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Essays on Behavioral Public Economics

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Abstract

English- This dissertation studies the interplay between individual and collective decision-making, particularly within behavioral public economics. In it, I study the influence of social preferences on taxation policies and assess how strategic interactions between prosocial actors shape the centralized and decentralized provision of public goods.

It consists of three papers that correspond to each one of the dissertation chapters and that seek to answer two broad questions. First: How do prosocial actors respond to pecuniary and non-pecuniary incentives in the context of public good provision in large economics? Second: How can we design tax policy to maximize social welfare while accounting for the strategic behavior of prosocial actors?

In order to answer these questions, each one of the papers first identifies the economic implications that prosocial actors have over public good provision in large economies, offering a positive evaluation. Second, it provides normative guidelines for the design of tax policy that is aware of the implications introduced by such prosocial actors.

The first chapter builds a structural model to analyze the inefficiencies in fundraising among U.S. charities, driven by competitive advertising. Using comprehensive data from nonprofit organizations and a leading charity assessment body, it documents substantial leakage—up to 40 percent of budgets used for fundraising rather than public goods provision. These findings imply that traditional estimates of optimal deductibility for charitable donations are overstated unless they account for endogenous responses to tax incentives, suggesting a necessary adjustment downward by approximately ten cents per dollar of deduction.

The second essay expands the prevailing focus on material sanctions within the

canonical model of optimal income taxation by introducing non-pecuniary motivations modeled through the lens of evolutionary semi-Kantian preferences as determinants of taxpayers' decisions to comply with the tax authority. It builds a general model of income taxation in the presence of a public good, which agents value morally, and solves for the optimal linear and non-linear taxation problems.

In the third essay, the introduction of semi-Kantian Homo Moralis preferences provides a novel framework for examining the long-term impact of citizens' moral preferences on state fiscal capacity. This model extends beyond traditional fiscal policy analysis by linking individual moral considerations to broader tax compliance and civic culture, contrasting and building upon existing models like Besley's framework on state capacity and social contracts.

Français- Cette thèse étudie les interactions entre les décisions individuelles et collectives, notamment dans le domaine de l'économie publique comportementale. Elle examine l'influence des préférences sociales sur les politiques fiscales et évalue comment les interactions stratégiques entre acteurs prosociaux façonnent la fourniture de biens publics de manière centralisée et décentralisée.

La thèse est composée de trois articles qui correspondent aux chapitres de la thèse et qui cherchent à répondre à deux questions larges. Premièrement : Comment les acteurs prosociaux réagissent-ils aux incitations pécuniaires et non pécuniaires dans le contexte de la fourniture de biens publics dans de grandes économies ? Deuxièmement : Comment pouvons-nous concevoir une politique fiscale pour maximiser le bien-être social tout en tenant compte du comportement stratégique des acteurs prosociaux ?

Pour répondre à ces questions, chaque article identifie d'abord les implications économiques que les acteurs prosociaux ont sur la fourniture de biens publics dans de grandes économies, offrant une évaluation positive. Ensuite, il fournit des directives normatives pour la conception d'une politique fiscale consciente des implications introduites par de tels acteurs prosociaux.

Le premier chapitre élabore un modèle structurel pour analyser les inefficacités dans la collecte de fonds par les organismes de bienfaisance américains, dues à la concurrence publicitaire. En utilisant des données exhaustives provenant d'organisations à but non lucratif et d'un organisme principal dans le domaine d'évaluation des charités, il documente une fuite substantielle - jusqu'à 40 pour cent des budgets sont alloués à la collecte de fonds plutôt qu'à la fourniture de biens publics. Ces résultats impliquent que les estimations traditionnelles de la déductibilité optimale pour les dons de bienfaisance sont surestimées, à moins de prendre en compte des réponses endogènes aux incitations fiscales, suggérant une réduction nécessaire d'environ dix cents par dollar de déduction.

Le deuxième essai élargit le focus prédominant sur les sanctions matérielles au sein du modèle canonique de la taxation optimale des revenus. Il introduit des motivations non pécuniaires modélisées à travers le prisme des préférences semi-kantiennes évolutives en tant que déterminants des décisions des contribuables de se conformer à l'autorité fiscale. Il construit un modèle général de taxation des revenus en présence d'un bien public, que les agents valorisent moralement, et résout les problèmes de taxation linéaire et non linéaire.

Dans le troisième essai, l'introduction des préférences semi-kantiennes Homo Moralis offre un cadre novateur pour examiner l'impact à long terme des préférences morales des citoyens sur la capacité fiscale de l'État. Ce modèle dépasse l'analyse traditionnelle de la politique fiscale en établissant un lien entre les considérations morales individuelles, la conformité fiscale et la culture civique plus large, en contraste et en complément des modèles existants tels que le cadre de Besley sur la capacité de l'État et les contrats sociaux.

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To my grandmother, who I believe would have found joy in my journey…

Chapter 1

Competing for Donations

Governments provide tax benefits to incentivize charitable giving. While higher tax benefits increase charitable giving, they also intensify potentially wasteful competition for funds among charities. I build a model where charities use advertising to attract individual donors. Competition leads to inefficient fundraising because charities incur excessive advertising costs, and the inefficiency increases as available funds increase. I estimate the structural model using data from the universe of Nonprofits in the U.S. paired with data from the country's most prominent charity assessment organization. I document that leakage, the proportion of charities' budget not spent on direct public good provision, reaches 40 percent in my sample for 2014. Moreover, findings from counterfactual analyses suggest that fundraising accounts for significant endogenous leakage of gross donations into advertising. These results suggest that estimates of the optimal deductibility rate for charitable giving that ignore competition must be adjusted downwards to account for charities' endogenous responses to the tax code. While sensitive to assumptions, the magnitude of this adjustment is of around ten cents for every dollar deducted on average. AA Alesina and Angeletos (2005)

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1.1 Introduction

With total donations amounting to 2.1 percent of GDP yearly, the charitable sector constitutes an integral part of the U.S. economy[1]. Non-governmental organizations cater to donors to fund public goods and services. Consequently, governments typically establish tax deductions on donations made to charitable organizations, which means that tax policy is a standard instrument used to provide incentives for giving. The objective of this paper is to assess the optimality of tax deductions for charitable giving.

Charities, NGOs, and Nonprofits are not passive players that merely wait for donations from well-intentioned samaritans[2]. In fact, NGOs compete to capture funds from donors. They hold costly advertising campaigns in order to capture the attention of interested donors. The main novelty of this paper is that it provides a tool to evaluate the optimality of subsidies to charitable giving, which considers the strategic nature of NGOs. Despite its immediate relevance, the extent to which competition affects the optimal deductibility rates is still an open question. Its answer requires both a theoretical model of how NGOs may compete with each other and structural empirical estimates of such a theoretical model. By doing so, this paper fully embraces the critique posed by Andreoni (2006): When studying the charitable

[1]Giving USA reports the figure for 2021 at $484.85 billion.

[2]Although legal definitions may differ, in this paper, I will use the terms "NGO," "charity" and "Nonprofit" interchangeably.

sector, it is fundamental to account for the fact that both sides of this market (donors and Nonprofits) are strategic players and will likely respond to changes in public policy, taxes, or other factors.

I proceed in two broad steps. First, on the positive side, I provide a theoretical characterization of the impact of tax policy on the supply and demand for donations. I show that to evaluate the welfare effects of tax deductions for charitable giving, one needs to account for a crucial statistic that summarizes the NGOs' conduct: what is the share of funds raised through costly advertising allocated to fund the campaign as opposed to public good production? I dub this share the "endogenous leakage coefficient". Second, I build and estimate an empirical model of the U.S. charitable sector to perform normative analysis by estimating policy counterfactuals. Counterfactual analysis allows us to answer critical policy questions. Does subsidizing donations increase welfare? Is competition in the sector desirable from a social welfare perspective?

This paper provides three main contributions. As a first contribution, I expand the optimal taxation formulae (Saez, 2004) to account for competitive effects. Contributions to the literature on optimal taxation have solved the design of an optimal income tax system in an economy where agents value the public good, considering leakage into advertising as a constant parameter (see Feldstein et al. (1980) for the seminal contribution). This paper instead considers leakage to be an endogenous variable determined by the strategic environment faced by NGOs, which decide on advertising intensities to fund their activities. Each NGO's decision over what share of resources to devote to advertising is a strategic choice that depends on the structure and characteristics of the charitable market and the total donations available. Since the planner's design of the tax schedule determines total donations, advertising incentives also indirectly depend on tax policy.

As a second contribution, my model accounts for several realistic features of the NGO market. First, NGOs may rely on informative campaigns to reach donors interested in funding their activities. Second, they can disclose their quality status to donors who may value high-quality charities. Third, I allow NGOs to be motivated by more than material concerns for fundraising, but instead to either have a broad or a narrow mandate, meaning they may value the impact of their public services and advertising activities over other suppliers. Fourth, I allow donors to have idiosyncratic tastes for NGOs, and concerns for quality[3].

In the equilibrium of this model, advertising expenditures are excessive compared to a welfare-maximizing benchmark. Moreover, this inefficiency is increasing the amount of funds available in the market, which means that tax policies that increase donations may increase inefficient competition. However, two opposing effects on welfare stem when considering the strategic responses of NGOs to tax policy. On the one hand, NGOs react to increased total donations by competing more fiercely, generating a "business stealing" effect. Opposing this effect, increasing the availability of funds for donations may lead to competition between NGOs that seek to increase market coverage instead of increasing public good provision by NGOs.

The model yields three predictions: (i) increases in the deductibility rate of charitable donations correlate positively with measures of the intensity of competition between charities, (ii) equilibrium quality provision may be affected by the deductibility rate, depending on the extent to which donors value high-quality charities, and (iii) existing estimates of the optimal deductibility rate that do not account for the effect of competition need to be adjusted downwards.

As a third contribution, I empirically assess the three predictions, (i)-(iii). I use data from the IRS, Kantar Media, and Charity Navigator to estimate a structural model of competition to evaluate (i) and (ii) and provide appropriate estimates on (iii) for the U.S. In sum, ignoring such an interaction has likely led past studies to

[3]The model builds on specific stylized facts documented by Aldashev and Verdier (2010) regarding how charities compete for funds. First, NGO projects are horizontally differentiated. Bilodeau and Slivinski (1997) describe how Nonprofits can actively attempt to offer differentiated public goods to the public, for instance, through different types of in-kind assistance to indigents or support for different kinds of medical research. Second, NGOs compete for private donations through fundraising. Nonprofits exert effort to attract private donations through fundraising advertising, as documented by De Waal (1997) and Smillie (1995). In particular, De Waal (1997) describes how the organizations with the most prominent media profiles often obtain the most funds from donors. Third, private donors have "spatial" preferences about NGOs and are sensitive to fundraising. Andreoni and Payne (2003) describes the latter by referring to donors having "latent demands for giving." Agents are often willing to give to nonprofit organizations but will not do so until asked for a contribution. Regarding the "spatial" dimension, Thornton (2006) establishes that differentiation in the nonprofit context may respond to factors such as ideology, methodology, or targeted beneficiaries.

overestimate (underestimate) the impact of marginal tax rates on donations when the detrimental (beneficial) effects of advertising dominate. I aim to empirically estimate this effect's magnitude and provide new policy estimates that account for competitive equilibrium outcomes.

I build a nested logit model (Berry, 1994), in which nests correspond to NGO classification as defined by IRS filings, and markets are defined geographically using Nielsen's DMAs. I then estimate a structural model of vertical and horizontal differentiation in which NGOs compete inside their categories, deriving predictions over market shares and responses to changes in NGO characteristics.

Moreover, an event study allows us to complement the structural estimation: the Tax Reform Act of 1986 studied by Duquette (2016). The Tax Reform Act of 1986 (TRA86) was a significant legislation that sweepingly changed the U.S. federal income tax system. It lowered tax rates and broadened the tax base by eliminating a number of tax loopholes and preferences. The impact of these changes was felt at the federal level and in state income tax systems across the country. Indeed, the effects of TRA86 on state tax systems were varied and complex, depending on each state's specific tax structure and policies. However, it introduced a considerable variation in the effective subsidies to giving: it decreased them substantially, with estimates from the change in the log cost of giving displaying increases ranging between 14.8 and 24.4 at the state level. I simulate a reversal of this tax reform for 2014 and estimate leakage in the entire sample to be just below 40 percent pre-reform, with a substantial variation along the quality dimension as measured by the Charity Navigator Star System, which is higher for low-quality NGOs, as expected. Moreover, leakage elasticity, which measures how the leakage parameter varies when total donations are changed due to a tax change, is positive and also varies widely across Charity Navigator Scores.

The counterfactual tax change of 1986 applied hypothetically in 2014 allows us to shed evidence on predictions (i), (ii), and (iii). First, for (i), the estimation of donation supply confirms how competition directly affects donation supply and reacts to policy variations in the deductions for charitable giving. Second, for (ii), I document substantial heterogeneity in fundraising responses with respect to quality, where the most aggressive NGOs are those in the middle of the quality distribution. Third, for (iii), I perform welfare analyses and find that ignoring competition leads to a substantial overestimation of the optimal magnitude of the deductibility rate. While sensitive to assumptions, the magnitude of this adjustment is of around ten cents for every dollar deducted on average.

As an additional contribution, this setting also allows testing relevant predictions obtained by Dewatripont et al. (2022) for environments with pro-socially motivated suppliers. My empirical results suggest that ethical NGOs (as measured by their Charity Navigator score) command higher market shares, suggesting that donors have preferences for high-quality NGOs, which means that, in the paragraph above, result (i) is dampened by the response of pro-social NGOs implied by result (ii).

Related literature. This paper contributes to several strands of literature concerning both Public Economics and the Industrial Organisation of Charitable Giving. First, it contributes to the literature that explores the optimal treatment of charitable donations. The two main contributions on this topic are the articles by Saez (2004) and Diamond (2006b). They provide the solution to the optimal taxation problem that the government faces when agents derive some warm-glow utility of contributing to a public good. However, these two contributions do not consider the subsequent effect of these tax deductions on the fundraising market. My paper asks whether this result is robust to endogenous competition by NGOs. As they do not consider the impact of competition, their results likely lead to a biased estimate of the optimal deductibility rate given to charitable contributions.

This paper contributes to investigations on the long-run equilibrium of the nonprofit sector and the optimal tax treatment of charitable donations. The earliest contribution to this literature is found in Rose-Ackerman (1982), which builds a theoretical model in which charities are differentiated in one dimension described as "ideology," and donors are initially uninformed of charities. Fundraising serves as a way to inform donors about the charities that are closest to them. She finds that competition for contributions leads to excessive fundraising. My model relates closely to hers. However, I allow donors to be both horizontally distributed and have concerns for provision quality. As a modeling choice, I rely instead on the informative advertising technology found in Grossman and Shapiro (1984), which yields an essential difference concerning the model of oligopolistic competition for private goods: the non-cooperative equilibrium level of advertising is independent of the market's competitiveness (which, in Hotelling models, is pinned down by the transport costs faced by consumers) [4]. The model presented in Section 2.2 of this paper also relates to Aldashev and Verdier (2010), which focuses on competition for funds in the market for development NGOs with horizontally differentiated projects, under the assumption that advertisement serves as a "cost shifter" and NGOs maximize public good provision instead of revenues[5]. My paper instead takes an approach similar to that of Scharf (2014), who considers warm-glow charities that could potentially lead to inefficient provision, with the key difference being that their paper focuses on the information asymmetries faced by donors when forming donation decisions, which is assumed away in my model[6].

The empirical part of my work also relates closely to that of Lapointe et al. (2018), who analyze the implications of market size for market structure in the charity sector. Using data from six local markets in Canada, they find empirical evidence supporting a Cournot model where charities are concerned about providing public goods but may be biased towards their production. Their focus is, however, devoted to analyzing the question of market size and entry, which, in the context of the U.S., could be more relevant for the set of charities that react strategically to tax policy (Duquette, 2016). Finally, it also relates to the recent literature that explores the strategic responses to charity ratings, described in two recent papers: Mayo (2021b), and Mayo (2021a).

The paper also is situated among the extensive literature on philanthropy, which

[4] This modeling choice resembles that of Andreoni and Payne (2003). In their model, solicitation letters are assumed to be randomly distributed to endogenize both the fund-raiser and donors' responses. An interesting generalization of this result is presented in Name-Correa and Yildirim (2013), but it's implications are outside of the scope of this paper.

[5] Crucially, their model yields a donation function that closely resembles a Tullock contest function (Tullock, 2013), which causes NGOs to decide on fundraising strategies independently of the amount of funds in the market, making NGO competition independent of tax policy.

[6] This paper also further complements recent theoretical work regarding charities' strategic decisions to cluster (Marini, 2020), delegate their decisions to motivated agents (Kopel and Marini, 2019), and react to publicly available contracts (Kopel and Marini, 2020).

has been vastly studied both theoretically and empirically (see Andreoni (2006) and List (2011) for reviews on the matter) and advertising.

The structure of the paper proceeds as follows. Section 1.2 presents an optimal taxation model that considers endogenous leakage in a reduced manner. Section 2.2 presents the model of NGO competition and several theoretical results, and Section 1.4 and Section 1.5 present the data and empirical results, respectively. Section 1.6 describes the components of the welfare analyses. Finally, Section 1.7 concludes the paper.

1.2 The optimal taxation problem with endogenous leakage

In this section, I study a "reduced" model of an economy in which public goods are funded partly or totally by charitable contributions. Consider an economy where the government and N charities provide a public good. Governmental provision is given by $G_0 \geq 0$, and the aggregate public good is denoted by $\bar{G} = \sum_{j=0}^{N} G_j$ where G_j is the provision by NGO $j \in \{1, \ldots, N\}$. Competitive forces will not be modeled yet but introduced indirectly as exogenous parameters; these will be endogenized in Section 2.2.

There is a continuum of donors indexed by i. Each donor derives utility from consumption $x_i \geq 0$, donations $d_i \geq 0$, and the aggregate public good $\bar{G}$[7]. Donations are deducted at a rate $-\tau^d$, where a negative (positive) rate $\tau^d < 0$ (resp. $\tau^d > 0$) constitutes a tax deduction (addition). Income is taxed uniformly at a rate τ, which means that the budget constraint faced by each individual is given by $x_i + d_i(1+\tau^d) \leq z_i(1-\tau) + R$, where z_i denotes pre-tax income and R is a lump sum transfer from the government. For a given aggregate public good $\bar{G}$, income z_i, and a lump sum transfer R, indirect utilities for agents i, v^i, are assumed to be given by $v^i\left(1-\tau, 1+\tau^d, R, \bar{G}\right)$. When there is no ambiguity, I let sub-indices denote partial derivatives.

[7] More generally, we can consider an economy where the government and charities provide M types of public goods and $N_m \times M$ different NGOs provide each type of public good, which donors may have preferences over. This distinction does not affect the results of this section substantially, so this section presents a simplified model in which donors care about aggregate provision by category. In the empirical sections, this assumption is relaxed.

The planner's program. The government sets τ, τ^d, R and G_0 to maximize the utilitarian welfare function:

$$W(\tau, \tau^d, R, G_0) = \int \mu^i v^i \left(1-\tau, 1+\tau^d, R, \bar{G}\right) di, \tag{1.1}$$

where μ^i is the weight associated to individual i, subject to the budget constraint:

$$\tau \bar{Z} + \tau^d \bar{D} \geq R + G_0 + E, \tag{1.2}$$

where E is exogenous government consumption per capita, $\bar{Z}$ is the aggregate income and $\bar{D}$ aggregate donations.

The leakage coefficient. As noted by Feldstein et al. (1980), when setting the price τ^d, the government must account for the leakage that typically occurs, i.e., the portion of donated funds that cannot be allocated directly towards the production of public good, and are instead used to cover costs associated with raising charitable donations. To capture this, let each organization j transform the donations it receives, denoted D_j, into a public good G_j according to the following technology:

$$G_j = \rho_j D_j, \tag{1.3}$$

where $(1-\rho_j) \in [0,1]$ denotes the *leakage coefficient*. Leakage represents all the money raised by charity j that does not go directly into public good provision but is instead spent on administrative costs, advertising, and other activities. After gathering funds by advertising, a charity j transforms monetary donations D_j into a public good. However, since advertising intensity is considered endogenous, the leakage coefficient is not constant to total donations or tax liabilities. By contrast to the existing literature, in Section 2.2, I allow the leakage coefficient to be endogenous to tax policy.

I define by $1-\eta_j$ the *individual elasticity of leakage to an increase in total donations* $\bar{D}$ where:

$$\eta_j(\bar{D}) = \frac{\rho_j'(\bar{D})\bar{D}}{\rho_j(\bar{D})}, \tag{1.4}$$

and its counterpart at the aggregate level $1-\bar{\eta}$, i.e the *aggregate elasticity of leakage to an increase in total donations* $\bar{D}$ where:

$$\bar{\eta}(\bar{D}) = \frac{\bar{\rho}'(\bar{D})\bar{D}}{\bar{\rho}(\bar{D})}, \quad \text{for aggregate leakage: } \bar{\rho}(\bar{D}) = \frac{\bar{D}}{\bar{G}}. \tag{1.5}$$

These elasticities are the primary outcome of interest in this study. They are crucial for describing the model's implications for the optimal deductibility rate. The results in the sections below relate them to the competition model.

Optimal taxation. The first reason to incentivize charitable output is that since it is a public good, provision is typically inefficiently low without subsidies. To capture this, I proceed by defining the social marginal value of the public good in terms of public funds as:

$$e = \int \beta^i \frac{\partial v^i/\partial \bar{G}}{\partial v^i/\partial R} di,$$

where $\beta^i = \mu^i v_R^i/\lambda$ denotes the average social marginal value of consumption of agent i from a one-dollar lump sum transfer from the government, for a planner with welfare weights μ^i and a multiplier $\lambda > 0$ of the budget constraint of the government in (1.2).

To simplify the problem and obtain solutions comparable to the baseline simulations found in Saez (2004), I impose three regularity conditions. First, I assume there are no income effects on earnings, i.e., $z_R^i = 0$ for all i. Second, I posit independence between aggregate earnings and contributions, i.e., $\bar{Z}_{G_0} = 0$ and $\bar{Z}_{1+\tau^d} = 0$. Finally, the compensated supply of contributions does not depend on earnings. $\partial d^i/\partial(1-\tau) = 0$, which allows us to write $\hat{D}_R = D_{1-\tau}/\overline{Z}$ as the average response weighted by earnings of contributions to a uniform one-dollar increase of the lump sum, and denote the elasticity of aggregate earnings to (one minus) the tax rate is given by

$\epsilon_Z = (1-\tau)\partial\overline{Z}_{1-\tau}/\overline{Z}$. Finally, denote by $r = -\overline{G}_{1+\tau^d}/\overline{G}$ the size of the price response of contributions after a change in the deductibility rate. These assumptions are further detailed in the Appendix. Proposition 1 characterizes the solution to the planner's problem.

Proposition 1. *Suppose first that the government cannot directly supply the public good (i.e, $G_0 = 0$) but can optimally set the tax code and transfers. In that case, the vector of policy parameters that maximizes welfare is described by the solution (τ, τ^d, R) vector to the non-linear system:*

$$\tau^d = -e \cdot \bar{\rho}(1+\bar{\eta}) + \frac{1}{r}\left[1 - \int \beta^i d^i di/\overline{D}\right] \tag{1.6}$$

$$\frac{\tau}{1-\tau} = \frac{1}{\epsilon_Z}\left[1 - \int \beta^i z^i di/\overline{Z} - (\tau^d + e \cdot \bar{\rho}(1+\bar{\eta}))\hat{D}_R\right] \tag{1.7}$$

$$\int \beta^i di = 1 - (\tau^d + e \cdot \bar{\rho}(1+\bar{\eta}))\bar{D}_R. \tag{1.8}$$

Suppose now that the government can supply the public good G_0 and that the solution implies positive provision, i.e: $G_0 > 0$. The optimal vector (τ, τ^d, R, G_0) is then characterized by the three equations above and additionally requires:

$$e = 1 - (\tau^d + e \cdot \bar{\rho}(1+\bar{\eta}))\partial\bar{G}/\partial G_0. \tag{1.9}$$

Proof. Proof: See Appendix.

Proposition 1 establishes the non-linear system that solves the welfare maximization problem. The highlighted elements of equations (1.6) to (1.9) above describe the impact of endogenous leakage on the baseline optimality formulas found in Saez (2004). As seen from the first equation in Proposition 1, the endogenous leakage elasticity has a first-order effect that reduces the deductibility rate by a magnitude of the external effect e, driving charitable deductions upwards. However, a change in the leakage elasticity also affects e, as seen in Equations (1.6) and (1.9)[8].

[8] In order to assess the impact of varying the leakage elasticity on deductibility rates, Table 1.5 in the Appendix provides numerical computations that compare the tax rate for different values of η with those obtained in the benchmark case of Saez with no leakage elasticity.

The US income tax law authorizes some expenditures to be fully deductible (Saez, 2004) of income tax. The case of full deductibility is, hence, of immediate policy relevance. Full deductibility is modeled as considering an additional constraint $\tau^d = -\tau$, i.e., contributions are deducted at the income tax rate. The following proposition derives the optimal rates when the government faces the constraint $\tau = -\tau^d$.

Proposition 2. *If charitable donations are fully deductible from taxable income, i.e., the government is constrained to set $\tau^d = -\tau$, then the optimal tax rate on income τ is given by:*

$$\frac{\tau}{1-\tau} = \frac{1}{\epsilon_Y}\left[1 - \int \beta^i y^i di/\overline{Y} + e \cdot \bar{\rho}(1+\bar{\eta})\left(r\frac{\bar{G}}{\bar{Y}} - \hat{G}_R\frac{\bar{Z}}{\bar{Y}}\right)\right], \tag{1.10}$$

where $\bar{Y} = \overline{Z} - \overline{G}$ denotes aggregate taxable income, and $\epsilon_Y = (1-\tau)\overline{Y}_{1-\tau}/\overline{Y}$ is the aggregate taxable income elasticity. If the government can provide the public good, then:

$$e = 1 - (\tau^d + e \cdot \bar{\rho}(1+\bar{\eta}))\partial\bar{G}/\partial G_0 = \frac{1-\tau^d \bar{D}_{G_0}}{1+\bar{\rho}(1+\bar{\eta})\bar{D}_{G_0}} \tag{1.11}$$

Proof. Proof: See Appendix.

Proposition 2 distinguishes itself from the baseline case of Proposition 1. First, since contributions are more responsive than earnings, it is the case that the elasticity of contributions is larger than that of earnings, i.e in terms of the model $\epsilon_Y > \epsilon_Z$, this drives the rate τ to be lower than in Proposition 1. Second, the term $\left(r\frac{\bar{G}}{\bar{Y}} - \hat{G}_R\frac{\bar{Z}}{\bar{Y}}\right)$ in Equation 1.10 shows how lowering the tax rate on taxable income has two opposing effects: it has a positive effect on contributions through an income effect represented by the first positive term, but it also increase the cost of giving: the net effect results from balancing r and $\hat{G}_R$. Moreover, notice how a larger leakage and leakage elasticity tend to reduce the importance of this trade-off. This means that high leakage implies that the socially optimal tax rate should be less responsive to the net trade-off changes in the relative cost of giving and income effect. The counterfactual analyses conducted in the empirical section revisit Propositions 1 and 2 for a hypothetical tax change in 2014.

1.3 A model of the competition between NGOs

I now present a model of competition that endogenizes the leakage coefficient and the leakage elasticity (see Equations (1.3) and (1.4)). The model comprises three actors: donors, NGOs, and the government. Each donor makes two decisions: he first pledges a donation amount after observing the tax code and subsequently selects his preferred NGOs among those in his choice set. Each of the $N \geq 2$ NGOs decides strategically on its advertisement intensity to maximize its social and private objectives. Anticipating these decisions, the government decides over tax policy, as argued previously.

In this model, donors and NGOs are distributed along a Salop circle [9]. Donors derive positive utility from donating but passively wait for NGOs to inform them about their existence. As such, donors only donate to those NGOs whose existence is known to them, i.e., those whose ads have reached them.

1.3.1 Donors and NGOs

There is a continuum of donors of mass 1. The utility derived by donor i from donating to an NGO j is given by $U(\chi_j, \theta_i)$, where χ_j is a vector that summarizes NGO characteristics, such as geographical location r_j, service quality α_j, and horizontal position p_j. For the estimation, I distinguish $\chi_j = (x_j, \xi_j)$, where x_j are observed NGO characteristics, and ξ_j are unobserved characteristics from θ_i, a vector of individual donor characteristics, such as income $z_i \geq 0$, horizontal preference parameter $h_i \in [0,1]$, and faced tax liability T_i.

I consider donors' choices as a two-step process. First, each donor pledges a constant fraction of his yearly expenses for donations (Bjornerstedt and Verboven, 2016). The amount of donations depends on tax policy but does not depend on the observed set of NGOs. Second, each donor observes NGO characteristics and donate the entire pledged amount to his preferred NGO inside his information set $\mathcal{I}_i \subset \mathcal{P}(\mathcal{J})$, where $\mathcal{J} = \{1, \dots N\}$ is the set of all NGOs and $\mathcal{P}(\mathcal{J})$ is the power set over

[9] I consider an informative advertising setting that generalizes the model of Grossman and Shapiro (1984) to account for quality heterogeneity under fixed prices.

the NGO universe. The total supply of donations available in the market is $D\left(\tau, \tau^d\right)$, a measure of the market size for gross available donations. D is a function of the tax system faced by the donors and, as such, it is determined by the tax schedule τ^d and τ: $D(\tau^d, \tau)$, where τ^d is the tax rate paid on donations and τ the income tax rate.

After observing the ads and learning χ_j for all $j \in \mathcal{I}_i$, each donor selects his preferred NGO in a discrete-choice fashion (Anderson et al., 1989). A given donor selects the NGO j^* that maximizes his indirect utility among all NGOs in his information set $\mathcal{I}_i$ according to a decision rule given by:

$$j^* \in \{j \in \mathcal{I}_i : u_{ij} > u_{ik}, \forall k \neq j\}. \tag{1.12}$$

In the estimation, I will assume that the indirect utility follows a random coefficient specification (Berry, 1994). Specifically, this means that indirect utility from the donation to NGO j, u_{ij}, will be modeled as depending on NGO characteristics. In the model section, I will limit those to NGO quality and donors' horizontal taste and will allow for more general specifications in the empirical section 1.5.

An NGO, indexed by j, decides on fundraising intensity $\phi_j \in [0, 1]$ and uses the rest of its proceeds to fund a public good $G_j \in \mathbb{R}_+$, for $j = 1, \dots, N$. It solves the program:

$$\max_{(\phi_j, G_j)} \Pi_j(\phi_j; \phi_{-j}) + \alpha_j \mathcal{PO}\left(G_j; \mathbf{G}_{-j}\right), \text{ subject to: } G_j = \Pi_j(\phi_j; \phi_{-j}), \tag{1.13}$$

where the term $\Pi_j(\phi_j; \phi_{-j})$ represents the total funds gathered by NGO j when advertising with intensity ϕ_j while the remaining NGOS choose intensities $\phi_{-j} = (\phi_1 \dots, \phi_{j-1}, \phi_{j+1}, \dots \phi_N)$. As in Dewatripont et al. (2022), NGOs place a non-negative weight $\alpha_j \geq 0$ on philanthropic output $\mathcal{PO}(\cdot) : \mathbb{R}^N_+ \to \mathbb{R}$, as a function of its own public good G_j and the vector of public goods produced by other NGOs, denoted $\mathbf{G}_{-j}$. This term captures NGOs' plausible concerns over social objectives, namely, the provision of public goods. NGOs are limited by a *non-distribution constraint*, which states that net funds Π_j must equal total public good provision G_j, i.e., $\Pi_j = G_j$. I assume that fund collection is described by:

$$\Pi_j(\phi_j;\phi_{-j}) = A(\phi_j;\phi_{-j}, D\left(\tau,\tau^d\right)) - K_j(\phi_j). \tag{1.14}$$

The first term represents the gross funds raised when advertising with intensity ϕ_j when the remaining NGOs advertise at the vector of intensities ϕ_{-j}. In the theoretical section, gross funds are taken as separable to falicitate exposition: $A(\phi_j;\phi_j, D) = D\left(\tau,\tau^d\right) a(\phi_j;\phi_j)$. The function K_j represents the cost of reach, which is taken as strictly increasing and weakly convex, i.e., $K_j : [0,1] \rightarrow \mathbb{R}$, $K_j(0) = 0$, $K_j' > 0$, $K_j'' \geq 0$. To simplify the mathematical exposition, K_j is assumed to be given by the quadratic specification:

$$K_j(\phi_j) = \frac{1}{2}c_j\phi_j^2, \tag{1.15}$$

which implies that the marginal cost is linear and given by $K'(\phi_j) = c_j\phi_j$, where $c_j > 0$ is a cost shifter.

Philanthropic output, whose? The function $\mathcal{PO}\left(G_j;\mathbf{G}_{-j}\right)$ in Equation (1.13) captures the utility derived by NGO j from the impact of its activities over philanthropic output. One can consider NGOs as having narrow concerns over philanthropic output, privileging its provision over provision by competing suppliers, or instead consider them to be concerned with the overall output of its sector. With this important distinction in mind, I study two possible definitions of philanthropic output and study their implications for the equilibrium vector of intensities and public good provision [10]. Consider the following specification:

$$\mathcal{PO}(G_j;G_{-j}) = G_j + \omega\sum_{k\neq j}^{N} G_k, \tag{1.16}$$

where $\omega \in \{0,1\}$ parametrizes the type of philanthropic output NGOs are concerned with into two possible cases as defined below. The philanthropic outcome parameter ω is common knowledge.

[10] There are other competing assumptions, among which the most prominent is to consider NGOs that internalize full welfare including misallocation costs. While this consideration is of theoretical interest, such an assumption would not change the qualitative result from the model.

I distinguish between two cases as determined by ω. When $\omega = 0$, I consider NGOs to be concerned with *narrow philanthropic output*: each NGO cares about the impact of its public good over philanthropic output, disregarding the activities of other competing suppliers. When $\omega = 1$, I say NGOs are motivated by *ethical philanthropic output*. An NGO that values philanthropic output considers its provision interchangeable with those carried out by different suppliers: it partially internalizes the negative externalities that intense advertising may induce on other competing NGOs within the sector in which it operates.

1.3.2 Equilibrium characterization

Given that the non-distribution constraint of each NGO binds and the assumed functional form over philanthropic output concerns $\mathcal{PO}(\cdot)$ the objective function of NGO j as a function of its fundraising profiles, and that of competing organizations, writes:

$$V_j(\phi_j, \phi_{-j}) = \Pi_j(\phi_j, \phi_{-j})(1 + \alpha_j) + \alpha_j \omega \sum_{k \neq j} \Pi_k(\phi_k, \phi_{-k}). \tag{1.17}$$

Assuming differentiability, the first-order necessary condition for NGO j to maximize its objective V_j is:

$$\frac{\partial V_j(\phi_j, \phi_{-j})}{\partial \phi_j} = \frac{\partial \Pi_j(\phi_j, \phi_{-j})}{\partial \phi_j}(1 + \alpha_j) + \alpha_j \omega \sum_{k \neq j} \frac{\partial \Pi_k(\phi_k, \phi_{-k})}{\partial \phi_j}. \tag{1.18}$$

Conditional on the N second-order conditions being also satisfied, an interior NGO fundraising equilibrium is a vector of advertising intensities that satisfies the above equation for all $j \in \{1, \ldots N\}$.

1.3.3 The endogenous leakage coefficient

The equilibrium defined by NGO advertising decisions in eq:FOCs and donors' discrete choices in eq:DC allows us to express donations to an NGO j as a function of intensities:

$$D_j = D_j(\phi). \tag{1.19}$$

Note that this defines the *leakage coefficient* for NGO j as a function of equilibrium intensities, $1 - \rho_j^b(\phi, \alpha)$, in a market in which donors have a taste for quality $b > 0$ and the vector of NGO quality is given by α, so I will write the NGO-level and market-level elasticities as: $\eta_j^b(\phi, \alpha)$ and $\bar{\eta}^b(\phi, \alpha)$, respectively. Henceforth, I omit the reach vector as an argument whenever there is no ambiguity[11].

1.3.4 Theoretical results

I now specialize the model to derive a handful of theoretical results that will guide the empirical analysis and the interpretation of the empirical results. Specifically, I reduce NGO characteristics to be NGOs horizontal position $p_j \in [0, 1]$ and quality α_j, which means that $\chi_j = (p_j, \alpha_j)$. I let each donor be characterized by two parameters: his position $h_i \in [0, 1]$ and a common taste $b \geq 0$ for NGO quality captured by the parameter α_j. Additionally, a donor derives utility from income z_i, his donation d_i, the aggregate public good provision G, which means that $\theta_i = (h_i, b, z_i, d_i, G)$. A donor first decides on the fraction of his income that will be devoted to charitable giving by taking into account the deductibility rate $\tau^d \in \mathbb{R}$ and a linear income tax $\tau \in \mathbb{R}$ [12], according to a generic function:

$$d^*(1 + \tau^d, z(1 - \tau)),$$

with $\partial d^* / \partial \tau^d < 0$ and $\partial d^* / \partial z(1 - \tau) > 0$, meaning that $1 + \tau^d$ is the effective price of giving, and donations are a normal good. After pledging his donation, each donor receives and observes the ads of those charities that reach him. Each charity j discloses two elements in its advertisement: its location p_j and its concern

[11] Note that Equation (1.3) defines the leakage coefficient at the sector level instead.

[12] In general, τ may be a non-linear function $\tau(z) : \mathbb{R} \to \mathbb{R}$. In the baseline model, I limit τ to be a linear function, following the optimal taxation literature, e.g., Diamond (2006b), and Saez (2004).

for philanthropic output α_j. The selected NGO j^* is such that:

$$(\alpha_{j^*}, p_{j^*}) = \underset{(\alpha_j, p_j) \in \mathcal{I}_i}{\arg\max}\, b\alpha_j - \Delta(h_i, p_j), \tag{1.20}$$

where $\Delta(h_i, p_j)$ is the smallest arc distance between NGO j, located at p_j and donor located at h_i, and the term b captures the donor's tastes over NGO quality. NGOs are distributed along a unitary Salop Circle with generic position $p_j = j/N$, as shown in Figure 1.1.

The taste parameter h_i is distributed independently of income z_i, which means that gross aggregate donations $D(\tau, \tau^d)$ are given by:

$$D(\tau, \tau^d) = \int_{\underline{z}}^{\overline{z}} d^*(1 + \tau^d; z(1 - \tau))dF(z). \tag{1.21}$$

Equilibrium results are benchmarked to the public-good maximizing profile of intensities ϕ^* defined as:

$$\phi^* = (\phi_1^*, \ldots, \phi_N^*) \in \underset{\phi}{\arg\max}\, G(\phi), \tag{1.22}$$

where:

$$G(\phi) \triangleq \sum_{k=1}^{N} G_k(\phi) \tag{1.23}$$

is the aggregate public good supplied by the N charities of the sector. This measure allows us to capture whether decentralized public good provision leads to inefficient provision due to competitive forces.

The 3-NGO Benchmark with symmetric costs. To facilitate exposition, I consider the case in which there are three NGOs in the market [13], and I fix $c_j = c > 0$ for all j.

[13] Derivations for larger markets with $N > 3$ are substantially more complicated, since the $N \times N$ system equivalent to the $N = 3$ case becomes increasingly difficult to solve analytically for larger polynomials. Certain benchmark results still hold, namely Proposition 1. Appendix 1.8.2 includes these results.

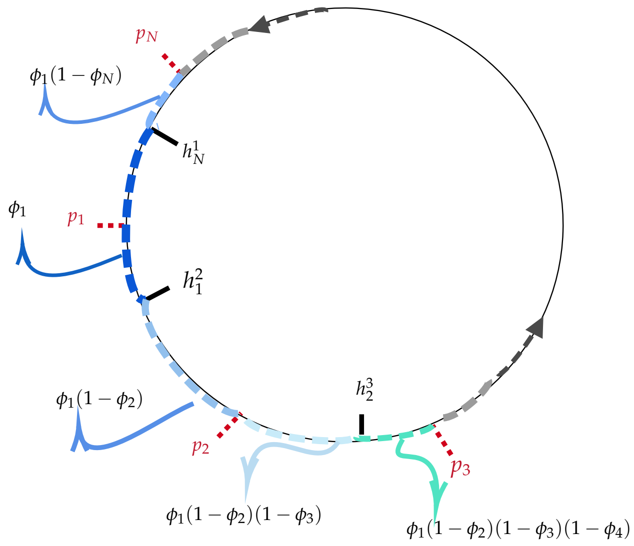


FIGURE 1.1: Salop circle depicting the NGO market. NGO j is located at p_j, and the arc distance between two neighboring NGOs is $1/N$. The value h_l^j denotes the indifferent donor between NGO j and l.

The market that NGO j faces in this environment is such that A in Equation (1.14) writes:

$$\begin{aligned} A(\phi_j;\phi_j) =& \phi_j \left[(1-\phi_{j+1})(1-\phi_{j-1})X_j^j + (1-\phi_{j-1})\phi_{j+1}X_j^{j+1}\right] \\ &+ \phi_j \left[(1-\phi_{j+1})\phi_{j-1}X_j^{j-1} + \phi_{j-1}\phi_{j+1}X_j^{j-1,j+1}\right] D(\tau^d,\tau), \end{aligned} \tag{1.24}$$

where X_j^{j+1} (resp. X_j^{j-1}) describes the mass of consumers that donates to NGO j when after having also received an ad from NGO $j+1$, which happens with probability $\phi_j(1-\phi_{j-1})\phi_{j+1}$ (resp. $j-1$, with probability $\phi_j(1-\phi_{j+1})\phi_{j-1}$), and $X_j^{j-1,j+1}$ is the mass of donors that donates to j after received ads of both $j+1$ and $j-1$, which occurs with probability $\phi_j\phi_{j-1}\phi_{j+1}$. X_j^j denotes the mass of consumers that give to j when only NGO j is in their information set. Since donors impose no minimum quality, it follows that $X_j^j = 1$. Importantly, as shown in Figure 1.1, indices are mod 3 (i.e, if $j=1$, then $j-1=3$ and $j+1=2$).

Using Equation (1.24), we obtain a characterization of necessary and given the concavity of the objective function implied by (1.14) sufficient first-order conditions. After some manipulation (details included in the Appendix) we obtain the following system of equations:

$$\frac{K'(\phi_1)}{D\left(\tau,\tau^d\right)} = (1-\phi_2)(1-\phi_3) + (1-\phi_3)\phi_2\left[\frac{X_1^2}{1+\omega\alpha_1}\right] + (1-\phi_2)\phi_3\left[\frac{X_1^3}{1+\omega\alpha_1}\right] + \phi_3\phi_2\left[\frac{X_1^{23}}{1+\omega\alpha_1}\right]$$
$$\frac{K'(\phi_2)}{D\left(\tau,\tau^d\right)} = (1-\phi_1)(1-\phi_3) + (1-\phi_3)\phi_1\left[\frac{1-X_1^2}{1+\omega\alpha_2}\right] + (1-\phi_1)\phi_3\left[\frac{X_2^3}{1+\omega\alpha_2}\right] + \phi_3\phi_1\left[\frac{X_2^{13}}{1+\omega\alpha_2}\right]$$
$$\frac{K'(\phi_3)}{D\left(\tau,\tau^d\right)} = (1-\phi_2)(1-\phi_1) + (1-\phi_1)\phi_2\left[\frac{1-X_2^3}{1+\omega\alpha_3}\right] + (1-\phi_2)\phi_1\left[\frac{1-X_1^3}{1+\omega\alpha_3}\right] + \phi_1\phi_2\left[\frac{1-X_2^{13}-X_1^{23}}{1+\omega\alpha_3}\right].$$

This system characterizes equilibrium strategy profiles as functions of the type of welfare concerns faced by NGOs (either $\omega = 1$ or $\omega = 0$), the strength of welfare concerns by the α terms, and the generic market shares X. Significantly, these last shares will depend on donors' taste for quality b, and the quality parameters α_1, α_2, α_3. I first provide a result for when $b = 0$ and then examine the case in which $b > 0$.

Proposition 3. *[Insensitive donors] Let donors be insensitive to NGO quality, i.e., $b = 0$. Then,*

1. *For any $\omega \in \{0,1\}$ and any $\alpha \in [0,1]^3$, the leakage coefficient is increasing in total donations D : $\bar{\eta}^0(\alpha) > 0$, and public good provision is lower than in the benchmark $G(\phi) < G(\phi^*)$.*

2. *If $\omega\alpha_j = 0$ for all j, there exists a unique equilibrium. This equilibrium is symmetric, i.e., all NGOs exert the same fundraising effort $\phi_j = \phi^{sym} \in (0,1)$. In equilibrium, the following properties hold:*

   (a) Reach is excessive with respect to the public-good maximizing level of reach ϕ^*: $\phi^{sym} > \phi^*$. Total public good provision is lower than in the public-good maximizing benchmark: $G(\phi^{sym}) < G(\phi^*)$.

   (b) $\eta^0(\alpha) > \eta^0(0,0,0)$ for all $\alpha \in \mathbb{R}/\{0,0,0\}$

3. *If $\omega\alpha_j = \alpha > 0$ for all $j \in \{1,2,3\}$, there exists a unique symmetric equilibrium, i.e., where all NGOs exert the same level of fundraising effort $\phi_j = \phi^{sym}(\alpha) \in (0,1)$, such that $\phi^{sym}(\alpha) > \phi^{sym}(0)$ for any $\alpha > 0$.*

4. *If $\omega = 1$ and instead the philanthropic output weights are heterogeneous and such that $\alpha_1 < \alpha_2 < \alpha_3$, then the market shares obtained by each NGO are such that $s_1 > s_2 > s_3$, and where individual leakage is increasing in α_j: $\eta_1^0(\alpha) < \eta_2^0(\alpha) < \eta_3^0(\alpha)$.*

Proof. Proof: See Appendix.

Proposition 3 establishes that in a reach equilibrium in which donors are insensitive to NGO quality, the public good will be under-provided with respect to the public-good maximizing benchmark defined in (1.22). The leakage coefficient is positive, and the elasticity of leakage to donations is positive. Several subcases defined by the combinations of NGO qualities, α_j, and the philanthropic mandate output are of relevance.

When $\alpha_j = 0$ for all j, each NGO is only concerned with the funds it captures from donors. It does not internalize the negative externalities that its advertising imposes on the other NGOs competing against it. This situation leads to excessive advertising in the market, exacerbated by increased available funds in the charitable market. The same holds when all NGOs are motivated by a narrow mandate, i.e., $\omega = 0$, since NGOs do not internalize the effects of their aggressiveness over the sectors' provision. Moreover, when NGOs are motivated by a narrow philanthropic output ($\omega = 0$ and $\alpha_j = \alpha > 0$), a higher value of α leads to a more aggressive market, which, in turn, increases the leakage elasticity.

An ethical philanthropic output ($\omega = 1$) implies that NGOs somewhat internalize the external effects of their advertising on other NGOs. When $\omega\alpha_j = \alpha > 0$ for all j, then we obtain a unique reach equilibrium, in which advertising aggressiveness is mitigated with respect to the case in which NGOs have no quality concerns.

At last, when $\omega = 1$ and NGOs differ in concerns for quality α, the model predicts that the high-quality suppliers will command lower market shares and, in fact, display lower leakage elasticities. High-quality NGOs will internalize the externalities that they impose on other suppliers. However, donors will not compensate for this with their donations, which leads them to command lower market shares.

I now let $b > 0$ to consider the more involved case in which the NGO heterogeneity matters for donors. First, one can consider the benchmark case where NGOs have narrow philanthropic output.

Proposition 4. *[Sensitive donors: narrow philanthropic output]*

Let $b > 0$, $\omega = 0$, and $\alpha_1 < \alpha_2 < \alpha_3$. Then, in equilibrium $\phi_1 < \phi_2 < \phi_3$ and $s_1 < s_2 < s_3$, and individual leakage is decreasing in α_j: $\eta_1^b > \eta_2^b > \eta_3^b$.

When NGOs are concerned by narrow philanthropic output and donors are sensitive to quality, we can distinguish two effects. First, higher-quality NGOs become more aggressive due to their narrow mandate, leading them to adopt more potent fundraising strategies and command higher market shares. Second, for equal advertising efforts, the NGO with the highest α obtains the highest market share when b>0, making advertising more profitable. Proposition 5 explores the reciprocal result for the case in which NGOs have broad concerns over philanthropic output.

Proposition 5. *[Insensitive donors: broad philanthropic output] Let $b > 0$, $\alpha_1 \leq \alpha_2 \leq \alpha_3$ and $\omega = 1$. Then, the following properties hold in equilibrium:*

1. *if $b < \frac{1}{2(\alpha_2 - \alpha_1)}$ the equilibrium system of market shares is such that $s_1 > s_2 > s_3$ and $\eta_1^b(\alpha) < \eta_2^b(\alpha) < \eta_3^b(\alpha)$;*
2. *if $b > \frac{1}{2(\alpha_2 - \alpha_1)}$ the equilibrium system of market shares is such that $s_1 < s_2 < s_3$, moreover $\partial |s_k - s_j| / \partial D(\tau, \tau^d) > 0$ and $\eta_1^b(\alpha) > \eta_2^b(\alpha) > \eta_3^b(\alpha)$.*

Proof. Proof: See Appendix.

When NGOs are concerned with a broad version of philanthropic output, they must balance two forces. First, intensive advertising imposes an externality over their competitors, valued with intensity α_j by NGOs. Second, advertising more intensely "reallocates" resources away from inferior-quality NGOs. Notably, the second effect is proportional to the donors' valuation for quality provision, b. Consequently, when donors' preferences for NGO quality are sufficiently strong, the theoretical model predicts that the NGOs with high perceived quality will command higher market shares in equilibrium. The converse is true when the donors' taste for quality is low.

This result tells us that we should expect more ethical firms to command higher market shares in equilibrium as long as the value for quality exceeds the threshold value of b, which is inversely proportional to the difference between the best and the worst NGO. This result is crucial because it is empirically testable with the rankings data from Charity Navigator. Moreover, if donors' taste for quality is significant, increases in gross donations should result in good NGOs commanding larger market shares and advertising more intensely.

1.4 Data

I work with a panel of tax filings from IRS Form 990 that contains observations at the NGO level, with 106 variables for each charity, including fundraising expenditures, tax-exemption status, year of creation, total revenues and total assets, and geolocalization. I define geographical markets by using Nielsen's DMA regions (Figure 1.2). The IRS Form 990 provides donation data at the Nonprofit level, a financial disclosure form that most tax-exempt nonprofits must file annually.

Charity Navigator. Data about organizations' quality scores are obtained from the Charity Navigator website. Charity Navigator is, by far, the most used source of ratings for Nonprofits. The Charity Navigator website ranks organizations in several dimensions: finances, transparency, governance, and others. Charity Navigator rates a subset of registered 501(c)(3) public charities in the U.S. based on guidelines such as allocating at least 1 percent of expenses to fundraising and administrative expenses for three consecutive years. The rating system has evolved, and highly rated charities are awarded a star rating based on an underlying score. The ratings are published roughly once a year, with a one-year lag between the release of Form 990 data and the publication of the rating. The ratings and underlying metrics are made available through the Charity Navigator API.

As an instrument of our advertising technology, I rely on the dataset provided by Spenkuch and Toniatti (2018), which measures the intensity of political advertising during presidential campaigns at the level Nielsen DMA level.

Data from the first-dollar tax cost faced by donors to asses the Tax Reform Act of 1986 comes from TAXSIM and completing tax liabilities from estimates reported by Duquette (2016) obtained using the IRS Public Use File, which uses a nationally

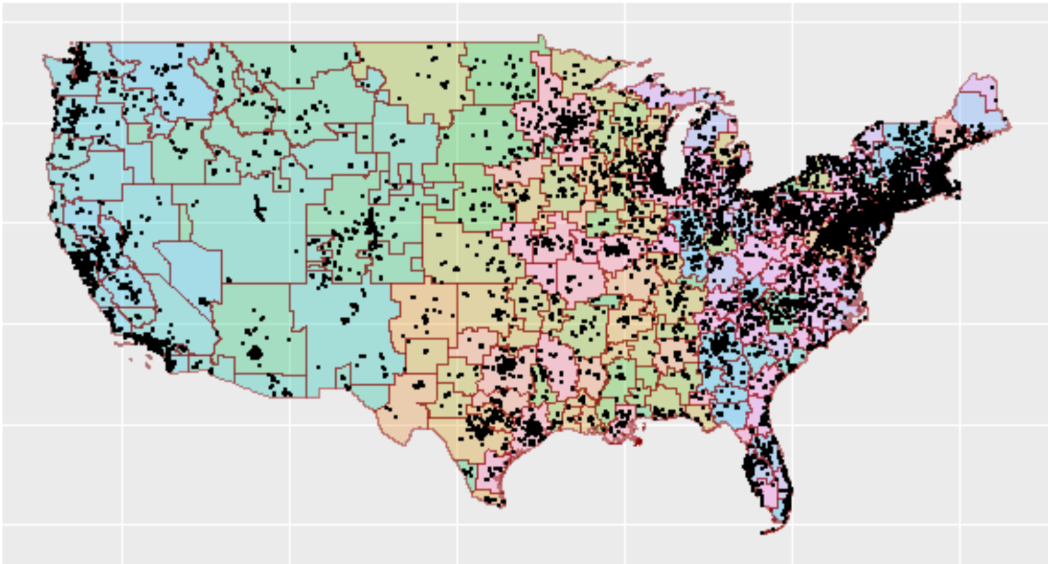


FIGURE 1.2: DMAs and NGO geolocalization for 2014.

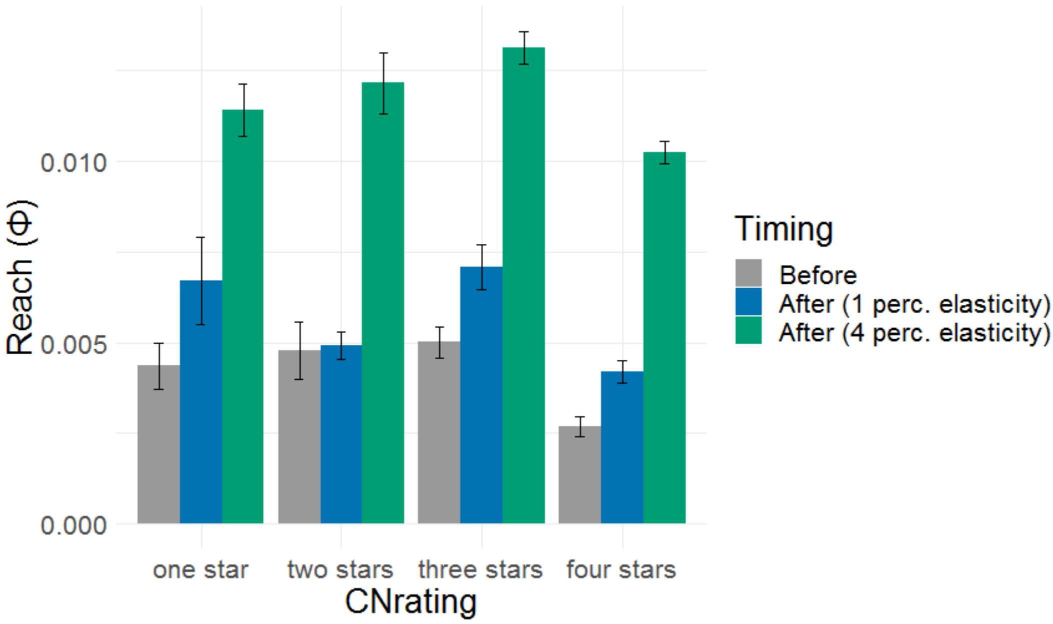
representative sample of tax returns at the individual level to estimate the marginal tax subsidy for the first dollar given for each state in the U.S.

Additionally, for the reduced-form comparison with the previous literature, some specifications use the IRS Statistics of Income Division (SOI) data sample all organizations with over 10 million USD in assets for 1982, 1983, and 1985 to the present. The SOI data also attempt to follow the same organizations each year.

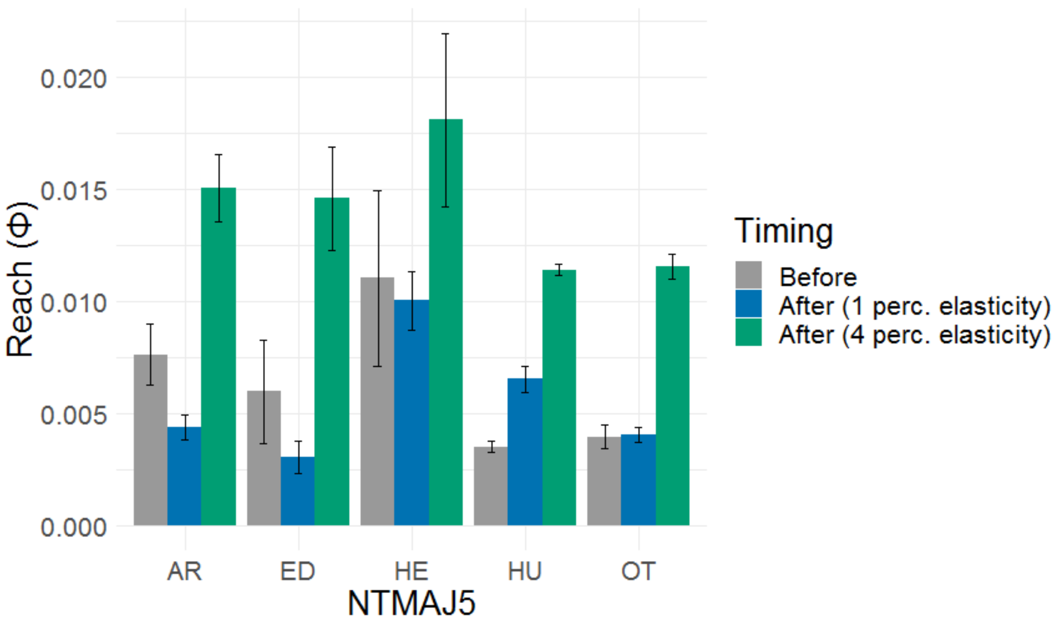
I also run robustness checks using data from Kantar Media, which tracks advertising expenditures by specific media providers for the period of interest, and Charity Navigator. Charity Navigator allows us to identify quality and advertising targeting measures.

1.5 Empirical Specification and Estimation

I bring the general model described in Section 2.2 to the data in this section. To do this, I proceed in three broad steps. First, I estimate the structural preference parameters that guide donation decisions. I follow a nested logit specification (Berry, 1994) of the discrete choice presented in Equation (1.12). Second, I use these estimates



0.5
(a)
h



0.5
(b)
h

FIGURE 1.3: Counterfactual reach for different elasticities.

and the NGO model to obtain estimates of the marginal cost of unconditional reach of each NGO at equilibrium. Third, I use my estimates to perform counterfactual analyses of interest.

1.5.1 Donation supply and market shares

I consider a setting with N_l NGOs in each market $l \in \{0, \ldots, L\}$, where each market corresponds to one of Nielsen's geographical DMAs. Henceforth, I hew as closely as possible to the notation of Berry (1994). NGOs are nested into 5 exhaustive and mutually exclusive nests, given sets, $m = 1, \ldots 5$, and the outside good, denoted by $m = 0$. I define nests to be given by the "major 5" categories as defined by the National Center for Charitable Statistics, NTMAJ5 [14]. Denote the set of NGOs in group m as $\mathcal{J}_m$, and the outside good, $j = 0$, be the only member of group 0. For NGO $j \in \mathcal{J}_m$, let the random coefficient specification of utility (1.20) for a donor i that donates to NGO j be:

$$u_{ij} = \delta_j + \varsigma_{im} + \beta_T f(z_i, T_l) + (1 - \sigma)\epsilon_{ij}, \tag{1.25}$$

where ϵ_{ij} is iid extreme value and the mean utility term δ_j is given by:

$$\delta_j = \mathbf{x}_j' \beta + \beta_\phi \phi_j + \beta_q q_j + \xi_j, \tag{1.26}$$

where $\mathbf{x}_j'$ is a vector of observed NGO characteristics, ϕ_j is the advertising intensity of NGO j, q_j is the measure of NGO quality as given by the Charity Navigator Score (i.e., the measure of α_j in the theoretical model), z_i denotes individual income, T_l is the mean tax liability faced by donors in market l, and where the function $f(z_i, T_l)$, as in Bjornerstedt and Verboven (2016), is taken to be the fixed expenditure demand specification [15]. The idiosyncratic group preference, ς_{im}, follows the unique distribution such that $\varsigma_{im} + (1 - \sigma)\epsilon_{ij}$ is also an extreme value random variable. The

[14] There are five major subsectors as categorized by the National Center for Charitable Statistics, each represented by a two-letter code. These codes are AR for Arts, culture, and humanities; ED for Education; HE for Health; HU for Human Services; and OT for Other.

[15] More generally, the mean tax liability T_l is a function of aggregate income and the interaction between the federal- and state-level tax policies, this may lead us to consider more general specifications in which the tax liability varies at the individual level, $T_{i,r}$. However, due to the lack of

parameter σ, with $0 \leq \sigma < 1$, characterizes the correlation of utilities that a donor experiences among the NGOs in the same group. As is standard, I normalize the mean utility of the outside good to zero $\delta_0 = 0$.

I allow mean utility in Equation (1.26) to depend on fundraising intensity ϕ_j. I interpret this specification as allowing advertising to increase the supply of donations under a persuasive motive, an approach often adopted by marketing studies (Shapiro, 2018). In terms of the theoretical model from Section 1.3.4, this is equivalent to allowing for indifferent donors at a given information set to be influenced by the equilibrium profile of intensities of NGOs within those NGOs that have reached them. Letting advertising influence mean utilities allows the supply of donations and the characterization of NGO equilibrium behavior to describe a setting where advertising informs and persuades donors[16].

Aggregate and Inverted Aggregated Donations. Aggregate donations for NGO j are given by the probability that a donor donates to an NGO, multiplied by the donation amount, $d_j(z_i)$, aggregated over all donors and according to income distribution F_z :

$$\begin{aligned} \mathcal{D}_j &= \int s_j(\delta,\sigma) d_j(z) dF_z(z) \\ &= s_j(\delta,\sigma) \int d_j(z) dF_z(z). \end{aligned} \tag{1.27}$$

The last equality follows from the fact that the choice probability $s_j(\delta,\sigma)$ is independent of income. We can solve the remaining integral in (1.27) relying on the constant expenditure specification of donations is such that, for a $\gamma \in [0,1]$, $f(z_i, T_l) = \gamma^{-1} \ln z_i - \ln T_l$, so donations are given by: $d_j(z_i) = \gamma \frac{z_i}{T_l}$. Using this last equation in the expression for the choice probabilities, we obtain:

$$\frac{T_l \mathcal{D}_j}{\gamma Z} = s_j(\delta,\sigma)$$

where Z is the total income of all donors. We can now recur to the standard approach

variation in tax liabilities within markets for the period after 2010, the present model cannot distinguish between this specification and that in (1.26)

[16]Notably, a distinction between the role of advertising as informative as opposed to persuasive allows us to decide on whether to include it in welfare estimation. When assessing welfare changes of the counterfactual tax change, I further consider the implications of this distinction.

	Dependent variable:	
	$\log(s_j) - \log(s_0)$	
	(1)	(2)
Reach (β_ϕ)	0.921***	0.964***
	(0.004)	(0.004)
Tax Liability (β_T)	0.0003	0.0002
	(0.003)	(0.003)
Nesting parameter (σ)	0.219***	0.218***
	(0.003)	(0.003)
CN Score (β_q)	0.009***	0.009***
	(0.0005)	(0.0005)
Fixed effects	Yes	No
Observations	101,750	101,750
R^2	0.569	0.569
Adjusted R^2	0.569	0.569
Residual Std. Error	1.187 (df = 101711)	1.187 (df = 101715)
F Statistic	3,532.527*** (df = 38; 101711)	3,945.579*** (df = 34; 101715)
Note:		*p<0.1; **p<0.05; ***p<0.01

TABLE 1.1: Second-stage estimation results for (1.29). The result Column 1 includes state-year and market fixed effects. The parameter γ is fixed at 2 percent of the GDP for the estimation. The estimation includes the panel of organizations that are present throughout the period 2012 to 2017.

and invert choice probabilities to solve for mean utilities. Following the constant expenditure specification of Bjornerstedt and Verboven (2016), in the estimation of (1.29), we let the random utility component be given by the logarithmic specification:

$$u_{ij} = \delta_j + \varsigma_{im} + \beta_T \gamma^{-1}(\log Z_i - \log T_l) + (1-\sigma)\epsilon_{ij}. \tag{1.28}$$

The estimation equation is then given by:

$$\log s_j - \log s_0 = \mathbf{x}_j' \beta + \beta_\phi \phi_j + \sigma \log \bar{s}_{j/m} + \beta_T T_l + \beta_q q_j + \xi_j, \tag{1.29}$$

where s_j is the market share of NGO j, s_0 that of the outside option, $s_{j/m}$ is the share of NGO j within it's nest, and δ_j is defined as in (1.26). Additionally, market shares are introduced in value terms instead of linearly. Finally, the potential market is assumed to be a fixed fraction of GDP, γZ. As standard, γ is not estimated but imposed according to a range of reasonable values.

Estimation. I estimate (1.29) by using an instrumental variable regression of market shares on NGO characteristics, tax liabilities, fundraising intensities, and nest market shares. Here, fundraising intensities (ϕ_j) and nest shares ($\bar{s}_{j/m}$) are endogenous variables. To tackle endogeneity and provide causal identification, I rely on instrumental variables. First, I instrument the inside-nest shares with the number of other NGOs present in the market of NGO j, as standard in the demand estimation literature. Second, fundraising intensities ϕ_j, are instrumented by relying on data on political advertising gathered by Spenkuch and Toniatti (2018) at the DMA level, which is a shifter of the advertising effectiveness at the DMA-level. Political advertising serves as a valid instrument as long as it works as an exogenous shifter of the advertising technology faced by NGOs. In this vein, the identifying assumption for the estimation corresponds to political advertising exogenously increasing the cost of reaching a given donor, holding everything else equal. I complement this instrument with as more classical demand instruments, like NGO characteristics.

Results. Table 1.1 presents the estimation results with and without state-year and market fixed effects. First, I discuss the coefficients associated with reach,β_ϕ. There is a positive and significant effect of advertising on log market shares for the current specification in (1.29). This result provides evidence of substantial persuasiveness of fundraising strategies as a means for attracting donors. Second, the nesting parameter, σ, is significant and positive. Its rather low value implies low substitutability of donations across nests. Third, as evidenced by the coefficient associated with β_q, donors display a positive taste for quality. Better quality charities, as measured by the Charity Navigator Score, command higher market shares. Lastly, it is important to mention that the coefficient associated with the tax liability, β_T is not statistically significant since we do not observe enough variation in the tax code for our sample. This problem is addressed in the following subsection when discussing the counterfactual study,

Relationship to theory and discussion. The positive and significant coefficient associated with our proxy for quality, the Charity Navigator Score, provides evidence of quality-sensitive donors. This fact, together with the result that higher-quality NGOs command market shares than low-quality ones, provides evidence of equilibrium with the characteristics of Proposition 5 from Section 2.2. More precisely, the positive correlation between the log market shares and β_q implies that we are in the third case of the Proposition. Furthermore, we expect leakage to be decreasing for high-quality NGOs. This issue is further addressed in the counterfactual study.

We can use Table 1.1 to shed light on our first two results [17]. First, as the advertising coefficient β_ϕ is positive and significant, fundraising, through advertising, plays a significant and considerable role as a driver of donors' donation decisions. Indeed, the model estimated implies large advertising elasticities of 4 percent on average. Second, quality, as measured by the Charity Navigator Score proxy, correlates positively with market shares. Donors display a taste for quality, which mitigates the potential adverse effect of competition as suggested by the Theory Section (Proposition 5).

1.5.2 Counterfactual

The Tax Reform Act of 1986 (TRA86) was a significant legislation that changed the US federal income tax system. Among other things, it lowered tax rates and broadened the tax base by eliminating several tax loopholes. The impact of these changes was felt at the federal level and in state income tax systems across the country. Indeed, the effects of TRA86 on state tax systems were varied and complex, depending on each state's specific tax structure and policies. Regarding the deductibility rate to charitable giving, the reform implied the highest decrease in the effective deductibility rate in the recent decades, making the tax cost of giving substantially higher across states, as seen in Figure 1.4. As a considerably significant source of variation in the tax code, TRA86 has been used widely by the empirical public finance literature, most notably for this study is Duquette (2016).

[17] Labeled as (i), (ii) in the introduction.

FIGURE 1.4: Tax Reform Act of 1986

Implementation. I simulate a reversal of TRA86 that takes deductibility rates back to their pre-1986 levels. This policy change serves as a test of the potential effect of the policy effects of a de facto increase in the incentives to give. For this, I use the estimation results to implement a counterfactual of interest. Since TRA86 constitutes the most prominent policy change in immediate history, I simulate its effects on the economy for 2014. Table 1.2 summarizes the results obtained from this exercise.

In order to implement the counterfactual, I need to assume a value for the giving elasticity, which I cannot identify from my data due to the lack of variation in my sample. To tackle this issue, I proceed by assuming two different giving elasticities that are found in the literature. The first estimate is obtained by Duquette (2016), which finds an elasticity of roughly 4 using the NCCS data for the years 1986 and 1987. The second estimate is obtained from the literature that relies on household surveys (Peloza and Steel, 2005), which reports an estimate of approximately one percent.

To compute the equilibrium effects of a change in the tax liability, I proceed in two steps: first, I estimate the equilibrium value of the vector of marginal cost to reach c_j, and second, I solve for the new equilibrium using the system of first-order conditions characterized by the non-linear system in (1.63). Implementation details are included in Appendix 1.8.3.

Table 1.2 summarizes the results from the counterfactual exercise. Note that leakage is estimated at just below 40 percent pre-reform, with a substantial variation along the quality dimension as measured by the Charity Navigator Star system, which is higher for low-quality NGOs, as expected. Moreover, leakage elasticity is positive and also varies widely across quality. The leakage elasticity is substantially higher when a larger elasticity to the deductibility rate is imposed, as documented by Columns 2 and 3 of Table 1.2.

In Figure 1.3 we observe how the hypothetical tax reform increases donor surplus. The effect is indeed more than proportional when the large income elasticity of 4 percent is imposed. This effect could induce us to consider changes that lower the cost of giving as beneficial, but a caveat applies. These effects are mainly driven by estimated responses to advertising that enter the utility function. If advertising is potentially wasteful, such considerable positive surplus change need not apply. Robustness shows that the significant differences documented in Table 1.2 are broadly mitigated by excluding advertising from mean utilities.

The counterfactual exercise underscores the importance of quality heterogeneity as a determinant of welfare assessment. Note that the most aggressive response in fundraising effort is driven by NGOs of three stars and lower, suggesting an inverse U-shape relationship between quality scores and aggressiveness of fundraising and advertising efforts. This relates directly to finding (ii) and is also reflected in the welfare measures above.

The counterfactual results evidence a large degree of response heterogeneity regarding fundraising and leakage elasticities at the Charity Navigator-rating level and the NTMAJ5 classification (see Figure 1.3). Fundraising elasticities display an inverse U-shaped relationship with respect to NGO quality as measured by Charity Navigator Stars. This result may be due to ratings being perceived in a binary fashion by donors as either positive or negative or to bunching in some categories

		Case 1 ($\beta_T \propto 1$)		Case 2 ($\beta_T \propto 4.1$)	
		Estimate	SE	Estimate	SE
	Leakage (l)				
	Full sample	0.39	0.23	-	-
	One star	0.558	0.251	-	-
	Two stars	0.406	0.231	-	-
	Three stars	0.390	0.226	-	-
	Four stars	0.385	0.220	-	-
	Leakage elas. (η^l_D)				
1	Full sample	0.008	0.0004	0.015	0.066
	One star	0.001	0.002	0.100	0.222
	Two stars	0.004	0.004	0.00155	0.00244
	Three stars	0.012	0.005	0.0148	0.0520
	Four stars	0.007	0.014	0.00620	0.0147
	Donor Surplus (ΔCS)				
	Full sample	186.6	0.16925	691.77	6.7
	One star	103.5	0.1235	641.3	1.39
	Two stars	150.35	0.3265	691.3	1.42
	Three stars	124.2756	0.18351	697.89	1.38
	Four stars	191.45	0.1565	183.74	1.28

TABLE 1.2: Counterfactual results. Simulating an equivalent tax liability change in 1986 for the year 2014.

(Mayo, 2021). In light of the model from Section 1.3.4, we can regard this result as capturing NGOs motivated by narrow philanthropic output competing with a somewhat broader mandate.

1.6 Welfare analysis and optimal deductibility

This Section leverages the previous estimation to perform welfare assessments that consider the endogenous competition between NGOs when obtaining normative estimates for the welfare-maximizing deductibility rate from our model section, accounting for the fact that competition between NGOs induces endogenous leakage into advertising due to competitive effects. I bring the estimated leakage elasticity coefficients to the welfare analysis of Proposition 1 and 2 from Section 1.5. The government solves policy parameters to maximize welfare, considering endogenous leakage ($\tau^{d(COMP)}$) and comparing it to the baseline estimates from Saez ($\tau^{d(SAEZ)}$). I plot these two deductibility rates as a function of the price response to giving, r, which I normalize between 0 and 1 [18] .

It is clear that the Saez estimates, which do not consider competitive forces nor endogenous leakage, prescribe a higher τ^d in absolute value. Failing to account for competitive advertising leads to larger deductibility per dollar donated, with an average difference of 0.1 with respect to the estimates that consider competition.

The characterization of optimal policy parameters is done according to Propositions 1 and 2 of Section 1.2. Since in the data I observe public goods of different classes, the social marginal value of each public good is taken to be nest-specific and given by:

$$e_m = \int \beta^i \frac{\partial v^i / \partial G_m}{\partial v^i / \partial R} di,$$

which implies that the numerical equivalents of Propositions 1 and 2 are obtained by replacing e with its counterpart $\sum_m e_m$. Additionally, welfare characterizations require making two technical assumptions (further detailed in the Appendix). First, I assume separation between discrete choices and marginal utilities from public good provision to disentangle donations decisions from overall public good provision satisfaction. Second, preferences for public good provision are assumed to replicate preferences from discrete choices. This assumption is the equivalent of requiring warm-glow giving to reflect overall public good provision preferences in the aggregate. I also require welfare to not account for advertising persuasiveness, meaning that I evaluate mean utilities at $\phi_j = 0$.

I follow the calibrations by Saez (2004) as closely as possible to obtain comparable estimates. I specify government per capita consumption E to be equal to 6000 dollars, which is the tax revenue raised by both federal- and state-level taxes. Aggregate supply functions are specified, and individual-level utility functions are specified up to the discrete choice term from the previous section. I make a few technical assumptions over functional forms to match as closely as possible the estimates included in the literature. Notably, marginal welfare weights are taken to be dependent

[18] The choice of plotting deductibility rates ad a function of the price response r is simply didactical, but through my sample the crowding-out parameter is estimated at around 0.2, consistent to estimates obtained by Andreoni and Payne (2003).

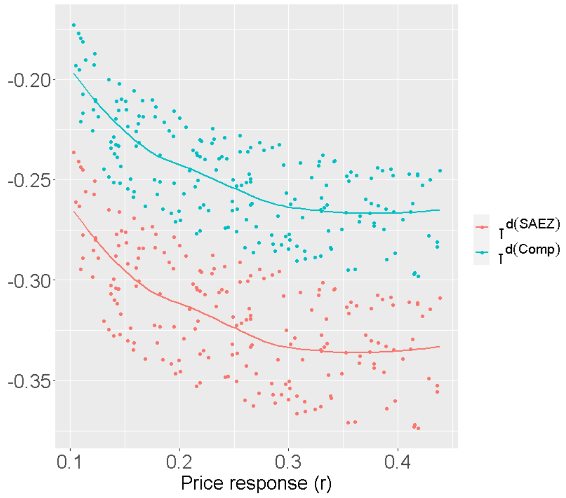


FIGURE 1.5: Estimates of the optimal deductibility rate for Proposition 1 including and excluding competition. In red, the baseline estimates ignore competitive forces ($\tau^{d(SAEZ)}$). In blue, estimates incorporating the estimated leakage coefficient and its elasticity ($\tau^{d(Comp)}$). Each dot corresponds to an estimate under different assumptions over the aggregate elasticities ϵ_Z and ϵ_R.

on disposable income only:

$$\beta^h = 1/\lambda\left(z^h(1-\tau)+R\right)^v$$

for λ a multiplier of the government's budget constraint and where v measures redistributive tastes for the government. We can parameterize $v = 0$ to be the case in which the government has no tastes for redistribution. I let $v = 1$ for my simulations. I assume earning elasticity ϵ_Z to be constant at the aggregate level, which is consistent with my empirical model of donation supply.

The full description of the derivations and functional forms used in the simulations is given in Appendix 1.8.6. Figure 1.5 above offers a representation of the solution for the deductibility rate and income tax as described in Propositions 1 and 2. For it, I fix the leakage parameter to be $\rho = 0.39$, and vary the aggregate elasticity $\bar{\eta}$ to match the two different values obtained in the counterfactual analysis. Notice that when the leakage elasticity is positive, meaning that leakage increases with donations, the estimates for τ^d in Proposition 2 imply a higher deductibility rate than that found by

Saez in a model with no competitive effects; the variation is a substantial range of parameter values. On the other hand, when the leakage elasticity is positive, the deductibility rate is higher in absolute terms than that proposed by the baseline model with no competitive effects. Competitive forces push the Saez estimates downward in absolute terms.

1.7 Results and discussion

Many governments worldwide offer tax benefits to encourage charitable donations. However, the current methods for determining the ideal level of these benefits overlook a significant factor. Higher tax benefits do increase charitable giving but also contribute to wasteful competition for funding among charities .

This paper presents a model in which NGOs compete for donations endogenously to tax policy. It uses data from the U.S. to estimate the model's parameters structurally and then exploits these estimates to perform positive and normative analyses. It provides evidence for a low substitution between categories of charitable giving and a high sensitivity of giving to fundraising expenditures. A counterfactual study further shows evidence of considerable sensitivity of fundraising to changes in deductibility rates. Welfare analyses suggest that such estimates indicate previous normative estimates found in the literature to be overestimating the positive social impact of charitable giving and, therefore, implying deductibility rates that are too high compared the baseline scenario with competition. Finally, the counterfactual exercise presented allows us to compute a measure of donor surplus of giving.

The research shows that leakage, the proportion of charities' budget not spent on direct public good provision, reached up to 40 percent in the 2014 sample. In addition, the findings suggest that fundraising plays a significant role in the endogenous leakage of gross donations into advertising. Therefore, any estimates that do not account for the effects of competition on charities must be adjusted downwards to accurately reflect the impact of NGO competition on optimal tax code design.

Several policy implications stem from the results contained in this paper. First, if policymakers aim to maximize donor's welfare, they need to consider the strategic nature of suppliers of public goods when deciding on optimal subsidies for charitable giving. Second, not all charitable output is equal or behaves equally when responding to tax policy. This last point is of immediate policy relevance: charitable subsidies are not contingent on the output quality, which generates inappropriate incentives for donors and suppliers. This research provides a rationale for quality-contingent subsidies to giving, as proposed in recent work by Halberstam and Hines Jr (2023).

Another direction to be addressed by future research is information asymmetries regarding charitable quality and how relaxing the full informativeness of advertising assumed in my model affects equilibrium predictions. An extension in the lines of the research by Scharf (2014) could further explore the interaction between quality heterogeneity and charities' responses to the tax code.

At last, I address a few issues for the robustness of my main results. First, entry and exit of NGOs is not an essential determinant of strategic responses. Entry of new NGOs is statistically unusual for the subset of NGOs that advertise more actively (Appendix 1.8.4). Additionally, Appendix 1.8.2 explores entry for the theoretical case and shows how entry is expected to be low in environments where donors have positive but moderately low concerns for quality.

Future research should aim to address the questions posed by these last points. First, there is the regulatory question. Since the charitable market is substantially more complex than our public provision models presume, should optimal policy look for other instruments to provide a better regulatory framework? Could quality contingent regulations improve welfare? The second set of questions that are opened are naturally those of entry. Could policy be tailored to induce more entry of high-quality suppliers in environments where the average supplier quality is low? These avenues offer a rich agenda for future investigation in the public economics of public provision.

1.8 Appendix

1.8.1 Appendix: proofs of taxation problem

The planner solves the problem of $\max_{\tau,\tau^d,R,G_0} W$ subject to equation (1.2). Denote by λ the multiplier of the government's budget constraint, then first-order conditions to this problem are given by:

$$-\int \mu^i \left[v^i_{1-\tau} + v^i_G \bar{G}_{1-\tau}\right] dv(i) + \lambda \left[\bar{Z} - \tau\bar{Z}_{1-\tau} - \tau^d \bar{G}_{1-\tau}\right] = 0, \tag{1.30}$$

$$\int \mu^i \left[v^i_{1+\tau^d} + v^i_G \bar{G}_{1+\tau^d}\right] dv(i) + \lambda \left[\bar{D} + \tau\bar{Z}_{1+\tau^d} + \tau^d \bar{G}_{1+\tau^d}\right] = 0, \tag{1.31}$$

$$\int \mu^i \left[v^i_R + v^i_G \bar{G}_R\right] dv(i) + \lambda \left[-1 + \tau\bar{Z}_R + \tau^d \bar{G}_R\right] = 0. \tag{1.32}$$

The derivatives of the average public good with respect to taxes and the lump-sum, namely $\bar{G}_{1-\tau}$, $\bar{G}_{1-\tau^d}$, and $\bar{G}_R$, are given by the following three equations:

$$\bar{G}_{1-\tau} = \rho(D)D_{1-\tau}(1+\eta^\rho_D) = D_{1-\tau}(1 - l(D)(1+\eta^l_D)), \tag{1.33}$$

$$\bar{G}_{1+\tau^d} = \rho(D)D_{1+\tau^d}(1+\eta^\rho_D) = D_{1+\tau^d}(1 - l(D)(1+\eta^l_D)), \tag{1.34}$$

$$\bar{G}_R = \rho(D)D_R(1+\eta^\rho_D) = D_R(1 - l(D)(1+\eta^l_D)). \tag{1.35}$$

Moreover, if the government can contribute to the public good the first-order condition with respect to G_0 writes:

$$\int \mu^i \left[v^i_G + v^i_G \bar{G}_{G_0}\right] dv(i) + \lambda[-1 + \tau\bar{Z}_{G_0} + \tau^d \partial\bar{G}/\partial G_0] = 0.$$

Where, in an analogous fashion as above, we have that:

$$\bar{G}_{G_0} = \rho(D)D_{G_0}(1+\eta^\rho_D) = D_{G_0}(1 - l(D)(1+\eta^l_D))$$

We can therefore re-express the previous system of equations as:

$$\left[1-\frac{\int \beta^i z^i di}{\bar{Z}}\right]\bar{Z} = \tau\bar{Z}_{1-\tau} + (\tau^d + e\cdot\rho(1+\eta_D^\rho))\bar{D}_{1-\tau}, \tag{1.36}$$

$$\left[1-\frac{\int \beta^i d^i di}{\bar{D}}\right]\bar{D} = -\tau\bar{Z}_{1+\tau^d} - (\tau^d + e\cdot\rho(1+\eta_D^\rho))\bar{D}_{1+\tau^d}, \tag{1.37}$$

$$1-\int \beta^i di = \tau\bar{Z}_R + (\tau^d + e\cdot\rho(1+\eta_D^\rho))\bar{D}_R. \tag{1.38}$$

and, finally, we have that if the government can contribute to the public good:

$$e = 1-\tau\bar{Z}_{G_0} - (\tau^d + e\cdot\rho(1+\eta_D^\rho))\partial\bar{G}/\partial G_0 \tag{1.39}$$

Three assumptions are made in order to simplify the system determined by the four equations above (see Saez (2004) for further discussion).

Assumption T1. There are no income effects on earning, i.e: $z_R^i = 0$ for all i.

Assumption T2. Independence between aggregate earnings and contributions , i.e: $\bar{Z}_{G_0} = 0$ and $\bar{Z}_{1+\tau^d} = 0$.

Assumption T3. Compensated supply of contributions does not depend on earnings. $\partial d^i/\partial(1-\tau) = 0$. This implies that:

$$\bar{D}_{1-\tau} = \bar{Z}\hat{D}_R \tag{1.40}$$

where $\hat{D}_R$ corresponds to the average response to a uniform one dollar increase in the lumpsum R, weighted by earnings. We can use Assumptions 1-3 to simplify our system in the following way:

$$\tau^d = -e \cdot (1 - l(D)) + \frac{1}{r}\left[1 - \frac{\int \beta^i d^i di}{\overline{D}} - \eta(D)\right]$$
$$\frac{\tau}{1-\tau} = \frac{1}{\epsilon_Z}\left[1 - \frac{\int \beta^i z^i di}{\overline{Z}} - (\tau^d + e \cdot (1 - l(D)))\hat{D}_R - \epsilon_Z^D\right]$$
$$\int \beta^i di = 1 - (\tau^d + e \cdot (1 - l(D)))\bar{D}_R - \eta(D) \cdot \bar{D}.$$

If the government can choose G_0 optimally:

$$e = 1 - (\tau^d + e(1 - l(D)))\partial\bar{G}/\partial G_0 - \eta(D) \cdot \bar{D} = \frac{1 - \tau^d \bar{D}_{G_0} - \eta(D) \cdot \bar{D}}{1 + (1 - l(D))\bar{D}_{G_0}} \tag{1.41}$$

$$\tau^d = -(1 - \eta(D))(1 - l(D)) + \frac{1}{r}(1 + (1 - l(D)) \cdot \partial\bar{G}/\partial G_0)\left[(1 - \frac{\int \beta^i d^i di}{\overline{G}} - \eta(D)\right]$$

When the government is constrained to set $\tau^d = -\tau$, the first-order condition with respect to income becomes:

$$\left[1 - \frac{\int \beta^i z^i di}{\overline{Z}}\right]\bar{Z} - \left[1 - \frac{\int \beta^i d^i di}{\overline{D}}\right]\bar{D} = \tau\bar{Z}_{1-\tau} + (-\tau + e \cdot \rho(1 + \eta_D^\rho))\bar{D}_{1-\tau}$$
$$+ \tau\bar{Z}_{1+\tau^d} + (-\tau + e \cdot \rho(1 + \eta_D^\rho))\bar{D}_{1+\tau}.$$

The formula for the optimal income tax follows from this.

1.8.2 Appendix: proofs of section 2.2

Preliminaries

Consider 3 charities with positions p_1,p_2,p_3 and qualities α_1,α_2,α_3. The power set that describes all possible information sets is given by $\{\emptyset, \{1\}, \{2\}, \{3\}, \{1,2\}, \{1,3\}, \{2,3\}, \{1,2,3\}\}$.

Among the donors with information set $\{j, r\}$ the indifferent donor is defined by:

$$\Delta(h, p_j) + b\,\alpha_j = \Delta(h, p_r) + b\,\alpha_r$$

For $j, r = 1, 2, 3$ and $j < r$ and $p_j < p_r$ and information sets composed of at most two NGOs the indifferent donor is given by:

$$h_j^r = \frac{p_j + p_r}{2} + \frac{b}{2}(\alpha_j - \alpha_r)$$
$$h_r^j = h_j^r - b(\alpha_j - \alpha_r) + \frac{1}{2} = \frac{1}{2} + \frac{p_j + p_r}{2} + \frac{b}{2}(\alpha_r - \alpha_j)$$

as illustrated in figure 1.1, where h_j^r denotes the mid point in the arc between NGO j and NGO r starting at position p_j and moving anti-clockwise, (resp. h_r^j for the complementary case, starting at point p_r). The associated mass of donors who give to NGO j for each one of these arc segments is given by:

$$\int_{p_j}^{h_j^r} i\,di = \frac{p_r - p_j}{2} + \frac{b}{2}(\alpha_j - \alpha_r)$$

$$\int_{h_r^j}^{p_j+1} i\,di = \frac{p_j - p_r}{2} + \frac{b}{2}(\alpha_j - \alpha_r) + \frac{1}{2}$$

Among those donors with informations sets given by $\{j, r\}$ NGO j thus raises:

$$X_j^r = min\left\{1, max\left\{\frac{1}{2} + b(\alpha_j - \alpha_r), 0\right\}\right\},$$

while NGO r raises the amount $1 - X_j^r$. Consider now the information set described by $\mathcal{J} = \{1, 2, 3\}$. Here I assume that competition is stronger among the two immediate neighbors, the donor who is indifferent between NGOs j and r is located on the shortest arc segment between these two NGOs. Hence I study the shares given by:

$$\int_{p_j}^{h_j^{j+1}} i\,di = \frac{p_{j+1} - p_j}{2} + \frac{b}{2}(\alpha_j - \alpha_{j+1})$$

$$\int_{h_{j-1}^j}^{p_{j+1}} i\,di = \frac{p_j - p_{j-1}}{2} + \frac{b}{2}(\alpha_j - \alpha_{j-1}) + \frac{1}{2}$$

And hence:

$$X_j^{j+1\ j-1} = \frac{1}{2} + \frac{b}{2}(2\alpha_j - \alpha_{j+1} - a_{j-1}) + \frac{p_{j+1} - p_{j-1}}{2}$$

In sum:

$$X_1^{23} = \frac{1}{2} + \frac{b}{2}(2\alpha_1 - \alpha_2 - a_3) - \frac{p_3 - p_2}{2}$$
$$X_3^{12} = \frac{1}{2} + \frac{b}{2}(2\alpha_3 - \alpha_2 - a_1) - \frac{p_2 - p_1}{2}$$
$$X_2^{13} = 1 - X_1^{23} - X_3^{12}$$
$$X_1^1 = X_2^2 = X_3^3 = 1$$

We can write the objective of NGO 1 as:

$$V_1 = \Pi_1 + \alpha_1(\Pi_1 + \omega(\Pi_2 + \Pi_3)) = \Pi_1(1 + \alpha_1) + \alpha_1\omega(\Pi_2 + \Pi_3),$$

FOCs write:

$$\frac{\partial V_1}{\partial \phi_1} = \frac{\partial \Pi_1}{\partial \phi_1}(1 + \alpha_1) + \alpha_1\omega\left(\frac{\partial \Pi_2}{\partial \phi_1} + \frac{\partial \Pi_3}{\partial \phi_1}\right) = 0$$

Where:

$$\Pi_1 = D\left(\tau, \tau^d\right)\ \phi_1\left[(1-\phi_2)(1-\phi_3)X_1^1 + (1-\phi_3)\phi_2 X_1^2 + (1-\phi_2)\phi_3 X_1^3 + \phi_3\phi_2 X_1^{23}\right]$$

$$\frac{\partial \Pi_1}{\partial \phi_1} = D\left(\tau, \tau^d\right)\ \left[(1-\phi_2)(1-\phi_3)X_1^1 + (1-\phi_3)\phi_2 X_1^2 + (1-\phi_2)\phi_3 X_1^3 + \phi_3\phi_2 X_1^{23}\right]$$

We can write revenues of NGOs 2 and 3 as:

$$\Pi_2 = D\left(\tau, \tau^d\right)\ \phi_2\left[(1-\phi_1)(1-\phi_3)X_2^2 + (1-\phi_3)\phi_1 X_2^1 + (1-\phi_1)\phi_3 X_2^3 + \phi_3\phi_1 X_2^{13}\right]$$

$$\Pi_3 = D\left(\tau, \tau^d\right)\ \phi_3\left[(1-\phi_2)(1-\phi_1)X_3^3 + (1-\phi_1)\phi_2 X_3^2 + (1-\phi_2)\phi_1 X_3^1 + \phi_1\phi_2 X_3^{21}\right]$$

And hence:

$$\begin{aligned}\frac{\partial \Pi_2}{\partial \phi_1} &= D\left(\tau, \tau^d\right)\ \phi_2\left[-(1-\phi_3)X_2^2 + (1-\phi_3)X_2^1 - \phi_3 X_2^3 + \phi_3 X_2^{13}\right] \\ &= -D\left(\tau, \tau^d\right)\ \phi_2\left[X_2^2 - X_2^1 + \phi_3\left[X_2^3 + X_2^1 - X_2^{13} - X_2^2\right]\right]\end{aligned}$$

$$
\begin{aligned}
\frac{\partial \Pi_3}{\partial \phi_1} &= D\left(\tau, \tau^d\right) \phi_3 \left[-(1-\phi_2)X_3^3 - \phi_2 X_3^2 + (1-\phi_2)X_3^1 + \phi_2 X_3^{21}\right] \\
&= -D\left(\tau, \tau^d\right) \phi_3 \left[X_3^3 - X_3^1 + \phi_2 \left[X_3^2 + X_3^1 - X_3^{21} - X_3^3\right]\right]
\end{aligned}
$$

Repeating these operations for NGO 2 and 3 we obtain the system:

$$
\frac{c_1\phi_1}{D(\tau,\tau^d)} = (1-\phi_2)(1-\phi_3) + (1-\phi_3)\phi_2\left[\frac{X_1^2}{1+\omega\alpha_1}\right] + (1-\phi_2)\phi_3\left[\frac{X_1^3}{1+\omega\alpha_1}\right] + \phi_3\phi_2\left[\frac{X_1^{23}}{1+\omega\alpha_1}\right] \tag{1.42}
$$

$$
\frac{c_2\phi_2}{D(\tau,\tau^d)} = (1-\phi_1)(1-\phi_3) + (1-\phi_3)\phi_1\left[\frac{1-X_1^2}{1+\omega\alpha_2}\right] + (1-\phi_1)\phi_3\left[\frac{X_2^3}{1+\omega\alpha_2}\right] + \phi_3\phi_1\left[\frac{X_2^{13}}{1+\omega\alpha_2}\right] \tag{1.43}
$$

$$
\frac{c_3\phi_3}{D(\tau,\tau^d)} = (1-\phi_2)(1-\phi_1) + (1-\phi_1)\phi_2\left[\frac{1-X_2^3}{1+\omega\alpha_3}\right] + (1-\phi_2)\phi_1\left[\frac{1-X_1^3}{1+\omega\alpha_3}\right] + \phi_1\phi_2\left[\frac{1-X_2^{13}-X_1^{23}}{1+\omega\alpha_3}\right] \tag{1.44}
$$

Proof for Proposition 3

Let $\omega\alpha_j = 0$ for all j in the system (1.42)-(1.44). Then the proof becomes equivalent to the general proof for arbitrary N is provided in Appendix 1.8.2.

Proofs for Propositions 4 and 5

With aims of recurring to the Inverse Function Theorem, define the continuously differentiable function $\mathbf{F} : [0,1]^3 \to \mathbf{R}^3$ as $\mathbf{F} = (F_1(\boldsymbol{\phi}), F_2(\boldsymbol{\phi}), F_3(\boldsymbol{\phi}))$ by rewriting system (**??**) as:

$$
\begin{aligned}
F_j(\boldsymbol{\phi}) =& \frac{c_j\phi_j}{D\left(\tau,\tau^d\right)} - (1-\phi_{j+1})(1-\phi_{j-1}) - (1-\phi_{j+1})\phi_j\left[\frac{X_j^{j+1}}{1+\omega\alpha_j}\right] \\
& - (1-\phi_{j+1})\phi_{j-1}\left[\frac{X_j^{j-1}}{1+\omega\alpha_j}\right] - \phi_{j+1}\phi_{j+1}\left[\frac{X_j^{j-1j+1}}{1+\omega\alpha_j}\right] = 0
\end{aligned}
$$

For all $j = 1, 2, 3$, we have:

$$\frac{\partial F_j(\boldsymbol{\phi})}{\partial \phi_j} = \frac{c_j}{D\left(\tau, \tau^d\right)}$$

Also:

$$\begin{aligned}
\frac{\partial F_1(\boldsymbol{\phi})}{\partial \phi_2} &= (1-\phi_3) - (1-\phi_3)\left[\frac{X_1^2}{1+\omega\alpha_1}\right] + \phi_3\left[\frac{X_1^3}{1+\omega\alpha_1}\right] - \phi_3\left[\frac{X_1^{23}}{1+\omega\alpha_1}\right] = (1-\phi_3)\left[1-\frac{X_1^2}{1+\omega\alpha_1}\right] + \phi_3\left[\frac{-X_1^{23}+X_1^3}{1+\omega\alpha_1}\right] \\
&= \left[1-\frac{X_1^2}{1+\omega\alpha_1}\right] + \phi_3\left[\frac{-X_1^{23}+X_1^3+X_1^2}{1+\omega\alpha_1} - 1\right] \\
&= \left[1-\frac{X_1^2}{1+\omega\alpha_1}\right] - \phi_3\left[1-\frac{X_1^{23}-X_1^3-X_1^2}{1+\omega\alpha_1}\right]
\end{aligned}$$

$$\begin{aligned}
\frac{\partial F_1(\boldsymbol{\phi})}{\partial \phi_3} &= (1-\phi_2) + \phi_2\left[\frac{X_1^2}{1+\omega\alpha_1}\right] - (1-\phi_2)\left[\frac{X_1^3}{1+\omega\alpha_1}\right] - \phi_2\left[\frac{X_1^{23}}{1+\omega\alpha_1}\right] = (1-\phi_2)\left[1-\frac{X_1^3}{1+\omega\alpha_1}\right] + \phi_2\left[\frac{-X_1^{23}+X_1^2}{1+\omega\alpha_1}\right] \\
&= \left[1-\frac{X_1^3}{1+\omega\alpha_1}\right] - \phi_2\left[1-\frac{X_1^{23}-X_1^2-X_1^3}{1+\omega\alpha_1}\right]
\end{aligned}$$

We can then write:

$$\begin{aligned}
\frac{\partial F_1(\boldsymbol{\phi})}{\partial \phi_2} &= \left[1-\frac{X_1^2}{1+\omega\alpha_1}\right] - \phi_3\left[\frac{\left(X_1^{23}+\frac{1}{3}\right)}{1+\omega\alpha_1}+1\right] \\
\frac{\partial F_1(\boldsymbol{\phi})}{\partial \phi_3} &= \left[1-\frac{X_1^3}{1+\omega\alpha_1}\right] - \phi_2\left[\frac{\left(X_1^{23}+\frac{1}{3}\right)}{1+\omega\alpha_1}+1\right]
\end{aligned}$$

And due to symmetry we have that:

$$\begin{aligned}
\frac{\partial F_2(\boldsymbol{\phi})}{\partial \phi_1} &= \left[1-\frac{X_2^1}{1+\omega\alpha_2}\right] - \phi_3\left[\frac{\left(X_2^{13}+\frac{1}{3}\right)}{1+\omega\alpha_2}+1\right] \\
\frac{\partial F_2(\boldsymbol{\phi})}{\partial \phi_3} &= \left[1-\frac{X_2^3}{1+\omega\alpha_2}\right] - \phi_1\left[\frac{\left(X_2^{13}+\frac{1}{3}\right)}{1+\omega\alpha_2}+1\right]
\end{aligned}$$

And for the third NGO:

$$\begin{aligned}
\frac{\partial F_3(\boldsymbol{\phi})}{\partial \phi_1} &= \left[1-\frac{X_3^1}{1+\omega\alpha_3}\right] - \phi_2\left[\frac{\left(X_3^{12}+\frac{1}{3}\right)}{1+\omega\alpha_3}+1\right] \\
\frac{\partial F_3(\boldsymbol{\phi})}{\partial \phi_2} &= \left[1-\frac{X_3^2}{1+\omega\alpha_3}\right] - \phi_1\left[\frac{\left(X_3^{12}+\frac{1}{3}\right)}{1+\omega\alpha_3}+1\right]
\end{aligned}$$

Consider the Jacobian Matrix:

$$\mathcal{J} = \begin{bmatrix} \frac{\partial F_1}{\partial \phi_1} & \frac{\partial F_1}{\partial \phi_2} & \frac{\partial F_1}{\partial \phi_3} \\ \frac{\partial F_2}{\partial \phi_1} & \frac{\partial F_2}{\partial \phi_2} & \frac{\partial F_2}{\partial \phi_3} \\ \frac{\partial F_3}{\partial \phi_1} & \frac{\partial F_3}{\partial \phi_2} & \frac{\partial F_3}{\partial \phi_3} \end{bmatrix}.$$

The determinant of the above matrix is given by:

$$\begin{aligned} \det \mathcal{J} &= \frac{\partial F_1}{\partial \phi_1}\left[\frac{\partial F_2}{\partial \phi_2}\frac{\partial F_3}{\partial \phi_3} - \frac{\partial F_2}{\partial \phi_3}\frac{\partial F_3}{\partial \phi_2}\right] - \frac{\partial F_1}{\partial \phi_2}\left[\frac{\partial F_2}{\partial \phi_1}\frac{\partial F_3}{\partial \phi_3} - \frac{\partial F_2}{\partial \phi_3}\frac{\partial F_3}{\partial \phi_1}\right] + \frac{\partial F_1}{\partial \phi_3}\left[\frac{\partial F_2}{\partial \phi_1}\frac{\partial F_3}{\partial \phi_2} - \frac{\partial F_2}{\partial \phi_2}\frac{\partial F_3}{\partial \phi_1}\right] \\ &= \frac{c_1}{D}\frac{c_2}{D}\frac{c_3}{D} + \frac{\partial F_1}{\partial \phi_2}\frac{\partial F_2}{\partial \phi_3}\frac{\partial F_3}{\partial \phi_1} + \frac{\partial F_1}{\partial \phi_3}\frac{\partial F_2}{\partial \phi_1}\frac{\partial F_3}{\partial \phi_2} - \frac{c_1}{D}\frac{\partial F_2}{\partial \phi_3}\frac{\partial F_3}{\partial \phi_2} - \frac{\partial F_1}{\partial \phi_2}\frac{\partial F_2}{\partial \phi_1}\frac{c_3}{D} - \frac{\partial F_1}{\partial \phi_3}\frac{\partial F_3}{\partial \phi_1}\frac{c_2}{D}. \end{aligned}$$

It is verified numerically that $\det \mathcal{J}(\phi) \neq 0$ for any $\phi \in [0,1]^3$. Which implies that the solutions obtaineed below numerically are unique.

For the comparative statics results we can recur to the Implicit Function Theorem. For this consider the partial derivatives of the system with respect to a generic variable v. We have that:

$$M \begin{bmatrix} \frac{\partial\ \phi_1^*}{\partial\ v} \\ \frac{\partial\ \phi_2^*}{\partial\ v} \\ \frac{\partial\ \phi_3^*}{\partial\ v} \end{bmatrix} = \mathbf{w}(v)$$

where $M = [M_1, M_2, M_3]^T$ is an invariable 3x3 matrix of marginal effects given by:

$$M = \begin{bmatrix} \frac{c_1}{D(\tau,\tau^d)} & (1-\phi_3)\left[1 - \frac{X_1^2}{1+\omega\alpha_1}\right] + \phi_3\left[\frac{X_1^3 - X_1^{23}}{1+\omega\alpha_1}\right] & (1-\phi_2)\left[1 - \frac{X_1^3}{1+\omega\alpha_1}\right] + \phi_2\left[\frac{X_1^2 - X_1^{23}}{1+\omega\alpha_1}\right] \\ (1-\phi_3)\left[1 - \frac{X_2^1}{1+\omega\alpha_2}\right] + \phi_3\left[\frac{X_2^3 - X_2^{13}}{1+\omega\alpha_2}\right] & \frac{c_2}{D(\tau,\tau^d)} & (1-\phi_1)\left[1 - \frac{X_2^3}{1+\omega\alpha_2}\right] + \phi_1\left[\frac{X_2^1 - X_2^{13}}{1+\omega\alpha_2}\right] \\ (1-\phi_3)\left[1 - \frac{X_3^1}{1+\omega\alpha_3}\right] + \phi_3\left[\frac{X_3^2 - X_3^{12}}{1+\omega\alpha_3}\right] & (1-\phi_1)\left[1 - \frac{X_3^2}{1+\omega\alpha_3}\right] + \phi_1\left[\frac{X_3^1 - X_3^{12}}{1+\omega\alpha_3}\right] & \frac{c_3}{D(\tau,\tau^d)}, \end{bmatrix}$$

and $w(v) = [w_1(v), w_2(v), w_3(v)]^T$ is a vector of marginal effects specific to each variable. We can hence use Cramer's Rule to study partial derivatives. We can then solve for our $\partial\phi_j/\partial v$ for $j = 1, 2, 3$ using Cramer's Rule:

$$\frac{\partial\, \phi_j^*}{\partial\, v} = \frac{\det M_j}{\det M}, \tag{1.45}$$

where:

$$M_1 = \begin{bmatrix} w_1 & (1-\phi_3)\left[1-\frac{X_1^2}{1+\omega\alpha_1}\right]+\phi_3\left[\frac{X_1^3-X_1^{23}}{1+\omega\alpha_1}\right] & (1-\phi_2)\left[1-\frac{X_1^3}{1+\omega\alpha_1}\right]+\phi_2\left[\frac{X_1^2-X_1^{23}}{1+\omega\alpha_1}\right] \\ w_2 & \frac{c_2}{D\left(\tau,\tau^d\right)} & (1-\phi_1)\left[1-\frac{X_2^3}{1+\omega\alpha_2}\right]+\phi_1\left[\frac{X_2^1-X_2^{13}}{1+\omega\alpha_2}\right] \\ w_3 & (1-\phi_1)\left[1-\frac{X_3^2}{1+\omega\alpha_3}\right]+\phi_1\left[\frac{X_3^1-X_3^{12}}{1+\omega\alpha_3}\right] & \frac{c_3}{D\left(\tau,\tau^d\right)} \end{bmatrix}$$

$$M_2 = \begin{bmatrix} \frac{c_1}{D\left(\tau,\tau^d\right)} & w_1 & (1-\phi_2)\left[1-\frac{X_1^3}{1+\omega\alpha_1}\right]+\phi_2\left[\frac{X_1^2-X_1^{23}}{1+\omega\alpha_1}\right] \\ (1-\phi_3)\left[1-\frac{X_2^1}{1+\omega\alpha_2}\right]+\phi_3\left[\frac{X_2^3-X_2^{13}}{1+\omega\alpha_2}\right] & w_2 & (1-\phi_1)\left[1-\frac{X_2^3}{1+\omega\alpha_2}\right]+\phi_1\left[\frac{X_2^1-X_2^{13}}{1+\omega\alpha_2}\right] \\ (1-\phi_3)\left[1-\frac{X_3^1}{1+\omega\alpha_3}\right]+\phi_3\left[\frac{X_3^2-X_3^{12}}{1+\omega\alpha_3}\right] & w_3 & \frac{c_3}{D\left(\tau,\tau^d\right)} \end{bmatrix}$$

$$M_3 = \begin{bmatrix} \frac{c_1}{D\left(\tau,\tau^d\right)} & (1-\phi_3)\left[1-\frac{X_1^2}{1+\omega\alpha_1}\right]+\phi_3\left[\frac{X_1^3-X_1^{23}}{1+\omega\alpha_1}\right] & w_1 \\ (1-\phi_3)\left[1-\frac{X_2^1}{1+\omega\alpha_2}\right]+\phi_3\left[\frac{X_2^3-X_2^{13}}{1+\omega\alpha_2}\right] & \frac{c_2}{D\left(\tau,\tau^d\right)} & w_2 \\ (1-\phi_3)\left[1-\frac{X_3^1}{1+\omega\alpha_3}\right]+\phi_3\left[\frac{X_3^2-X_3^{12}}{1+\omega\alpha_3}\right] & (1-\phi_1)\left[1-\frac{X_3^2}{1+\omega\alpha_3}\right]+\phi_1\left[\frac{X_3^1-X_3^{12}}{1+\omega\alpha_3}\right] & w_3 \end{bmatrix}$$

Comparative statics are then obtained by differentiating F with respect to each variable of interest, obtaining w and computing (1.45). Indeed we have:

$$w(b) = \begin{bmatrix} \phi_2\left[\frac{(\alpha_1-\alpha_2)}{1+\omega\alpha_1}\right]-\phi_3\left[\frac{(\alpha_1-\alpha_3)}{1+\omega\alpha_1}\right]+\phi_3\phi_2\left[\frac{(2\alpha_1-\alpha_2-\alpha_3)/2}{1+\omega\alpha_1}\right] \\ \phi_1\left[\frac{(\alpha_2-\alpha_1)}{1+\omega\alpha_2}\right]-\phi_3\left[\frac{(\alpha_2-\alpha_3)}{1+\omega\alpha_2}\right]+\phi_3\phi_1\left[\frac{(2\alpha_2-\alpha_1-\alpha_3)/2}{1+\omega\alpha_2}\right] \\ \phi_1\left[\frac{(\alpha_3-\alpha_1)}{1+\omega\alpha_3}\right]-\phi_2\left[\frac{(\alpha_3-\alpha_2)}{1+\omega\alpha_2}\right]+\phi_2\phi_1\left[\frac{(2\alpha_3-\alpha_1-\alpha_2)/2}{1+\omega\alpha_2}\right] \end{bmatrix}, \quad w(D(\tau^d,\tau)) = \begin{bmatrix} \frac{c_1\phi_1}{D\left(\tau,\tau^d\right)^2} \\ \frac{c_2\phi_2}{D\left(\tau,\tau^d\right)^2} \\ \frac{c_3\phi_3}{D\left(\tau,\tau^d\right)^2} \end{bmatrix} \tag{1.46}$$

Comparative statics are them obtained by noting that $\det M > 0$, which means that the numerator of expression (1.45) determines the sign in question and substituting (1.46) accordingly.

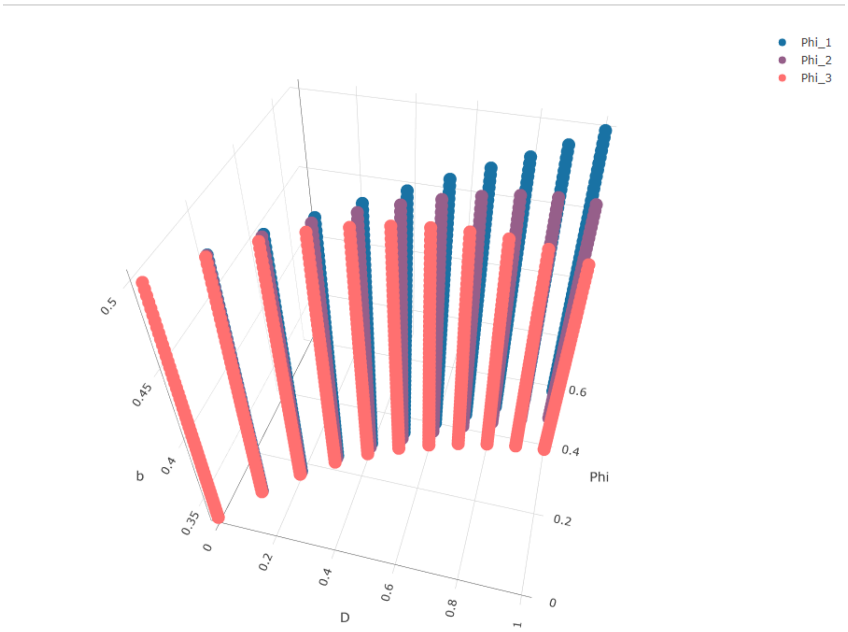


FIGURE 1.6: Equilibrium reach for $N = 3$, $\alpha = 0.5$, $\omega = 1$

Proofs for a large N

Under symmetry and $b = 0$, the objective function of an NGO that advertises at intensity ϕ while the remaining NGOs advertise $\bar{\phi}$ is:

$$\Pi_j(\phi;\bar{\phi}) = \phi \cdot D \cdot \left(1 + (1-\bar{\phi}) + (1-\bar{\phi})^2 + \cdots + (1-\bar{\phi})^{N-1}\right) - K(\phi) \tag{1.47}$$

$$= \phi \cdot \frac{D}{N} \cdot \frac{1-(1-\bar{\phi})^N}{\bar{\phi}} - K(\phi). \tag{1.48}$$

Welfare at a symmetric level of reach is then given by:

$$W(\phi) = N \cdot \Pi_j(\phi;\bar{\phi}) = D\left[1-(1-\bar{\phi})^N\right] - N \cdot K(\phi). \tag{1.49}$$

The first-order conditions that pin-down ϕ^* and ϕ^{sym} are, respectively:

$$D(1-\phi^*)^{N-1} - K'(\phi^*) = 0, \tag{1.50}$$

$$\frac{D}{N} \cdot \frac{1-(1-\phi^{sym})^N}{\phi^{sym}} - K'(\phi^{sym}) = 0. \tag{1.51}$$

By assumption $K'(\phi) > 0$ and $K''(\phi) > 0$, while the functions $D(1-\phi)^{N-1}$ and $\frac{D}{N} \cdot \frac{1-(1-\phi)^N}{\phi}$ are both strictly decreasing and convex in $\phi \in [0,1]$, they hence cross $K'(\phi)$ at most once. Moreover, since for any $\phi \in (0,1]$ and $N > 1$ $(1-\phi)^{N-1}(N+1-\phi) > 1$, the follow inequality holds true:

$$D(1-\phi)^{N-1} > \frac{D}{N} \cdot \frac{1-(1-\phi)^N}{\phi}. \tag{1.52}$$

Together, the first-order conditions, equation (1.52), and the fact that the cost function $K(\phi)$ in increasing an covex imply that $\phi^{sym} > \phi^*$. At last, second-order conditions are met since both objectives are globally concave for all $\phi \in [0,1]$:

$$\frac{\partial^2 \Pi_j}{\partial \phi^2} = -K''(\phi) < 0, \text{for all } j, \text{ and } \frac{\partial^2 W}{\partial \phi^2} = -N(N-1)(1-\phi)^{N-2} - NK''(\phi) < 0. \tag{1.53}$$

To compare these solutions for a large N, let $K(\phi) = 0.5\phi^2$ and study the solutions for the functions:

$$f(x) \triangleq x - D(1-x)^{N-1} = 0,$$

$$g(x) \triangleq x^2 - \frac{D}{N}\left[1-(1-x)^N\right] = 0.$$

Define x_f and x_g as solutions to the above equations. This means that:

$$f(x_f) = 0, \text{ and } f(x_g) = 0.$$

To analyse x_f consider the change of variable $M = N - 1$ and $x_f = \frac{z_f}{M}$. We then study $\frac{z_f}{M} = a\left(1 - \frac{z_f}{M}\right)^M$. As M gets large then the exponential approximation implies:

$$\left(1 - \frac{z_f}{M}\right)^M \approx \exp(-z_f)$$

For a large M then $z_f \approx MD\exp(-z_f) \Leftrightarrow z_f \exp(z_f) \approx MD$. We can then express z_f approximately using the Lambert W function as $z_f \approx W(MD) \approx \log MD -$

$\log\log MD + o(1)$ which gives

$$x_f \approx \frac{W(MD)}{M} \approx \frac{\log MD - \log\log MD + o(1)}{M}.$$

So x_f grows roughly like $\frac{\log DM}{M}$. For x_g use the change of variables $x_g = z_g\sqrt{\frac{D}{N}}$. And study:

$$z_g^2 = \left(1 - \left(1 - z_g\sqrt{\frac{D}{N}}\right)^N\right).$$

The exponential approximation yields $\left(1 - z_g\sqrt{\frac{D}{N}}\right)^N \approx \exp\left(-z_g\sqrt{DN}\right)$. The approximation allows to obtain a lower bound; we have $\left(1 - z_g\sqrt{\frac{D}{N}}\right)^N \leq \exp\left(-z_g\sqrt{DN}\right)$ which implies:

$$z_g^2 \geq 1 - \exp\left(-z_g\sqrt{DN}\right).$$

Since $\exp(-x) = \frac{1}{\exp(x)} \leq \frac{1}{1+x}$ we can then obtain:

$$z_g^2 \geq 1 - \frac{1}{1 + z_g\sqrt{DN}}.$$

Now, notice that we have $g(0) < 0$ and $g(1) = 1$ so x_g is the unique real root between 0 and 1 and it lies between a sign change from negative to positive; this tells us that if $g(x) \leq 0$ then $x \leq x_g$. The bounds above applied to $g(x)$ give

$$\begin{aligned} g(x) &\leq x^2 - \frac{a}{N}\left(1 - \exp\left(-Nx\right)\right) \\ &\leq x^2 - \frac{D}{N}\left(1 - \frac{1}{1+Nx}\right) \end{aligned}$$

and substituting in $x = \frac{\sqrt{D}}{N}$ gives that

$$g\left(\frac{D}{N}\right) \leq \frac{D}{N^2} - \frac{D}{N}\frac{\sqrt{D}}{1+\sqrt{D}}$$

which is ≤ 0 as long as $N \geq 1 + \frac{1}{\sqrt{D}}$. So, assuming this from now on, we conclude that $x_g \geq \frac{\sqrt{D}}{N}$ and hence that $z_g \geq \frac{1}{\sqrt{N}}$. This gives

$$z_g^2 \geq 1 - \frac{1}{1 + z_g\sqrt{DN}} \geq 1 - \frac{1}{1+\sqrt{D}} = \frac{\sqrt{D}}{1+\sqrt{D}}$$

which gives

$$x_g \geq \frac{\sqrt{D}}{(1+\sqrt{D})\sqrt{N}}.$$

We can now bootstrap a second time to get

$$z_g^2 \geq 1 - \exp\left(-z_g\sqrt{DN}\right) \geq 1 - \exp\left(-\frac{a}{1+\sqrt{D}}\sqrt{N}\right).$$

This means that z_g is in fact exponentially close to 1 when N is large. We have established that for N sufficiently large, x_f is bounded from above by $\frac{\log DN}{N}$ while x_g is bounded from below by $\sqrt{\frac{D}{N}}$. We can therefore establish that an approximation to the ratio $x_f/x_g \approx (\sqrt{N}\log D(N-1))/((N-1)\sqrt{D})$. Coming back too our problem of interest, this means that:

$$\frac{\phi^*}{\phi^{sym}} \approx \frac{\sqrt{N}\log D(N-1)}{N-1)\sqrt{D}}. \tag{1.54}$$

And it follows that $\frac{\phi^*}{\phi^{sym}} < 1$ and $\frac{\phi^*}{\phi^{sym}} \to 0$ as $N \to \infty$. Moreover, $\frac{\phi^*}{\phi^{sym}}$ decreases in D, which implies that increases in market size imply a larger absolute difference between ϕ^{sym} and ϕ^{OP}.

1.8.3 Appendix: estimation details

Linking NGO decisions to donation supply estimates

Having estimated the donation supply at (1.29), I use the system (1.63) to obtain marginal costs of reach at equilibrium. First, write aggregate donations $\mathcal{D}(\phi_j)$ as a function of reach:

$$\mathcal{D}_j(\phi) = \mathcal{D}(\delta(\phi)) = \gamma T_r s_j(\delta(\phi), \sigma),$$

which is the empirical equivalent to equation (1.19) from the model section. The net fundraising function for NGO j, in turn writes:

$$\Pi(\phi_j;\phi_{-j}) = -K_j(\phi_j) + \phi_j A(\phi_j;\phi_{-j},\mathcal{D}_j), \tag{1.55}$$

where the fund-collection function $A(\phi_j;\phi_-j)$ is given by:

$$A(\phi_j;\phi_{-j},\mathcal{D}_j) = \prod_{k\in\mathcal{J}_g/j}(1-\phi_k)\mathcal{D}_j\left(\phi_j,\phi^c_{-j}\right) + \sum_{S\subset\mathcal{J}_g/j}^{N_g}\prod_{\substack{m\in S\\ k\in\overline{S}/\mathcal{J}_g}}\phi_m(1-\phi_k)\mathcal{D}_j\left(\phi_j,\phi_m,\phi^c_k\right) \tag{1.56}$$

Here, $\mathcal{D}_j(\phi_j,\phi^c_{-j})$ represents the gross donations perceived by NGO j when advertising at intensity ϕ_j, while other NGOs advertise with intensities summarized by the vector of dimension $N_g - 1$ that represents the probability that no other NGOs reach a donation segment: $\phi^c_{-j} = \mathbf{1} - \phi_{-j}$. Similarly, $\mathcal{D}_j\left(\phi_j,\phi_m,\phi^c_k\right)$ corresponds to gross donations perceived by NGO j when $|S|$ NGOs indexed by m are in the same segment while the remaining, indexed by k are not: ϕ_m is a vector with entries ϕ_m for $m \in S$, and ϕ^c_k is a vector with entries $\phi^c_k = 1 - \phi_k$ for $k \in \overline{S}/j$.

The effects of a change in the price of giving

Similarly, I compute the equilibrium effects of a change in tax liabilities differentiating (1.63) with respect to the tax liability, which yields:

$$\phi_j c_j = (1+\alpha_j)\frac{\partial A(\phi_j;\phi_{-j},\mathcal{D}_j)}{\partial \mathcal{D}_j}\frac{\partial \mathcal{D}_j}{\partial T_r} + \alpha_j\omega\sum_{k\neq j}^{N}\frac{\partial A_k}{\partial \mathcal{D}_k}\frac{\mathcal{D}_K}{\partial T_r}, \tag{1.57}$$

which becomes:

$$\phi_j c_j = (1+\alpha_j)A(\cdot)\frac{\beta_T}{1-\sigma}s_j(1-\sigma\bar{s}_{j|g}(1-\sigma)s_j) + \alpha_j\omega\sum_{k\neq j}^{N}A(\cdot)\frac{\beta_T}{1-\sigma}s_k(1-\sigma\bar{s}_{k|g}-(1-\sigma)s_k), \tag{1.58}$$

Estimation algorithm

Estimation proceeds in the following way. First, define the elements $\bar{j}$ and $\underline{j} \in S$ as:

$$\bar{j} = argmin_{k \in S/j}\, (k \bmod N) - j$$
$$\underline{j} = argmin_{k \in S/j}\, j - (k \bmod N)$$

For instance, if $j = 1$, and $S = \{1, \ldots N\}$ then:

$$\bar{j} = 2$$
$$\underline{j} = N$$

For instance, if $j = 1$, and $S = \{4, \ldots N-1\}$ then:

$$\bar{j} = 4$$
$$\underline{j} = N-1$$

Define the cardinality of S by $|S|$. We then have a general formula:

$$X_j^S = \begin{cases} \frac{1}{2} + b(\alpha_j - \alpha_r) & S = \{r\},\ r \neq j \\ 1 & S = \{j\} \\ \frac{b}{2}(2\alpha_j - \alpha_q - \alpha_r) + \frac{p_q - p_r}{2} & S = \{q, r\},\ q > r,\ q, r \neq j, j\ \neq\ 1,\ N \\ \frac{b}{2}(2\alpha_j - \alpha_{\bar{j}} - \alpha_{\underline{j}}) + \frac{p_{\bar{j}} - p_{\underline{j}}}{2} & |S| > 2,\ j \notin S\ j\ \neq\ 1,\ N \\ \frac{1}{2} + \frac{b}{2}(2\alpha_j - \alpha_q - \alpha_r) - \frac{p_q - p_r}{2} & S = \{q, r\},\ q > r,\ q, j = 1\ or\ j = N \\ \frac{1}{2} + \frac{b}{2}(2\alpha_j - \alpha_{\bar{j}} - \alpha_{\underline{j}}) - \frac{p_{\bar{j}} - p_{\underline{j}}}{2} & |S| > 2,\ j \notin S\ ,\ j = 1\ or\ j = N \end{cases} \tag{1.59}$$

I do not observe p_j directly, so I will assume that $p_j = j/N$. I also do not observe the ordering j; the ordering matters for our computations.

Notice that $j = 1, N$ are special; there is a $1/2$ and a change of sign (this is because they represent the end of the circle). We estimate in the code:

$$\hat{X}_j^S = \max\left\{\min\left\{X_j^S, 1\right\}, 0\right\}$$

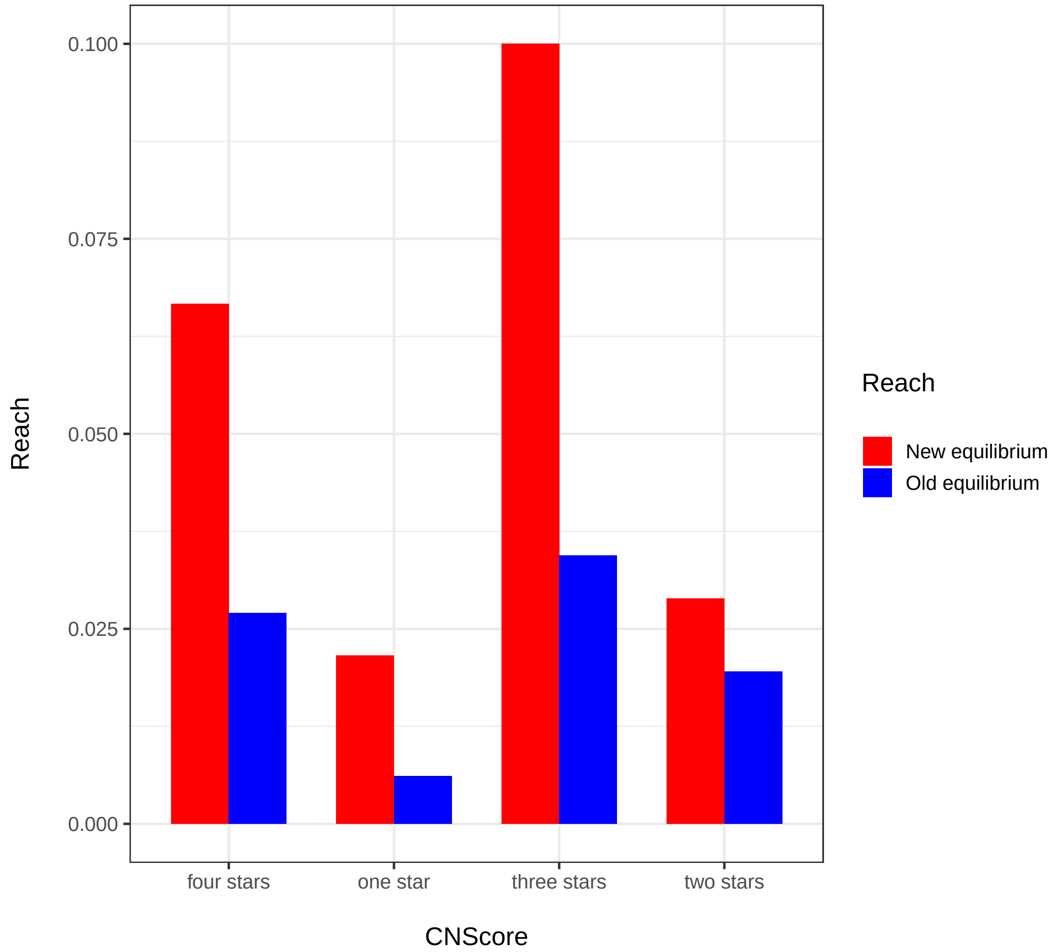
For this, first, pick a random line j=1, and then compute

$$\frac{1}{2} + \frac{b}{2}(2\alpha_1 - \alpha_r - \alpha_q)$$

for all the possible combinations of $r, q \in \{2, 3, \ldots N\}$. Then select the minimal (maximal) value and define the positions $\bar{r} = N$ and $\underline{q} = 2$. Now compute again

$$\frac{1}{2} + \frac{b}{2}(2\alpha_1 - \alpha_r - \alpha_q)$$

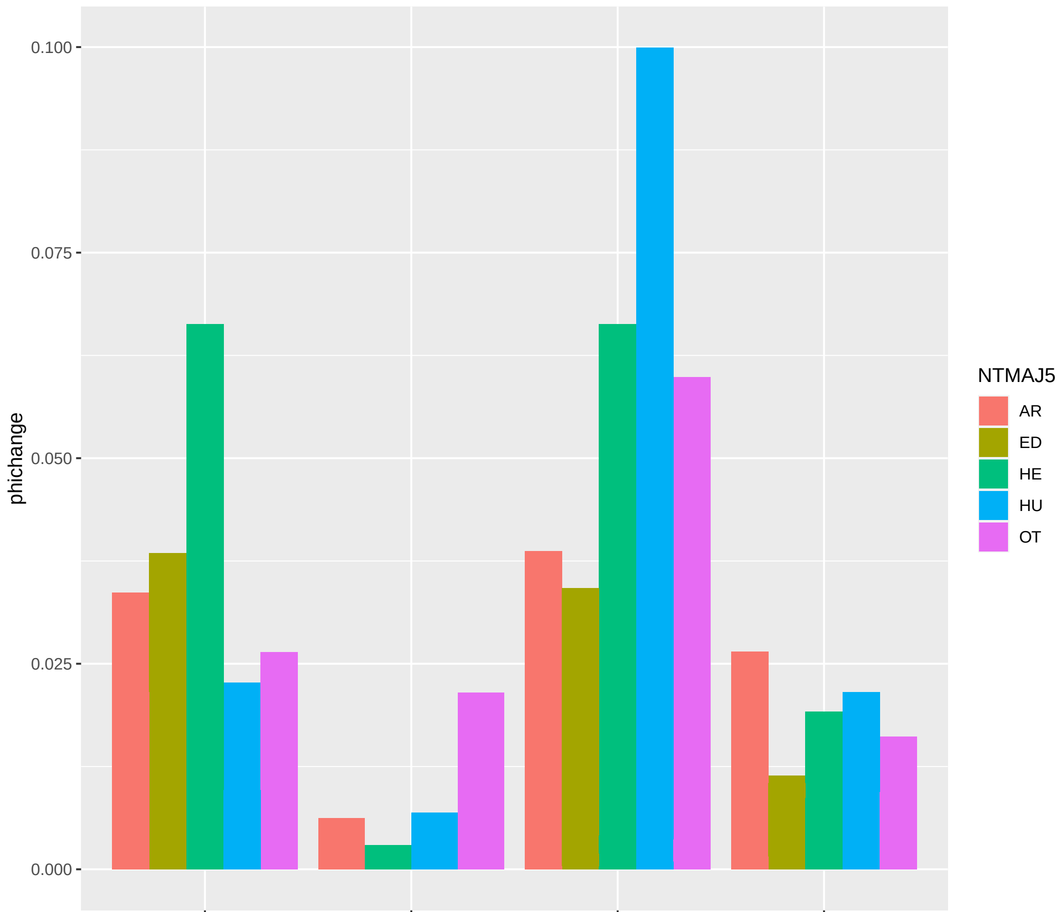
For all possible combinations of $r, q \in \{3, \ldots N - 1\}$. Then select the minimal (maximal) value and define the positions $\bar{r} = N - 2$ and $\underline{q} = 3$. Repeat until all the observations have assigned positions.


Reach
0.100
0.075
0.050
0.025
0.000
four stars
one star
three stars
two stars
CNScore
Reach
New equilibrium
Old equilibrium

0.5

(a)

h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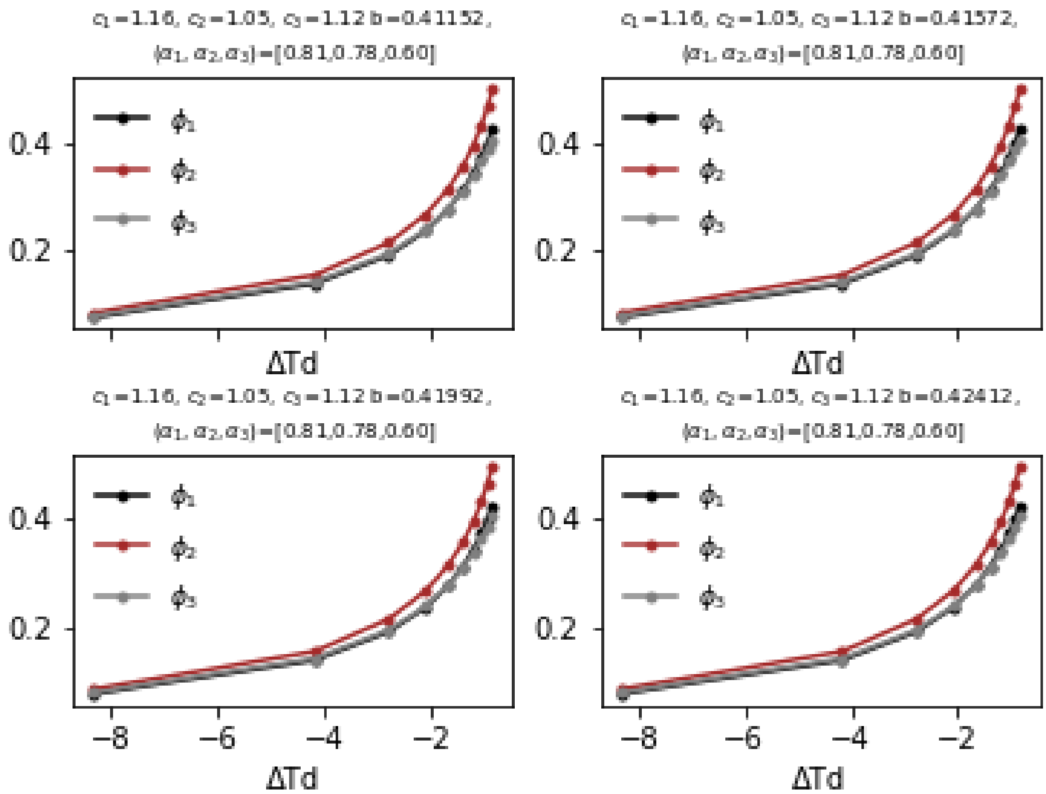
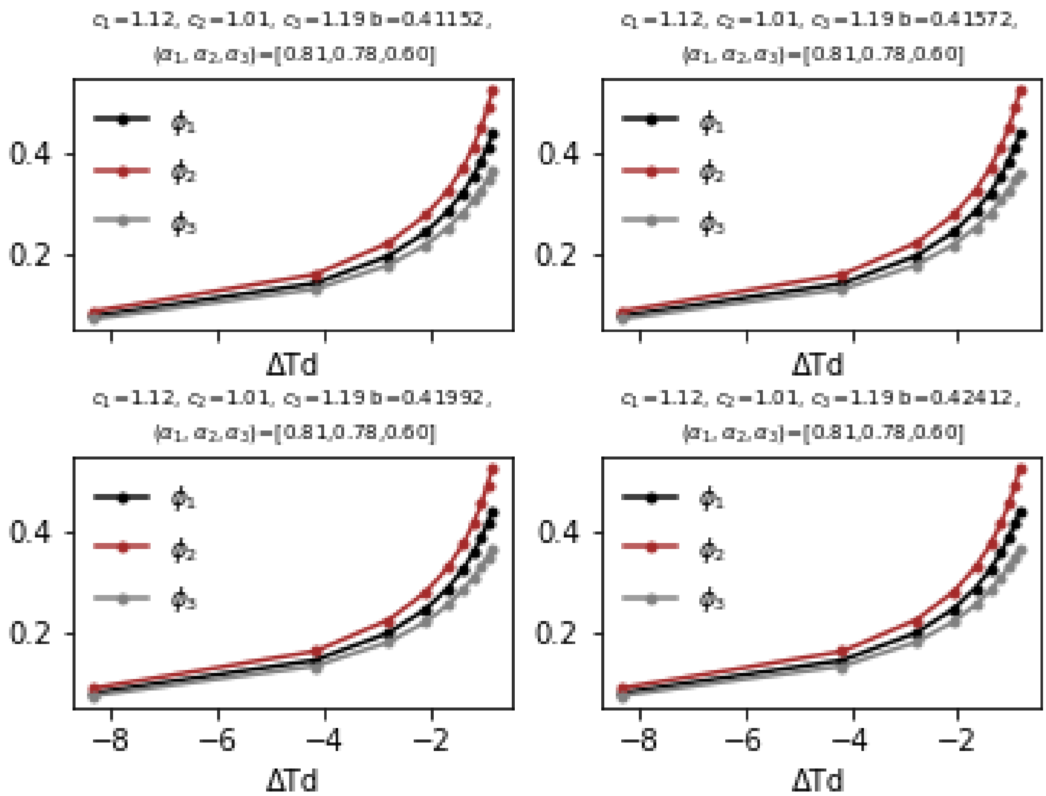


0.4

(a)

h



0.4

(b)

h

FIGURE 1.8: A subsample of estimated best responses as a function of a change in the deductibility rate, assuming the donation supply elasticity of Peloza and Steel (2005) of -1.2.

1.8.4 Appendix: Estimation tables

	market	Costs	Elasticity
1	Atlanta	6.08	0.27
2	Baltimore	0.67	0.02
3	Bangor	1.78	0.09
4	Billings	15.22	0.41
5	Binghamton	4.58	1.73
6	Boise	15.06	0.73
7	Boston	0.93	0.01
8	Buffalo		0.02
9	Charleston, SC	16.12	2.47
10	Charlotte	7.28	0.85
11	Chicago		0.01
12	Cincinnati	2.77	0.06
13	Cleveland	2.24	0.06
14	Columbus, OH		0.06
15	Dayton	1.78	0.08
16	Denver	13.55	1.96
17	Detroit		0.03
18	Erie		0.02
19	Evansville	2.77	0.07
20	Houston	9.59	0.48
21	Indianapolis	1.59	0.06
22	Kansas City		0.25
23	Lansing		0.04
24	Los Angeles	2.10	0.08
25	Louisville	1.92	0.10
26	Madison	1.42	0.04
27	Marquette	0.61	0.03
28	Memphis	3.38	0.11
29	Milwaukee	1.59	0.05
30	Nashville	3.07	0.08
31	New York		0.01
32	Oklahoma City	15.37	0.50
33	Omaha	2.61	0.08
34	Philadelphia		0.02
35	Pittsburgh	1.85	0.04
36	Portland, OR	7.51	0.44
37	Rochester, NY		0.02
38	Rockford	0.50	0.01
39	Salisbury	1.45	0.32
40	Salt Lake City	15.02	0.41
41	San Antonio	6.47	0.36
42	San Diego		0.06
43	Spokane	15.40	0.38
44	Syracuse	0.80	0.02
45	Toledo	3.03	0.06
46	Youngstown	0.79	0.06
47	Zanesville	1.45	0.04

TABLE 1.3: Mean estimates by DMA.

NTMAJ5	Cost parameter $\omega = 0$	$\omega = 1$	Adver. Elasticity
AR	2.73	1.95	0.05
ED	2.65	1.87	0.10
HE	4.26	1.65	0.13
HU	5.75	2.92	0.06
OT	5.72	3.40	0.12

TABLE 1.4: Mean estimates by nest.

1.8.5 Appendix: Indirect utility and discrete choice

Consider an economy with $J+1$ goods and statistically identical and independent donors, all endowed with income z. Good 0 is a perfectly divisible outside good. The other J goods are the indivisible variants of a differentiated product. These N NGOs can be classified into G exhaustive and mutually exclusive groups with J_g variants in the gth group, such that $\sum_{g=1}^{G} N_g = N$. The log-price of giving is $T_{kh} \leqslant z$. A donor's conditional indirect utility of good k in group h is

$$u_{kh} = \gamma^{-1} \log z - T_{kh} + b_{kh} + \epsilon_{kh},$$

where b_{kh} is the quality of good k in group h and ϵ_{kh} is the random part of utility. Note that price and income enter linearly in (1). For the nested logit model, the $\epsilon_{11}, \dots, \epsilon_{J_G G}$, follow the multivariate cumulative distribution function:

$$F(\epsilon_{11}, \dots, \epsilon_{J_G G}) = \exp\left[-\sum_{g=1}^{G} \left(\sum_{j=1}^{N_g} \mathrm{e}^{-\epsilon_{g'}\mu_g} \right)^{\mu_g'^{\mu}} \right],$$

where $0 \leqslant \mu_g \leqslant \mu$.[4] A consumer chooses the good with the highest utility. The probability $\boldsymbol{P}_{kh}$ that a consumer buys good k from group h then equals the probability that $\tilde{U}_{jg}$ is maximized at good k from group h. Demand for NGO k from group h is $\boldsymbol{P}_{kh}$.

For the nested logit distribution function (2), it is well known that $\boldsymbol{P}_{kh}$ equals

$$\boldsymbol{P}_{kh} = \frac{\exp((b_{kh} - T_{kh})/\mu_h)}{\sum_{j=1}^{J_h} \exp((b_{jh} - T_{jh})/\mu_h)} \cdot \frac{\exp(I_h/\mu)}{\sum_{g=1}^{G} \exp(I_g/\mu)},$$

where:

$$I_g = \mu_g \ln \sum_{j=1}^{J_g} \exp((b_{jg} - T_{jg})/\mu_g),$$

is called the inclusive value of group g. It can be shown that I_g is the expected value of the maximum of the utilities of the goods within a group g, and that $\mu \ln \sum_{g=1}^{G} \exp(I_g/\mu)$ is the expected value of the maximum of the utilities of all goods. Some calculations transform (3) into:

$$\ln \left[\left(\frac{\boldsymbol{P}_{kh}}{\sum_{j=1}^{N_h} \boldsymbol{P}_{jh}} \right)^{\mu_h} \cdot \left(\sum_{j=1}^{N_h} \boldsymbol{P}_{jh} \right)^{\mu} \right] = -\mu \cdot \ln \left(\sum_{g=1}^{G} \exp(I_g/\mu) \right) + b_{kh} - T_{kh},$$

where $\boldsymbol{P}_{kh} / \sum_{j=1}^{J_h} \boldsymbol{P}_{jh} \equiv \boldsymbol{P}_{k|h}$ is the probability that a consumer donates to k, given that he/she buys from group h, and where $\sum_{j=1}^{J_h} \boldsymbol{P}_{jh} \equiv \boldsymbol{P}_h$ is the probability that a donor donates to group h[5].

Now consider an alternative economy with $J+1$ perfectly divisible goods and one representative consumer, endowed with income Z. Good 0 is the outside good sold at price $T_0 = 1$. The other J goods are the variants of a differentiated product. A good j in group g is sold at price p_{jg}. The representative consumer's budget constraint is:

$$\sum_{g=1}^{G} \sum_{j=1}^{N_g} T_{jg} X_{jg} + X_0 \leqslant Z,$$

where X_{jg} is the donation amount to j from group g and X_0 is the quantity of the outside good. A representative consumer's direct utility function consistent with the nested logit demand system or its transformation is:

$$U = v_0(G) + \sum_{g=1}^{G} \left[\sum_{i=1}^{N_g} \left[b_{ig} \log \left(\frac{X_{ig}}{\sum_{j=1}^{J_g} X_{jg}} \right)^{\mu_g} \left(\frac{\sum_{j=1}^{J_g} X_{jg}}{} \right)^{\mu} \right] X_{ig} \right] + X_0$$

To prove this, consider the Lagrangian for the consumer's maximization problem is written as:

$$L = \sum_{g=1}^{G} \left[\sum_{i=1}^{J_g} \left[b_{ig} - \ln \left(\frac{X_{ig}}{\sum_{j=1}^{J_g} X_{jg}} \right)^{\mu_g} \left(\frac{\sum_{j=1}^{J_g} X_{jg}}{N} \right)^{\mu} \right] 2_{ig} \right] + X_0$$
$$+ \lambda \left(Z - X_0 - \sum_{g=1}^{G} \sum_{i=1}^{J_X} T_{ig} X_{ig} \right),$$

where λ is the traditional budget constraint multiplier. The first-order condition for X_0 yields $\lambda = 1$. The first-order condition for an X_{kh} yields, after some rearrangements,

$$\ln \left(\left(\frac{X_{kh}}{\sum_{j=1}^{J_h} X_{jh}} \right)^{\mu_h} \cdot \left(\frac{\sum_{j=1}^{J_h} X_{jh}}{N} \right)^{\mu} \right) = (-\mu) + b_{kh} - T_{kh}.$$

Reinterpreting the market shares $X_{jg}/1$ of the representative consumer model as the probabilities $\boldsymbol{P}_{jg}$ of the discrete choice model, (8) and (5) become strikingly similar. They coincide if and only if

$$(-\mu) = -\mu \ln \left(\sum_{g=1}^{G} \exp(I_g/\mu) \right).$$

To show that this is indeed the case, rewrite (8) as

$$\frac{X_{kh}}{\sum_{j=1}^{J_h} X_{jh}} \cdot \left(\frac{\sum_{j=1}^{J_h} X_{jh}}{N} \right)^{\mu/\mu_h} = \exp \left(\frac{-\mu + b_{kh} - T_{kh}}{\mu_h} \right)$$

and add for $j = 1, \ldots, N_h$:

$$\left(\frac{\sum_{j=1}^{J_h} X_{jh}}{1} \right)^{\mu/\mu_h} = \exp \left(\frac{-\mu + I_h}{\mu_h} \right).$$

Rewrite this as:

$$\frac{\sum_{j=1}^{J_h} X_{jh}}{1} = \exp \left(\frac{\mu + I_h}{\mu} \right),$$

and add for $g = 1, \ldots, G$. This gives (9). To verify that the solution to the first-order conditions does indeed maximize U, calculate the second-order condition for an X_{kh}:

$$\frac{\mu_h}{X_{kh}} + \frac{\mu - \mu_h}{\sum_{j=1}^{J_h} X_{jh}}.$$

This is negative if $\mu \geqslant \mu_h \geqslant 0$.

1.8.6 Appendix: numerical analysis

In order to compare to the baseline simulations presented by Saez (2004), the numerical analysis adopts the functional forms present in that paper, together with the majority of parameter values.

Government consumption per capita, E is fixed at \$6000. Aggregate earnings are given by:

$$\bar{Z} = \bar{Z}_0 \left(\frac{1-\tau}{1-\tau_0} \right)^{\epsilon_Z},$$

where the earnings elasticity ϵ_Z is assumed to be constant, τ_0 is the current average marginal income tax rate taken as equal to 30%, and $\bar{Z}_0$ corresponds to the baseline aggregate earnings.

General deductibility		Full deductibility		Parameters			
τ^d	τ^d_{Saez}	τ	τ_{Saez}	$\bar{\eta}$	$1-\rho$	ϵ_Z	ϵ_G
-0.17	-0.40	1.01	0.60	0.008	0.39	0.25	1.00
-0.30	-0.52	1.01	0.59	0.008	0.39	0.25	1.50
0.10	-0.05	1.02	0.60	0.008	0.39	0.25	0.50
0.01	-0.31	1.03	0.48	0.008	0.39	0.50	1.00
-0.09	-0.45	1.02	0.47	0.008	0.39	0.50	1.50
0.34	0.14	1.04	0.48	0.008	0.39	0.50	0.50
-0.08	-0.40	0.97	0.60	0.015	0.39	0.25	1.00
-0.21	-0.52	0.97	0.59	0.015	0.39	0.25	1.50
0.1	-0.05	0.95	0.60	0.015	0.39	0.25	0.50
-0.04	-0.31	0.95	0.48	0.015	0.39	0.50	1.00
-0.14	-0.45	0.95	0.47	0.015	0.39	0.50	1.50
0.31	0.14	0.91	0.48	0.015	0.39	0.50	0.50

TABLE 1.5: Solution to Propositions 1 and 2 for given parameters.

Aggregate donations $\bar{D}$ are given by:

$$\bar{D} = \bar{D}_0 \frac{e^{-\rho(1+t)}}{e^{-\rho(1+t_0)}} \left[\frac{\bar{Z}(1-\tau) + R}{\bar{Z}_0 (1-\tau_0) + R_0} \right]^{\epsilon_R} - \alpha G^0,$$

where $r = -\bar{D}_{1+/}/\bar{D}$ is a constant parameter that measures the price response of contributions,$\bar{D}_0$ are the baseline aggregate donation, ϵ_R corresponds to the income elasticity of donations (assumed to be constant), and α is a crowding out parameter.

I assume that$\frac{v_D^h}{v_R^h} = B \cdot \left(s \cdot \bar{G} + G^0\right)^{-l}$, for constant parameter B and l. This implies that the external effect e given by:

$$e = B \cdot \left(s \cdot \vec{G} + G^0\right)^{-1} \beta(R). \tag{1.60}$$

Individual earnings are given by,

$$z^h = z_0^i \left(\frac{1-\tau}{1-\tau_0}\right)^{\epsilon_Z}.$$

Where τ^0 is the average marginal tax rate, and z_0^i is the baseline earnings level for individual i. The elasticity is taken as constant and uniform across individuals (recall that only linear taxation is considered, which makes this assumption fairly harmless).

The marginal welfare weights β^i depend on disposable income only and thus are specified as, $\beta^i = 1/\left(z^i(1-\tau) + R\right)^v$, where v is a measures the redistributive preferences of the government.

1.8.7 Estimation details

If NGO j is in group g, i.e., $j \in \mathcal{J}_g$, then the selection probability of product j conditional on group g being selected equals:

$$\bar{s}_{j|g} = \frac{\exp\left(\frac{\delta_j}{1-\sigma}\right)}{D_g},$$

where the denominator D_g is described by:

$$D_g = \sum_{k \in \mathcal{J}_g} \exp\left(\frac{\delta_k}{1-\sigma}\right). \tag{1.61}$$

In the same manner, the probability of choosing one of the g NGO groups is given by:

$$\bar{s}_g(\delta,\sigma) = \frac{D_g^{1-\sigma}}{\sum_g D_g^{1-\sigma}},$$

and hence market shares are given by:

$$s_j(\delta,\sigma) = \bar{s}_{j|g}(\delta,\sigma)\bar{s}_g(\delta,\sigma) = \frac{\exp\left(\frac{\delta_k}{1-\sigma}\right)}{D_g^{\sigma}\sum_g D_g^{1-\sigma}}. \tag{1.62}$$

We can now use the expression for the NGOs objective function in (1.17) together with (1.55) to obtain the first-order conditions of the estimated model. Assuming a quadratic cost specification $K_j(\phi_j) = 0.5c_j\phi_j^2$ we have that this system is given by:

$$\phi_j\left(c_j - \frac{\partial A_j}{\partial \phi_j}\right) = A(\phi_j;\phi_{-j},\mathcal{D}_j)(1+\alpha_j) + \alpha_j\omega\sum_{k\neq j}^{N}\frac{\partial A_k}{\partial \phi_j}, \tag{1.63}$$

where the derivative on the right-hand-side corresponds to the aggregate elasticity given by:

$$\frac{\partial A_j}{\partial \phi_j} = \gamma T_r\prod_{k\neq j}(1-\phi_k)\frac{\partial s_j\left(\phi_j,\phi_{-j}^c\right)}{\partial \phi_j} + \gamma T_r\sum_{S\subset\mathcal{J}_g/j}^{N_g}\prod_{\substack{m\in S\\ k\in\bar{S}/\mathcal{J}}}\phi_m(1-\phi_k)\frac{\partial s_j\left(\phi_j,\phi_m,\phi_k^c\right)}{\partial \phi_j}, \tag{1.64}$$

and the derivatives of the choice probabilities above are computed with the standard formulas:

$$\frac{\partial\,\bar{s}_j}{\partial\,\phi_j} = \beta_\phi\frac{\partial\,\bar{s}_j}{\partial\,\delta_j} = \frac{\beta_\phi}{1-\sigma}s_j(1-\sigma\bar{s}_{j|g}-(1-\sigma)s_j), \tag{1.65}$$

evaluated at their respective intensity profiles as in (1.66). Similarly, the derivative at the right-hand-side of (1.66) is given by:

$$\frac{\partial A_k}{\partial \phi_j} = \gamma T_r\sum_{S\subset\mathcal{J}_g/j}^{N_g}\prod_{\substack{m\in S\\ k\in\bar{S}/\mathcal{J}}}\phi_r(1-\phi_m)\frac{\partial s_k\left(\phi_j,\phi_m,\phi_k^c\right)}{\partial \phi_j}, \tag{1.66}$$

and again the cross-derivatives of the choice probabilities above are computed as:

$$\frac{\partial s_k}{\partial \phi_j} = \beta_\phi s_j s_k. \tag{1.67}$$

Together, equations (1.63) to (1.67) allow us to estimate the marginal cost of reach at the observed equilibrium for each year. These estimates are summarized in Table 1.4.

Chapter 2

Taxing Moral Agents

Experimental and empirical findings suggest that non-pecuniary motivations play a significant role as determinants of taxpayers' decision to comply with the tax authority and shape their perceptions and assessment of the tax code. By contrast, the canonical optimal income taxation model focuses on material sanctions as the primary motive for compliance. In this paper, I show how taxpayers equipped with semi-Kantian preferences can account for both these non-pecuniary and material motivations. I build a general model of income taxation in the presence of a public good, which agents value morally, and solve for the optimal linear and non-linear taxation problems.

Keywords: Optimal Income Taxation, Kantian Agents, Prosocial motivations

JEL Codes: H210, H410, D910

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2.1 Introduction

Tax administration practitioners recognize the importance of non-pecuniary factors as drivers of tax compliance. For instance, Luttmer and Singhal (2014) refer to the following statement by the OECD (2001): *"the promotion of voluntary compliance should be a primary concern of revenue authorities in its principles for good tax administration, and it has highlighted the importance of tax morale more generally* ". This view is consistent with evidence from the World Values Survey (WVS) and European Social Survey (ESS), which indicate that a considerable proportion of citizens perceive tax evasion as being unjustifiable[1] (see Figure 2.1). Contrastingly, the traditional theoretical analysis of tax evasion (Allingham and Sandmo, 1972) and taxation under asymmetric information (Mirrlees, 1971) focuses on monetary penalties and enforcement as the sole drivers of individual behavior and compliance decisions. While workhorse models of income taxation and income tax evasion view the relationship between the State and its citizens as one of coercion[2], empirical findings show that this cannot be reconciled with high rates of tax compliance observed in some countries (Graetz and Wilde, 1985), nor with experimental findings[3] that find that a considerable proportion of people choose not to evade when playing tax evasion games. More recent findings found in Stantcheva (2021) use large-scale social economics surveys issued to representative U.S. samples and associated experiments to show how social preferences and views of the trustworthiness and scope of government are also crucial drivers of respondents' stance on income tax policy and support for taxes.

In this paper, I consider moral motivations as partial drivers of citizens' sense of civic duty, willingness to pay taxes, and contribute to public goods. In the model,

[1]The WVS reports that when asked to rate how justifiable "cheating on taxes if you have a chance" is, 60 percent answer that cheating is never justifiable. In the same vein, 80 percent of the respondents to the ESS "agreed" or "strongly disagreed" with the phrase "citizens should not cheat on their taxes".

[2]According to this coercive view, the taxpayers' main driver to report taxes truthfully is either the possibility of a material sanction (Allingham and Sandmo, 1972) or the design by the Government of an incentive-compatible consumption-leisure bundle (Stiglitz, 1982).

[3]See Alm and Malézieux (2021) for a review of the experimental literature on tax evasion games.

agents consider the role of the government as a provider of public goods when undertaking their compliance decisions. Particularly, they ask themselves about the hypothetical public good provision that would arise if other members of the society made the same compliance decision as them, holding constant the production function of the government. This is reminiscent of Kant's (1785) categorical imperative; what if a fraction of the population were to act in the same way that I am acting?. It is also compatible with the "social contract" perspective of the State held by Rousseau (1762), which has been previously studied under the label of "reciprocity" between the citizens and the State (Levi, 1989; Besley, 2020).

The model considers agents that have *Homo moralis* preferences. As shown by Alger and Weibull for pair-wise interactions (2013a) and then generalized to interactions with infinitely many players (2016a), these preferences have strong evolutionary foundations. The model relies on this last generalization and considers an economy with a continuum of agents whose contribution/tax liability funds a global public good, they can be interpreted as agents whose valuation for the public good is constituted by the convex combination of two possible cases: the material public good and a semi-Kantian valuation of the public good. The former valuation is the standard in the literature, it constitutes the "real" public good that a selfish agent derives utility from; the latter considers the material pay-off that she would obtain if all other agents would contribute the same amount that she does, universalizing her actions. *Homo moralis* agents value the public good between these two extremes: they are selfish to some degree, but they also take into account their action in a Kantian sense.

This theoretical setting allows to answer questions regarding the expansion of fiscal capacity in an economy populated with *Homo moralis agents*. More broadly, it also allows to perform normative analysis, considering the problem faced by a utilitarian social planner that maximizes "material" social welfare (absent moral considerations). I consider both the linear and non-linear optimal taxation problems. The results in these two cases write as follows.

First, in the linear income taxation setting, a higher degree of morality is directly linked to an expansion of fiscal capacity: societies with a higher degree of morality can tax income at higher rates and provide more public goods. The public good maximizing income tax that can be implemented by the government increases the degree of morality. *Homo moralis* agents recognize the role played by their taxes at funding a public good and adjust their labor supply accordingly. At a given tax rate, a citizen with higher κ is willing to work more hours if she knows that the income taxes will be used to fund a public good that she values, even if her marginal contribution is atomistic.

Second, in the non-linear income taxation setting, as the government designs the non-linear tax schedule for *Homo moralis* agents an interesting trade-off arises. On the one hand, moral motivations allow the government to collect higher revenues as they relax the incentive constraints of high-ability moral agents. On the other hand, when the government raises the tax paid by low-skilled workers it also crowds out the moral motivation of high-skilled workers, as their Kantian preferences become less stringent at inducing truthful reporting. This result stems from the counter-factual logic employed by Kantian agents: they ask themselves what their utility would be if all the agents of their specific income type were to behave in the same manner as they do. More concretely, when a Kantian agent reports dishonestly to have a lower income and consequently pays a lower income tax, he suffers a utility loss proportional to the difference between the income tax paid by high vs. low-income agents. This means that when low-income agents are paying high taxes, the Kantian concern of high-income types is somewhat "diluted". This also has implications over marginal tax rates of low-income types, which in general increase for low levels of morality and decrease for high morality levels.

At last, for this non-linear taxation environment, I derive a new version of the Samuelson condition which can be directly compared to the one presented by Boadway and Keen (1993). I show that in an economy populated by *Homo moralis* the solution to the problem faced by a utilitarian social planner is such that the sum of marginal rates of substitution between private good and public good consumption is equal to the sum of: (i) the cost of public goods; (ii) the cost of screening, and; (iii) a "moral effect" that affects the provision of public good positively when the net benefit of raising the marginal tax rate for low-skilled agents is high.

Related literature. In the context of public good provision, the possibility of moral considerations has been addressed by authors like Sen (1977), Laffont (1975), and Johansen (1977). For instance the latter states "No society would be viable without some norms and rules of conduct. Such norms and rules are especially necessary for viability in fields where strictly economic incentives are absent and cannot be created. Some degree of honesty in various sorts of communication is one such example, and it might have at least some bearing upon the problem of collective decisionmaking about public goods". More broadly, several forms of intrinsic motivations may be driver citizens' decision to provide public goods[4]. For instance: preferences for honesty (Baiman and Lewis, 1989), social and self-image concerns (Bénabou and Tirole, 2006), or ethical motivations (Laffont, 1975). This paper relates the closest to the latter, which considers the role of Kantian agents in the context of provision of public goods in a large economy, but in the absence of taxation[5].

This work also contributes to the literature on tax morale (Luttmer and Singhal, 2014), which studies several types of non-pecuniary motivations for tax compliance. It provides a new potential motivation for the observed variation in tax morale, and adds a new approach to the list of theories that have been studied by the literature, among those: (i)"warm glow" or impure altruism (Andreoni et al., 1998; Andreoni, 1990; Dwenger et al., 2016); (ii) reciprocity with the state (Levi, 1988; Feld and Frey, 2002; Torgler, 2005; Alm et al., 1993); (iii) peer effects (Besley, 2020);(iv) culture (Kountouris and Remoundou, 2013; DeBacker et al., 2012); and fairness (Bordignon, 1993; Gordon, 1989). In particular, Gordon (1989) proposes an approach that is based on the "Kantian rule" to determine the fair price for the public goods supplied by the state. In this work, individuals consider it fair to pay as much as they would like others to pay. It is assumed that a taxpayer considers it fair to pay the Kantian tax only if they

[4]Empirically, Dwenger et al. (2016) document a high degree of compliance with the German Protestant Church tax that is consistent with a desire to follow the law.

[5]However, other types of ethical rules have been proposed in Economics. For instance, for the case of voting in large elections, Feddersen et al. (2006) and Coate and Conlin (2004) build on the work of Harsanyi (1982; 1992) and study ethical voters as citizens that are "rule utilitarians" that act as a social planner for their group, which results in positive equilibrium turnout rates.

perceive that everyone else is doing the same, and they will revise their desired payment otherwise. My approach differs from this contribution in two ways. Firstly, it is preference-based and does not require the imposition of a "fairness constraint". Secondly, the focus of Gordon (1989) is on the evasion problem, not redistribution[6].

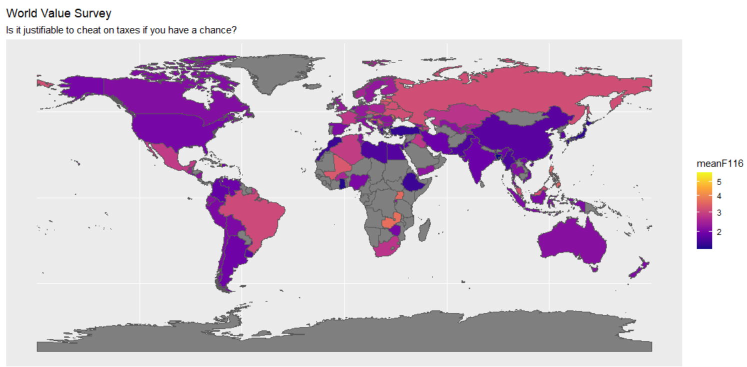

FIGURE 2.1: Percentage of people who think cheating on taxes is never justifiable for different countries, WVS. "meanF116" refers refers to the country-average across WVS's waves 1 to 7. A response of 1 asserts that cheating is never justifiable, while higher scores indicate higher justifiability of cheating in taxes.

Finally, this work contributes directly to the literature that considers the role of Kantian ethics in several economic environments. It closely relates to the early contribution of Laffont (1975), who introduces the notion of Kantian behaviour when individuals optimize in an environment with macroeconomic constraints. More particularly, it is the first study of *Homo moralis* preferences in the optimal income taxation setting, and constitutes another application of these preferences in diverse economics environments: Sarkisian (2017, 2021a, 2021b) (team incentives), and Alger and Laslier (2020) and Alger and Laslier (2021) (voting), Eichner and Pethig (2020b) (Piguvian taxation), Eichner and Pethig (2020a) (climate policy), Norman (2020) (the use of fiat money).

[6]Evasion is not explicitly modeled, but rather through incentive constraints, as in Stiglitz (1982)

The paper is organized as follows: in Section 2 I introduce the baseline economic model. In Section 3 I establish the main results regarding *Homo-moralis* under income homogeneity for both the voluntary contributions benchmark and the linear income taxation environment. Section 4 expands to account for heterogeneity in income and considers the non-linear income taxation case. Section 5 discusses some applications, and Section 6 concludes.

2.2 The baseline model

The baseline model studies *Homo moralis* agents (citizens) in an economy with a global public good, to which they may contribute (through voluntary contributions or taxes). Agents are atomistic and differ solely in their pre-tax income.

The public good. The economy is populated by an infinite number of agents, each one indexed by i in the (measurable) continuum $I = [0, 1]$. Each agent $i \in I$ contributes a non-negative amount $g_i \geq 0$ to a public good [7]. The public good is produced according to a linear technology:

$$G = \int_I g_i \, di. \tag{2.1}$$

An important technical observation is that since agents are atomless, the production of the public good is invariant to individual contributions: $\partial G / \partial g_i = 0$ for each $i \in I$.

Preferences. Agents' preferences are *Homo moralis*. This means that they attach some weight to their material utility, which represents their preferences absent any social or moral concerns, while also attaching some weight to a generalized version of Kantian morality. The exact relationship between material utility and moral concerns is clarified in the following paragraphs.

The material utility function. Preferences over material payoffs follow the typical structure studied in the optimal taxation literature [8]: each agent $i \in I$ derives utility from the consumption of the public good G, private consumption x_i, and the number

[7] While this paper focuses on the case in which g_i corresponds to a tax liability, g_i may generally also correspond to a voluntary contribution.

[8] E.g: Stiglitz (1982), and Bordignon (1993).

of hours spent working $l_i \in [0,1]$. The *material utility function* is given by the real-valued, differentiable and strictly concave function over the vector (G, x_i, l_i) :

$$U(G, x_i, l_i). \tag{2.2}$$

I assume that U satisfies the Inada conditions and that agents enjoy the consumption of both the private and the public good ($\partial U/\partial x_i > 0$,w and $\partial U/\partial G > 0$) but dislike working, as it implies spending fewer hours enjoying leisure ($\partial U/\partial l_i < 0$). Henceforth, I use the notation U_m to refer to the partial derivative of U with respect to the m-th entry of the vector (G, x_i, l_i).

The type-structure. Each agent $i \in I$ has a productivity-type $w_n \in \{w_l, w_h\}$, where $w_h \geq w_l$. Productivities can also be interpreted as exogenously determined hourly wages and are distributed across the population according to weights $p_h \in (0,1)$,and $p_l = 1 - p_h$. Whenever, $w_h = w_l$ then model is equivalent to one with only one productivity type. For that special case, I omit the index i and refer to labor supply as $l = l^i(w)$ the labour supply of agent $i \in I$ with productivity $w = w_h = w_l$. Define the budget set of a given agent of type n as:

$$\mathcal{B}(x_n, g_n, l_n) = \{(x_n, g_n, l_n) \in \mathbb{R}^2 \times [0,1] : x_n + g_n \leq l_n \cdot w_n\}, \quad \text{for } n \in \{l, h\}.$$

To convey the main features of *Homo moralis* agents in the baseline model, labor supply will be assumed to be provided inelastically by all agents ($l(w_n) = 1$ for all n). This assumption will be then relaxed when addressing the optimal taxation problem.

Welfare criterion, Samuelson is king. Throughout the paper, welfare analysis will be based on the material utility function in equation (2.2), moreover I assume the planner's material welfare function to be utilitarian. This means that a variant of the Samuelson Rule (Samuelson (1954)) applies as a characterization of the set of Pareto-Optimal allocations. In particular, let labour supply be inelastic at $l_h = l_l = 1$ and denote by $(G^*, x^*(w_n))_{n \in \{l,h\}}$ for the welfare maximizing bundles of public good provision and private consumption.

Proposition 6 (Samuelson Rule). *If the planner is utilitarian and labour supply is inelastic, then the socially optimal level of public good provision and private consumption, denoted* (G^*, x_n^*) *for* $i \in \{l, h\}$, *is such that*

$$\sum_{n \in \{l,h\}} p_n \cdot \frac{U_2(G^*, x_n^*, 1)}{U_1(G^*, x_n^*, 1)} = 1 \tag{2.3}$$

The proof is in the Appendix. Efficiency in the consumption of public goods requires that the (weighted) sum of marginal rates of substitution between private consumption and consumption of the public good is equal to the marginal rate of transformation between the two goods.

2.3 Income Homogeneity

In this section, I assume that there is only one income-type $w = w_l = w_h > 0$. In this environment, *Homo-moralis* are defined as followed: a partially Kantian agent takes into account the hypothetical impact that her contribution would have over the global public good if it were to be adopted by some share of the population.

Definition 1. *Homo moralis utilities in a large economy*. Assume that every agent in I has a **degree of morality** $\kappa \in [0, 1]$. Let G denote the global public good. *Homo moralis* preferences over the provision of public good for a given agent $i \in I$ that pays a total tax of $T_i \geq 0$ are given by $U(\mathcal{G}(T_i; G, \kappa), x_i)$, where $\mathcal{G}(T_i; G, \kappa)$ is defined as the *moral valuation over the provision of public good* and is given by:

$$\mathcal{G}(T_i; G, \kappa) = (1 - \kappa) \cdot G + \kappa \cdot T_i. \tag{2.4}$$

The moral valuation of the public good is a convex combination between G, the real public good which would be the only component valued by a selfish agent T_i, the tax paid by agent i, where the weight attached to the latter is the degree of morality κ.

Note that this definition is silent about the nature of T_i: it can be either a voluntary contribution or a tax liability. In this paper, I examine the latter case and leave the remaining case for an accompanying paper.

2.3.1 Linear optimal income taxation

In this section, I adapt the baseline model to incorporate a government that funds the public good with the proceeds collected from an income tax. I relax the assumption of inelastic labor supply. Under inelastic labor supply, the government would be always able to achieve first-best outcomes as taxation would not induce any changes in the citizens' utility maximization.

A government selects an income tax $\tau \in [0,1]$ and uses the proceeds to provide the public good G:

$$G = \tau \int_I y_i \, di, \tag{2.5}$$

where $y_i = wl_i$ denotes the pre-tax income of agent i at tax rate τ.

In this setting, an agent with *Homo moralis* preferences considers what the public good provision would be, if a share κ of the other agents were to pay the same amount of taxes that they pay. The moral-valuation of the public good of an agent with income y_n is given by:

$$\mathcal{G}(\tau y_i; G, \kappa) = (1-\kappa)G + \kappa \cdot \tau y_i. \tag{2.6}$$

This expression shows how *Homo moralis* agents perceive a positive utility from paying their taxes to provide a public good. Naturally, this raises the marginal benefit of spending time working: *Homo moralis* agents internalize part of the benefit that their taxable income has on the provision of public goods. For simplicity, below I will write $\mathcal{G}^i$ when referring to $\mathcal{G}(T_i; G, \kappa)$.

The Planner's problem. A utilitarian social planner chooses $\tau \in [0,1]$ and a lump-sum demogrant $b \geq 0$ in order to maximize the sum of material utilities taking the public good production function as given and accounting for the strategic behaviour of its citizens (individual rationality constraint). Mathematically:

$$\max_{(G,\tau)} \int_I U(G, (1-\tau)y_i + b, 1 - \frac{y_i}{w_i})di \tag{2.7}$$

subject to:

$$G = \tau \int_I y_i(\tau)di, \quad \text{and } \{x_i, l_i\} \in \arg\max U(\mathcal{G}^i, x_i, l_i) \text{ for all } i \in I. \tag{2.8}$$

Proposition 7. *The solution to the program (2.7) is such that:*

1. *The agents' maximization problem implies that:*

$$\tau = \frac{1 - \frac{U_3(\cdot)}{w}U_2(\cdot)}{1 - \kappa U_1(\cdot)/U_2(\cdot)} \tag{2.9}$$

2. *There is a unique optimal tax rate $\tau^*(\kappa) \in [0,1]$.*

3. *At any interior solution, we have that $\frac{\partial \tau^*(\kappa)}{\partial \kappa} > 0$*

Proof. Included in Appendix 2.6.2.

The optimal tax rate τ weakly increases in the degree of morality κ. This is the consequence of the fact that Kantian moral agents recognize the use of resources that their income tax has as a provider of public goods, and adjust their labor supply to be less sensitive to increases in the optimal income tax. The example below displays how part of the mechanism that yields these results stems from an expansion of fiscal capacity.

Example: expansion of fiscal capacity. Assume that the material utility function of the citizens is separable on leisure of the form $U(G, x_i, l_i) = G^\alpha x_i^{1-\alpha} + \log 1 - l_i$ for all $i \in I$, where $\alpha \in (0,1)$ measures the preferences for the public good. *Homo moralis* agents decide on leisure-consumption bundles (l_i, x_i) according to:

$$\max_{(l_i,x_i)} \mathcal{G}(\tau w l_i; G, \kappa)^\alpha x_i^{1-\alpha} + \log(1 - l_i) \tag{2.10}$$

$$\text{subject to:} \quad (l_i, x_i) \in \mathcal{B}(\tau; w),$$

where the budget set above is defined as in (2.8) and $\mathcal{G}(\tau w l_i; G, \kappa)$ is the moral valuation of the public good in 2.6 evaluated at $l_i = 1 - y_i/w_i$. In an equilibrium, every agent $i \in I$ maximizes 2.10 taking τ and G as given. Equilibrium labour supply in this case is given by:

$$\hat{l}_i(\tau, \kappa) = 1 - \frac{(1-\tau)^{1-\alpha}(\gamma\tau)^{\alpha}}{w((1-\alpha)+\alpha\kappa)}. \tag{2.11}$$

Equilibrium labour supply follows an inverse U-shaped pattern (Figure 2.11) with respect to the tax rate τ, meaning that starting from $\tau = 0$, raising taxes increases labour supply for moral agents that value the public good according to (2.6). However, there exists a threshold value of τ, call it $\tilde{\tau}$, such that $l_i^*(\tilde{\tau}, \kappa) > l_i^*(\tau, \kappa)$ for all $\tau \in [0, 1]$ such that $\tau \neq \tilde{\tau}$.. Moreover, $\tilde{\tau}$ is interior and independent of κ. Equilibrium public good provision is given by:

$$\hat{G}(\kappa; \tau) = \tau \cdot \hat{y}_i(\tau, \kappa) = \tau \cdot w_i \hat{l}_i(\tau, \kappa). \tag{2.12}$$

Figure 2.2 shows that the equilibrium public good provision $\hat{G}(\kappa; \tau)$ inherits the inverse U-shaped pattern with respect to the income tax. We can notice a "Laffer-like" pattern in which there exists an interior level of the tax rate τ, be it $\tau^L(\kappa)$ such that $\hat{G}(\kappa; \tau) < \hat{G}(\kappa; \tau^L(\kappa))$ for all $\tau \neq \tau^L(\kappa)$. Moreover, $\tau^L(\kappa)$ is increasing in κ, this suggests that homogeneous societies with higher κ would be able to sustain higher taxes without suffering from a decrease in public good provision.

The following section expands these results for the more complex environment in which there is heterogeneity of income types, and agents hold private information on their productivity parameters.

2.4 Income Heterogeneity

I now solve the non-linear taxation problem a la Mirrlees (1971): each agent private information about his productivity type (how productive they are), while the government knows only the distribution of types and the degree of morality κ, but she cannot

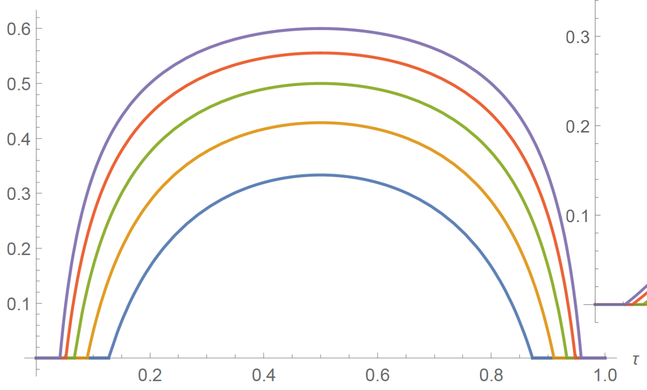

FIGURE 2.2: Equilibrium labour supply in an economy of identical agents with $\alpha = 0.5$, $w = 5$ and $\gamma = 1$.

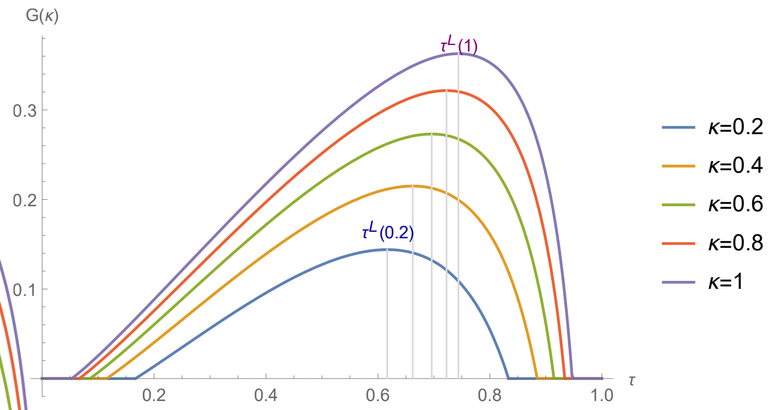

FIGURE 2.3: Equilibrium provision of the public good in an economy of identical agents with $\alpha = 0.5$, $w = 5$ and $\gamma = 1$, $\tau^L(\kappa)$ indicates public good maximising "Laffer" rates.

observe these characteristics when dealing with a particular agent. The government, however, observes each agent's pre-tax income y. It levies an income tax of $\tau(y)$ and the workers choose consumption and leisure optimally in order to maximize their utility $U\left(G, x, \frac{y}{w_j}\right)$ subject to a private resource constraint $x = y - \tau(y)$ and the government's budget constraint. For convenience, I recur to the following standard notation:

$$U\left(G, x, \frac{y}{w_j}\right) = V^j\left(G, x, y\right), \tag{2.13}$$

where the index j refers to the agent's true productivity type. Let $\psi(z, w_j)$ denote the marginal rate of substitution between labor and private consumption, where $z = (G, x, y)$:

$$\psi(z, w_j) = \frac{-V_3^j\left(G, x, y\right)}{V_2^j\left(G, x, y\right)}. \tag{2.14}$$

Assumption 1 (Agent monotonicity or single crossing)**.** *The utility function in* (2.13) *is such that* $\psi^j(z, w_j)$ *is a strictly decreasing function of* w_j*. Or, equivalently, for any z:*

$$\frac{\partial\psi_(z, w_j)}{\partial w_j} < 0. \tag{2.15}$$

Assumption 1 is the standard *single-crossing condition*. In the same spirit as with equation (2.14), define the marginal rate of substitution between public good consumption and private good consumption as:

$$\phi(z, w_j) = -\frac{V_1^j(G, x, y)}{V_2^j(G, x, y)}. \tag{2.16}$$

Let there be two types with productivites w_h and w_l: $w_h > w_l$, with proportions p_h, and $p_l = 1 - p_h \in [0, 1]$. The government cannot observe w_j nor l separately. However, it observes that each agent's pre-tax income is given by $y = w_j \cdot l$ and is able to tax it according to the tax function $\tau(y)$. Therefore, each agent's budget set is given by:

$$\mathcal{B}^j = \{(x, y) \in \mathbb{R}_+^2 : x \leq y - \tau(y)\}. \tag{2.17}$$

The government selects pairs of consumption and pre-tax income (x_n, y_n) for $n \in \{l, h\}$ in order to maximize the utilitarian welfare function subject to the two incentive compatibility and the budget constraint being met. In equilibrium, high-productivity agents choose (x_h, y_h), and low-productivity types choose (x_l, y_l). Hence, the equation for the government's budget constraint is given by:

$$G \leq p_l\tau(y_l) + p_h\tau(y_h) = p_h(y_h - x_h) + p_l(y_l - x_l). \tag{2.18}$$

As a consequence of their semi-Kantian nature, Homo moralis agents face non-standard incentive constraints which reflect the implications of the Kantian reasoning over their willingness to misreport their true type to the government. More specifically, when a type j chooses the bundle tailored for another type, she internalizes the effect on public good provision that such an action would imply if a share κ of agents of her type were to behave in the same way. Hence, when a type j of corresponding mass p_j selects an income equal to y, she perceives a virtual public good provision equal to:

$$\mathcal{G}_i^j = G + \kappa p_j \left[\tau(y_i) - \tau(y_j)\right] \tag{2.19}$$
$$= G + \kappa p_j \left[(y_i - x_i) - (y_j - x_j)\right]. \tag{2.20}$$

The above equation is what I refer to as the moral valuation of the public good. A Kantian moral agent values the public good in such a way that he weighs by κ the public good provision that would arise if all agents of his type were to report in the same way under the proposed tax code $\tau(\cdot)$ [9].

This will have an effect on the incentive constraints as they will now write:

$$V^j(\mathcal{G}_j^j, x_j, y_j) \geq V^j(\mathcal{G}_i^j, x_r, y_r), \quad \text{for all } r \neq j. \tag{2.21}$$

Noting that $\mathcal{G}_j^j = G$, the government's program hence writes:

$$\begin{aligned} &\max_{x_h, x_l, y_h, y_l} p_h \cdot V^h(G, x_h, y_h) + p_l \cdot V^l(G, x_l, y_l) \\ &(BC): \quad p_h \cdot (y_h - x_h) + p_l \cdot (y_l - x_l) \geq G \\ &(IC_h): \quad V^h(G, x_h, y_h) \geq V^h\left(\mathcal{G}_l^h, x_l, y_l\right) \\ &(IC_l): \quad V^l(G, x_l, y_l) \geq V^l\left(\mathcal{G}_h^l, x_h, y_h\right). \\ &(LS): \quad \frac{y_j}{w_r} \leq 1, \quad \text{for all } j, r \in \{l, h\}. \end{aligned} \tag{2.22}$$

Proposition 8 (Solution to program (2.22))**.** . *Assume that the cross derivative between Public Good and leisure is equal to zero, i.e :* $V_{31}(\cdot) = 0$*. Then, the solution to the problem defined in* (2.22) *for any* $\kappa \in [0,1]$ *is such that:*

1. *If* (IC_h) *binds, then the following conditions hold:*

[9] This is a simplification, since the design of $\tau(\dot{})$ may also serve for redistribution concerns, however, I abstract from this complication in the present exposition.

(a) *There is* ***no distortion at the top.*** *the marginal tax paid by the high ability type agents still remains equal to zero:*

$$\psi_h(G, x_h, y_h, w_h) = 1;$$

(b) *There is* ***distortion at the bottom.*** *Low skilled agents face a lower marginal tax rate, but the marginal tax rate depends on κ according to a function $\alpha(\kappa)$ such that:*

$$\psi_l(G, x_l, y_l, w_l) = \alpha(\kappa) < 1, \quad \textit{for } \alpha(\kappa) > 0.$$

2. *If (IC_l) binds, then the following conditions hold:*

(a) ***No distortion at the bottom.*** *the marginal tax faced by the low ability types is equal to zero:*

$$\psi_l(G, x_l, y_l, w_l) = 1;$$

(b) ***Less intense distortion at the top.*** *High skilled agents face a negative marginal tax rate, which is decreasing in the degree of morality κ according to a function $\gamma(\kappa)$ such that:*

$$\psi_l(G, x_h, y_h, w_h) = \gamma(\kappa) > 1, \quad \textit{for } \gamma(\kappa) < 0.$$

A helpful way to interpret the last proposition is to study the last equation of the proof and consider the expression:

$$\underbrace{\mu \cdot p_l}_{\substack{\text{Marginal benefit of} \\ \text{increasing } \tau(y_l) \text{ in terms} \\ \text{of the public good}}} - \underbrace{\lambda_h \kappa \cdot V_1^h(\mathcal{G}, x_l, y_l)}_{\substack{\text{Marginal cost of} \\ \text{increasing } \tau(y_l) \text{ in terms of} \\ \text{the incentive constraint}}} . \tag{2.23}$$

The first term constitutes the direct benefit of increasing the tax revenues derived from low-type consumers in terms of the public good. The second term stems from the morality motive embedded in the incentive constraints. This implies that *the planner faces an incentive to distort the marginal tax rate of the less able consumer, but when doing so he also* ***crowds out*** *the moral incentive of the able types.* Recall that moral agents have higher incentives to report truthfully, but such incentives are diluted when misreporting is not very costly in terms of the public good, which is the case when low-ability types face high-income taxes.

When the incentive constraint of the low-ability agents binds the marginal tax rates faced by less able agents are equal to zero, while the marginal tax rate faced by the high-ability individuals is negative: selection constraints require them to work more than they would in a first-best world. Moreover, notice that as the degree of morality κ increases, the marginal tax rate becomes even more negative, this is because to sustain the separating solution, the government must distort the bundle of high-types even further, as moral low-types face a relaxed IC constraint.

2.4.1 The quasilinear case

The quasilinear case captures the main trade-offs that the planner faces when solving program (2.22)[10]. Assume that agents can supply L total hours of work[11], and consider the material utility function:

$$U\left(G, x, \frac{y}{w_n}\right) = \theta G + v(x) + \left(L - \frac{y}{w_n}\right), \tag{2.24}$$

where $v(x)$ is a real-valued twice continuously differentiable function with derivatives $v'(x) > 0$ and $v''(x) < 0$, $\theta \geq 2$, and $h \geq 3$. With this parametrization allows us to characterize several objects presented above. In particular: $\psi_n = \frac{1}{w_n v'(x_n)}$, and $\phi_n(G, x, y, w_n) = \frac{\theta}{v'(x_)}$ for $n \in \{l, h\}$. The incentive constraint of the high types writes:

$$v(x_h) - v(x_l) \geq \frac{y_h - y_l}{w_h} - \kappa p_h \theta((y_h - x_h) - (y_l - x_l)).$$

[10]For the interested reader, a solution to the quasilinear case is included in Appendix 2.6.4

[11]Previously, we used the normalization $L = 1$. Here, we relax this parameter to guarantee interior solutions.

The incentive constraint above is crucial to the result, as the last term at the right-hand-side of the inequality relaxes/tightens the incentive constraint depending on the sign of the term $(y_h - x_h) - (y_l - x_l)$. As we will see, this ambiguity plays an important role in the solution to the planner's problem. Since $\theta \geq 2$, in any solution, the planner decides to set labour supply to its maximum value: $l_n = h$ for all $n \in \{l, h\}$. This consideration, together with the fact that in any solution IC_h yields the no-distortion at the top result result. Let (x_n^{sb}, y_n^{sb}) for $n \in \{l, h\}$ denote the second best solution that solves (2.22). Then, the following are necessary conditions for (2.22):

$$v'(x_h^{sb}) = \frac{1}{w_h}, \quad v(x_h^{sb}) - v(x_l^{sb}) = \frac{y_h^{sb} - y_l^{sb}}{w_h} - \kappa p_h \theta((y_h^{sb} - x_h^{sb}) - (y_l^{sb} - x_l^{sb})), \tag{2.25}$$

$$y_h^{sb} = hw_h, \quad y_l^{sb} = hw_l. \tag{2.26}$$

These equations implicitly define x_l^{sb}, Figure 2.4 presents it for some specific parameter values. As can be seen, as for low levels of κ, increases in κ lead to lower levels of x_l compared to the baseline $\kappa = 0$. This effect stems from the fact that the right-hand side of the incentive constraint is now shifted by $-\kappa p_h \theta$ this effect tends to reduce x_l linearly. Now, for low levels of κ, this effect dominates and the principal further distorts x_l downwards to guarantee that high types do not mimic. As we move to the right, we find that there is a $\hat{\kappa}$ such that this effect is reversed. The following proposition fully characterizes it.

Proposition 9 (Marginal tax rates in the quasilinear case)**.** *Assume the material utility function is given by 2.4, then any interior solution to (2.22), denoted $(x_n^{sb}(\kappa), y_n^{sb}(\kappa))$ for $n \in \{l, h\}$, is such that (2.25) holds.*

Proof. See Appendix 2.6.4.

This finding is illustrated by Figure **??** for given parameter values. An entirely selfish agent of low productivity w_l perceives the tax schedule that is implicitly determined by the solution $(x_n^{sb}(\kappa), y_n^{sb}(\kappa))$ to be even further distorted than the

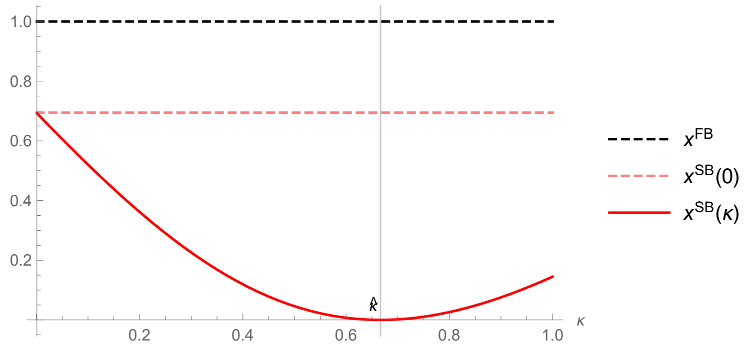

FIGURE 2.4: Second best consumption as a function of κ for $v(x) = 2\sqrt{x}$, $\theta = 2$, and $h = 4$.

baseline case (with $\kappa = 0$) whenever $\kappa < \hat{\kappa}$, and such effect would, however, be diminished for $\kappa > \hat{\kappa}$. The intuition of this result lies on the behaviour of the incentive constraint and it's effect over the consumption of the low-type that was discussed above. Increasing the degree of morality leads to surprising non-linearities on marginal tax rates once we consider heterogeneous income levels: low levels of morality may induce higher marginal taxes on low types, while this need not be the case for high levels of morality. Next, I characterize the solution to problem (2.22) for any general utility function. Some of these intuitions still hold, but the derivations are far more involved.

Figure 2.5 summarizes the result. If κ is low, the principal finds it profitable to raise marginal taxes of low types without incurring a significant incentive costs: I call this the "exploitative effect". On the other hand, if κ is high, it becomes very costly to provide incentives to high-types when marginal taxes are high for low-types (see inequality (2.59)): I call this, the "moral incentive effect"

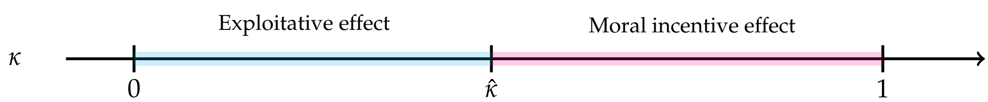

FIGURE 2.5: Morality parameter and marginal tax rate of low-ability types.

2.4.2 On the optimal level of public good provision

Following the approach proposed by Boadway and Keen (1993), I obtain a formula for the distortion in the provision of public goods, and disentangle the part of this effect that stems from the incentive compatibility constraint from the part that is due to the morality motive. For the sake of reducing the length of the notation, I denote the utility of the mimicker as:

$$\hat{V}^h = V^h(\mathcal{G}_l^h, x_n, y_l) \tag{2.27}$$

Focus on the condition of optimality for the public good given in the proof of Proposition 8. We can add and subtract $\lambda_h \cdot \hat{V}_2^h \left(\frac{V_1^l}{V_1^h}\right)$ and obtain the following:

$$\frac{\partial \mathcal{L}}{\partial G} = \left((1-p_h)V_2^l - \lambda_h \hat{V}_2^h\right) \cdot \frac{V_1^l}{V_2^l} + (p_h + \lambda_h)V_1^h + \lambda_h \hat{V}_2^h \left(\frac{V_1^l}{V_2^l} - \frac{\hat{V}_1^h}{\hat{V}_2^h}\right) = 0 \tag{2.28}$$

We can now substitute for the terms $(1-p_h)V_2^l - \lambda_h \hat{V}_2^h$ and $(p_h + \lambda_h)$ using the optimality conditions for $\{x_l\}$ and $\{x_h\}$ respectively and obtain the following expression:

$$\frac{1}{\mu}\frac{\partial \mathcal{L}}{\partial G} = \left[(1-p_h)\frac{V_1^l}{V_2^l} + p_h\frac{V_1^h}{V_2^h} - 1\right] + \frac{\lambda_h \hat{V}_2^h}{\mu}\left(\frac{V_1^l}{V_2^l} - \frac{\hat{V}_1^h}{\hat{V}_2^h}\right) + \kappa\frac{\hat{V}_2^h \cdot \lambda_h}{\mu}\left[\frac{V_1^h}{V_2^h}\frac{V_1^h}{\hat{V}_2^h} + \frac{V_1^l}{V_2^l}\frac{\left((1-p_h)V_1^h - \hat{V}_1^h\right)}{\hat{V}_2^h}\right] \tag{2.29}$$

equation (2.29) gives us the change in social welfare measured in terms of public sector funds given a raise in the public good G. It contains three elements: (i) the direct effect of increasing the provision of the public good net of the cost (which is 1); (ii) the indirect effect of this increase on the incentive compatibility constraints. These first two effects were studied first by Boadway and Keen (1993). The morality motive, however, provides a new component: (iii) the "moral" or "pro-social" motive. This term implies that the change in social welfare when raising the provision of the public good is proportional to the sum of the marginal rate of substitution of high types between the consumption of the public good and the private good $\frac{V_2^h}{V_1^h}$ and the same marginal rate of substitution for the low types $\frac{V_2^l}{V_1^l}$ adjusted by the net cost of attaining the incentive constraint for the low types $\left((1-p_h)V_2^h - \hat{V}_2^h\right)$.

Proposition 10. *If the social planner is utilitarian, the welfare-maximizing public good provision is pinned-down by:*

$$\sum_{n\in\{l,h\}} p_n \frac{V_2^n}{V_1^n} = \underbrace{1}_{(y)} + \underbrace{\frac{\lambda_h \hat{V}_1^h}{\mu}\left(\frac{\hat{V}_2^h}{\hat{V}_1^h} - \frac{V_2^l}{V_1^l}\right)}_{(ii)} \underbrace{- \kappa \frac{\hat{V}_1^h \cdot \lambda_h}{\mu}\left[\frac{V_2^h}{V_1^h}\frac{V_2^h}{\hat{V}_1^h} + \frac{V_2^l}{V_1^l}\frac{\left((1-p)V_2^h - \hat{V}_2^h\right)}{\hat{V}_1^h}\right]}_{(iii)} \tag{2.30}$$

Proposition 10 expands the baseline result obtained by Boadway and Keen (1993): the planner's design problem implies that optimality requires that the sum of marginal rates of substitution is equal to (i) the cost of public goods, plus (ii) a term of distortion that stems from the fact that the planner must choose the optimal level of public good while still providing incentives for the high types to report truthfully. However, the morality motive (iii) provides for a new distortion to the Samuel condition above, which is given by the blue term in equation (2.30). Again, it is proportional to the net gain of an increase of the taxes for the low type agents.

We can interpret (ii) in the following way: provided $\kappa = 0$, when the low ability types value the public good more than the mimicking $\left(\frac{\hat{V}_1^h}{\hat{V}_2^h} < \frac{V_1^l}{V_2^l}\right)$, then the public good should be over-provided with respect to the social optimum given by the Samuelson Rule. The intuition behind this result is that over-provision can be used by the planner as an instrument for redistribution because of its effect on the incentive constraints. The argument is symmetric for the opposite case in which the low-ability types value the public good less than the mimicker.

Now, focus on (iii), for any positive degree of morality $\kappa > 0$, a positive value of the term in brackets would imply that the planner raises the level of provision of the public good. This would happen when either the (a) baseline utility derived of high types *that don't mimic* V_1^h / V_2^h is high, or (b) the *net benefit of raising the marginal tax rate of the low type* $\left((1-p_h)V_1^h - \hat{V}_1^h\right)$ is high. In the natural case in which this net benefit is negative, this yields an attenuation of the over-provision result implied by (ii), as the crowding out effect described in the previous section implies that redistribution through over-provision of the public good would be more costly compared to the baseline.

2.5 Discussion and application

The model presented in this paper is designed to be as general as possible and can be applied in a variety of economic environments. Some possible applications are outlined in the appendix, while others are left for future research.

Global Public Goods: Energy Conservation, Climate Action. This model is well-suited for examining global public goods, where individual actions have a minimal impact on overall provision. It is interesting to note the repeated calls for individual action in these contexts, despite the negligible effects of such actions. For example, in one of the earliest contributions to this literature, Laffont (1975) raised this issue in regards to energy conservation: "Why should voluntary conservation efforts work if people are selfish maximizers?" A similar argument can be made today for efforts to reduce high carbon-emitting practices that contribute to the public bad of climate change, such as promoting greener lifestyles, diets, and products, and reducing the use of one-use plastics.

Public or Private Provision: The Case for Charitable Contributions. The model can also be used to examine charitable giving, in which individuals derive utility from contributing to a public good, and the government can complement this through taxes and deductions. This application is discussed in Section **??** (work in progress), based on the work of Diamond (2006a).

Civic Virtue. Algan and Cahuc (2009) argues that civic virtue plays a critical role in the design of public unemployment insurance. Future work could explore whether the model presented here yields similar predictions when unemployment insurance is considered a public good.

2.6 Conclusion

Departing from the useful but unlikely assumption that individuals are *exclusively* motivated by their selfish agendas solves some empirical inconsistencies that are regularly found in the literature in public economics. More specifically, assuming that individuals may be partially motivated by a version of Kantian morality, asking themselves if they are acting according to what they would like to be universal behavior across the population, leads to results that may be closer to the empirical findings regarding voluntary contributions on a public good and willingness to pay taxes.

Homo moralis preferences help explain why voluntary contributions to a public good may be positive even if group size is infinitely large. They provide a channel through which agents may partially internalize the cost that they impose on others when free-riding. This implies a higher public good provision in equilibrium than the one achieved when consumers are entirely selfish. Moreover, public good production may be increasing in the degree of morality of such a population.

The same holds for the case in which individuals do not contribute voluntarily, but instead, there exists a government that is in charge of taxing individuals' labor income to finance the production of the public good. *Homo moralis* preferences predict that in such a setting the average income tax rate will increase to finance a higher provision of public good, while marginal tax rates -however- will still attain the *no distortion at the top* property observed in the typical non-linear taxation problems.

At last, a higher degree of morality is directly linked to an expansion of fiscal capacity: societies with a higher degree of morality can tax income at higher rates and provide more public goods. The public good maximizing income tax that can be implemented by the government increases in the degree of morality.

Appendix

2.6.1 Proofs of proposition 6

Proof. The planner's problem writes:

$$\max_{\{x_l, x_h, G\}} p_h \cdot U\left(G, x_h, 1\right) + p_l \cdot U\left(G, x_l, 1\right) \tag{2.31}$$

subject to the public good production constraint:

$$\sum_{n \in \{l,h\}} p_n (w_n - x_n) \geq G. \tag{2.32}$$

and the feasibility constraints:

$$x_l \in [0, w_l] \quad \text{and} \quad x_h \in [0, w_h]. \tag{2.33}$$

Since U is increasing in both G and x, equation (2.32) must bind. Therefore the Lagrangian associated to this problem, with associated multipliers μ_1 and μ_2, writes:

$$\begin{aligned} \mathcal{L}\left(x_h, x_l, \mu, 1\right) =& p_h \cdot U\left(\sum_{n \in \{l,h\}} p_n (w_n - x_n), x_h, 1\right) + p_l \cdot U\left(\sum_{n \in \{l,h\}} p_n (w_n - x_n), x_l, 1\right) \\ & + \mu_1 (w_1 - x_1) + \mu_2 (w_2 - x_2). \end{aligned} \tag{2.34}$$

The necessary first-order conditions satisfy:

$$\frac{\partial \mathcal{L}\left(x_h, x_l, \mu\right)}{\partial x_h} = p_h \left[-p_h U_1(G, x_h, 1) + U_2(G, x_h, 1)\right] + p_l \left[-p_h U_1(G, x_l, 1)\right] - \mu_1 = 0 \tag{2.35}$$

$$\frac{\partial \mathcal{L}\left(x_h, x_l, \mu\right)}{\partial x_l} = p_h \left[-p_l U_1(G, x_h, 1)\right] + p_l \left[-p_l U_1(G, x_l, 1) + U_2(G, x_h, 1)\right] - \mu_2 = 0 \tag{2.36}$$

At an interior solution $(x_l, x_h) \in (0, w_l) \times (0, w_H)$ we have that $\mu_1 = \mu_2 = 0$, so we can combine the previous equations to obtain $U_2(G, x_h, 1) = p_l U_1(G, x_l, 1) + p_h U_1(G, x_l, 1) = U_2(G, x_l, 1)$, which we can divide by $U_2(G, x_l)$ and $U_2(G, x_h)$ to obtain:

$$\sum_{n \in \{l,h\}} p_n \cdot \frac{U_1(G, x^*(w_n), 1)}{U_2(G, x^*(w_n), 1)} = 1$$

2.6.2 Proof of Proposition 7

We can write the objetive function of the agent as $U\left(\mathcal{G}^i, (1-\tau)y_i, 1-\dfrac{y_i}{w_i}\right)$. Hence, the agent optimaility condition writes:

$$\kappa\tau U_1(\cdot) + (1-\tau)U_2(\cdot) - \frac{1}{w_i}U_3(\cdot) = 0$$

We can divide this equation by $U_2(\cdot)$ and solve for the tax rate:

$$\begin{aligned}
\kappa\tau\frac{U_1(\cdot)}{U_2(\cdot)} + (1-\tau) - \frac{1}{w_i}\frac{U_3(\cdot)}{U_2(\cdot)} &= 0 \\
1-\tau\left(1-\kappa\frac{U_1(\cdot)}{U_2(\cdot)}\right) - \frac{1}{w_i}\frac{U_3(\cdot)}{U_2(\cdot)} &= 0 \\
\tau\left(1-\kappa\frac{U_1(\cdot)}{U_2(\cdot)}\right) &= 1 - \frac{1}{w_i}\frac{U_3(\cdot)}{U_2(\cdot)} \\
\tau &= \frac{1-\frac{1}{w_i}\frac{U_3(\cdot)}{U_2(\cdot)}}{\left(1-\kappa\frac{U_1(\cdot)}{U_2(\cdot)}\right)}
\end{aligned}$$

The Government's objective has an associated lagrangian with mutiplier $\lambda > 0$ give by:

$$\mathcal{L}(G,\tau,\lambda) = U\left(G, y(\tau)(1-\tau), 1-\frac{y}{w}\right) + \lambda(G - \tau y(\tau))$$

The First Order Conditions then write:

$$(\tau):\ -U_2(\cdot)(y(\tau)) - \frac{1}{w}U_3(\cdot) = \lambda(y(\tau))$$
$$(G):\ U_1(\cdot) = -\lambda$$

These two conditions imply that together with the solution of the agents' problem imply that:

$$\tau = \frac{1 - y(\tau)\left(\frac{U_1(\cdot)}{U_2(\cdot)} + 1\right)}{\left(1-\kappa\frac{U_1(\cdot)}{U_2(\cdot)}\right)}$$

2.6.3 Proof of Proposition 8

When IC_h binds, the Lagrangian associated with problem (2.22) writes:

$$\begin{aligned}
\mathcal{L}\left(x_h, y_h, x_l, y_l, G\right) =& p_h \cdot V^h\left(G, x_h, y_h\right) + p_l \cdot V^l\left(G, x_l, y_l\right) + \lambda_h\left(V^h\left(G, x_h, y_h\right) - V^h\left(\mathcal{G}_l^h, x_l, y_l\right)\right) \\
&+ \mu\left(p_h \cdot (y_h - x_h) + p_l \cdot (y_l - x_l) - G\right) \qquad (2.37)
\end{aligned}$$

Recalling that $\mathcal{G}_l^h = G + \kappa p_h((y_l - x_l) - (y_h - x_h))$, the necessary first order conditions to this problem write:

$$\frac{\partial \mathcal{L}}{\partial x_h} = p_h \cdot V_2^h(G, x_h, y_h) + \lambda_h V_2^h(G, x_h, y_h) - \lambda_h \kappa p_h V_1^h(\mathcal{G}_l^h, x_l, y_l) - \mu \cdot p_h = 0 \tag{2.38}$$

$$\frac{\partial \mathcal{L}}{\partial x_l} = p_l \cdot V_2^l(G, x_l, y_l) - \lambda_h \left(-\kappa p_h V_1^h\left(\mathcal{G}_l^h, x_l, y_l\right) + V_2^h\left(\mathcal{G}_l^h(y_l), x_l, y_l\right)\right) - \mu \cdot p_l = 0 \tag{2.39}$$

$$\frac{\partial \mathcal{L}}{\partial y_h} = p_h \cdot V_3^h(G, x_h, y_h) + \lambda_h \left(V_3^h\left(\mathcal{G}_l^h, x_h, y_h\right) + \kappa p_h V_1^h\left(\mathcal{G}_l^h, x_l, y_l\right)\right) + \mu \cdot p_h = 0 \tag{2.40}$$

$$\frac{\partial \mathcal{L}}{\partial y_l} = p_l \cdot V_3^l(G, x_l, y_l) - \lambda_h \left(V_3^h(G, x_l, y_l) + \kappa p_h V_1^h(\mathcal{G}_l^h, x_l, y_l)\right) + \mu \cdot p_l = 0 \tag{2.41}$$

$$\frac{\partial \mathcal{L}}{\partial G} = p_h \cdot V_1^h(G, x_h, y_h) + p_l \cdot V_1^l(G, x_l, y_l) + \lambda_h \left(V_1^h(G, x_h, y_h) - V_1^h\left(\mathcal{G}_l^h, x_l, y_l\right)\right) - \mu = 0 \tag{2.42}$$

Summing up the first and third equations:

$$p_h \cdot V_2^h(G, x_h, y_h) + p_h \cdot V_3^h(G, x_h, y_h) + \lambda_h \left(V_2^h(G, x_h, y_h) + V_3^h(G, x_h, y_h)\right) = 0. \tag{2.43}$$

Hence we obtain the no distortion at the top result:

$$\psi_h(G, x_h, y_h) = \frac{-V_3^h(G, x_h, y_h)}{V_2^h(G, x_h, y_h)} = 1. \tag{2.44}$$

Divide the fourth equation by the second one and obtain:

$$\frac{V_3^l(G, x_l, y_l)}{V_2^l(G, x_l, y_l)} = \frac{-\mu \cdot p_l + \lambda_h \left(V_3^h(\mathcal{G}_l^h, x_l, y_l) + \kappa p_h V_1^h(\mathcal{G}_l^h, x_l, y_l)\right)}{\lambda_h \left(V_2^h(\mathcal{G}_l^h, x_l, y_l) - \kappa V_1^h(\mathcal{G}_l^h, x_l, y_l)\right) + \mu \cdot p_l}. \tag{2.45}$$

We can now multiply both sides by $(\lambda_h \left(V_2^h(\mathcal{G}_l^h, x_l, y_l) - \kappa V_1^h(\mathcal{G}_l^h, x_l, y_l)\right) + \mu \cdot p_l) / V_2^h(G, x_l, y_l)$:

$$\begin{aligned}
&\frac{V_3^l(G, x_l, y_l)}{V_2^l(G, x_l, y_l)} \left(\frac{\lambda_h \left(V_2^h(\mathcal{G}_l^h, x_l, y_l) - \kappa V_1^h(\mathcal{G}_l^h, x_l, y_l)\right) + \mu \cdot p_l}{V_2^h(\mathcal{G}_l^h, x_l, y_l)}\right) \\
&= \frac{-\mu \cdot p_l + \lambda_h \left(V_3^h(\mathcal{G}_l^h, x_l, y_l) + p_h \kappa V_1^h(\mathcal{G}_l^h, x_l, y_l))\right)}{V_2^h(\mathcal{G}_l^h, x_l, y_l)} \\
&= -\frac{\mu \cdot p_l - \lambda_h p_h \kappa V_1^h(\mathcal{G}_l^h, x_l, y_l)}{V_2^h(\mathcal{G}_l^h, x_l, y_l)} + \frac{\lambda_h V_3^h(\mathcal{G}_l^h, x_l, y_l)}{V_2^h(\mathcal{G}_l^h, x_l, y_l)}.
\end{aligned}$$

Rearranging the last equation we obtain:

$$\frac{\mu \cdot p_l - \lambda_h p_h \kappa V_1^h(\mathcal{G}_l^h, x_l, y_l)}{V_2^h(\mathcal{G}_l^h, x_l, y_l)} \left(1 + \frac{V_3^l(G, x_l, y_l)}{V_2^l(G, x_l, y_l)}\right) = \lambda_h \left(\frac{V_3^h(\mathcal{G}_l^h, x_l, y_l)}{V_2^l(G, x_l, y_l)} - \frac{V_3^l(G, x_l, y_l)}{V_2^l(G, x_l, y_l)}\right) \tag{2.46}$$

The term in brackets on the left-hand side of the last equation constitutes the marginal tax right for the low ability types. Recall that the single crossing assumption asserts that $\psi_h(G, x_l, y_l) < \psi_l(G, x_l, y_l)$ given that $V_{13} = 0$ by assumption.

2. If $(IC)_L$ binds the Lagrangian associated with problem (2.22) writes:

$$\begin{aligned}\mathcal{L}\left(x_h, y_h, x_l, y_l, G\right) = & p_h \cdot V^h\left(G, x_h, y_h\right) + p_l \cdot V^l\left(G, x_l, y_l\right) + \lambda_l\left(V^l\left(G, x_l, y_l\right) - V^l\left(\mathcal{G}_h^l, x_h, y_h\right)\right) \\ & + \mu\left(p_h \cdot (y_h - x_h) + p_l \cdot (y_l - x_l) - G\right)\end{aligned} \tag{2.47}$$

Recalling that $\mathcal{G}_h^l = G + \kappa p_l((y_h - x_h) - (y_l - x_l))$, the necessary first order conditions to this problem write. The necessary first order conditions to this problem write:

$$\frac{\partial \mathcal{L}}{\partial x_h} = p_h \cdot V_2^h\left(G, x_h, y_h\right) + \lambda_l\left(-V_2^l\left(\mathcal{G}_h^l, x_h, y_h\right) + \kappa \cdot p_l V_1^l\left(\mathcal{G}_h^l, x_h, y_h\right)\right) - \mu \cdot p_h = 0 \tag{2.48}$$

$$\frac{\partial \mathcal{L}}{\partial y_h} = p_h \cdot V_3^h\left(G, x_h, y_h\right) + \lambda_l\left(-V_3^l\left(\mathcal{G}_h^l, x_h, y_h\right) - \kappa \cdot p_l V_1^l\left(\mathcal{G}_h^l, x_h, y_h\right)\right) + \mu \cdot p_h = 0 \tag{2.49}$$

$$\frac{\partial \mathcal{L}}{\partial x_l} = p_l \cdot V_l^2\left(G, x_l, y_l\right) + \lambda_l\left(V_2^l\left(G, x_l, y_l\right) - \kappa p_l V_1^l\left(\mathcal{G}_h^l, x_h, y_h\right)\right) - \mu \cdot p_l = 0 \tag{2.50}$$

$$\frac{\partial \mathcal{L}}{\partial y_l} = p_l \cdot V_l^2\left(G, x_l, y_l\right) + \lambda_l\left(V_3^l\left(G, x_l, y_l ht\right) + \kappa p_l V_1^l\left(\mathcal{G}_h^l, x_h, y_h\right)\right) + \mu \cdot p_l = 0 \tag{2.51}$$

$$\frac{\partial \mathcal{L}}{\partial G} = p_h \cdot V_1^h\left(G, x_h, y_h\right) + p_l \cdot V_1^l\left(G, x_l, y_l\right) + \lambda_l\left(V_1^l\left(G, x_l, y_l\right) - V_1^h\left(\mathcal{G}_h^l, x_h, y_h\right) - \mu = 0\right. \tag{2.52}$$

in the same manner as in the previous proof, summing up the third and fourth equations:

$$\psi_l(G, x_l, y_l) = \frac{-V_3^l(\mathcal{G}, x_l, y_l)}{V_2^l(G, x_l, y_l)} = 1 \tag{2.53}$$

On the other hand, we can define again $C(\kappa) = -\kappa V_1^l(\mathcal{G}_h^l, x_h, y_h)$, divide the second equation by the first one and obtain:

$$\frac{V_3^h\left(G, x_h, y_h\right)}{V_2^h(G, x_h, y_h)} = \frac{-\mu \cdot p_h + \lambda_l\left(V_3^l(\mathcal{G}_h^l, x_h, y_h) - C(\kappa)\right)}{\lambda_l\left(V_2^l(\mathcal{G}_h^l, x_h, y_h) + C(\kappa)\right) + \mu \cdot p_h} \tag{2.54}$$

Following the same logic of the previous proof, we can now multiply both sides by:

$$(\lambda_l\left(V_3^l(\mathcal{G}, x_h, y_h) + C(\kappa)\right) + \mu \cdot p_h)/V_2^l(\mathcal{G}, x_h, y_h)$$

and obtain:

$$(1 - \psi_h(G, x_h, y_h)) = \frac{\lambda_l V_2^l(\mathcal{G}_h^l, x_h, y_h)}{\mu \cdot p_h + \lambda_l \cdot C(\kappa)}\left(\psi_h\left(\mathcal{G}_h^l, x_h, y_h\right) - \frac{V_3^l(\mathcal{G}_h^l, x_h, y_h)}{V_2^h(G, x_h, y_h)}\right) < 0 \tag{2.55}$$

As in the previous proof, the term in brackets is negative as long as there is separability between leisure and the consumption of the public good, which yields the desired result.

2.6.4 Proof of Section 4: The quasilinear case

Assume that agents have utilities of the form:

$$V^j(\mathcal{G}(y_j), x_j, y_j) = A^j(x_j, y_j) + \theta \cdot \mathcal{G}(\kappa; y_j), \quad \text{for } \theta \geq 1. \tag{2.56}$$

This means that preferences are quasilinear with respect to the public good. Notice that the single-crossing assumption for the low-ability agents in this case writes:

$$\psi_l(w_l) = \frac{-\partial A^h(x_l, y_l)/\partial y_l}{\partial A^h(x_l, y_l)/\partial x_l} < \frac{-\partial A^l(x_l, y_l)/\partial y_l}{\partial A^l(x_l, y_l)/\partial x_l} = \psi_l(w_h). \tag{2.57}$$

From the previous equation, notice that quasi linearity implies that single crossing is independent from the consumption of the public good. Using the definition of the moral valuation of the public good presented above:

$$V^j(\mathcal{G}(y_n), x_n, y_n) = A^j(x_n, y_n) + \theta \cdot \left[(1-\kappa) \cdot G + \kappa \cdot p_j \cdot (y_j - x_j)\right]. \tag{2.58}$$

Equation (2.58) allows us to write the incentive constraints of the high-ability agents as:

$$A^h(x_h, y_h) - A^h(x_l, y_l) \geq \kappa \cdot p_h \cdot \theta \left[(y_l - x_l) - (y_h - x_h) \right]. \tag{2.59}$$

The problem faced by an utilitarian planner that has paternalistic preferences over the provision of public good (i.e, she only considers G instead of $\mathcal{G}(\kappa)$ in her objective function):

$$\begin{aligned}
&\max_{x_h, x_l, y_h, y_l} \theta \cdot G + p_h \cdot V^h\left(x_h, y_h\right) + p_l \cdot V^l\left(x_l, y_l\right) \\
&(BC): \quad p_h \cdot (y_h - x_h) + p_l \cdot (y_l - x_l) \geq G \\
&(IC_h): \quad A^h(x_h, y_h) - A^h(x_l, y_l) \geq -\kappa \cdot p_h \cdot \theta \left((y_h - x_h) - (y_l - x_l) \right) \\
&(IC_l): \quad A^l(x_l, y_l) - A^l(x_h, y_h) \geq -\kappa \cdot p_l \cdot \theta \left((y_l - x_l) - (y_h - x_h) \right)
\end{aligned} \tag{2.60}$$

Assume that one of the two incentive constraints binds and then substitute this in the objective function of the principal. Notice that the problem is strictly increasing in G, therefore the budget constraint (BC) must bind at any solution. Therefore, substitute the budget constraint in the objective function and write the Lagrangian associated with the problem above as a function of x_n and y_n:

$$\begin{aligned}
\mathcal{L}\left(x_h, y_h, x_l, y_l, \lambda_h\right) =& \theta \cdot \left(\sum_{j \in l,h} p_j (y_j - x_j) \right) + p_h \cdot V^h\left(x_h, y_h\right) + p_l \cdot V^l\left(x_l, y_l\right) \\
&+ \lambda_h \left(A^h(x_h, y_h) - A^h(x_l, y_l) + \kappa \cdot p_h \cdot \theta \left((y_h - x_h) - (y_l - x_l) \right) \right)
\end{aligned} \tag{2.61}$$

The first-order optimality conditions to this problem write:

$$\frac{\partial \mathcal{L}\left(x_h, y_h, x_l, y_l, \lambda_h\right)}{\partial x_h} = -\theta \cdot p_h + p_h \cdot A^h_{x_h} + \lambda_h \left(A^h_{x_h} - \theta \cdot \kappa \cdot p_h \right) = 0 \tag{2.62}$$

$$\frac{\partial \mathcal{L}\left(x_h, y_h, x_l, y_l, \lambda_h\right)}{\partial y_h} = \theta \cdot p_h + p_h \cdot A^h_{y_h} + \lambda_h \left(A^h_{y_h} + \theta \cdot \kappa \cdot p_h \right) = 0 \tag{2.63}$$

$$\frac{\partial \mathcal{L}\left(x_h, y_h, x_l, y_l, \lambda_h\right)}{\partial x_l} = -\theta \cdot p_l + p_l \cdot A^l_{x_l} + \lambda_h \left(-A^h_{x_l} + \theta \cdot \kappa \cdot p_h \right) = 0 \tag{2.64}$$

$$\frac{\partial \mathcal{L}\left(x_h, y_h, x_l, y_l, \lambda_h\right)}{\partial y_l} = \theta \cdot p_l + p_l \cdot A^l_{y_l} + \lambda_h \left(-A^h_{y_l} - \theta \cdot \kappa \cdot p_h \right) = 0 \tag{2.65}$$

(2.66)

The above system allows us to characterize completely the solution to the planner's problem. First. Notice that we adding the two first order conditions yields:

$$\frac{-\partial A^h(x_h, y_h)/\partial y_h}{\partial A^h(x_h, y_h)/\partial x_h} = 1.$$

It follows from the decentralized solution (see proposition 8) that optimality requires that the planner provides an undistorted bundle to the high-ability types: this is the classic *no distortion at the top* result from the contract theory literature.

Next, we can re-arrange the last two equations provided above in order to obtain:

$$\psi_l(w_l) \triangleq \frac{-A^l_{y_l}}{A^l_{x_l}} = \frac{\theta \cdot p_l - \lambda \left(A^h_{y_l} + \theta \cdot \kappa \cdot p_h\right)}{\theta \cdot p_l + \lambda \left(A^h_{x_l} + \theta \cdot \kappa \cdot p_h\right)} \tag{2.67}$$

In order to ease the manipulation of the previous equation I define the following constants that will allow to handle the last equation easily:

$$v = \frac{\lambda_h A^h_{x_l}}{\theta p_l}, \quad \text{and} \quad K(\kappa) = \theta \cdot \kappa \cdot p_h. \tag{2.68}$$

We can now rewrite the previous equation as:

$$\psi_l(w_l) \triangleq \frac{-A^l_{y_l}}{A^l_{x_l}} = \frac{1 - v \cdot K(\kappa) + \psi_l(w_h)}{1 + v - vK(\kappa)} \tag{2.69}$$

By multiplying the previous equation by $1 + v - vK(\kappa)$ and rearranging the result we obtain:

$$(1 - v \cdot K(\kappa))(1 - \psi_l(w_l)) = v \cdot (\psi_l(w_l) - \psi_l(w_h)) \tag{2.70}$$

Recall that the single crossing assumption implies that the term in the numerator is always positive. On the other hand, the quadratic term $\left(1 - \theta\kappa p_l/A^l_{x_l}\right)\left(1 - \lambda A^h_{x_l}\kappa p_h/p_l\right)$ is increasing in κ if and only if $\kappa > \hat{\kappa}(\theta, \lambda_h, p_h, A^l_{x_l} A^h_{x_l})$ where:

$$\hat{\kappa}(\theta, \lambda_h, p_h, A^l_{x_l}, A^l_{x_l}) = \frac{1}{\theta}\frac{A^l_{x_l}}{p_l} + \frac{1}{\lambda_h}\frac{p_l}{p_h}\frac{1}{A^h_{x_l}}.$$

Chapter 3

Moral preferences as determinants of fiscal capacity

This paper introduces semi-Kantian Homo Moralis preferences (Alger and Weibull 2013, 2016) as a new framework to model how citizens' preferences influence the long-term fiscal capacity of states. This approach explains notable correlations between government trust and tax compliance, as shown in various surveys. It serves as an alternative microfoundation to Besley's (2020) reciprocity-based model. In both models, the fair distribution of tax proceeds by the Elite enhances citizens' tax compliance. However, this paper's framework extends beyond Besley's by linking the equilibrium of higher taxation and the emergence of strong civic cultures to individual moral considerations, offering insights into the relationship between fiscal policies and intrinsic individual moral values.

3.1 Introduction

Scholars have developed two distinct theories about the origins of states. The first theory is based on the notion of a "social contract" between the citizens and the State (Rousseau, 1762) . It suggests that community members voluntarily give a select group the power to rule, with this governing entity tasked with delivering crucial public services. The second strand of theories, developed after the work of Thomas Hobbes, instead focuses on the exploitative nature of the government as a cohesive institution. These extractive theories of government argue instead that a powerful elite group forms the State mainly to exploit resources through taxation and similar methods.

In this paper, I consider Kantian moral motivations as determinants of citizens' sense of civic duty, consistent with the social contract view of the State. In the model, agents consider the role of the government as a provider of public goods tab1.png

FIGURE 3.1: World Values Survey: determinants of tax compliance, from Besley (2020)

and transfers to the citizens when undertaking their compliance decisions. Notably, they ask themselves about the hypothetical public good provision and transfers that would arise if other members of the society made the same compliance decision as them. This universalization logic resembles Kant's (1785) categorical imperative, which posits the question: What if a fraction of the population were to act in the same way that I am acting?

As shown by Figure 3.1, evidence from the World Values Survey demonstrates a positive correlation between trust in the government and tax compliance. This finding is consistent with the social contract theories, suggesting that trust in the government and institutions is fundamental for fostering well-functioning States.

So far, most economic literature has focused on views that resemble the Hobbesian nature of the relationship between citizens and a ruler. The literature that has focused on the social contract view has instead relied on the concept of reciprocity' between the citizens and the State (Levi, 1989; Besley, 2020). In this paper, I propose an alternative model based on individual moral preferences for universalization.

Instead of relying on the concept of reciprocity, it presents a novel approach to understanding the dynamics of fiscal capacity development in states; this approach consists of considering the role of semi-Kantian Homo Moralis preferences, as developed by Alger and Weibull (2013b) and Alger and Weibull (2016b). In more detail, the work extends the current theoretical framework to include the influence of citizens' moral preferences on their interactions with the State, providing an alternative set of microfoundations for modeling the evolution of state fiscal capacity

While Besley's model primarily examines the role of the Elite's tax strategies in shaping civic culture and tax compliance through the lens of civic-minded citizens who make their compliance decisions based on the expenditure patterns of a ruling Elite, this paper derives predictions based on moral dimensions that motivate citizens' compliance behavior as captured by citizens' degree of Kantian morality. It explores how a fair distribution of tax proceeds by the Elite not only fosters voluntary compliance but is also dependent on the intrinsic moral values of the citizens. This paper hypothesizes that individual moral considerations significantly impact the long-term fiscal strategies of states, influencing both the equilibrium of higher taxation and the emergence of robust civic cultures.

To compare the conclusions implied by this new model of preferences, I present a model that stays as closely as possible to that of Besley but instead lets citizens be equipped with Homo moralis preferences. In the model, agents can be laymen or part of the ruling Elite. The Elite chooses the income tax rate the rest of the population pays. Tax proceeds have three uses: to finance a pure public good to redistribute among the Elite and the non-elite. The non-elite pays the tax, but they can try to hide part of their income. Civic-motivated citizens are more likely to pay taxes if the redistribution to the Elite is sufficiently moderate, that is if the Elite is 'fair.' In a coordination game, the Elite finds it optimal not to appropriate the resources as long as the collected taxes are 'large enough,' which depends on the fiscal capacity (the degree of tax enforcement), compliance, and the degree of Kantian morality in the population. However, the degree of compliance depends on whether the elite appropriates the resources. Ultimately, the equilibrium depends on fiscal capacity and individual morality.

The last section discusses the critical distinction between the two modeling alternatives and the relevant conclusions implied by my approach. In a nutshell, Homo moralis agents, characterized by their concern for the perceived usefulness of their contributions, adjust their compliance decisions conditionally based on the government's funding of public goods considered beneficial to the public, unlike civic-minded citizens who solely react to the disparity between taxes raised and public expenditures.

Moreover, Kantian moral agents are shown to react positively to increased institution cohesiveness, leading to greater compliance and possibly putting forward a preference-based alternative to the emergence of common interest states. Societies with high levels of morality may incentivize public provision even when the marginal value of public goods is relatively low.

The rest of the paper is organized as follows: Sections 2 to 4 lay out the baseline model and derive its main predictions. Section 5 discusses the results and proposes avenues for future research.

3.2 Baseline model

I consider a model in which citizens can belong to two different groups: (i) a ruling elite that makes decisions about transfers and public goods and (ii) tax-paying citizens. To simplify mathematical expressions, I fix the population size to 2 and let all the citizens have income $w \geq 0$.

The material utility function of all citizens is linear in public and private goods, that is, $U(G, y) = \alpha G + y$, where G is expenditure on a public good financed through taxes, $\alpha > 0$ is the marginal utility from the consumption of the public good and y is private consumption. We may interpret α as capturing the intensity of the threat of war (Besley and Persson, 2011). Therefore, larger values of α are associated with a larger necessary investment in defensive capabilities. Citizens can hide a fraction $n \in [0,1]$ of their income from the tax authorities (n stands for non-compliance).

3.2.1 Policy and institutions

The Elite decides on policy, which is comprised of four elements:

1. t: tax rate on income w,
2. G: expenditure of the public good,
3. B: transfers to the Elite[1],
4. b: transfers to the taxpayers.

As in the baseline model by Besley and Persson (2011), to capture the strength of institutions, I assume that for every unit that the elite transfers to itself, it must give $\sigma \in (0,1)$ units to the taxpayers: $b = \sigma B$. An increase in σ implies that institutions are more cohesive and, in turn, motivates the state to spend on the public good G. We can substitute $b = \sigma B$ and write the government budget constraint as:

$$B = \theta(\sigma)[T - G],$$

where T stands for taxation per capita and $\theta(\sigma) = [1+\sigma]^{-1} \in [1/2, 1]$ is the effective "price" of the public good to the Elite, taking into account that the transfers spent to provide them. It is convenient to decompose the tax revenues as the proportion $1 - \rho \in [0,1]$ used for transfers and the one ρ used for the public good. That is, $G = \rho T$, which means that we can write the total transfer to the Elite and citizens as:

$$B + b = (1-\rho)T. \tag{3.1}$$

3.2.2 Compliance by moral agents

Citizens decide how much income they should misreport to the authorities by maximizing their Homo-Moralis utilities.

Assume that every citizen has a **degree of morality** $\kappa \in [0,1)$. Let G denote the global public good. *Homo moralis* preferences over the provision of public good for a citizen that conceals a fraction of their income $n \in [0,1]$ are given by:

$$(1-\kappa)U\left(G, y(w(1-n), b)\right) + \kappa U\left(G^{\mathcal{M}}(n), y\left(w(1-n), b^{\mathcal{M}}(n)\right)\right), \tag{3.2}$$

[1] An alternative interpretation of B is money lost due to loopholes that the members of the Elite exploit.

where $G^{\mathcal{M}}(n)$ and $b^{\mathcal{M}}(n)$ stand for the universalized levels of public good and transfers to the citizens implied by the compliance decision of each agent. They are given by:

$$G^{\mathcal{M}}(n) = \rho T(t, w(1-n)), \quad \text{and } b^{\mathcal{M}}(n) = (1-\rho)\frac{\sigma}{1+\sigma}T(t, w(1-n)), \tag{3.3}$$

where $T(t, w(1-n)) = tw(1-n)$ stands for total government revenues raised when imposing a flat income tax rate t and when all the citizens report income $w(1-n)$. Following Definition 3.2.2, each citizen solves for the level of concealment n that maximizes her utility function in (3.2). Given the linear utility specification, we can write the problem solved by each citizen as follows:

$$\max_n (1-\kappa)(\alpha G + b) + \kappa\left(\alpha G^{\mathcal{M}}(n) + b^{\mathcal{M}}(n)\right) + w\left(1 - t(1-n) - c \cdot C(n)\right),$$

where $c \cdot C(n)$ is the expected cost of non-compliance, $c > 0$ is a parameter that captures detection effort, and the rightmost component of the utility function stands for the expected net savings from concealment after paying income tax. For simplicity, assume that $C'(n) = n^2/2$. The solution to the taxpayers' problem is given by:

$$\hat{n}(\kappa; \rho, \alpha, c) = \min\left\{\max\left\{\frac{t\left(1-\kappa\left(\rho\alpha + (1-\rho)\frac{\sigma}{1+\sigma}\right)\right)}{c}, 0\right\}, 1\right\},$$

which means that an agent with a degree of morality κ decides on concealment proportional to the income tax levied by the Elite, t, but inversely proportionally to its degree of morality κ weighted by the government's effective provision as given by the convex combination $\rho\alpha + (1-\rho)\frac{\sigma}{1+\sigma}$. Homo moralis agents are more likely to be compliant when their tax revenues are being used efficiently for the citizenry. This can either mean funding a relatively useful public good when α is high by setting a high public share ρ or instead focusing on providing transfers given the distribution constraint implied by institutions captured by σ.

3.3 Fiscal Capacity and the Laffer Curve

Fiscal capacity is defined as the maximum tax revenue a government can raise given the degree of morality κ and the coercive power of government given by c. Tax revenue per capita, given a tax rate of t and an expenditure mix duplet of transfers and public good (b, G), is given by

$$T(t, \rho, \kappa, c, \sigma) = tw\left[1 - \hat{n}(\kappa; \rho, \alpha, c)\right] = \frac{tw}{c}\left[c - t\left(1 - \kappa\left(\rho\alpha + (1-\rho)\frac{\sigma}{1+\sigma}\right)\right)\right]. \tag{3.4}$$

As shown in Figure 3.2, equation (3.4) leads to the emergence of a variation of the Laffer Curve. As we increase the degree of morality κ, the Elite can raise taxes further without finding itself on the downward-sloping region to the right of the revenue-maximizing tax rate. This becomes apparent when observing the upward shift in $T(t)$ when we allow citizens to have a higher degree of morality κ.

The revenue-maximizing tax rate solves for the optimum of $T(t, \rho, \kappa, c, \sigma)$. We can find it by maximizing expression (3.4) with respect to the income tax rate t. It is given by:

$$\hat{t}(\rho, \kappa, c, \sigma) = \arg\max_{t \geq 0} \{T(t, \rho, \kappa, c)\} = \frac{c/2}{1 - \kappa\left(\rho\alpha + (1-\rho)\frac{\sigma}{1+\sigma}\right)}. \tag{3.5}$$

Substituting equation (3.5) into (3.4) we can express total tax revenues as a function of the public good share ρ, the morality parameter κ, the marginal utility of the public good α, and c. Indeed:

$$T(\hat{t}(\rho, c, \sigma), \rho, \kappa, c) = \frac{wc}{1 - \kappa\left(\rho\alpha + (1-\rho)\frac{\sigma}{1+\sigma}\right)} \frac{1}{4} \tag{3.6}$$

Tt_alpha05_sigma01_rho0.4_NOLEGEND.pdf

FIGURE 3.2: Laffer Curves for different κ: $T(t)$ for $\alpha = 0.5$, $\rho = 0.4$, $\sigma = 0.1$, $w = c = 1$.

Teq_alpha05_sigma01.pdf

FIGURE 3.3: Tax proceeds as a function of the public good share $T(\rho)$ for $\alpha = 0.5$, $\sigma = 0.1$, $w = c = 1$.

3.4 The Elite's problem

The Elite chooses the policy mix of public good, transfers, and taxes, $(G(\rho), B(\rho), \hat{t}(\rho, \kappa, c))$ that maximizes its utility subject to the resource constraint given the institutions of the economy and morality parameter κ of the agents in the population:

$$\max_{\rho} \alpha G(\rho) + B(\rho) \tag{3.7}$$

$$\text{s.t: } [T(\hat{t}(\rho, c, \sigma), \rho, \kappa, c) - G]\theta(\sigma) = B(\rho) \tag{3.8}$$

$$\tag{3.9}$$

The Elite will choose the revenue-maximizing tax rate for any given expenditure mix. Moreover, the constraint set is convex, so the Elite will choose a corner solution where either G or B is zero.

Proposition 11. *The solution to the Elite's problem in the program 3.7 in terms of the public good proportion $\rho^* \in [0,1]$ is such that:*

1. *if $\alpha > \frac{1}{1+\sigma}$ the Elite spends all the tax proceeds in the public good and sets $\rho^* = 1$.*
2. *if $\alpha \leq \frac{1}{1+\sigma}$ then there exists a threshold level of the degree of morality $\bar{\kappa}(\alpha, \sigma)$ such that:*

$$\rho^* = \begin{cases} 1, & \text{if } \kappa \geq \bar{\kappa}(\alpha, \sigma) \\ 0, & \text{if } \kappa < \bar{\kappa}(\alpha, \sigma) \end{cases} .$$

Moreover, the threshold level of the degree of morality is decreasing in α unconditionally and on σ provided $\alpha > 1/2$. Formally,

$$\frac{\partial \bar{\kappa}(\alpha, \sigma)}{\partial \alpha} < 0; \ \frac{\partial \bar{\kappa}(\alpha, \sigma)}{\partial \sigma} = \frac{-2 + \alpha^{-1}}{(1-\sigma)^2} > 0 \text{ iff } \alpha < 1/2.$$

The Elite will devote the collected revenue whenever the marginal utility is sufficiently large. More interestingly, even for cases in which the public good is less desirable, a reasonably large degree of morality $\kappa \geq \bar{\kappa}(\alpha, \sigma)$ induces the Elite to spend its resources in public provision. This result is somewhat striking: while the Elite's marginal utility of appropriating the money of the citizens, given by $\frac{1}{1+\sigma}$ is larger than the marginal value of provision given by α, the conditional compliance of Homo moralis agents leads the ruler's to spend instead on the public good G by setting $\rho^* = 1$.

In the solution to the Elite's program above, tax revenues are described by:

$$T^*(\rho, \kappa, c, w, \sigma) = \begin{cases} \frac{wc}{1-\kappa\alpha} \frac{1}{4}, & \text{if } \rho^* = 1 \\ \frac{wc}{1-\frac{\kappa}{1+\sigma}} \frac{1}{4}, & \text{if } \rho^* = 0 \end{cases} \tag{3.10}$$

This says that taxation is proportional to c, resulting from the quadratic compliance cost specification. More substantively, the result says that when κ increases, civic-minded citizens increase compliance when the Elite is committed to public expenditure.

Proposition 1 and its Corollary are illustrated by Figure 3.8. In it, the plots of the Elite's objective function for different levels of the population's degree of morality (κ), productivity levels (α), and institutions' cohesiveness (σ). The apparent first conclusion to observe is the effect of the degree of morality on the provision optimality of public provision by the state: Holding institutions and public good productivity constant, more moral societies are more likely to incentivize the Elite to pursue the funding of public goods and set $\rho = 1$. We may interpret this as incentivizing the emergence of common interest states (Besley and Persson, 2011).

Second, notice that moral agents condition their cooperative behavior upon public good productivity. This means that any increase in the productivity of the public good α also incentivizes the emergence of common interest states, as moral agents react partially to the hypothetical changes their provision would have on the aggregate economy.

Third, Kantian moral agents also react to institution strength as measured by σ. This means that they incorporate the hypothetical impact of their transfers in redistribution through transfers; this effect is evident when comparing panels (a) and (b) with (c) and (d) vertically in Figure 3.8.

3.5 Discussion and avenues for future research

As put forward by the results of the previous section, semi-Kamtian preferences offer a potential micro foundation for the emergence of fiscal capacity. This microfoundation has similar implications to those explored Besley (2020), under which civic-minded citizens link their compliance decisions to the Elite's expenditure pattern. In this section, I compare the two approaches and contrast their different implications.

First, just as with agents that are motivated by reciprocity, under Homo moralis preferences, compliance decisions are also linked to the expenditure patterns of the Elite, as captured by the public good share ρ. Indeed, agents equipped with semi-Kantian preferences universalize the impact of their compliance decision, considering the magnitude of their decisions as determined by the optimal mix ρ.

Contrastingly, Homo moralis agents care about the perceived usefulness of their contributions, as captured by the preference parameter α. This means that they do not simply adjust their compliance decisions to the government's expenditure mix. However, they do so conditionally based on the government funding public goods that are considered useful to the public. This is not the case for civic-minded citizens, as modeled by Besley, who react to the divergence between taxes raised and public expenditures in the public good G.

A similar effect is captured by the way Homo moralis agents react to σ, the parameter that guides institution cohesiveness. Kantian moral agents are fully aware that a more cohesive redistributive institution implied by a higher σ, makes them better off for each possible expenditure mix (ρ, G); this leads them to be more compliant and leads to the emergence of common interest states in which $\rho = 1$ trough a purely preference-based channel. This conclusion strikingly distinguishes the Homo moralis model from the reciprocity model proposed by Besley: Kantian agents internalize the full expenditure mix of the government and lead to the emergence of equilibrium public good provision that is not only driven by government parameters but mediated by pure preference parameters, in this case, the degree of morality κ.

Another important distinction is the required assumptions over α. While with reciprocity-motivated agents, one needs to require that $\alpha \geq 1$ so that citizens always prefer public production to pure transfers, as put forward by Proposition 1 part 2, societies in which morality is high enough may manage to incentivize public provision even for lower levels of α, as long as the marginal value of transfer *net of the Elite's appropiation*, i.e $\sigma/(1+\sigma)$ is high enough to lead to conditional compliance.

This last distinction drives an important prediction that opens many avenues for future research. In particular, the model of state capacity as based in Homo moralis agents offers a sharp prediction: we should observe societies in which individual measures of Kantian morality, more precisely κ, are large, to be more prone to the emergence of common interest states in which the relative levels of taxation s large and fiscal capacity is relatively large. Empirical and experimental work in the near future may focus on establishing whether these predictions hold. For that, it is necessary to have adequate estimates of the degree of morality, κ. Techniques pioneered by Van Leeuwen and Alger (2019) may be exploited.

.1 Appendix: proofs

Proof. We can manipulate the objective function of the Elite to obtain:

$$\alpha G + \theta(\sigma)(1-\rho)\frac{wc}{1-\kappa\left(\rho\alpha + \frac{1-\rho}{1+\sigma}\right)}\frac{1}{4}$$

subject to

$$\frac{wc}{1-\kappa\left(\rho\alpha + \frac{1-\rho}{1+\sigma}\right)}\frac{1}{4} - G = (1-\rho)\frac{wc}{1-\kappa\left(\rho\alpha + \frac{1-\rho}{1+\sigma}\right)}\frac{1}{4}$$

We can rearrange the constraint above and write:

$$wG = \rho\frac{wc}{1-\kappa\left(\rho\alpha + \frac{1-\rho}{1+\sigma}\right)}\frac{1}{4}$$

Now substitute this in the objective function:

$$\begin{aligned}\alpha\rho\frac{wc}{1-\kappa\left(\rho\alpha + \frac{1-\rho}{1+\sigma}\right)}\frac{1}{4} + \theta(\sigma)(1-\rho)\frac{wc}{1-\kappa\left(\rho\alpha + \frac{1-\rho}{1+\sigma}\right)}\frac{1}{4} \\ = \frac{wc}{1-\kappa\left(\rho\alpha + \sigma\frac{1-\rho}{1+\sigma}\right)}\frac{1}{4}(\alpha\rho + \theta(\sigma)(1-\rho))\end{aligned}$$

Using the definition of $\theta(\sigma) = (1+\sigma)^{-1}$:

$$= \frac{wc}{4} \frac{\frac{1}{1+\sigma} + \rho\left(\alpha - \frac{1}{1+\sigma}\right)}{1 - \kappa\left(\frac{\sigma}{1+\sigma} + \rho\left(\alpha - \frac{\sigma}{1+\sigma}\right)\right)}$$

$$= \frac{wc}{4} \frac{\frac{\left(\alpha - \frac{1}{1+\sigma}\right)^{-1}}{1+\sigma} + \rho}{\left(\alpha - \frac{1}{1+\sigma}\right)^{-1} - \kappa\left(\frac{\sigma}{1+\sigma}\left(\alpha - \frac{1}{1+\sigma}\right)^{-1} + \rho\frac{\alpha - \frac{\sigma}{1+\sigma}}{\alpha - \frac{1}{1+\sigma}}\right)} \text{ if } \alpha \neq \frac{1}{1+\sigma}$$

The first order condition to this problem with respect to ρ writes:

$$= \frac{wc}{4} \frac{\left(\alpha - \frac{1}{1+\sigma}\right)^{-1} - \kappa\left(\frac{\sigma}{1+\sigma}\left(\alpha - \frac{1}{1+\sigma}\right)^{-1} + \rho\frac{\alpha - \frac{\sigma}{1+\sigma}}{\alpha - \frac{1}{1+\sigma}}\right) + \kappa\left(\frac{\alpha - \frac{\sigma}{1+\sigma}}{\alpha - \frac{1}{1+\sigma}}\right)\left(\frac{\left(\alpha - \frac{1}{1+\sigma}\right)^{-1}}{1+\sigma} + \rho\right)}{\left(\left(\alpha - \frac{1}{1+\sigma}\right)^{-1} - \kappa\left(\frac{\sigma}{1+\sigma}\left(\alpha - \frac{1}{1+\sigma}\right)^{-1} + \rho\frac{\alpha - \frac{\sigma}{1+\sigma}}{\alpha - \frac{1}{1+\sigma}}\right)\right)^2}$$

$$= \frac{wc}{4} \frac{\left(\alpha - \frac{1}{1+\sigma}\right)^{-1} - \kappa\left(\frac{\sigma}{1+\sigma}\left(\alpha - \frac{1}{1+\sigma}\right)^{-1}\right) + \frac{\kappa}{1+\sigma}\frac{\alpha - \frac{\sigma}{1+\sigma}}{\left(\alpha - \frac{1}{1+\sigma}\right)^2}}{\left(\left(\alpha - \frac{1}{1+\sigma}\right)^{-1} - \kappa\left(\frac{\sigma}{1+\sigma}\left(\alpha - \frac{1}{1+\sigma}\right)^{-1} + \rho\frac{\alpha - \frac{\sigma}{1+\sigma}}{\alpha - \frac{1}{1+\sigma}}\right)\right)^2}$$

$$= \frac{wc}{4} \frac{\left(\alpha - \frac{1}{1+\sigma}\right)^{-1} - \kappa\frac{1}{1+\sigma}\left(\alpha - \frac{1}{1+\sigma}\right)^{-1}\left(\sigma - \frac{\alpha - \frac{\sigma}{1+\sigma}}{\alpha - \frac{1}{1+\sigma}}\right)}{\left(\left(\alpha - \frac{1}{1+\sigma}\right)^{-1} - \kappa\left(\frac{\sigma}{1+\sigma}\left(\alpha - \frac{1}{1+\sigma}\right)^{-1} + \rho\frac{\alpha - \frac{\sigma}{1+\sigma}}{\alpha - \frac{1}{1+\sigma}}\right)\right)^2}$$

If $\alpha > \frac{1}{1+\sigma}$ the derivative is positive iff:

$$1 - \kappa\frac{1}{1+\sigma}\left(\sigma - \frac{\alpha - \frac{\sigma}{1+\sigma}}{\alpha - \frac{1}{1+\sigma}}\right) > 0$$

$$1 - \kappa\frac{1}{1+\sigma}\left(\frac{\alpha(\sigma - 1)}{\alpha - \frac{1}{1+\sigma}}\right) > 0$$

$$1 + \kappa\frac{\alpha}{1+\sigma}\left(\frac{1 - \sigma}{\alpha - \frac{1}{1+\sigma}}\right) > 0$$

$$\Longrightarrow \kappa > 0 > -\frac{\alpha - \frac{1}{1+\sigma}}{1 - \sigma}\frac{1+\sigma}{\alpha}$$

Which always holds.

If $\alpha < \frac{1}{1+\sigma}$ the derivative is positive iff:

$$1 - \kappa\frac{1}{1+\sigma}\left(\sigma - \frac{\alpha - \frac{\sigma}{1+\sigma}}{\alpha - \frac{1}{1+\sigma}}\right) < 0$$

$$1 - \kappa\frac{\alpha}{1+\sigma}\left(\frac{1 - \sigma}{-\alpha + \frac{1}{1+\sigma}}\right) < 0$$

$$\kappa > \frac{1+\sigma}{\alpha}\frac{\frac{1}{1+\sigma} - \alpha}{1 - \sigma} == \frac{\alpha^{-1} - (1+\sigma)}{1 - \sigma}$$

$$\Longrightarrow \kappa > \overline{\kappa}(\alpha, \sigma) = \frac{\alpha^{-1} - (1+\sigma)}{1 - \sigma}$$

Notice that:

$$\frac{\partial\overline{\kappa}(\alpha,\sigma)}{\partial\alpha} < 0;\ \frac{\partial\overline{\kappa}(\alpha,\sigma)}{\partial\sigma} = \frac{-(1-\sigma)+\alpha^{-1}-(1+\sigma)}{(1-\sigma)^2} = \frac{-2+\alpha^{-1}}{(1-\sigma)^2} > 0 \text{ iff } \alpha < 1/2$$

alpha06_sigma0.pdf

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FIGURE 3.4: Low productivity and weak institutions $\alpha = 0.6$, $\sigma = 0$.

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alpha08sigma0.pdf

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