaining power within the household is positively correlated with relative productivity, then marginal tax rates on couples should be lower than their counterpart for singles.

Cassiano B. Alves, Northwestern University

Carlos E. da Costa, FGV EPGE Brazilian School of Economics and Finance

Felipe Lobel, University of California Berkeley

Humberto Moreira, FGV EPGE Brazilian School of Economics and Finance

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## A Lemmatta

### A.1 Collective decision

#### The consumption allocation problem within the household

**Lemma 4.** *The efficient solution to the household consumption allocation problem is  $x_a = \alpha x$  and  $x_b = (1 - \alpha)x$ .*

*Proof.* The disposable income  $x = z - T(z)$  is allocated to the consumption of private goods of the two spouses according to efficient Nash bargaining protocol. Under this protocol the within household consumption allocation problem is

$$\max_{(x_a, x_b) \in \mathbb{R}_{++}^2} [x_a]^\alpha [x_b]^{1-\alpha}$$

subject to

$$x_a + x_b = x,$$

where  $\alpha$  is the bargaining power of spouses  $a$ . The first-order condition (FOC) for this problem is

$$(A.1) \quad \frac{\alpha}{1 - \alpha} = \frac{x_a}{x_b}$$

and, substituting in the constraint  $x_a + x_b = x$ , we have the solution

$$(A.2) \quad x_a = \alpha x \quad \text{and} \quad x_b = (1 - \alpha)x.$$

This proves the result. □

**Lemma 5.** *Each spouse's earned income  $z_i$ , for  $i \in \{a, b\}$ , can be expressed in terms of household income  $z$ , productivity gap  $\theta_a/\theta_b$  and the Pareto coefficient  $\alpha$  as*

$$\frac{z_a}{z} = \frac{[(1 - \alpha)\theta_b]^{\frac{1}{\gamma}}}{[(1 - \alpha)\theta_b]^{\frac{1}{\gamma}} + [\alpha\theta_a]^{\frac{1}{\gamma}}} \quad \text{and} \quad \frac{z_b}{z} = \frac{[\alpha\theta_a]^{\frac{1}{\gamma}}}{[(1 - \alpha)\theta_b]^{\frac{1}{\gamma}} + [\alpha\theta_a]^{\frac{1}{\gamma}}}.$$

*Proof.* Given our assumptions of efficient allocation within the household, the division of labor supply is made in order to minimize the disutility costs of getting a given income level  $z \in \mathbb{R}_+$ . Therefore, the collective choice of labor supply is the solution to

$$\min_{z_a, z_b} \alpha \left( \theta_a \frac{z_a^{1+\gamma}}{1 + \gamma} \right) + (1 - \alpha) \left( \theta_b \frac{z_b^{1+\gamma}}{1 + \gamma} \right)$$

subject to

$$z_a + z_b = z.$$

The first-order condition for this problem is

$$(A.3) \quad \frac{\alpha}{1-\alpha} \frac{\theta_a}{\theta_b} = \left( \frac{z_b}{z_a} \right)^\gamma.$$

Using  $z = z_a + z_b$ , we have

$$(A.4) \quad z_a = z \left[ \left( \frac{\alpha}{1-\alpha} \frac{\theta_a}{\theta_b} \right)^{\frac{1}{\gamma}} + 1 \right]^{-1} \quad \text{and} \quad z_b = z \left[ \left( \frac{1-\alpha}{\alpha} \frac{\theta_b}{\theta_a} \right)^{\frac{1}{\gamma}} + 1 \right]^{-1}.$$

This proves the result.  $\square$

**Lemma 6.** *The household welfare function for a type  $(\theta_a, \theta_b, \alpha)$  family can be expressed as a function of total earned income  $z$  and disposable income  $x$  as*

$$V(x, z, \theta_a, \theta_b, \alpha) = \kappa(\alpha) + \ln x - \omega(\theta_a, \theta_b, \alpha) \frac{z^{1+\gamma}}{1+\gamma},$$

where  $\kappa(\alpha) \equiv \alpha \ln(\alpha) + (1-\alpha) \ln(1-\alpha)$  and

$$\begin{aligned} \omega(\theta_a, \theta_b, \alpha) \equiv & \alpha \theta_a \left( \frac{[(1-\alpha)\theta_b]^{\frac{1}{\gamma}}}{[(1-\alpha)\theta_b]^{\frac{1}{\gamma}} + [\alpha\theta_a]^{\frac{1}{\gamma}}} \right)^{1+\gamma} \\ & + (1-\alpha)\theta_b \left( \frac{[\alpha\theta_a]^{\frac{1}{\gamma}}}{[(1-\alpha)\theta_b]^{\frac{1}{\gamma}} + [\alpha\theta_a]^{\frac{1}{\gamma}}} \right)^{1+\gamma}. \end{aligned}$$

*Proof.* Using Lemma 4 and 5 we can restate the family utility in (2) as

$$\begin{aligned} V(x, z, \theta_a, \theta_b, \alpha) = & \alpha \ln \alpha + (1-\alpha) \ln(1-\alpha) + \ln x \\ & - \left\{ \alpha \theta_a \left[ 1 + \left( \frac{\alpha}{1-\alpha} \frac{\theta_a}{\theta_b} \right)^{\frac{1}{\gamma}} \right]^{-(1+\gamma)} + (1-\alpha)\theta_b \left[ 1 + \left( \frac{1-\alpha}{\alpha} \frac{\theta_b}{\theta_a} \right)^{\frac{1}{\gamma}} \right]^{-(1+\gamma)} \right\} \frac{z^{1+\gamma}}{1+\gamma} \end{aligned}$$

defining  $\omega(\theta_a, \theta_b, \alpha)$  and  $\kappa(\alpha)$  as in the statement of the lemma and we have the result proved.  $\square$

**Lemma 7.** *The indirect utility of spouses in a family with total income  $z$ , disposable income  $x$ , types  $\theta_a, \theta_b$  and Pareto weight  $\alpha$  for the wife can be written as*

$$\begin{aligned} V_a(x, z, \theta_a, \theta_b, \alpha) = & \ln \alpha - \kappa(\alpha) + V(x, z, \theta_a, \theta_b, \alpha) + [\omega - \omega_a] \frac{z^{1+\gamma}}{1+\gamma} \quad \text{and} \\ V_b(x, z, \theta_a, \theta_b, \alpha) = & \ln(1-\alpha) - \kappa(\alpha) + V(x, z, \theta_a, \theta_b, \alpha) + [\omega - \omega_b] \frac{z^{1+\gamma}}{1+\gamma}, \end{aligned}$$



where  $V(x, z, \theta_a, \theta_b, \alpha)$ ,  $\kappa(\alpha)$  and  $\omega(\theta_a, \theta_b, \alpha)$  are defined in (6) and (7), respectively,

$$(A.5) \quad \omega_a(\theta_a, \theta_b, \alpha) \equiv \theta_a \left( \frac{[(1-\alpha)\theta_b]^{\frac{1}{\gamma}}}{[(1-\alpha)\theta_b]^{\frac{1}{\gamma}} + [\alpha\theta_a]^{\frac{1}{\gamma}}} \right)^{1+\gamma} \quad \text{and}$$

$$\omega_b(\theta_a, \theta_b, \alpha) \equiv \theta_b \left( \frac{[\alpha\theta_a]^{\frac{1}{\gamma}}}{[(1-\alpha)\theta_b]^{\frac{1}{\gamma}} + [\alpha\theta_a]^{\frac{1}{\gamma}}} \right)^{1+\gamma}.$$

*Proof.* Let  $V_a(x, z, \theta_a, \theta_b, \alpha)$  and  $V_b(x, z, \theta_a, \theta_b, \alpha)$  be indirect utility derived by spouses;  $a$  and  $b$  in a family type  $(\theta_a, \theta_b, \alpha)$  from the aggregate bundle  $(x, z)$ . Using Lemma 4 and 5, we have

$$V_a(x, z, \theta_a, \theta_b, \alpha) = \ln \alpha x - \omega_a(\theta_a, \theta_b, \alpha) \frac{z^{1+\gamma}}{1+\gamma} \quad \text{and}$$

$$V_b(x, z, \theta_a, \theta_b, \alpha) = \ln(1-\alpha)x - \omega_b(\theta_a, \theta_b, \alpha) \frac{z^{1+\gamma}}{1+\gamma},$$

where

$$\omega_a(\theta_a, \theta_b, \alpha) \equiv \theta_a \left( \frac{[(1-\alpha)\theta_b]^{\frac{1}{\gamma}}}{[(1-\alpha)\theta_b]^{\frac{1}{\gamma}} + [\alpha\theta_a]^{\frac{1}{\gamma}}} \right)^{1+\gamma} \quad \text{and}$$

$$\omega_b(\theta_a, \theta_b, \alpha) \equiv \theta_b \left( \frac{[\alpha\theta_a]^{\frac{1}{\gamma}}}{[(1-\alpha)\theta_b]^{\frac{1}{\gamma}} + [\alpha\theta_a]^{\frac{1}{\gamma}}} \right)^{1+\gamma}.$$

It is straightforward to see from these definitions that

$$\omega(\theta_a, \theta_b, \alpha) = \alpha\omega_a(\theta_a, \theta_b, \alpha) + (1-\alpha)\omega_b(\theta_a, \theta_b, \alpha).$$

Using the definition of  $V(x, z, \theta_a, \theta_b)$  from Lemma 6 and neglecting the dependence for shortness

$$\begin{aligned} V &= \kappa(\alpha) + \ln x - \omega \frac{z^{1+\gamma}}{1+\gamma} = \kappa(\alpha) + \ln \left( \alpha x \frac{1}{\alpha} \right) - [\alpha\omega_a + (1-\alpha)\omega_b] \frac{z^{1+\gamma}}{1+\gamma} \\ &= \kappa(\alpha) - \ln(\alpha) - (1-\alpha)[\omega_b - \omega_a] \frac{z^{1+\gamma}}{1+\gamma} + \left[ \ln(\alpha x) - \omega_a \frac{z^{1+\gamma}}{1+\gamma} \right] \\ &= \kappa(\alpha) - \ln(\alpha) - (1-\alpha)[\omega_b - \omega_a] \frac{z^{1+\gamma}}{1+\gamma} + V_a. \end{aligned}$$

Notice that

$$(1-\alpha)[\omega_b - \omega_a] = [(1-\alpha)\omega_b + \alpha\omega_a] - \omega_a = \omega - \omega_a.$$

Rearranging terms we have

$$V_a = \ln(\alpha) - \kappa(\alpha) + V + [\omega - \omega_a] \frac{z^{1+\gamma}}{1+\gamma}.$$

Analogously,

$$V_b = \ln(1 - \alpha) - \kappa(\alpha) + V + [\omega - \omega_b] \frac{z^{1+\gamma}}{1+\gamma},$$

where all functions are evaluated at  $(\theta_a, \theta_b, \alpha)$ . □

**Lemma 8.** *Suppose that the social welfare function follows the household's utility (as in (2)). In an interval where  $z(\omega)$  is strictly increasing, the marginal tax rate for the optimal nonlinear income joint taxation will follow exactly as in Mirrlees' model:*

$$(A.6) \quad T'(z(\omega)) = \frac{z(\omega)^\gamma}{\psi(\omega)} \int_{\omega}^{\bar{\omega}} \left[ x(s) - \frac{1}{\lambda} \right] \psi(s) ds,$$

where  $\lambda \in \mathbb{R}_+$  is the Lagrange multiplier associated with the budget constraint.

*Proof of Lemma 8.* By the revelation principle, the planner's problem based solely on the family's utility can be restated in the space of direct mechanism as<sup>38</sup>

$$\max_{(x,z):\Omega \rightarrow \mathbb{R}_{++} \times \mathbb{R}_+} \int_{\Omega} \left[ \ln x(\omega) - \omega \frac{z(\omega)^{1+\gamma}}{1+\gamma} \right] \psi(\omega) d\omega,$$

subject to incentive compatibility constraints: for every  $\omega \in \Omega$

$$\omega \in \arg \max_{\tilde{\omega} \in \Omega} \left[ \ln x(\tilde{\omega}) - \omega \frac{z(\tilde{\omega})^{1+\gamma}}{1+\gamma} \right],$$

and a budget constraint:

$$\int_{\Omega} [z(\omega) - x(\omega)] \psi(\omega) d\omega \geq 0.$$

Let  $v(\omega)$  denote the utility assignment of a family with type  $\omega$  in the mechanism. Taking  $v(\omega)$  and  $z(\omega)$  as the choice variables,  $x(\omega)$  is implicitly defined by

$$v(\omega) = \ln x(v(\omega), z(\omega), \omega) - \omega \frac{z(\omega)^{1+\gamma}}{1+\gamma}.$$

First, the family's utility satisfies the *Spence-Mirrlees condition* with respect to the parameter  $\omega$  since

$$\frac{dx}{dz} \bigg|_{v(\omega)=v} = \frac{h'(z)}{u'(x)} = \omega x z^\gamma,$$

---

<sup>38</sup>Since the term  $\kappa(\alpha)$  is not affected by the allocation we can ignore it.

which means that the slope of the indifference curve is increasing in the parameter  $\omega$ . Hence, incentive compatibility can be fully characterized by the local constraints. The planner solves the following program:

$$\max_{(v,z):\Omega \rightarrow \mathbb{R} \times \mathbb{R}_+} \int_{\Omega} v(\omega) \psi(\omega) d\omega$$

subject to the local first-order incentive constraint:

$$(A.7) \quad \dot{v}(\omega) = V_{\omega}(x, z, \omega) = \frac{z(\omega)^{1+\gamma}}{1+\gamma};$$

the monotonicity constraint:  $z(\omega)$  is increasing; and the feasibility constraint:

$$\int_{\Omega} [z(\omega) - x(v(\omega), z(\omega), \omega)] \psi(\omega) d\omega = 0.$$

By the implicit function theorem,

$$(A.8) \quad x_v = \frac{1}{u'(x(v(\omega), z(\omega), \omega))} = x(v(\omega), z(\omega), \omega),$$

$$(A.9) \quad x_z = \frac{h'(z(\omega))}{u'(x(v(\omega), z(\omega), \omega))} = \omega z(\omega)^{\gamma} x(v(\omega), z(\omega), \omega).$$

Under this approach, the income  $z(\omega)$  is the control variable and utility of the family  $v(\omega)$  is the state variable. Hence, the Hamiltonian associated to this problem is

$$\mathcal{H}(v(\omega), z(\omega), \mu(\omega), \lambda, \omega) = v(\omega) \psi(\omega) + \lambda [z(\omega) - x(v(\omega), z(\omega), \omega)] \psi(\omega) - \mu(\omega) \frac{z(\omega)^{1+\gamma}}{1+\gamma},$$

where  $\lambda \in \mathbb{R}$  is the Lagrange multiplier associated to the resources constraint and  $\mu(\omega)$  is the co-state variable. At the optimum, the control variable  $z(\omega)$  maximizes the Hamiltonian function:

$$(A.10) \quad \lambda \psi(\omega) [1 - x_z] = \mu(\omega) z(\omega)^{\gamma}.$$

The first-order condition of the Hamiltonian is

$$\dot{\mu}(\omega) = -\frac{\partial}{\partial v} \mathcal{H} = \psi(\omega) [\lambda x_v - 1]$$

and the transversality condition is  $\mu(\underline{\omega}) = \mu(\bar{\omega}) = 0$ . Integrating on both sides

from  $\omega$  to  $\bar{\omega}$ , we have

$$\mu(\bar{\omega}) - \mu(\omega) = \int_{\omega}^{\bar{\omega}} \dot{\mu}(s) ds = \int_{\omega}^{\bar{\omega}} \psi(s) [\lambda x_v(v(s), z(s), s) - 1] ds.$$

Using the transversality condition we have

$$(A.11) \quad \mu(\omega) = \lambda \int_{\omega}^{\bar{\omega}} \psi(s) [\lambda^{-1} - x_v(v(s), z(s), s)] ds.$$

Note that from the transversality condition  $\mu(\underline{\omega}) = 0$  we can pin down the social value of an extra unit of income:

$$0 = \mu(\underline{\omega}) = \lambda \int_{\underline{\omega}}^{\bar{\omega}} \psi(s) [\lambda^{-1} - x_v(v(s), z(s), s)] ds.$$

Therefore,

$$\lambda = \frac{1}{\int_{\underline{\omega}}^{\bar{\omega}} x_v(v(s), z(s), s) \psi(s) ds} = \frac{1}{\int_{\underline{\omega}}^{\bar{\omega}} x(v(s), z(s), s) \psi(s) ds}$$

or

$$\lambda = \mathbb{E}^{\psi}[x]^{-1}.$$

Substituting  $\mu(\omega)$  defined in (A.11) into equation (A.10) we have

$$[1 - x_z(v(\omega), z(\omega), \omega)] = \frac{z(\omega)^{\gamma}}{\psi(\omega)} \int_{\omega}^{\bar{\omega}} [\lambda^{-1} - x_v(v(s), z(s), s)] \psi(s) ds.$$

This gives us an expression for the optimal joint income tax rate that follows exactly the one of the standard Mirrlees' model:

$$(A.12) \quad T'(z(\omega)) = \frac{z(\omega)^{\gamma}}{\psi(\omega)} \int_{\omega}^{\bar{\omega}} [x_v(v(s), z(s), s) - \lambda^{-1}] \psi(s) ds,$$

whenever this differential equation gives an increasing function  $z(\omega)$ . Using  $\lambda = \mathbb{E}^{\psi}[x]^{-1}$  and  $x_v = x(v(\omega), z(\omega), \omega)$ , we can rewrite, with some abuse of notation ( $x_v(v(s), z(s), s) = x(s)$ ), the formula for the optimal marginal taxation as

$$(A.13) \quad T'(z(\omega)) = \frac{z(\omega)^{\gamma}}{\psi(\omega)} \int_{\omega}^{\bar{\omega}} [x(s) - \mathbb{E}^{\psi}[x]] \psi(s) ds.$$

□

**Lemma 9.** *Suppose that there is a introduction of a small tax  $t$  in the spirit of Subsection 4.1. The household welfare function for a type  $(\theta_a, \theta_b, \alpha)$  family can once again be expressed*

as a function of total earned income,  $z$  and disposable income  $x$  as

$$V(x, z, \theta_a, \theta_b, \alpha, t) = \kappa(\alpha) + \ln x - \omega(\theta_a, \theta_b, \alpha, t) \frac{z^{1+\gamma}}{1+\gamma},$$

where  $\kappa(\alpha) \equiv \alpha \ln(\alpha) + (1 - \alpha) \ln(1 - \alpha)$  is fully determined by  $\alpha$ , hence exogenous, and

$$\begin{aligned} \omega(\theta_a, \theta_b, \alpha, t) \equiv & \alpha \theta_a \left( \frac{[(1 - \alpha) \theta_b (1 - t)]^{\frac{1}{\gamma}}}{[(1 - \alpha) \theta_b (1 - t)]^{\frac{1}{\gamma}} + [\alpha \theta_a]^{\frac{1}{\gamma}}} \right)^{1+\gamma} + \\ & (1 - \alpha) \theta_b \left( \frac{[\alpha \theta_a]^{\frac{1}{\gamma}}}{[(1 - \alpha) \theta_b (1 - t)]^{\frac{1}{\gamma}} + [\alpha \theta_a]^{\frac{1}{\gamma}}} \right)^{1+\gamma}. \end{aligned}$$

*Proof.* In our collective approach to the household choice, the spouses' labor supply maximizes the family welfare. Given our assumptions of efficient allocation within the household, the division of labor supply is made in order to minimize the disutility costs of getting a given income level  $z \in \mathbb{R}_+$ . Therefore, the collective choice of labor supply is the solution to

$$\min_{z_a, z_b} \alpha \left[ \theta_a \frac{z_a^{1+\gamma}}{1+\gamma} \right] + (1 - \alpha) \left[ \theta_b \frac{z_b^{1+\gamma}}{1+\gamma} \right]$$

subject to

$$z_a(1 - t) + z_b = z.$$

The first-order condition for this problem is

$$(A.14) \quad \frac{\alpha \theta_a z_a^\gamma}{1 - t} = (1 - \alpha) \theta_b z_b^\gamma.$$

Using  $z = z_a(1 - t) + z_b$  we have

$$(A.15) \quad z_a = z \left[ \left( \frac{\alpha}{1 - \alpha} \frac{\theta_a}{\theta_b} \frac{1}{1 - t} \right)^{\frac{1}{\gamma}} + 1 \right]^{-1} \text{ and}$$

$$(A.16) \quad z_b = z \left[ \left( \frac{1 - \alpha}{\alpha} \frac{\theta_b}{\theta_a} (1 - t) \right)^{\frac{1}{\gamma}} + 1 \right]^{-1}.$$

Substituting in the family utility function we have

$$(A.17) \quad V(x, z, \theta_a, \theta_b, \alpha, t) = \kappa(\alpha) + \ln x - \omega(\theta_a, \theta_b, \alpha, t) \frac{z^{1+\gamma}}{1+\gamma},$$

where

$$\omega(\theta_a, \theta_b, \alpha, t) \equiv \alpha \theta_a \left[ 1 + \left( \frac{\alpha}{1-\alpha} \frac{\theta_a}{\theta_b} \frac{1}{1-t} \right)^{\frac{1}{\gamma}} \right]^{-(1+\gamma)} + (1-\alpha) \theta_b \left[ 1 + \left( \frac{1-\alpha}{\alpha} \frac{\theta_b}{\theta_a} (1-t) \right)^{\frac{1}{\gamma}} \right]^{-(1+\gamma)}$$

and

$$\kappa(\alpha) = \alpha \ln \alpha + (1-\alpha) \ln(1-\alpha).$$

□

## B Utilitarian welfare criteria based on individuals

Assume that the planner is utilitarian across and within households. Recall that  $V_a(x, z, \theta_a, \theta_b, \alpha)$  and  $V_b(x, z, \theta_a, \theta_b, \alpha)$  are the indirect utility derived by spouses  $a$  and  $b$  in a couple  $(\theta_a, \theta_b)$  from the allocation  $(x, z)$  calculated in Lemma 7.

The planner's welfare of a given allocation  $(x, z) : [\underline{\theta}, \bar{\theta}] \times [\underline{\theta}, \bar{\theta}] \times (0, 1) \rightarrow \mathbb{R}_{++} \times Z$  is (neglecting the explicit dependence of  $(x, z)$  on types to simplify the formula):

$$\int_0^1 \int_{\underline{\theta}}^{\bar{\theta}} \int_{\underline{\theta}}^{\bar{\theta}} \left[ \frac{1}{2} V_a(x(\cdot), z(\cdot), \theta_a, \theta_b, \alpha) + \frac{1}{2} V_b(x(\cdot), z(\cdot), \theta_a, \theta_b, \alpha) \right] d\tilde{F}(\theta_a, \theta_b, \alpha).$$

where  $\tilde{F}$  denotes the distribution of the random vector  $(\theta_a, \theta_b, \alpha)$ . Given the characterization in Lemma 7 of  $V_a$  and  $V_b$ , we can re-write the welfare criteria as a function of  $(\omega, \omega_a)$ . In fact, substituting  $V_a$ ,  $V_b$  and  $\kappa(\alpha)$  we have

$$\begin{aligned} \frac{1}{2} V_a + \frac{1}{2} V_b &= \left( \frac{1}{2} - \alpha \right) \ln \frac{\alpha}{1-\alpha} + V + \left[ \omega - \frac{\omega_a + \omega_b}{2} \right] \frac{z^{1+\gamma}}{1+\gamma} \\ &= \left( \frac{1}{2} - \alpha \right) \ln \frac{\alpha}{1-\alpha} + V + \left( \alpha - \frac{1}{2} \right) [\omega_a - \omega_b] \frac{z^{1+\gamma}}{1+\gamma} \\ &= \left( \frac{1}{2} - \alpha \right) \ln \frac{\alpha}{1-\alpha} + V + \left( \alpha - \frac{1}{2} \right) \left( \frac{\omega_a - \omega}{1-\alpha} \right) \frac{z^{1+\gamma}}{1+\gamma}, \end{aligned}$$

where in the second equality we substitute  $V_a$ ,  $V_b$  and  $\kappa(\alpha)$ . In the third and fifth equalities we used  $\omega = \alpha \omega_a + (1-\alpha) \omega_b$ . Therefore, we can define the planner's social welfare function based on individuals in terms of family type and spouse  $a$  type as

$$W(x, z, \omega, \omega_a, \alpha) = \left( \frac{1}{2} - \alpha \right) \ln \frac{\alpha}{1-\alpha} + V(x, z, \omega, \omega_a, \alpha) + \left( \alpha - \frac{1}{2} \right) \left( \frac{\omega_a - \omega}{1-\alpha} \right) \frac{z^{1+\gamma}}{1+\gamma}.$$

## C Proofs

*Proof of Proposition 1.* As in the proof of Lemma 8, let  $v(\omega)$  denote the utility of type  $\omega$  in the mechanism. Taking  $v(\omega)$  and  $z(\omega)$  as choice variables,  $x(\omega)$  is implicitly defined by

$$v(\omega) = \ln x(v(\omega), z(\omega), \omega) - \omega \frac{z(\omega)^{1+\gamma}}{1+\gamma}.$$

First, notice that we can rewrite the objective function as

$$\begin{aligned} \int_0^1 \int_{\underline{\omega}}^{\bar{\omega}} \int_{\underline{\omega}_a}^{\bar{\omega}_a} \left[ v(\omega) + \left( \alpha - \frac{1}{2} \right) \left( \frac{\omega_a - \omega}{1 - \alpha} \right) \frac{z(\omega)^{1+\gamma}}{1 + \gamma} \right] \hat{\psi}_c(\omega_a | \omega, \alpha) \hat{\psi}_m(\omega, \alpha) d\omega_a d\omega d\alpha = \\ \int_0^1 \int_{\underline{\omega}}^{\bar{\omega}} v(\omega) \left[ \int_{\underline{\omega}_a}^{\bar{\omega}_a} \hat{\psi}_c(\omega_a | \omega, \alpha) d\omega_a \right] \hat{\psi}_m(\omega, \alpha) d\omega d\alpha + \\ \int_0^1 \int_{\underline{\omega}}^{\bar{\omega}} \left( \alpha - \frac{1}{2} \right) \frac{z(\omega)^{1+\gamma}}{1 + \gamma} \int_{\underline{\omega}_a}^{\bar{\omega}_a} \left[ \left( \frac{\omega_a - \omega}{1 - \alpha} \right) \hat{\psi}_c(\omega_a | \omega, \alpha) d\omega_a \right] \hat{\psi}_m(\omega, \alpha) d\omega d\alpha, \end{aligned}$$

using

$$\int_{\underline{\omega}_a}^{\bar{\omega}_a} \hat{\psi}_c(\omega_a | \omega, \alpha) d\omega_a = 1$$

and

$$\int_{\underline{\omega}_a}^{\bar{\omega}_a} \omega_a \hat{\psi}_c(\omega_a | \omega, \alpha) d\omega_a \equiv \mathbb{E}[\omega_a | \omega, \alpha].$$

Define the marginal density

$$\psi(\omega) \equiv \int_0^1 \hat{\psi}_m(\omega, \alpha) d\alpha.$$

We can rewrite the objective function as

$$\int_{\underline{\omega}}^{\bar{\omega}} v(\omega) \psi(\omega) d\omega + \int_{\underline{\omega}}^{\bar{\omega}} \int_0^1 \left[ \left( \alpha - \frac{1}{2} \right) \left( \frac{\mathbb{E}[\omega_a | \omega, \alpha] - \omega}{1 - \alpha} \right) \right] \frac{z(\omega)^{1+\gamma}}{1 + \gamma} \hat{\psi}_m(\omega, \alpha) d\alpha d\omega.$$

Thus, the planner chooses  $v, z : \Omega \rightarrow \mathbb{R}$  to maximize this objective function subject to the local first-order local incentive constraint:

$$(C.1) \quad \dot{v}(\omega) = \frac{z(\omega)^{1+\gamma}}{1 + \gamma};$$

and monotonicity constraints:  $z(\omega)$  is increasing; and budget constraint:

$$\int_{\underline{\omega}}^{\bar{\omega}} [z(\omega) - x(v(\omega), z(\omega), \omega)] \psi(\omega) d\omega \geq 0.$$

By the implicit function theorem,

$$x_v = \frac{1}{u'(x(v(\omega), z(\omega), \omega))} = x(v(\omega), z(\omega), \omega),$$

$$x_z = \frac{h'(z(\omega))}{u'(x(v(\omega), z(\omega), \omega))} = \omega z(\omega)^\gamma x(v(\omega), z(\omega), \omega).$$

In this approach the income  $z(\omega)$  is the control variable and utility of the family  $v(\omega)$  is the state variable.

The Hamiltonian associated to this problem is

$$\mathcal{H}(v(\omega), z(\omega), \mu(\omega), \lambda, \omega) = \frac{z(\omega)^{1+\gamma}}{1+\gamma} \left[ \int_0^1 \left( \alpha - \frac{1}{2} \right) \left( \frac{\mathbb{E}[\omega_a | \omega, \alpha] - \omega}{1-\alpha} \right) \hat{\psi}_m(\omega, \alpha) d\alpha \right]$$

$$+ v(\omega) \psi(\omega) + \lambda [z(\omega) - x(v(\omega), z(\omega), \omega)] \psi(\omega) - \mu(\omega) \frac{z(\omega)^{1+\gamma}}{1+\gamma},$$

where  $\lambda \in \mathbb{R}_+$  is the Lagrange multiplier associated to the government budget constraint, and  $\mu(\omega)$  is the co-state variable. At the optimum, the control  $z(\omega)$  maximizes the Hamiltonian function giving the following first-order condition:

$$z(\omega)^\gamma \left[ \int_0^1 \left( \alpha - \frac{1}{2} \right) \left( \frac{\mathbb{E}[\omega_a | \omega, \alpha] - \omega}{1-\alpha} \right) \hat{\psi}_m(\omega, \alpha) d\alpha \right] + \lambda(1 - x_z) \psi(\omega) = \mu(\omega) z(\omega)^\gamma$$

and the other first-order condition of the Hamiltonian is

$$\dot{\mu}(\omega) = -\frac{\partial}{\partial v} \mathcal{H}(\cdot) = -[1 - \lambda x_v] \psi(\omega)$$

or

$$\dot{\mu}(\omega) = \psi(\omega) [\lambda x_v - 1]$$

and the transversality conditions  $\mu(\underline{\omega}) = \mu(\bar{\omega}) = 0$ . Integrating on both sides from  $\omega$  to  $\bar{\omega}$  and applying the fundamental theorem of calculus we have

$$\mu(\bar{\omega}) - \mu(\omega) = \int_\omega^{\bar{\omega}} \dot{\mu}(s) ds = \int_\omega^{\bar{\omega}} \psi(s) [\lambda x_v - 1] ds.$$

Using the transversality condition we have

$$(C.2) \quad \mu(\omega) = \lambda \int_\omega^{\bar{\omega}} \psi(s) [\lambda^{-1} - x_v(v(s), z(s), s)] ds.$$

Note that from the transversality condition  $\mu(\underline{\omega}) = 0$  we can pin down the social



value of an extra unit of income:

$$0 = \mu(\underline{\omega}) = \lambda \int_{\underline{\omega}}^{\bar{\omega}} \psi(s) \left[ \frac{1}{\lambda} - x_v(v(s), z(s), s) \right] ds.$$

Therefore,

$$\lambda = \frac{1}{\int_{\underline{\omega}}^{\bar{\omega}} x_v(v(s), z(s), s) \psi(s) ds} = \frac{1}{\int_{\underline{\omega}}^{\bar{\omega}} x(v(s), z(s), s) \psi(s) ds}$$

or

$$\lambda = \mathbb{E}^\psi[x]^{-1}.$$

Substituting  $\mu(\omega)$  in (C.2) into equation (C.2) we have

$$\begin{aligned} z(\omega)^\gamma \left[ \int_0^1 \left( \alpha - \frac{1}{2} \right) \left( \frac{\mathbb{E}[\omega_a | \omega, \alpha] - \omega}{1 - \alpha} \right) \hat{\psi}_m(\omega, \alpha) d\alpha \right] + \lambda(1 - x_z)\psi(\omega) = \\ z(\omega)^\gamma \lambda \int_{\omega}^{\bar{\omega}} \psi(s) [\lambda^{-1} - x_v(v(s), z(s), s)] ds. \end{aligned}$$

This gives us the following expression for the marginal tax rate

$$\begin{aligned} T'(z(\omega)) = \frac{z(\omega)^\gamma}{\psi(\omega)} \int_{\omega}^{\bar{\omega}} \left[ x_v(v(s), z(s), s) - \frac{1}{\lambda} \right] \psi(s) ds \\ - \frac{z(\omega)^\gamma}{\lambda \psi(\omega)} \left[ \int_0^1 \left( \alpha - \frac{1}{2} \right) \left( \frac{\mathbb{E}[\omega_a | \omega, \alpha] - \omega}{1 - \alpha} \right) \hat{\psi}_m(\omega, \alpha) d\alpha \right]. \end{aligned}$$

Using  $\lambda = \mathbb{E}^\psi[x]^{-1}$  and  $x_v = x(v(\omega), z(\omega), \omega)$ , we can rewrite with some abuse of notation ( $x_v(v(s), z(s), s) = x(s)$ ) the formula for the optimal marginal taxation as

$$\begin{aligned} T'(z(\omega)) = \frac{z(\omega)^\gamma}{\psi(\omega)} \int_{\omega}^{\bar{\omega}} [x(s) - \mathbb{E}^\psi[x]] \psi(s) ds \\ - \frac{z(\omega)^\gamma}{\psi(\omega)} \mathbb{E}^\psi[x] \left[ \int_0^1 \left( \alpha - \frac{1}{2} \right) \left( \frac{\mathbb{E}[\omega_a | \omega, \alpha] - \omega}{1 - \alpha} \right) \hat{\psi}_m(\omega, \alpha) d\alpha \right]. \end{aligned}$$

For future reference if we assume  $\alpha$  to be constant across all households, this last formula simplifies to

$$T'(z(\omega)) = \frac{z(\omega)^\gamma}{\psi(\omega)} \int_{\omega}^{\bar{\omega}} [x(s) - \mathbb{E}^\psi[x]] \psi(s) ds - z(\omega)^\gamma \mathbb{E}^\psi[x] \left( \alpha - \frac{1}{2} \right) \left( \frac{\mathbb{E}[\omega_a | \omega] - \omega}{1 - \alpha} \right).$$

□

*Proof of Proposition 2.* The Gateaux derivative of the earning supply functional, is

defined by

$$(C.3) \quad dz_{\iota}(T; H) \equiv \lim_{\mu \rightarrow 0} \frac{z_{\iota}(T + \mu H) - z_{\iota}(T)}{\mu} = \left. \frac{\partial z_{\iota}}{\partial \mu} \right|_{\mu=0}.$$

Increase the marginal tax rate by  $d\tau$  in a small interval  $(z', z' + dz')$ . Let  $\Phi(z)$  denote the distribution of income induced by the candidate optimal tax schedule,  $T(\cdot)$  (and the distribution  $F(\cdot)$  of types  $\iota$ ). Let us then consider the overall impact of such a reform.

**Impact on government revenues** For agents with taxable income in the interval  $(z', z' + dz')$ , there is a mechanical effect  $M_1 = d\tau dz'$ . But there is also a behavioral effect, which is given by

$$B_1(z', \iota) = T'(z') \left. \frac{dz}{d\tau} \right|_u d\tau = T'(z') \epsilon^c(z', \iota) \frac{z'}{1 - T'(z')} d\tau.$$

Let  $\bar{\varphi}(\iota|z')$  be the conditional distribution on  $z'$  of  $\iota$ . Then, the average response at income  $z'$  is

$$B_1(z') = \frac{z' T'(z')}{1 - T'(z')} \int \epsilon^c(z', \iota) d\bar{\varphi}(\iota|z') d\tau = \frac{z' T'(z')}{1 - T'(z')} \epsilon^c(z') d\tau,$$

for  $\epsilon^c(z')$  as defined in Section 5.

This affects agents in the interval  $(z', z' + dz')$ , which results in an overall effect

$$\epsilon^c(z') \frac{T'(z')}{1 - T'(z')} z' \varphi(z') dz' d\tau,$$

where  $\varphi$  is the density of  $z$  induced by the tax system.

For agents with taxable income in  $[z', \bar{z}]$ , we have again a mechanical effect  $d\tau dz'$  which affects all agents for an overall increase in revenues given by

$$M_2 = [1 - \Phi(z')] d\tau dz'.$$

For all agents in this interval there is also a behavioral response due to income effect

$$B_2(z, \iota) = T'(z) \frac{dz}{dI} d\tau dz' = \frac{T'(z)}{1 - T'(z)} \eta(z, \iota) d\tau dz',$$

which can be aggregated across all households earning  $z$  through

$$B_2(z) = \frac{T'(z)}{1 - T'(z)} \int \eta(z, \iota) d\bar{\varphi}(\iota|z) d\tau dz' = \frac{T'(z)}{1 - T'(z)} \eta(z) d\tau dz'.$$

Finally, we can use the expression above to find the overall behavior effect on tax revenues for agents in this range

$$B_2(z, \iota) = d\tau dz' \int_{z'}^{\bar{z}} \frac{T'(z)}{1 - T'(z)} \eta(z) \varphi(z) dz.$$

This is exactly as in [Saez \(2001\)](#) with the proviso that we are using a different definition for the elasticities we are aggregating.

**Welfare impacts** As for the welfare effects, again, let us start with households with taxable income in the interval  $(z', z' + dz')$ . First note that for this group, the tax reform has no first-order mechanical effect on utility,  $V$ . The relevant ‘decision’ elasticities are, therefore, Hicksian.

The impact on welfare is however measured according to the planner’s valuation, i.e., the ‘experience’ utility  $W$ . Hence,

$$dW_1(z', \iota) = \frac{\partial}{\partial x} W(z' - T(z'), z', \iota) [1 - T'(z')] \frac{dz}{d\tau} \Big|_u d\tau + \frac{\partial}{\partial z} W(z' - T(z'), z', \iota) \frac{dz}{d\tau} \Big|_u d\tau,$$

which simplifies to

$$dW_1(z', \iota) = \frac{\partial}{\partial x} W(z' - T(z'), z', \iota) \left[ 1 - T'(z') + \frac{\frac{\partial}{\partial z} W(z' - T(z'), z', \iota)}{\frac{\partial}{\partial x} W(z' - T(z'), z', \iota)} \right] \frac{dz}{d\tau} \Big|_u d\tau,$$

or

$$dW_1(z', \iota) = \frac{\partial}{\partial x} W(z' - T(z'), z', \iota) [1 - \xi(z', \iota)] \epsilon^c(z', \iota) z' d\tau,$$

where, for all  $z$ ,

$$\xi(z, \iota) \equiv \frac{1}{1 - T'(z)} \frac{\frac{\partial}{\partial z} W(z - T(z), z, \iota)}{\frac{\partial}{\partial x} W(z - T(z), z, \iota)}.$$

Let  $\bar{\varphi}(\iota|z')$  the conditional on  $z'$  distribution of  $\iota$ . The overall welfare effect at  $z'$  is

$$W_1 = dz' d\tau z' \int [g(z', \iota) [1 - \xi(z', \iota)] \epsilon^c(z', \iota)] d\bar{\varphi}(\iota|z'),$$

for  $g(z', \iota)$  the marginal social value of income in the hands of a  $\iota$  household earning  $z'$ .

To simplify this expression, let  $\tilde{\varphi}(\cdot|z)$  be a measure equivalent to  $\bar{\varphi}(\cdot|z)$ , ( $\tilde{\varphi}(\cdot|z) \equiv \bar{\varphi}(\cdot|z)$ ) whose Radon-Nikodym derivative with respect to  $\bar{\varphi}(\cdot|z')$  is the function  $g(z, \cdot)/\bar{g}(z)$ , where  $\bar{g}(z) = \int g(z, \iota) d\bar{\varphi}(\iota|z)$ . This measure allows us to re-express the definitions for  $\bar{\xi}(z)$  and  $\bar{\epsilon}^c(z)$  from Section 5, as  $\bar{\xi}(z) = \int \xi(z, \iota) d\tilde{\varphi}(\iota|z) = \tilde{\mathbb{E}}[\xi(z, \iota)]$ , and  $\bar{\epsilon}^c(z) = \tilde{\mathbb{E}}[\epsilon^c(z, \iota)]$ . It also allows us to define a covariance term

$$\zeta^{\epsilon, \xi}(z) = c\tilde{o}v\left(\epsilon^c(z, \iota), \xi(z, \iota)\right) = \tilde{\mathbb{E}}[\epsilon^c(z, \iota)\xi(z, \iota)] - \bar{\xi}(z)\bar{\epsilon}^c(z).$$

Using these definitions we write

$$W_1 = dz' d\tau z' \bar{g}(z') [ [1 - \bar{\xi}(z')] \bar{\epsilon}^c(z') - \zeta^{\epsilon, \xi}(z') ].$$

For households with taxable income  $z \geq z'$ ,

$$dW_2(z, \iota) = -\frac{\partial}{\partial x} W(z - T(z), z, \iota) dz' d\tau + \frac{\partial}{\partial x} W(z - T(z), z, \iota) [1 - T'(z)] \frac{dz}{dI} dz' d\tau + \frac{\partial}{\partial z} W(z - T(z), z, \iota) \frac{dz}{dI} dz' d\tau$$

leading to

$$dW_2(z, \iota) = -\frac{\partial}{\partial x} W(z - T(z), z, \iota) \left\{ 1 + \left[ 1 - T'(z) + \frac{\frac{\partial}{\partial z} W(z - T(z), z, \iota)}{\frac{\partial}{\partial x} W(z - T(z), z, \iota)} \right] \frac{dz}{dI} \right\} dz' d\tau,$$

and finally

$$dW_2(z, \iota) = -g(z, \iota) \{ 1 + [1 - \xi(z, \iota)] \eta(z, \iota) \} dz' d\tau.$$

To aggregate across all household earnings at the same  $z$ , we integrate over  $\iota$

$$d\bar{W}_2(z) = dz' d\tau \int [ -g(z, \iota) \{ 1 + [1 - \xi(z, \iota)] \eta(z, \iota) \} ] d\bar{\varphi}(\iota | z').$$

Analogously, to what we have done for  $dW_1$  we can further simplify this expression to

$$d\bar{W}_2(z) = d\tau dz' \bar{g}(z) [ [1 - \bar{\xi}(z)] \bar{\eta}^c(z) - \zeta^{\eta, \xi}(z) ],$$

where the covariance term  $\zeta^{\eta, \xi}(z)$  is also under the equivalent measure,  $\tilde{\varphi}(\cdot | z)$ .

The overall effect on this household welfare is

$$W_2 = d\tau dz' \int_{z'}^{\bar{z}} \bar{g}(z) \{ 1 + [1 - \bar{\xi}(z)] \bar{\eta}(z) - \zeta^{\eta, \xi}(z) \} \varphi(z) dz.$$

At the optimum all these effects must cancel out and we get

$$M_1 + M_2 + B_1 + B_2 + W_1 + W_2 = 0.$$

Substituting the expressions for each on of these terms we get

$$\begin{aligned} & \frac{T'(z')}{1 - T'(z')} \epsilon^c(z') z' \varphi(z') - g(z') [ [1 - \xi(z')] \bar{\epsilon}^c(z') - \zeta^{\epsilon, \xi}(z') ] z' \varphi(z') + [1 - \Phi(z')] \\ & + \int_{z'}^{\bar{z}} \frac{T'(z)}{1 - T'(z)} \eta(z) \varphi(z) dz + \int_{z'}^{\bar{z}} g(z) \{ 1 + [1 - \xi(z)] \bar{\eta}(z) - \zeta^{\eta, \xi}(z) \} \varphi(z) dz = 0 \end{aligned}$$

Reorganizing the terms,

$$\begin{aligned} \frac{T'(z')}{1-T'(z')} \epsilon^c(z') z' \varphi(z') &= \int_{z'}^{\bar{z}} \left[ 1 - g(z) + \frac{T'(z)}{1-T'(z)} \eta(z) \right] \varphi(z) dz \\ &+ \int_{z'}^{\bar{z}} g(z) \{ [1 - \xi(z)] \bar{\eta}(z) - \zeta^{\eta, \xi}(z) \} \varphi(z) dz \\ &+ g(z') \left[ [1 - \xi(z')] \bar{\epsilon}^c(z') - \zeta^{\epsilon, \xi}(z') \right] z' \varphi(z') \end{aligned}$$

or

$$\begin{aligned} \text{(C.4)} \quad \frac{T'(z)}{1-T'(z)} &= \frac{1}{\epsilon^c(z)} \frac{1 - \Phi(z)}{z \varphi(z)} \left\{ \int_z^{\bar{z}} \left[ 1 - g(\tilde{z}) + \frac{T'(\tilde{z})}{1-T'(\tilde{z})} \eta(\tilde{z}) \right] \frac{\varphi(\tilde{z})}{1 - \Phi(\tilde{z})} d\tilde{z} \right. \\ &+ \int_{z'}^{\bar{z}} g(\tilde{z}) \{ [1 - \xi(\tilde{z})] \bar{\eta}(\tilde{z}) - \zeta^{\eta, \xi}(\tilde{z}) \} \frac{\varphi(\tilde{z})}{1 - \Phi(\tilde{z})} d\tilde{z} \Big\} \\ &- \frac{g(z)}{\epsilon^c(z)} \{ [1 - \xi(z)] \bar{\epsilon}^c(z) - \zeta^{\epsilon, \xi}(z) \} \end{aligned}$$

□

*Proof of Proposition 3.* We prove Proposition 3 as a particular case of Proposition 2. Under the assumptions of Proposition 3,  $\xi(z) = \bar{\xi}(z)$ ,  $\epsilon^c(z) = \bar{\epsilon}^c(z)$  and  $\eta(z) = \bar{\eta}c(z)$ , for all  $z$ . Moreover,  $\zeta^{\epsilon, \xi}(z) = 0$  and  $\zeta^{\eta, \xi}(\tilde{z}) = 0$ , for all  $z$ . As a consequence, expression (19) collapses to (20).

If we define

$$\kappa(z) \equiv \frac{T'(z)}{1-T'(z)},$$

$$A(z)^{-1} \equiv \frac{1}{\epsilon^c(z)} \frac{1 - \Phi(z)}{z \varphi(z)},$$

$$B(z) \equiv [1 - g(z) + g(z)[1 - \xi(z)]\eta(z)] \frac{\varphi(\tilde{z})}{1 - \Phi(\tilde{z})},$$

$$C(z) \equiv \eta(z) \frac{\varphi(\tilde{z})}{1 - \Phi(\tilde{z})}$$

and

$$D(z) = g(z)[1 - \xi(z)]A(z),$$

then (C.4) can be written as

$$A(z)\kappa(z) = \int_z^{\bar{z}} [B(\tilde{z}) + C(\tilde{z})\kappa(\tilde{z})] d\tilde{z} - D(z)$$

and solved for

$$\kappa(z) = -\frac{1}{A(z)} \int_z^{\bar{z}} \left[ B(\tilde{z}) + \frac{D(\tilde{z})C(\tilde{z})}{A(\tilde{z})} - D(\tilde{z}) \right] \exp \left\{ \int_z^{\tilde{z}} \frac{C(\tilde{\tilde{z}})}{A(\tilde{\tilde{z}})} d\tilde{\tilde{z}} \right\} d\tilde{z} + \frac{D(z)}{A(z)}$$

or

$$(C.5) \quad \frac{T'(z)}{1 - T'(z)} = \frac{1}{\varepsilon^c(z)} \frac{1 - \Phi(z)}{\varphi(z)z} \int_z^{\bar{z}} \{g(\tilde{z}) - 1\} \exp \left\{ \int_{\tilde{z}}^z \frac{\eta(\tilde{\tilde{z}})}{\varepsilon^c(\tilde{\tilde{z}})} \frac{d\tilde{\tilde{z}}}{\tilde{\tilde{z}}} \right\} \frac{\varphi(\tilde{\tilde{z}})}{1 - \Phi(z)} d\tilde{\tilde{z}} - g(z) \{1 - \xi(z)\}.$$

□

## D Gender-based Tax Reforms

To simplify the analysis we retain the assumption of separable preferences,  $U(x, l) = u(x) - h(l)$ . Let

$$\mathcal{U}(x, \boldsymbol{\iota}) \equiv \max_{x_a} \alpha u(x_a) + (1 - \alpha)u(x - x_a)$$

and

$$\mathcal{H}(z_a, z_b, \boldsymbol{\iota}) \equiv \alpha \theta_a h(z_a) + (1 - \alpha) \theta_b h(z_b),$$

where we have omitted the parameters related to the household type for simplicity. In this case,

$$\mathcal{V}(x, z_a, z_b; \boldsymbol{\iota}) = \mathcal{U}(x, \boldsymbol{\iota}) - \mathcal{H}(z_a, z_b, \boldsymbol{\iota}),$$

and we write the household's maximization problem as

$$\max_{z_a, z_b} \mathcal{U}(z_a + z_b - T(z_a, z_b) - \mu H(z_a, z_b), \boldsymbol{\iota}) - \mathcal{H}(z_a, z_b, \boldsymbol{\iota}).$$

From the planner's perspective, however, the household welfare is equal to

$$\mathcal{W}(x, z_a, z_b, \boldsymbol{\iota}) = u(x_a(x)) + u(x - x_a(x)) - \theta_a h(z_a) - \theta_b h(z_b).$$

Hence, a reform  $\tilde{T} = T + \mu H$  changes the family welfare, as perceived by the planner, according to

$$dW = \left\{ -\frac{\partial \mathcal{W}}{\partial x} + \frac{\partial \mathcal{W}}{\partial x} [1 - T'(z)] \left[ \frac{dz_a}{d\mu} + \frac{dz_b}{d\mu} \right] + \frac{\partial \mathcal{W}}{\partial z_a} \frac{dz_a}{d\mu} + \frac{\partial \mathcal{W}}{\partial z_b} \frac{dz_b}{d\mu} \right\} d\mu H,$$

which may be re-written as

$$dW = [1 - T'(z)] \frac{\partial \mathcal{W}}{\partial x} \left\{ -1 + [1 - \xi_a(z)] \frac{dz_a}{d\mu} + [1 - \xi_b(z)] \frac{dz_b}{d\mu} \right\} d\mu H,$$

where

$$\xi_i(z) = \frac{1}{1 - T'(z)} \frac{\partial \mathcal{W} / \partial z_i}{\partial \mathcal{W} / \partial x}, i = a, b.$$

Again, if  $\xi_i(z) \neq 1$ , one needs to find an expression for  $dz_a/d\mu$  and  $dz_b/d\mu$  if one is to assess the welfare effect of such reform.

It is not hard to show that<sup>39</sup>

$$\begin{pmatrix} dz_a \\ dz_b \end{pmatrix} = \tilde{\Delta}^{-1} \begin{bmatrix} \mathcal{U}''(x) [R_H + H_a z_a] + \mathcal{U}'(x) H_a \\ \mathcal{U}''(x) [R_H + H_b z_b] + \mathcal{U}'(x) H_b \end{bmatrix} d\mu,$$

where

$$\tilde{\Delta} = \mathcal{U}''(x) (1 - T_a, 1 - T_b) \begin{pmatrix} 1 - T_a \\ 1 - T_b \end{pmatrix} - \mathcal{U}'(x) \begin{bmatrix} T_{aa} & T_{ab} \\ T_{ba} & T_{bb} \end{bmatrix} - \begin{bmatrix} \mathcal{H}_{aa} & \mathcal{H}_{ab} \\ \mathcal{H}_{ba} & \mathcal{H}_{bb} \end{bmatrix}$$

and  $R_H = H(z_a, z_b) - H_a z_a - H_b z_b$ .

Our baseline schedule is  $T \in \mathcal{T}_0$ , in which case the expression above simplifies to

$$\tilde{\Delta} = [\mathcal{U}''(x) (1 - T')^2 - \mathcal{U}'(x) T''] I - \begin{bmatrix} \mathcal{H}_{aa} & \mathcal{H}_{ab} \\ \mathcal{H}_{ba} & \mathcal{H}_{bb} \end{bmatrix}.$$

The expressions above allow us to calculate for any family with earnings  $(z_a, z_b)$  the welfare impact and the labor supply (or earnings) response of any tax reform. Still, there are some subtleties that arise when we attempt to derive a multidimensional analog to (20).

To derive Proposition 3 we considered a slight perturbation  $d\tau$  of a *one-dimensional* schedule in a small interval  $[z', z' + dz]$ . Here, we may take any direction of change and must also define the region in the space  $\mathbb{R}_+^2$  to apply this reform. For example, we could increase the tax rate for spouse  $a$  by an amount  $d\tau_a$  in an interval  $[z'_a, z'_a + dz_a]$ . In this case, all couples such that spouse  $a$  earns between  $z'_a$  and  $z'_a + dz_a$  would be directly affected by the reform, independently on the other spouse's earnings  $z_b$ . Another possibility would be to increase this tax for all spouses such that  $z \in [z', z' + dz]$ , independently of how total earnings is split between spouses. These two reforms have very different consequences both to households in these intervals, but also to households whose earnings exceed either  $z'$  or  $z'_a$ . Other reforms can be considered, but the general point is that, even if our starting point is a schedule (and preferences) that induces the same choices for all households which share the same  $\omega$ , a reform will generate heterogeneous consequences for these households.

Which choices are more useful for producing intuitive expressions for optimal tax schedules is an interesting question which we refrain from addressing here.

<sup>39</sup>Subscripts denote partial derivatives, e.g.,  $\partial^2 \mathcal{H} / \partial z_a \partial z_b = \mathcal{H}_{ab}$ .

## E Implementation Algorithm for the Numeric Simulations

In this section we compute numerically the optimal tax schedules derived in Proposition 1 and Corollary 2, using real data from the 2017 March CPS to have a clear idea of the shape of the optimal taxation in both cases. We use the sample of couples without dependents, using wages as a proxy for types.

Note that the marginal tax rate in Proposition 1 depends on the distribution of  $\omega$ ,  $\psi(\omega)$ , and on the distribution of  $\omega_a$ , conditional on  $\omega$ ,  $\phi(\omega_a | \omega)$ . However, we can calculate the implied distribution of  $\omega$ ,  $\psi(\omega)$ , from the knowledge of the wage distribution. It is important to notice that we only need to estimate the conditional expectation  $\mathbb{E}[\omega_a | \omega]$  and we do that non-parametrically using a simple kernel regression. This simplifies our analysis by avoiding the calculation of the conditional distribution of  $\omega$ ,  $\phi(\omega_a | \omega)$  without relying on any additional restrictive assumptions.

After calculating these objects, we simulate the marginal tax rate by adapting the algorithm proposed by [Mankiw et al. \(2009\)](#), based on a discrete grid of the empirical distributions. The algorithm goes as in the following steps:

*Step 1:* Given  $\psi(\omega)$ , discretize the probability mass function  $\pi(\omega)$  in the following way: divide the interval considered  $[\underline{\omega}, \bar{\omega}]$  in  $N$  bins of equal bandwidth  $\Delta$ , creating a grid where  $\{\omega_i\}_{i=1}^N$  with  $\underline{\omega} \leq \omega_1 \leq \dots \leq \omega_n \leq \dots \leq \omega_N \leq \bar{\omega}$  are the midpoints in the grid. The probability mass function at each  $\omega$  is given by

$$\pi(\omega) = \Psi(\omega + \Delta/2) - \Psi(\omega - \Delta/2),$$

where  $\Psi(\cdot)$  is the cumulative distribution function of  $\omega$ .

*Step 2:* For each  $\{\omega_i\}_{i=1}^N$  estimate the conditional expectation using the Nadaraya and Watson kernel regression as

$$\hat{\mathbb{E}}[\omega_a | \omega_i] = \frac{1/(Nh) \sum_{j=1}^N K(\frac{\omega_j - \omega_i}{h}) \omega_{aj}}{1/(Nh) \sum_{j=1}^N K(\frac{\omega_j - \omega_i}{h})},$$

where  $K(\cdot)$  is the Gaussian density and  $h$  is the bandwidth.

Now we start the loop for the calculation of the optimal marginal tax rate  $T_k(\omega_i)$ .

*Step 3:* Start with a simple guess for the marginal tax rate. For instance, a flat tax schedule  $T_0(\omega_i) = .35$  for all  $\omega_i$  in the grid and a lump-sum transfer  $t_0 = .0001$ .

*Step 4:* Since  $T_{k-1}(\cdot)$  at each iteration is only calculated at points of the grid, extrapolate  $T_{k-1}(\cdot)$  to be defined as well at points outside the grid in the following



way:

$$T'_{k-1}(\omega) = \begin{cases} T'_{k-1}(\omega_1), & \text{for } \underline{\omega} \leq \omega \leq \omega_1; \\ T'_{k-1}(\omega_2), & \text{for } \omega_1 \leq \omega \leq \omega_2; \\ \dots & \\ T'_{k-1}(\omega_n), & \text{for } \omega_{n-1} \leq \omega \leq \omega_n; \\ \dots & \\ T'_{k-1}(\omega_N), & \text{for } \omega_{N-1} \leq \omega \leq \bar{\omega}; \end{cases}$$

generating the tax schedule

$$T_{k-1}(\omega_i) = \begin{cases} T'_{k-1}(\omega_1)z(\omega_i) - t_{k-1}, & \text{for } \underline{\omega} \leq \omega_i \leq \omega_1; \\ T'_{k-1}(\omega_1)z(\omega_1) + T'_{k-1}(\omega_2)[z(\omega_i) - z(\omega_1)] - t_{k-1}, & \text{for } \omega_1 \leq \omega_i \leq \omega_2; \\ \dots & \\ T'_{k-1}(\omega_1)z(\omega_1) + \sum_{j=2}^{n-1} T'_{k-1}(\omega_j)[z(\omega_j) - z(\omega_{j-1})] + \\ T'_{k-1}(\omega_n)[z(\omega_i) - z(\omega_{n-1})] - t_{k-1}, & \text{for } \omega_{n-1} \leq \omega_i \leq \omega_n; \end{cases}$$

*Step 5:* Given  $T_{k-1}(\cdot)$ , calculate the optimal labor supply at each  $\omega_i$  by solving

$$\max_z \ln(z - T_{k-1}(z)) - \omega_i \frac{z^{1+\gamma}}{1+\gamma}.$$

The necessary first-order condition for the type  $\omega_i$  problem is

$$(E.1) \quad 1 - T'_{k-1}(z) = \omega_i z^\gamma (z - T_{k-1}(z))$$

and the optimal  $z^*(\omega_i)$  is implicitly defined in this first-order condition.

*Step 6:* Given the optimal choice of  $z(\omega_i)$ , we can define the consumption as

$$x(\omega_i) = z^*(\omega_i) - T_{k-1}(z^*(\omega_i))$$

and use all the information to update the marginal tax rate in each point of the grid using Corollary 2 and the first-order condition of the planner's problem as follows

$$(E.2) \quad T'_k(\omega_i) = \frac{z^*(\omega_i)^\gamma}{\psi(\omega_i)} \int_{\omega_i}^{\bar{\omega}} [x(s) - \mathbb{E}^\psi[x]] \psi(s) ds \\ - z^*(\omega_i)^\gamma \mathbb{E}^\psi[x] \left( \alpha - \frac{1}{2} \right) \left( \frac{\mathbb{E}[\omega_a | \omega_i] - \omega_i}{1 - \alpha} \right).$$

Since the family utility satisfies the single-crossing property w.r.t.  $\omega_i$ , this first-order condition and the monotonicity of  $z^*(\omega_i)$  are sufficient for optimality.

*Step 7:* The formula in *Step 6* is unfeasible to estimate given our approximation

of the wage distribution in the grid. Therefore, we must use a discrete approximation. One possibility is as follows:

$$\begin{aligned}
(E.3) \quad T'_k(\omega_i) &\approx \frac{1}{x(\omega_i)\omega_i} \frac{1}{\pi(\omega_i)/\Delta} \left[ \sum_{j=i+1}^N \left[ x(\omega_j) - \hat{\mathbb{E}}[x] \right] \pi(\omega_j) \right] \\
&\quad - \frac{1}{x(\omega_i)\omega_i} \hat{\mathbb{E}}[x] \left( \alpha - \frac{1}{2} \right) \left( \frac{\hat{\mathbb{E}}[\omega_a|\omega_i] - \omega_i}{1 - \alpha} \right) \\
&= \frac{1}{x(\omega_i)\omega_i} \frac{1}{\pi(\omega_i)/\Delta} \left[ \sum_{j=i+1}^N x(\omega_j) \pi(\omega_j) - \hat{\mathbb{E}}[x] (1 - \Pi(\omega_i)) \right] \\
&\quad - \frac{1}{x(\omega_i)\omega_i} \hat{\mathbb{E}}[x] \left( \alpha - \frac{1}{2} \right) \left( \frac{\hat{\mathbb{E}}[\omega_a|\omega_i] - \omega_i}{1 - \alpha} \right),
\end{aligned}$$

where  $\hat{\mathbb{E}}[\omega_a|\omega_i]$  is calculated at *Step 2* and

$$\hat{\mathbb{E}}[x] = \sum_{j=1}^N x(\omega_j) \pi(\omega_j).$$

*Step 8:* Update  $t$  to ensure the budget constraint in the following way:

$$t_k = \sum_{j=1}^N T_k(\omega_j) \pi(\omega_j).$$

*Step 9:* Return to *Step 4* until

$$\max_i \{ |T'_k(\omega_i) - T'_{k-1}(\omega_i)| \} < 10^{-3}.$$

*Step 10:* After getting a fixed-point of this operator, the only thing to be checked is the monotonicity to guarantee that the found tax schedule is implementable.

Note that this approximation is increasingly precise as  $\Delta \rightarrow 0$  and  $\omega_N \rightarrow +\infty$ . From this numerical exercise, we can make some counter-factuals. For example, evaluating how the marginal tax rates vary as the spouses' bargaining power changes within the household.

## F Labor market participation

When considering the labor supply of married women, the participation choice is an important margin. In this section we allow individuals to make both extensive and intensive margin labor supply decisions, by deciding whether or not to participate in the labor market, and how much effort to make in case of participation.

To incorporate extensive margin decisions, we assume that spouses have different costs of participating in the market. Given that the majority of individuals who leave the labor force are women, we assume that there is an opportunity cost  $A$  for women to participate in the labor market. Moreover, in this section, we hold  $\alpha$  constant across households.

We allow the government to design different tax schedules:  $T_1(\cdot)$  for households with one earner and  $T_2(\cdot)$  for households with two earners. Equivalently, we consider two different allocations  $(v_1(\theta_b), z(\theta_b))$  for household in which only the husband works and  $(v_2(\omega), z_2(\omega))$  for households with two earners.

It will be convenient to redefine the problem in terms of  $(\theta_b, \omega)$  types. That is, we define a couple by the husband's productivity  $\theta_b$  and the household productivity  $\omega$ . Letting the support of the joint distribution of  $(\theta_a, \theta_b)$  to be  $\Theta \times \Theta$ , with  $\Theta = (0, \infty)$ , the same is the support for the joint distribution of  $(\theta_b, \omega)$  is  $\Theta \times \tilde{\Theta}$ , where  $\tilde{\Theta}(\theta_b) := \{\omega \in \mathbb{R}_+ | \omega < (1 - \alpha)\theta_b\}$  and  $\tilde{\Theta} = \cup_{\theta_b \in \Theta} \tilde{\Theta}(\theta_b)$ .

We use  $F_{\omega|b}(\omega|\theta_b)$  to denote the conditional distribution of  $\omega$  given  $\theta_b$ .<sup>40</sup> Using our definition of  $\omega$ , a  $(\theta_a, \theta_b)$  couple with earned income  $z$  attains utility

$$V(x, z, \omega) = \kappa(\alpha) + \ln x - \omega \frac{z^{1+\gamma}}{1+\gamma} - \alpha A,$$

where  $\kappa(\alpha) \equiv \alpha \ln(\alpha) + (1 - \alpha) \ln(1 - \alpha)$ , if both spouses work, and

$$V_b(x, z, \theta_b) = \kappa(\alpha) + \ln x - (1 - \alpha)\theta_b \frac{z^{1+\gamma}}{1+\gamma},$$

if only the husband works.

Given the tax schedules  $T_1(\cdot)$  and  $T_2(\cdot)$ , the family's optimization problem can be written as

$$\max \left\{ \max_{z_2} \left\{ \ln(z_2 - T_2(z_2)) - \omega \frac{z_2^{1+\gamma}}{1+\gamma} \right\} - \alpha A, \right. \\ \left. \max_{z_1} \left\{ \ln(z_1 - T_1(z_1)) - (1 - \alpha)\theta_b \frac{z_1^{1+\gamma}}{1+\gamma} \right\} \right\}.$$

Define the extensive margin choice rule  $\mathcal{C} : \tilde{\Theta} \times \Theta_b \mapsto \{1, 2\}$  which specifies to every couple  $(\omega, \theta_b)$  whether there should be one or two spouses working. First we show that for any pair of schedules  $T_1(\cdot)$  and  $T_2(\cdot)$  this choice rule takes the form of an increasing function  $\omega^\circ = c(\theta_b)$  which establishes for each  $\theta_b$  a value  $\omega^\circ$  such that every  $\theta_b$  couple with  $\omega < \omega^\circ$  will have both spouses working and for

<sup>40</sup>If  $F_{a|b}(\cdot|\theta_b)$  is the conditional distribution of  $\theta_a$  given  $\theta_b$ , then

$$F_{\omega|b}(\omega|\theta_b) = F_{a|b}(\{\omega^{-1/\gamma} - ((1 - \alpha)\theta_b)^{-1/\gamma}\}^{-\gamma} \alpha^{-1} | \theta_b).$$

every couple with  $\omega \geq \omega^\circ$  only the husband will work.

**Lemma 10.** *Given  $T_1(\cdot)$  and  $T_2(\cdot)$ , there exists an increasing threshold function  $c(\theta_b)$ ,  $\mathcal{C}(\omega, \theta_b) = 1$  if  $\omega \geq c(\theta_b)$  and  $\mathcal{C}(\omega, \theta_b) = 2$ , otherwise.*

*Proof.* Let  $\omega$  and  $\theta_b$  be such that  $v_2(\omega) - \alpha A = v_1(\theta_b)$ . For any  $\omega' < \omega$  that shares the same  $\theta_b$  we have

$$v_2(\omega') \geq \ln(x_2(\omega)) - \omega' \frac{z_2(\omega)^{1+\gamma}}{1+\gamma} > v_2(\omega) = v_1(\theta_b) + \alpha A.$$

Hence,  $\omega'$  couple decides that both spouses should work. If we consider, instead, a couple with the same  $\theta_b$  but  $\omega < \omega''$ , then we can show that  $v_2(\omega) > v_2(\omega'')$ , which implies that couple  $\omega''$  decides that only the husband must work.

Next, for an arbitrary  $\theta_b$ , let  $\omega$  be such that  $v_2(\omega) - v_1(\theta_b) = \alpha A$ . Now consider slightly increasing  $\theta_b$ , thus reducing  $v_1$  while preserving the difference constant at  $\alpha A$ . Because  $v_2(\cdot)$  is decreasing in  $\omega$ , this requires also increase in  $\omega$ .  $\square$

For every  $\theta_b \in \Theta$ , define the set  $\tilde{\Theta}(\theta_b)$  through

$$\tilde{\Theta}(\theta_b) := \left\{ \omega \in \mathbb{R}_+ \mid \exists \theta_a \in \Theta \text{ such that } \omega = \{(\alpha \theta_a)^{-1/\gamma} + ((1-\alpha)\theta_a)^{-1/\gamma}\}^{-\gamma} \right\}.$$

Although different possibilities regarding  $c(\cdot)$  may arise at the optimum, we shall focus on the case illustrated by Figure 12 in which, for all  $\omega$ , there is a value  $\theta'_a$  such that  $\mathcal{C}(\theta_a, \theta_b) = 1$ . When this is the case, we establish the solution for the second step of the program.<sup>41</sup>

For any  $\theta_b \in \Theta$ , we define

$$\mathcal{G}_1(\theta_b | c) = \int_0^{\theta_b} \int_{c(\tilde{\theta}_b)}^{(1-\alpha)\tilde{\theta}_b} f(\omega, \tilde{\theta}_b) d\omega d\tilde{\theta}_b = \int_0^{\theta_b} \left[ 1 - F_{\omega|b}(c(\tilde{\theta}_b) | \tilde{\theta}_b) \right] f_b(\tilde{\theta}_b) d\tilde{\theta}_b.$$

Lemma 11, below, shows that the way we define the intervals of integration is without loss.<sup>42</sup>

**Lemma 11.** *At the optimum there is a  $\theta'_b$  such that, for all  $\theta_b > \theta'_b$ , one can find  $\theta'_a \in \Theta$  such that  $\mathcal{C}(\theta_a, \theta_b) = 1$  for all  $\theta_a < \theta'_a$ . Moreover, if  $\theta'_b > 0$  then,  $\mathcal{C}(\theta_a, \theta_b) = 2$ , for all  $\theta_a \in \Theta$ ,  $\theta_b < \theta'_b$ .*

*Proof.* Assume that this is not the case. That is, assume that there is  $\theta''_b > \theta'_b$  such that  $\mathcal{C}(\theta_a, \theta_b) = 2$  for all  $\theta_a \in \Theta$ ,  $\theta_b \in [\theta''_b, a)$ , where  $a > \theta''_b$  is possibly infinite.

<sup>41</sup>Another possibility is that, for some subset(s) of  $\Theta$ , all couples will have both spouses working at the optimum. In this case, it is more convenient to work with the program defined as a function of  $\omega$  instead of  $\theta_b$ .

<sup>42</sup>Modulo the alternative configuration for which it is the set of couples where both agents work that contains all possible types  $\theta_b$ .

Without loss we define  $c(\theta_b) = (1 - \alpha)\theta_b$  for  $\theta_b \in [\theta_b'', a)$ . Now consider replacing  $c(\cdot)$  with  $\bar{c}(\cdot)$  which we define as follows. Choose  $\delta_1$  and  $\delta_2$  satisfying

$$\max \left\{ \left| v_2(c(\theta_b'') - \delta_1) - c(\theta_b'') \right|; \left| v_2(c(a + \delta_2) - c(a)) \right| \right\} < \kappa,$$

$$c(\theta_b'') - \delta_1 = a + \delta_2 = \epsilon$$

for some small positive  $\kappa$  and  $\epsilon$ . Now,  $\bar{c}(\cdot)$  is equal to  $c(\cdot)$  in  $\Theta \setminus [\theta_b'' - \delta_1, a + \delta_2)$ , and is defined through  $\bar{c}(\theta_b) = (1 - \alpha)\theta_b - \epsilon$  in  $[\theta_b'' - \delta_1, a + \delta_2)$ . Note that  $\dot{c}(\theta_b) = 1 - \alpha$  in  $[\theta_b'' - \delta_1, a + \delta_2)$ . Using (F.2) one easily verifies that the allocation  $v_1(\cdot)$  in this interval is defined through  $z_1(\theta_b)^{1+\gamma} = z_2(c(\theta_b))^{1+\gamma}$ . For small enough  $\epsilon$ ,  $c(\theta_b) \approx (1 - \alpha)\theta_b$ , which implies  $\ln x_1(\theta_b) = \ln x_2(c(\theta_b)) - \alpha A$ . The utility change with the new allocation is infinitesimal for a finite reduction in cost.  $\square$

We may also define

$$\mathcal{G}_2(\omega|c) \equiv \int_0^\omega \int_{c^{-1}(\tilde{\omega})}^\infty f(\omega, \tilde{\theta}_b) d\tilde{\theta}_b d\omega = \int_0^\omega [1 - F_{\theta_b|\omega}(c^{-1}(\tilde{\omega})|\tilde{\omega})] f_\omega(\tilde{\omega}) d\tilde{\omega},$$

with associated density  $[1 - F_{\theta_b|\omega}(c^{-1}(\tilde{\omega})|\tilde{\omega})] f_\omega(\tilde{\omega})$ .

For our purposes it will be important to further note that, from  $\mathcal{G}_2(c(\theta_b)|c)$ , the density  $\check{\mathcal{D}}_2(\theta_b|c) \equiv c'(\theta_b) [1 - F_{\theta_b|\omega}(\theta_b|c(\theta_b))] f_\omega(c(\theta_b))$  is well defined.

In order to characterize  $c(\cdot)$ , write

$$v_2(\omega) \equiv \max_{z_1} \left\{ \ln(z_2 - T_2(z_2)) - \omega \frac{z_2^{1+\gamma}}{1+\gamma} \right\} - \alpha A$$

and

$$v_1(\theta_b) \equiv \max_{z_1} \left\{ \ln(z_1 - T_1(z_1)) - (1 - \alpha)\theta_b \frac{z_1^{1+\gamma}}{1+\gamma} \right\}.$$

In this case,  $v_2(c(\theta_b)) = v_1(c(\theta_b))$ , for all  $\theta_b$ , implicitly defines function  $c(\cdot)$ . Now, differentiating this equation we obtain

$$\dot{v}_1(\theta_b) = \dot{v}_2(c(\theta_b))c'(\theta_b),$$

which, given the envelope condition,

$$(F.1) \quad \dot{v}_1(\theta_b) = -(1 - \alpha) \frac{z_1(\theta_b)^{1+\gamma}}{1 + \gamma}$$

becomes

$$(F.2) \quad (1 - \alpha)^{\frac{1}{1+\gamma}} z_1(\theta_b) = z_2(c(\theta_b))c'(\theta_b)^{\frac{1}{1+\gamma}}.$$

Following [Gomes et al. \(2017\)](#), it is now possible to solve the planner's program

in two steps. First, take  $c(\cdot)$  as given and solve the constrained planner's program. This will give the best allocation among those that induce  $c(\cdot)$ . In the second step, we choose the optimal  $c(\cdot)$ .

Note that the restriction  $v_1(\theta_b) = v_2(c(\theta_b))$  implies that, for a given  $c(\cdot)$ , the planner's objective can be simply written as

$$(F.3) \quad \max \int_{\underline{\theta}_b}^{\bar{\theta}_b} v_1(\theta_b) \mathcal{G}(\theta_b|c) d\theta_b,$$

where

$$\mathcal{G}(\theta_b|c) = F_{\theta_b|\omega}(c(\theta_b)|\theta_b)\phi_b(\theta_b) + c'(\theta_b)F_{\theta_b|\omega}(\theta_b|c(\theta_b))\phi_\omega(c(\theta_b)).$$

As for the resource constraint, note that

$$x_1(\theta_b) = \exp \left\{ v_1(\theta_b) + (1 - \alpha)\theta_b \frac{z_1(\theta_b)^{1+\gamma}}{1 + \gamma} \right\}.$$

Next,

$$v_2(c(\theta_b)) = \ln x_2(c(\theta_b)) - c(\theta_b) \frac{z_2(c(\theta_b))^{1+\gamma}}{1 + \gamma}$$

implies

$$v_2(c(\theta_b)) = \ln x_2(c(\theta_b)) - (1 - \alpha) \frac{c(\theta_b)}{c'(\theta_b)} \frac{z_1(\theta_b)^{1+\gamma}}{1 + \gamma},$$

which gives

$$x_2(c(\theta_b)) = \exp \left\{ v_1(\theta_b) + \frac{c(\theta_b)}{c'(\theta_b)} (1 - \alpha) \frac{z_1(\theta_b)^{1+\gamma}}{1 + \gamma} \right\}.$$

Hence, the resource constraint reduces to

$$(F.4) \quad \int \left\{ z_1(\theta_b) - \exp \left\{ v_1(\theta_b) + (1 - \alpha)\theta_b \frac{z_1(\theta_b)^{1+\gamma}}{1 + \gamma} \right\} \right\} \bar{\mathfrak{D}}_1(\theta_b|c) d\theta_b + \\ \int \left\{ z_1(\theta_b) \left( \frac{1 - \alpha}{c'(\theta_b)} \right)^{\frac{1}{1+\gamma}} - \exp \left\{ v_1(\theta_b) + (1 - \alpha) \frac{c(\theta_b)}{c'(\theta_b)} \frac{z_1(\theta_b)^{1+\gamma}}{1 + \gamma} \right\} \right\} \bar{\mathfrak{D}}_2(\theta_b|c) d\theta_b \geq B,$$

where

$$\bar{\mathfrak{D}}_1(\theta_b|c) \equiv [1 - F_{\omega|b}(c(\theta_b)|\theta_b)] f_b(\theta_b)$$

and

$$\bar{\mathfrak{D}}_2(\theta_b|c) \equiv c'(\theta_b) [1 - F_{\theta_b|\omega}(\theta_b|c(\theta_b))] f_\omega(c(\theta_b)).$$

Thus, the planner's program is to maximize (F.3) subject to (F.4) and the intensive margin incentive constraint, comprised of the envelope condition (F.1) and the monotonicity condition  $z_1(\theta_b)$  decreasing.

As usual, we ignore the monotonicity constraint and verify ex-post its validity.

Solving the relaxed versions of the problem above is as simple as solving the usual Mirrlees' program. The first-order condition with respect to  $z_1(\theta_b)$  yields

$$\frac{-\mu(\theta_b)}{\lambda}(1-\alpha)z_1(\theta_b)^{\gamma+1} = T'_1(z_1(\theta_b))z_1(\theta_b)\tilde{\partial}_1(\theta_b|c) + T'_2(z_2(c_2(\theta_b)))z_2(c(\theta_b))\tilde{\partial}_2(\theta_b|c),$$

where  $\mu(\cdot)$  is the Lagrange multiplier associated with the intensive margin IC constraint (F.1) and  $\lambda$  is the Lagrange multiplier associated with the resource constraint (F.4).

The first-order condition with respect to  $v_1(\theta_b)$  allows us to calculate

$$\lambda = \left\{ \int_0^\infty \left\{ x_1(\theta_b)\tilde{\partial}_1(\theta_b|c) + x_2(c(\theta_b))\tilde{\partial}_2(\theta_b|c) \right\} d\theta_b \right\}^{-1}$$

and

$$\mu(\theta_b) = \int_0^{\theta_b} \left\{ [1 - \lambda x_1(a)]\tilde{\partial}_1(a|c) + [1 - \lambda x_2(c(a))]\tilde{\partial}_2(a|c) \right\} da.$$

When compared to a typical Mirrlees' program, the only difference is that it is the average (between the two schedules) of marginal tax rates that matter for incentive provision in the intensive margin at each level of  $\theta_b$ .

**Solving for  $c(\cdot)$**  As for the second step in the characterization procedure, assume that we know the optimal  $(z_1(\theta_b))_{\theta_b}$  allocation,  $(z_1^*(\theta_b))_{\theta_b}$ . Given  $(z_1^*(\cdot))$ , the problem is now to find a continuous, strictly increasing (over  $(\theta'_b, \bar{\theta}_b)$ ) function such that  $c(\theta_b) = 0$ , for all  $\theta_b < \theta'_b$ , that maximizes the program above.

Assume that we have already chosen  $\theta'_b$ . Given  $v_1(\theta'_b)$ , then  $z_1^*(\cdot)$  pins down the whole path for  $v_1(\theta_b)$  through (F.1) and the boundary condition.

Define  $J(c(\theta_b), c'(\theta_b), \theta_b)$  through

$$\begin{aligned} J(c(\theta_b), c'(\theta_b), \theta_b) := & v_1^*(\theta_b)\tilde{\partial}(\theta_b|c) + \\ & \lambda \left\{ z_1^*(\theta_b) - \exp \left\{ v_1^*(\theta_b) + \theta_b \frac{z_1^*(\theta_b)^{1+\gamma}}{1+\gamma} \right\} \right\} \tilde{\partial}_1(\theta_b|c) + \\ & \lambda \left\{ z_1^*(\theta_b) \left( \frac{1-\alpha}{c'(\theta_b)} \right)^{\frac{1}{1+\gamma}} - \exp \left\{ v_1^*(\theta_b) + (1-\alpha) \frac{c(\theta_b)}{c'(\theta_b)} \frac{z_1^*(\theta_b)^{1+\gamma}}{1+\gamma} \right\} \right\} \tilde{\partial}_2(\theta_b|c), \end{aligned}$$

This is a calculus of variation problem whose solution is characterized by the Euler equation:

$$(F.5) \quad \frac{d}{d\theta_b} \frac{\partial J(c(\theta_b), c'(\theta_b), \theta_b)}{\partial c'(\theta_b)} = \frac{\partial J(c(\theta_b), c'(\theta_b), \theta_b)}{\partial c(\theta_b)}.$$

Gomes et al. (2017) go through great lengths to derive an interpretable expression for this Euler equation in the case of quasi-elastic preferences. For our pur-

poses this is a much harder task since we take income effects into account.

Fortunately, in practice, one can solve for the optimal  $c(\cdot)$  by purely numeric methods, with no need for solving (F.5) directly.

## G Elasticities

We first recall that in [Saez's](#) original paper, elasticities were defined for linearized budget sets. Here, we follow, instead, [Jacquet et al. \(2013\)](#) and [Scheuer and Werning \(2017\)](#) in using the elasticities defined under nonlinear budget sets. That is, we define the elasticity of taxable income with respect to the retention rate  $1 - T'(z)$ ,  $\epsilon(z, \iota)$ , as

$$\epsilon(z, \iota) = \Delta^{-1} \left[ \partial_{xz} V(x, z, \iota) z - \partial_{xx} V(x, z, \iota) \frac{\partial_z V(x, z, \iota)}{\partial_x V(x, z, \iota)} z - \partial_x V(x, z, \iota) \right] \frac{1 - T'(z)}{z},$$

where

$$\Delta = \left[ \partial_{xx} V(x, z, \iota) \left( \frac{\partial_z V(x, z, \iota)}{\partial_x V(x, z, \iota)} \right)^2 - 2 \partial_{xz} V(x, z, \iota) \frac{\partial_z V(x, z, \iota)}{\partial_x V(x, z, \iota)} + \partial_{zz} V(x, z, \iota) - \partial_x V(x, z, \iota) T''(z) \right].$$

The last term in  $\Delta$ ,  $\partial_x V(x, z) T''(z)$ , captures the curvature in the budget set. [Saez \(2001\)](#), in contrast, defines the elasticity using  $\tilde{\Delta} = \Delta + \partial_x V(x, z) T''(z)$ . The advantage of using  $\tilde{\Delta}$  is its familiarity, whereas the advantage of using  $\Delta$  is the simplification of optimal tax formulae.

We can also define the income elasticity of taxable earnings

$$\eta(z, \iota) = \Delta^{-1} \left[ \partial_{xx} V(x, z, \iota) \frac{-\partial_z V(x, z, \iota)}{\partial_x V(x, z, \iota)} + \partial_{xz} V(x, z, \iota) \right] (1 - T'(z)),$$

and, using the Slutsky equation, we can compute the compensated elasticity

$$\epsilon^c(z, \iota) = \epsilon(z, \iota) - \eta(z, \iota) = \Delta^{-1} [\partial_x V(x, z, \iota)] \frac{1 - T'(z)}{z}.$$



## H Table and Figures

Table 1: Inequality Measures Implied by the Optimal Tax

	Household Level	Individual Level	Household Level	Individual Level	Household Level	Individual Level
	$\alpha = .3$		$\alpha = .5$		$\alpha = .7$	
No Dissonance	0.1119	0.2560	0.1084	0.1084	0.1103	0.2552
Dissonance	0.0517	0.2258	0.1084	0.1084	0.0894	0.2447

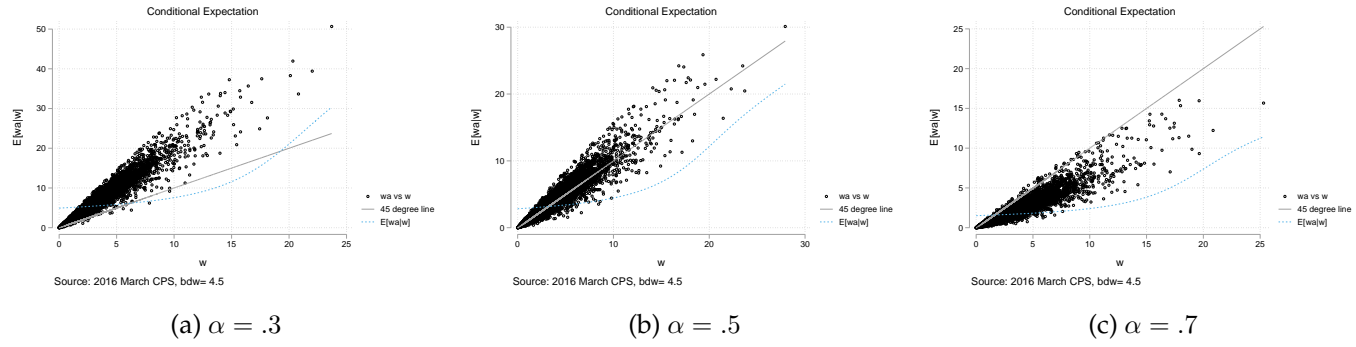


Figure 1: This figure shows the conditional expectation of spouse  $a$ 's modified type  $\omega_a$  given the household's aggregate type ( $E[\omega_a|\omega]$ ). This expectation varies with spouses income and Pareto weight ( $\alpha$ ). As  $\alpha$  is perturbed in each figure, we can see shifts in the conditional expectation. The plotted joint income comes from the empirical distribution based on the 2016 March CPS.

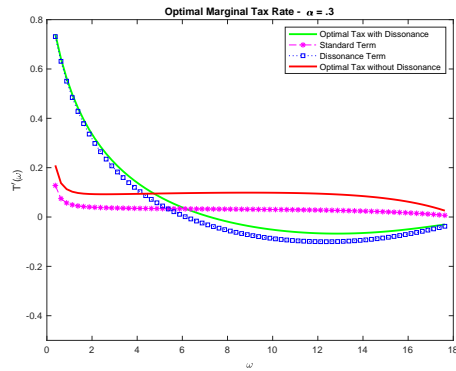
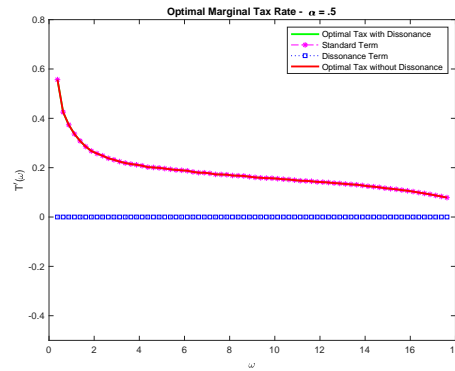
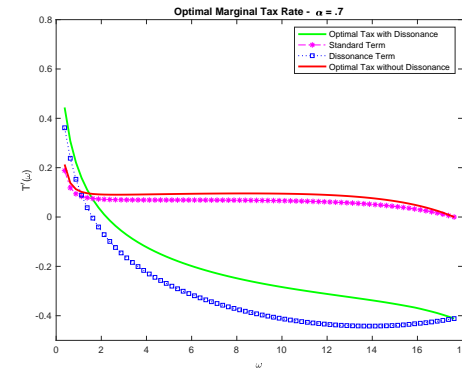
(a)  $\alpha = .3$ (b)  $\alpha = .5$ (c)  $\alpha = .7$ 

Figure 2: The figure simulates the shape of the optimal tax schedule calibrated for the US economy. The solid green line depicts the optimal marginal tax rate (MTR) as in Corollary 2 where the planner maximizes individual-oriented utilitarian criteria. The dotted lines decompose the MTR into a standard Mirrleesian term (pink with diamond markers), and a novel modified part (blue with square markers) induced from dissonance. The solid red line plots the optimal MTR as in Equation 9 where the planner maximizes household-oriented utilitarian criteria. These figures shed light on the impacts of families' dynamics in the optimality of policy decisions.

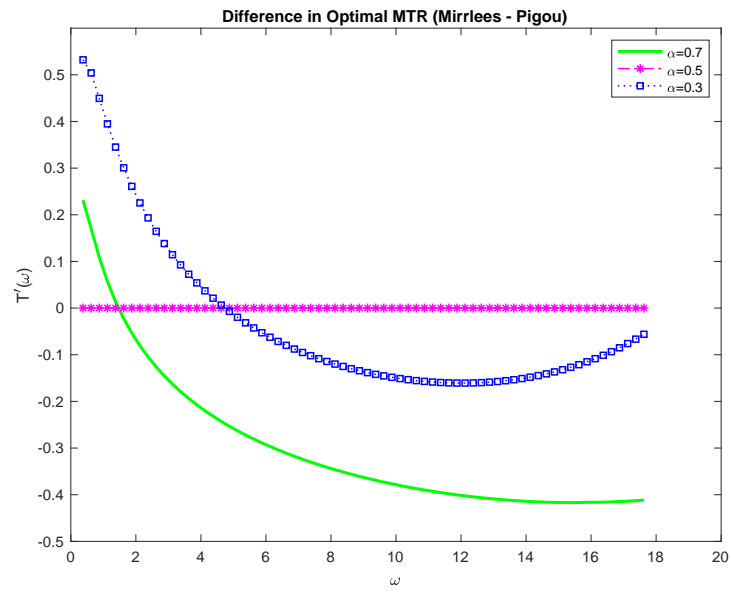


Figure 3: The figure plots the difference between the optimal marginal tax rate without dissonance (as in (9)) and the optimal marginal tax rate with the Pigouvian correction (as in Corollary 2). This difference varies with  $\alpha$  and  $\omega$ . When  $\alpha = 0.5$  this difference collapses to zero.

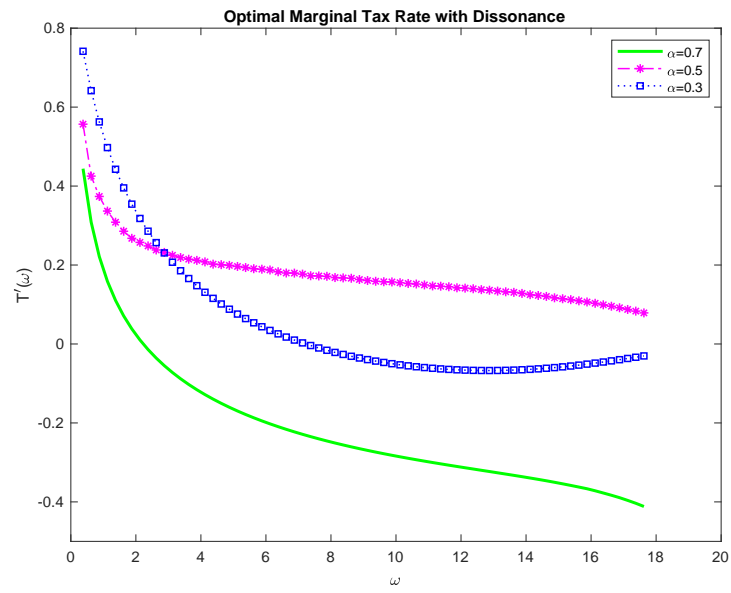
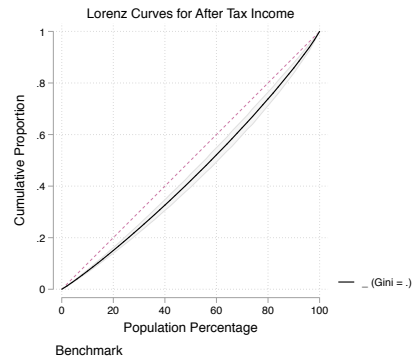
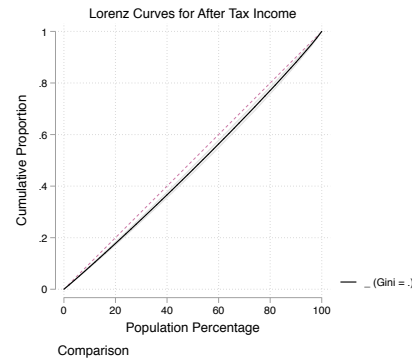


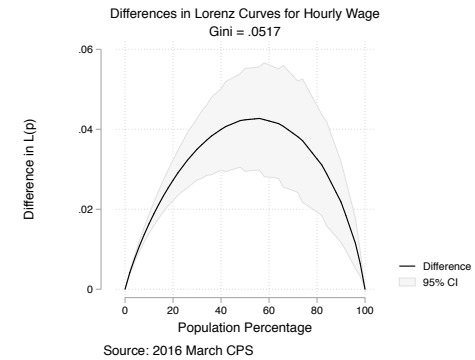
Figure 4: The figure shed light on the variation of optimal marginal tax rates when dissonance is accounted (as in Corollary 2), for different levels of the Pareto weight  $\alpha$ . This figure helps to compare the impact of optimal tax with dissonance across the productivity space.



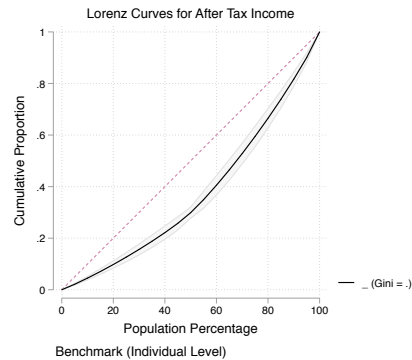
(a)



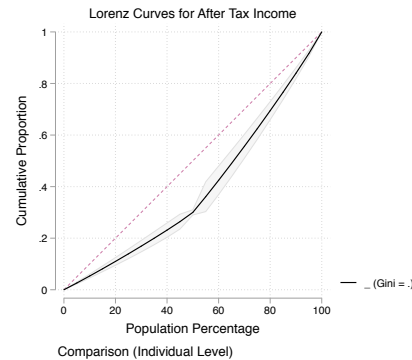
(b)



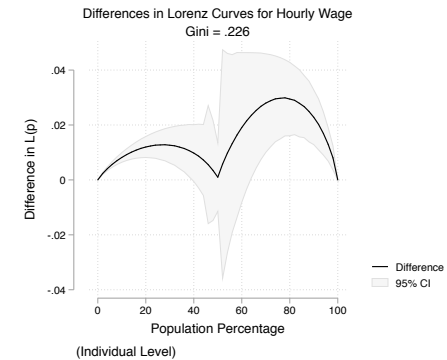
(c)



(d)



(e)



(f)

**Figure 5: Lorenz Curves** This figure displays a series of Lorenz curves implied by the optimal tax system to uncover the level of inequality measured at different levels and scenarios: The Benchmark is the case without dissonance and inequality is measured at the household level Panel (a), individual level Panel (d). The Comparison is the case of optimal taxation with dissonance, again for this case inequality is measured at the household level Panel (b), individual level Panel (e). Panels (c) and (f) display the differences of the Lorenz curves.

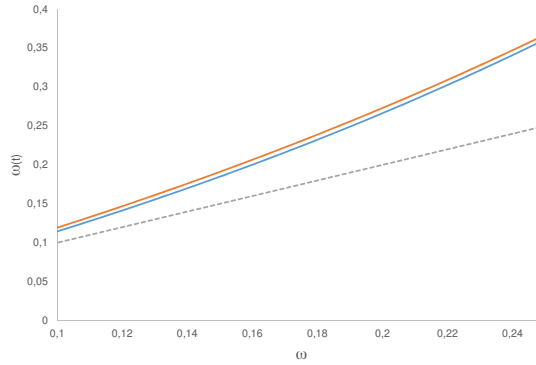


Figure 6: The figure shows how the introduction of a tax on spouse  $a$ 's earnings changes the household disutility of effort for couples with the same initial  $\omega$ . We consider two different values for  $\alpha$  and let  $\theta_b$  respond while holding  $\theta_a$  fixed to match the initial  $\omega$ . The gray curve (45o line) corresponds to  $\omega(0)$ , whereas the blue and red curves display  $\omega(t)$  for  $t > 0$  for the different combinations of  $\alpha$  and  $\theta_b$  that lead to the same  $\omega(0)$ .

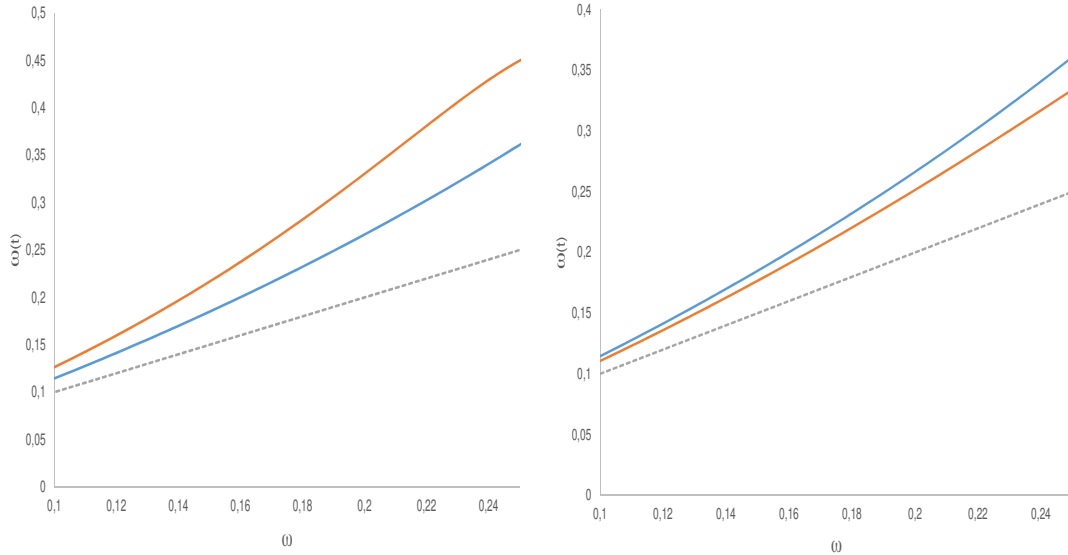


Figure 7: The figure shows how the introduction of a tax on spouse  $a$ 's earnings changes the household disutility of effort for couples with the same initial  $\omega$ . In the left panel, for every  $\omega$ , we consider different pairs of values for  $\theta_b$  and  $\alpha$  that lead to  $\omega$  keeping  $\theta_a$  fixed when  $t = 0$ . The blue and red curves show  $\omega(t)$  for the different combinations of  $\theta_b$  and  $\alpha$  when  $t > 0$ . In the right panel, for each  $\omega$ , we consider different pairs of  $\theta_a$  and  $\theta_b$  keeping  $\alpha$  fixed.

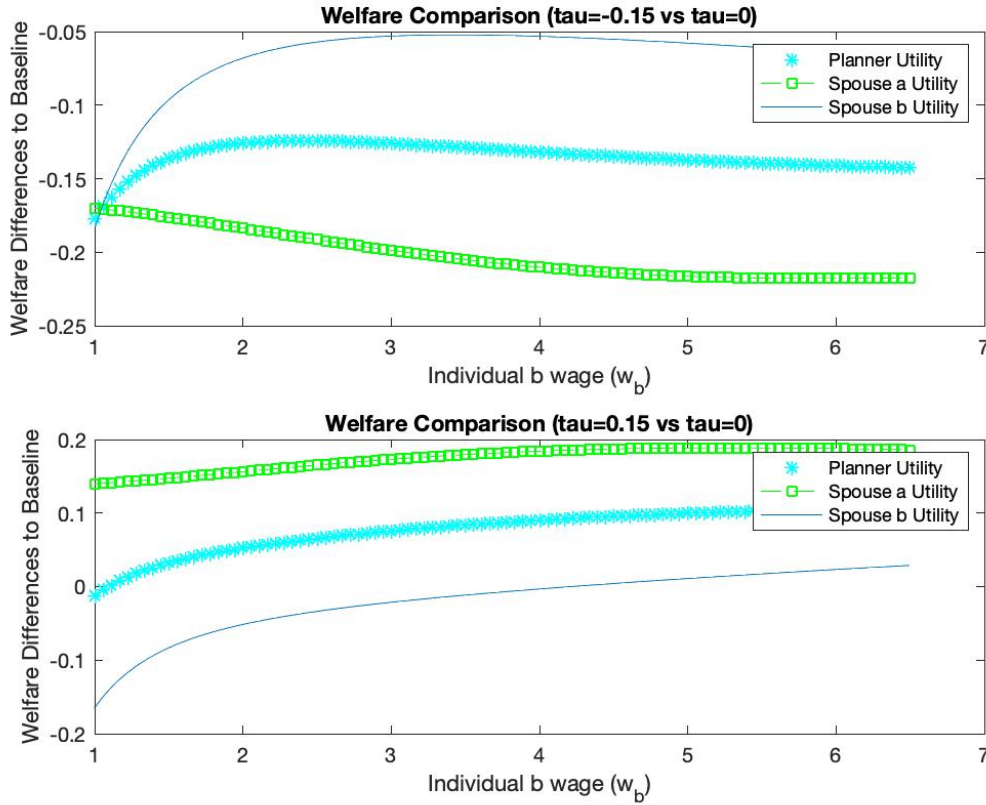


Figure 8: The figure shows welfare gains for spouse  $a$ , spouse  $b$ , and the social planner's own evaluation of household welfare change,  $DW = .5Dv_a + .5Dv_b$ , as a function of  $w_b = \theta_b^{-1/1+\gamma}$ . Introducing a small tax (bottom panel),  $\tau = 0.05$ , or subsidy (upper panel),  $\tau = -0.05$ , on  $a$ .  $w_a$  is held fixed at  $w_a = 3$  and  $\alpha = 0.3$ . Total revenues are held fixed by adjusting  $\chi$ . It is assumed that the distribution of  $w_b$  conditional on  $w_b$  is uniform.



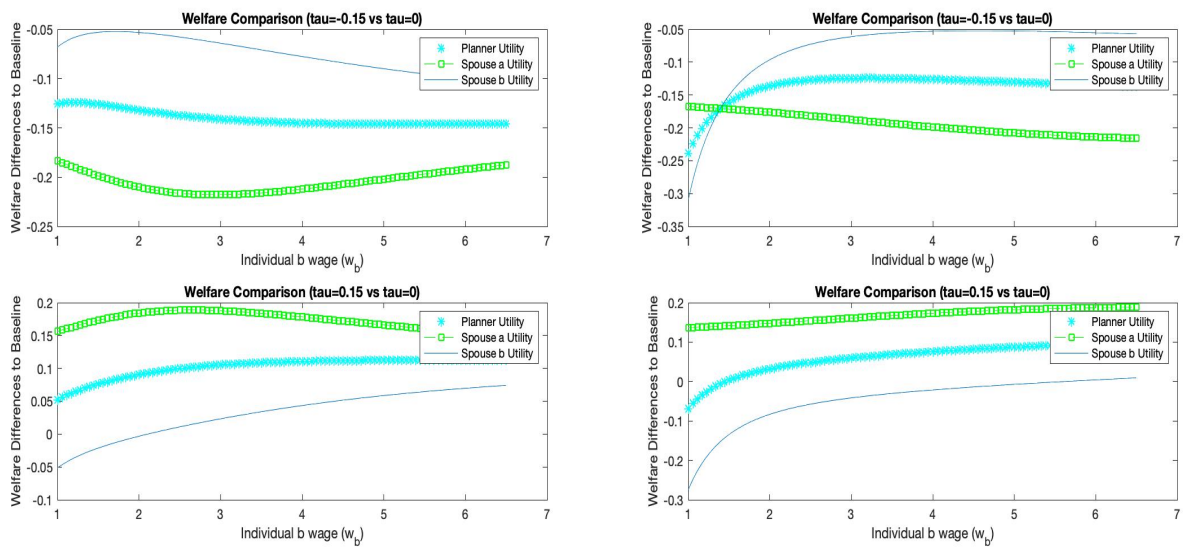


Figure 9: The only difference to Figure 8 is that  $w_a$  varies. On the left panel  $w_a$  is held fixed at  $w_a = 1.5$  and  $\alpha = 0.3$ . On the right panel  $w_a$  is held fixed at  $w_a = 4$  and  $\alpha = 0.3$ . The figure shows welfare gains for spouse  $a$ , spouse  $b$ , and the social planner's own evaluation of household welfare change,  $DW = .5Dv_a + .5Dv_b$ , as a function of  $w_b = \theta_b^{-1/1+\gamma}$ . Introducing a small tax (bottom panel),  $\tau = 0.05$ , or subsidy (upper panel),  $\tau = -0.05$  on  $a$ . Total revenues are held fixed by adjusting  $\chi$ . It is assumed that the distribution of  $w_b$  conditional on  $w_b$  is uniform.

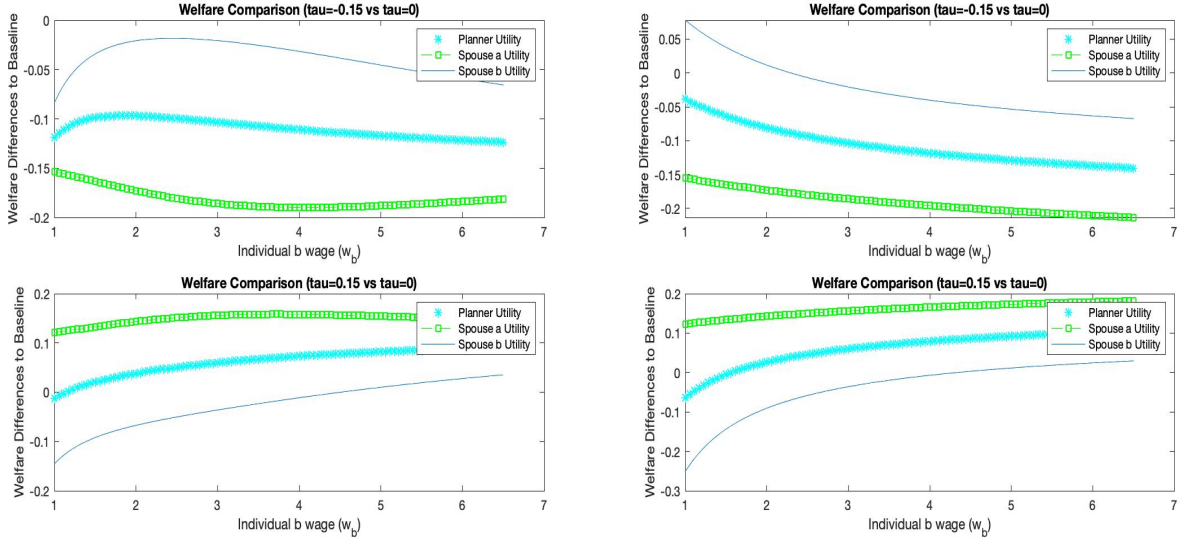


Figure 10: The only difference to Figure 9 is that  $\alpha$  varies. On the left panel  $w_a$  is held fixed at  $w_a = 3$  and  $\alpha = 0.5$ . On the right panel  $w_a$  is held fixed at  $w_a = 3$  and  $\alpha$  is endogenous to spouses' relative productivity ( $\frac{w_a}{w_a + w_b}$ ). The figure shows welfare gains for spouse  $a$ , spouse  $b$ , and the social planner's own evaluation of household welfare change,  $DW = .5Dv_a + .5Dv_b$ , as a function of  $w_b = \theta_b^{-1/1+\gamma}$ . Introducing a small tax (bottom panel),  $\tau = 0.05$ , or subsidy (upper panel),  $\tau = -0.05$  on  $a$ . Total revenues are held fixed by adjusting  $\chi$ . It is assumed that the distribution of  $w_b$  conditional on  $w_b$  is uniform.

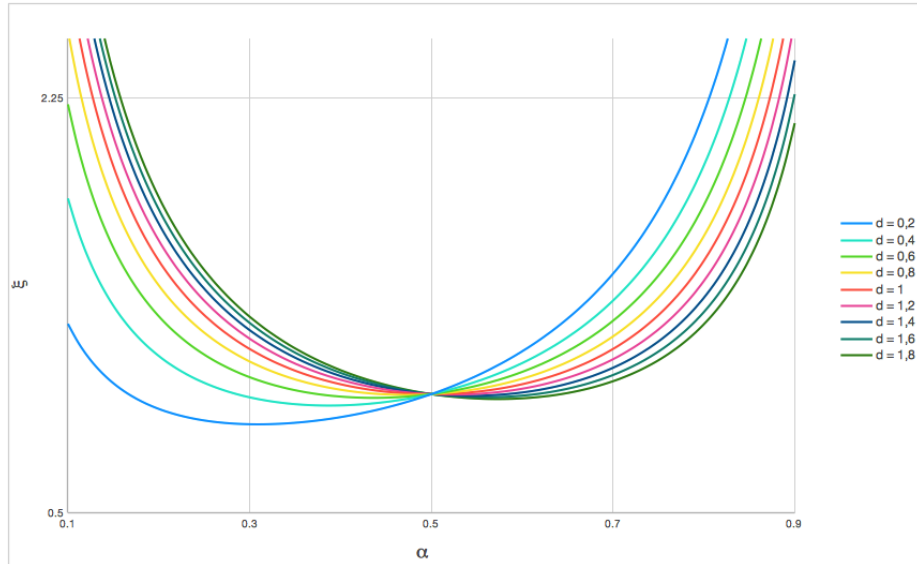


Figure 11: For different values of  $d = [w_a/w_b]^{1+\gamma}$  and preferences of the form studied in Section 3 the figure displays how the correction term  $\xi(z, l)$  varies with  $\alpha$ . For this specification,  $\xi(z, l)$  is independent of  $z$ .

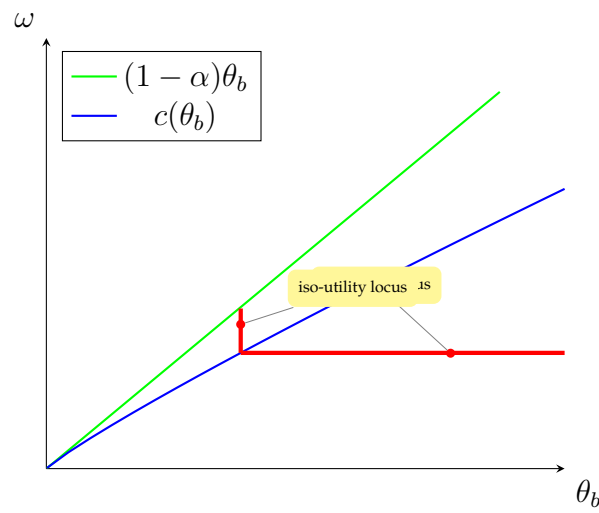


Figure 12: **Participation decision** The figure shows the support for the joint distribution of  $\omega$  and  $\theta_b$  along with the threshold function,  $c(\cdot)$ . In red we see the set of agents who share the same flow utility  $v_1(\theta_b) = v_2(c(\theta_b)) - \alpha A$ .

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**EPGE Escola Brasileira de Economia e Finanças**

**Diretor Geral:** Rubens Penha Cysne

**Vice-Diretor:** Aloisio Araujo

**Coordenador de Graduação:** José Gustavo Feres

**Coordenadores de Pós-graduação Acadêmica:** Humberto Moreira & Lucas Jóver Maestri

**Coordenadores do Mestrado Profissional em Economia e Finanças:** Ricardo de Oliveira Cavalcanti & Joísa Campanher Dutra & Maria Teresa Duclos