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FernUniversität in Hagen

August 2013

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August 8, 2013

Abstract

This paper introduces a work effort norm into a three-type ability approach to optimal linear income taxation. According to this social norm type, individuals experience stigma when working more or less than the average. This leads to a smaller dispersion in labor supply. The individual work incentives then induce post-tax income inequality to rise. Based on this, it can be shown that the socially optimal tax rate is unambiguously increasing with the strength of the work effort norm. Turning to majority voting the tax rate preferred by the median voter could decrease when the work effort norm is introduced. We can show that the majority tax rate turns out to be inefficiently low or high. Beyond, for large preference parameters the difference between the first-best tax rate and the majority tax rate seems to diminish. Further, for specific wage distributions there seem to exist a preference strength which ensures efficient taxation. Subsequently, the work effort norm can reduce the inefficiency implemented by majority voting.

JEL classification: D70, H21, H30
Key words: optimal income taxation, majority voting
work effort norm, labor supply, redistribution

*I am grateful to Thomas Eichner, Benjamin Florian Siggelkow and Gilbert Kollenbach for helpful comments and discussions.

1 Introduction

Catching a glimpse on job market statistics and public expenditures data reveals large differences in individual employment and working behavior as well as governmental welfare spending across countries. Against this backdrop, economics literature aims to analyze the effects of redistributive tax policies on labor market decisions. According to the traditional scientific consensus progressive taxation schemes reduce individual work incentives (see e.g. Roberts, 1977; Meltzer and Richard, 1981). However, an increasing strand of literature considers the role of work norms as constraints to this moral hazard behavior (Lindbeck 1995; Lindbeck et al., 1999). This view is strongly encouraged by numerous empirical studies (see e.g. Clark, 2003; Conlin et al. (2003) or Stutzer and Lalive, 2004).

Elster (1989) points out work norms as an important branch of social norms which describe codes of conduct in groups or societies concerning individual labor market decisions. Breaching with a behavioral rule gives rise to embarassement or shame resulting in a psychic distutility. However, according to Elster (1989) this sense of stigma need not be implied by external sanctions. An individual process of internalization leads to internal sanctions which are sufficient for social norms to be effective.

Aronsson and Sjögren (2010) introduce a work effort norm into a decision on individual labor supply.[1] Supposing the intensity of the norm to be endogenous they aim to analyze the optimal non-linear tax structure. Thereby, the widely-used two-type ability approach (see e.g. Mirrlees, 1971; Stern, 1982 or Stiglitz, 1982) is employed. In the sequel, we follow the assumption of e.g. Lindbeck et al. (1999) or Aronsson and Sjögren (2010) and hence consider the strength of the work effort norm as being endogenous. It deserves to be mentioned that we treat the existence of the social norm as exogenously given.

The politico-economic literature on redistributive taxation considers the political process of majority voting (see e.g. Roberts, 1977; Meltzer and Richard, 1981, Harms and Zink, 2003; Tridimas and Winer, 2005). In these settings, the tax rate preferred by the median voter constitutes the political equilibrium. Supposing wage distributions to be right skewed, the median voter's wage rate deceeds the average wage.[2] This difference has been shown to play a decisive role for the degree of income redistribution. More precisely, the difference between median and average income before taxation is ceteris paribus larger, the larger the deviation of the median voter's wage to the average is. Then, reducing this income difference by raising income taxation becomes more desirable.

Eichner (2002) compares socially optimal taxation and the tax rate resulting from a majority voting in the absence of social norms. By employing a three-type ability approach where individual labor supply is determined endogenously the decision on optimal taxation is interpreted

[1] Aronsson and Sjögren (2010) refer to it as *hours of work norm*. We intend to use a rather non-dimensional notation. Beyond, they implement a participation norm which captures welfare stigma similar to e.g. Lindbeck et al. (1999). However, to keep the analysis tractable we restrict our focus to the case of a work effort norm.

[2] This seems to describe the shapes of real-world income distributions adequately.

from an ex ante perspective.[3] A numerical simulation shows that the inequality in pre-tax incomes affects the first-best tax rate positively while the majority tax rate primarily depends on the wage differences between the median voter and the other groups. As mentioned above, this approach neglects the role of social, non-pecuniary motives for the individual decision on work effort and the structure of redistributive tax policies.

Consequently, we aim to analyze the interdependencies concerning a work effort norm and redistributive taxation. For that purpose, we employ the abovementioned three-ability type framework of Eichner (2002) augmented by a work effort norm. Based on this, we analyze first-best taxation chosen by a utilitarian social planner. Taken this as a benchmark, we determine the tax rate constituted by majority voting and shed some light on the efficiency properties of the political equilibrium. In line with the literature on social stigma in economic decisions (e.g. Lindbeck et al., 1999; Aronsson and Sjögren, 2010 or Traxler, 2010) we model the strength of the norm as being endogenous. Instead of analyzing the optimal structure of non-linear taxation schemes as conducted by Aronsson and Sjögren (2010) we introduce a linear, indirectly progressive, taxation scheme. Beyond, as opposed to their framework, our analysis is augmented by an exploration of the political equilibrium regarding redistributive taxation.

We can show that introducing the work effort norm leads to a smaller dispersion of labor supply across the three groups as working more or less than the average becomes less attractive. The norm-induced changes in the individual work incentives lead to a larger post-tax income inequality if the tax rate is not too large. In order to compare the socially optimal tax rate and the tax rate preferred by the median voter we have to resort to a numerical example.

Turning to changes in the work effort norm strength, we find that socially optimal taxation is unambiguously increasing when the norm is introduced. With respect to the majority tax rate we observe a somewhat unclear picture. For a small difference between the average and the median wage the tax rate resulting from majority voting could decrease when the work effort norm is introduced. However, for a sufficiently strong norm the difference between both tax rates turns out to be smaller than in the case where the work effort norm is absent. Beyond that, for specific wage rate distributions there seem to exist a norm preference strength which ensures the efficiency of the majority tax rate. Subsequently, introducing the work effort norm is able to weaken the inefficiency implemented by the political process of majority voting.

The remainder of this paper is organized as follows. Section 2 presents the model's basic assumptions. Based on this, the decision on individual labor supply is covered by section 3. Then, section 4 constitutes the decision problem on socially optimal taxation as well as the median voter's decision problem regarding taxation. Further insights on the efficiency properties of the political equilibrium are given by a numerical simulation in section 5. Section 6 concludes the analysis.

[3] Note that Eichner (2002) divides the analysis into a constitutional and post-constitutional decision. From a constitutional perspective redistributive taxation chosen behind the veil of ignorance provides social insurance (see e.g. Varian, 1980; Sinn, 1995, 1996; Eichner and Wagener, 2004). In this paper we interpret this decision from an ex-post view where a social planner chooses first-best taxation by maximizing the sum of individual utilities. The utilitarian welfare function is then equivalent to expected utility of a representative individual.

2 The model

We basically employ the framework of Eichner (2002) to capture the individual labor supply decision where the society is presumed to consist of three ability types $i = 1, 2, 3$. The individual types differ with respect to their productivity as characterized by discretely distributed exogenous wage rates, i.e. $w_3 > w_2 > w_1 > 0$. The wage distribution reflects the existence of a lower (group 1), middle (group 2) and upper class (group 3).[4] Without loss of generality the population mass is normalized to unity. Hence, the group shares p_i within the population satisfy $\sum_{i=1}^{3} p_i = 1$.

Pre-tax and post-tax income. An individual generates income by supplying labor ℓ_i at the market at her wage rate w_i. The pre-tax income of each type-i individual is then defined as $x_i = w_i \ell_i$. Introducing an indirectly progressive taxation scheme $\Pi = \{\tau, T\}$ with the linear tax rate $\tau \in [0, 1)$ and the lump-sum transfer T leads to the post-tax income

$$y_i = (1 - \tau) w_i \ell_i + T. \tag{1}$$

When making their labor supply decision individual take both the tax rate and the lump-sum transfer as exogenously given.

Individual preferences. To begin with, each group i derives utility from post-tax income y_i and labor supply ℓ_i. The utility function

$$U(y_i, \ell_i) \tag{2}$$

is quasi-concave and additively separable. We presume utility to be increasing in post-tax income ($\frac{\partial U}{\partial y_i} > 0$) while supplying labor goes along with a disutility ($\frac{\partial U}{\partial \ell_i} \leq 0$).[5] Further, the utility function is concave in post-tax income ($\frac{\partial^2 U}{\partial {y_i}^2} \leq 0$) and convex in work effort ($\frac{\partial^2 U}{\partial {\ell_i}^2} \leq 0$). It is worth mentioning that the separability implies cross derivatives between post-tax income and work effort to be zero ($\frac{\partial U}{\partial y_i \partial \ell_i} = \frac{\partial U}{\partial \ell_i \partial y_i} = 0$).

By introducing a work effort norm in the vein of Aronsson and Sjögren (2010) individuals experience a disutility $V(\bar{\ell}, \ell_i)$ when working more or less than a specified reference level of work effort. This disutility results from a sense of shame or embarrassment in case of breaching with the norm.[6] Indicating α as the preference strength of the work effort norm individual utility is represented by

$$U(y_i, \ell_i) - \alpha V(\bar{\ell}, \ell_i). \tag{3}$$

[4]Note that fixed wage rates are associated with constant marginal productivity of labor which stems from a linear production technology.

[5]In other words, individuals prefer leisure time. Note, that individuals are endowed with an exogenous amount of time H. Hence, leisure $z_i = H - l_i$ is decreasing with the work effort.

[6]A loss of reputation in case of a higher work effort could result from less time for social activities, e.g. family, friends or volunteer work. See Aronsson and Sjögren (2010) for details. In what follows we refer to both deviations as stigma.

For sake of simplicity we follow Aronsson and Sjögren (2010) and define $V(\bar{\ell}, \ell_i) := (\bar{\ell} - \ell_i)^2$ for the subsequent analysis. Thus we get $\frac{\partial V}{\partial \bar{\ell}} = (\bar{\ell} - \ell_i)$ as well as $\frac{\partial V}{\partial \ell_i} = -(\bar{\ell} - \ell_i)$. Further, we define the average labor supply as norm level of work effort, i.e.

$$\bar{\ell} := \sum_{i=1}^{3} p_i \ell_i. \tag{4}$$

We assume that individuals treat average work effort as exogenously given which seems to be reasonable if the society is sufficiently large.

3 Individual labor supply

In this section, we turn to the individual decision on work effort. Suppose that individuals are fully informed about their group affiliation. Hence, the individuals know their productivity or wage rate, respectively. Beyond, the tax rate τ as well as the public transfer T are taken as exogenously given. The individual's decision problem is given by

$$\max_{\ell_i} \; U(y_i, \ell_i) - \alpha V(\bar{\ell}, \ell_i) \quad s.t. \qquad y_i = (1-\tau) w_i \ell_i + T \tag{5}$$

for each group $i = 1, 2, 3$. Restricting our attention to interior solutions we obtain the first-order condition

$$(1-\tau) w_i \frac{\partial U}{\partial y_i} + \frac{\partial U}{\partial \ell_i} + \alpha(\bar{\ell} - \ell_i) = 0, \tag{6}$$

which implicitly determines the optimal individual labor supply $\ell_i^*(\alpha, \tau, T, \bar{\ell})$ of each group i. Raising the work effort ℓ_i marginally affects utility threefold. The first term represents the *income effect of labor supply* which is positive since labor enhances income by $(1-\tau)w_i > 0$. Second, increasing labor supply goes along with less leisure and therefore enhances the disutility from working as depicted by the *leisure effect of labor supply*, i.e. $\frac{\partial U}{\partial \ell_i} < 0$. Eventually, increasing labor supply affects stigma concerning the work effort as captured by the third term. This *stigma effect of labor supply* could be positive or negative depending on whether the individual works more or less than the norm level. For $\ell_i < \bar{\ell}$ the stigma effect of labor is positive such that at the margin increasing work effort is utility-enhancing. In other words, increasing labor reduces stigma. However, in case of $\ell_i > \bar{\ell}$ the stigma effect is negative. Subsequently, working more than the average is associated with stigma and it is therefore beneficial to reduce work effort. Reducing individual work effort then tempers this stigma and results in higher utility. In what follows, we focus on the comparative static effects of the work effort norm and the tax policy with respect to individual work effort.

Work effort norm and labor supply. Implicitly differentiating (6) yields the comparative static effect of the preference parameter α on optimal labor supply:

$$\text{sign}\, \frac{\partial \ell_i^*}{\partial \alpha} = \text{sign}\, (\bar{\ell} - \ell_i). \tag{7}$$

According to (7) the effect of the work effort norm on individual labor supply is indeterminate in sign. As shown above, whether the stigma effect is positive or negative depends on the difference between individual and average labor supply. In either case, the effect ceteris paribus becomes larger according to amount the more intense the preference for the social norm is. Then for $\ell_i < \bar{\ell}$ ($\ell_i > \bar{\ell}$) individual labor supply increases (decreases) with α, i.e. $\frac{\partial \ell^*}{\partial \alpha} > 0$ ($\frac{\partial \ell^*}{\partial \alpha} < 0$). This result leads to an individual work effort of each group which is more compressed to the average labor supply as has already been pointed out by Aronsson and Sjögren (2010).

Further, the individual work effort is increasing in the reference level of labor supply, i.e.

$$\operatorname{sign} \frac{\partial \ell_i^*}{\partial \bar{\ell}} = \operatorname{sign} \alpha \geq 0. \tag{8}$$

For $\alpha > 0$ expression (8) is unambiguously positive. An increase in the average work effort ceteris paribus enlarges (weakens) the stigma effect of labor supply for $\ell_i < \bar{\ell}$ ($\ell_i > \bar{\ell}$). In both cases individuals are induced to raise the work effort.

Labor supply and redistributive taxation. The comparative static effect of the tax rate τ on labor supply is ambiguous, formally

$$\operatorname{sign} \frac{\partial \ell_i^*}{\partial \tau} = -\operatorname{sign} \left\{ w_i \left[(1-\tau) w_i \ell_i^* \frac{\partial^2 U}{\partial y_i^2} + \frac{\partial U}{\partial y_i} \right] \right\}. \tag{9}$$

According to (9) increasing the tax rate exhibits two contrary effects on the income effect of labor supply. First, increasing the tax rate ceteris paribus dampens the positive income effect of labor supply. As a consequence, working becomes less desirable at the margin since a larger share of the additional income would be claimed by the government. This effect is captured by the positive second term in brackets, i.e. $\frac{\partial U}{\partial y_i} > 0$. By contrast, the tax-induced cut in the individual's income ceteris paribus enhances the marginal utility of post-tax income. Since increasing labor supply raises post-tax income working becomes more attractive at the margin which is characterized by the first term in brackets with $\frac{\partial^2 U}{\partial y_i^2} \leq 0$. However, which of these effects dominate remains unclear.

The effect of the lump-sum transfer T on individual work effort is unambiguously negative. Implicit differentiation of (6) yields

$$\operatorname{sign} \frac{\partial \ell_i^*}{\partial T} = \operatorname{sign} (1-\tau) w_i \frac{\partial^2 U}{\partial y_i^2} < 0 \tag{10}$$

for $\frac{\partial^2 U}{\partial y_i^2} < 0$ as well as $\tau < 1$. Increasing the welfare benefit would ceteris paribus enhance post-tax income which reduces the incentives to work. Thus, individuals alleviate their labor supply.

Balanced equilibrium and indirect utility. In order to prepare for the analysis of redistributive tax policies in the following section the governmental budget

$$T = \tau \sum_i p_i w_i \ell_i \tag{11}$$

has to be taken into account. According to the fiscal budget constraint, the lump-sum transfer must equal the (per-capita) tax revenue. Solving (11) for the transfer allows to write the lump-sum transfer as a function of the tax rate, i.e. $\mathcal{T}(\tau)$. This can be substituted into the individual optimal values ℓ_i^* and $\bar{\ell}(\ell_i^*)$ in order to define the *balanced individual labor supply*

$$L_i(\tau) := \ell_i^*(\alpha, \tau, \mathcal{T}(\tau), \bar{\ell}), \tag{12}$$

as well as the *balanced average labor supply*

$$\bar{L}(\tau) := \sum_{i=1}^{3} p_i L_i(\tau).^7 \tag{13}$$

Further, inserting the balanced values into individual utility then allows us to constitute the indirect utility functions

$$W_i(\tau) := U\left[(1-\tau)w_i L_i(\tau) + \mathcal{T}(\tau), \mathcal{L}_{\rangle}(\tau)\right] - \alpha V(\bar{L}(\tau), L_i(\tau)), \tag{14}$$

Hence, we can write indirect utility of each group i as function of the tax rate. Based on this, we are able to analyze the tax policy.

4 Redistributive tax policy

This section considers the cases of socially optimal taxation and the tax rate chosen by majority voting. By using the first-best tax rate as a benchmark we are able to explore the efficiency properties of the political equilibrium.

Social optimum. Consider a utilitarian social planner who maximizes the sum of individual utilities. The decision problem of the social planner is given by:

$$\max_{\tau} \sum_i p_i W_i(\tau). \tag{15}$$

Solving (15) leads to the socially optimal or first-best taxation scheme. By applying the envelope theorem the first-order condition reads

$$\sum_{i=1}^{3} p_i \left(\frac{\partial U}{\partial y_i} \left[-w_i L_i + \frac{\partial \mathcal{T}}{\partial \tau} \right] - \alpha \cdot \frac{\partial V}{\partial \bar{\ell}} \cdot \frac{\partial \bar{L}}{\partial \tau} \right) = 0, \tag{16}$$

which determines the socially optimal tax rate τ^*. Equation (16) reveals two effects of the tax rate on expected utility. The first term in round brackets captures an income effect of taxation. The second term represents the effect of the tax rate on the average labor supply and therefore on (aggregated) work effort stigma.

Majority voting. After having characterized the first-best taxation we turn to the tax rate which results from majority voting. According to Roberts (1977) or Meltzer and Richard (1981)

[7] For reasons of simplicity, we omit α and $e\bar{l}l$.

the tax rate preferred by the median voter constitutes the political equilibrium. Hence, in order to determine the majority tax rate, the utility of the median voter $i = m$ is maximized. The decision problem is then given by

$$\max_{\tau} W_m(\tau). \tag{17}$$

This leads to the first-order condition

$$\frac{\partial U}{\partial y_m}\left[-w_m L_m + \frac{\partial \mathcal{T}}{\partial \tau}\right] - \alpha \cdot \frac{\partial V}{\partial \bar{\ell}} \cdot \frac{\partial \bar{L}}{\partial \tau} = 0 \tag{18}$$

by exploiting the envelope theorem. Equation (18) constitutes the tax rate τ^m preferred by the median voter. The effects are similar to equation (16). In contrast, the income effect relates solely to the income of the median voter.

Since the the comparative static effects of the work effort norm regarding taxation cannot be determined analytically, we apply specific utility functions in order to obtain distinct results. Thus, a numerical analysis is conducted in the following section.

5 Numerical example

This section aims for a thorough comparison of the socially optimal tax rate and the tax rate preferred by the majority. To get further insights we have to resort to a numerical example.[8] For that purpose preferences are represented by the quadratic utility function

$$u_i = ay_i - by_i^2 - c\ell_i^2 - \alpha(\bar{\ell} - \ell_i)^2. \tag{19}$$

For sake of simplicity we assume a uniform population distribution, i.e. $p_1 = p_2 = p_3 = 1/3$ where group 2 is to be the median voter. Further, we set the parameters $a = 12$, $b = 2$, $c = 2$ and assume the wage rate distribution $w_1 = 1.5$, $w_2 = 2.0$ and $w_3 = 4.0$ in the following analysis.[9] Regarding the norm preference, we consider the values $\alpha = 0$ and $\alpha = 10$ in order to compare the situation where the norm is absent with the case where the social norm is introduced. First, let us consider how the work effort norm affects the individual work incentives and therefore the post-tax incomes of each group.

Labor supply and post-tax incomes. The balanced labor supply curves $L_i(\tau)$ of the three individual types i and the balanced average labor supply curve $\bar{L}(\tau)$ for $\alpha = 10$ are sketched in fig. 1. It deserves to be mentioned that we obtain labor supply curves similar to that of Eichner (2002). Hence, for tax rates below $\tau \approx 0.34$ we get $L_1(\tau) > L_2(\tau) > L_3(\tau)$. It can be seen that the labor supply of group 3 is first increasing and then becomes decreasing in the tax rate for a high degree of taxation. In contrast, the labor supply of groups 1 and 2 is strictly decreasing with the tax rate. As shown below income is mainly redistributed from

[8] Neither we nor Mathematica are able to establish the optimal tax rates as a function of the parameters. The computer programme of the numerical analysis is available from the author upon request.

[9] We show in the appendix that for this parameter specification the utility function is well defined.

group 3 to the other groups, the high-ability group increases work effort in order to mitigate the income loss.[10] Further, we can see that for tax rates smaller than $\tau \approx 0.56$ the high-ability group 3 works less than the average while groups 1 and 2 supply more labor than the average.

Fig. 2 illustrates the distribution of the post-tax incomes. We can observe that groups 1 and 2 earn a below-average post-tax income ($Y_1(\tau) < Y_2(\tau) < \bar{Y}(\tau)$) while group 3 yields an income above the average ($Y_3(\tau) > \bar{Y}$). Hence, income is redistributed from group 3 to groups 1 and 2.

Beyond, it can be shown that changing the work effort norm affects the individual work incentives and post-tax income inequality which is captured by fig. 3 where we set the tax rate at $\tau = 0.4$. The left-hand panel illustrates that increasing the work effort norm α reduces the labor supply dispersion σ_L. The intuition behind this result is as follows. Raising the preference parameter α reinforces the stigma effect of labor supply. For individuals working less than the average (group 3) increasing work effort becomes desirable. In contrast, individuals working more than the average (groups 1 and 2) benefit from reducing labor supply.

By contrast, the post-tax income inequality is increasing with the preference strength α.[11] This variation is induced by the abovementioned changes in individual work incentives. Since individuals of group 3 raise the work effort a higher post-tax income follows. However, the reduction in work effort of groups 1 and 2 lead to a lower post-tax income for both groups. As outlined above, groups 1 and 2 are below-average earners while group 3 receives an above-average income. Then, the changes in work effort and therefore in income enlarges the inequality in post-tax incomes. To summarize, we can state the following result.

Result 1 *Introducing the work effort norm induces individuals with below-average (above-average) work effort to supply more (less) labor. This results in a smaller dispersion of individual labor supply. The change in work incentives induce the post-tax income inequality to rise.*

After having sketched the effect of the work effort norm on individual work incentives as well as the post-tax income distribution we turn to the features of redistributive taxation.

Social optimum. As shown before, the first-best tax rate maximizes utilitarian welfare. However, for expositional reasons we base our analysis and the corresponding interpretations on the mean-standard deviation framework. For quadratic utility functions it can be shown that maximizing the sum of individual utilities and the μ-σ-approach turn out to be equivalent.[12] Bearing that in mind, we find that increasing the tax rate goes along with four partial effects on average post-tax income μ_Y, post-tax income inequality σ_Y, average labor supply μ_L and labor supply dispersion σ_L.

Initially, let us consider $\alpha = 0$ as a benchmark case. The partial effects of taxation are then depicted by the dashed curves in fig. 4-7. We can observe that increasing the tax rate

[10]Given a different wage rate distribution, income could be partially redistributed from group 2 to group 1, too.

[11]This holds, if the tax rate is not too large. For large tax rates, however, introducing the work effort norm could reduce post-tax income inequality.

[12]Hence, utilitarian welfare could be rewritten as a function of mean μ and standard deviation σ of post-tax income y_i as well as work effort ℓ_i. See the appendix for details.

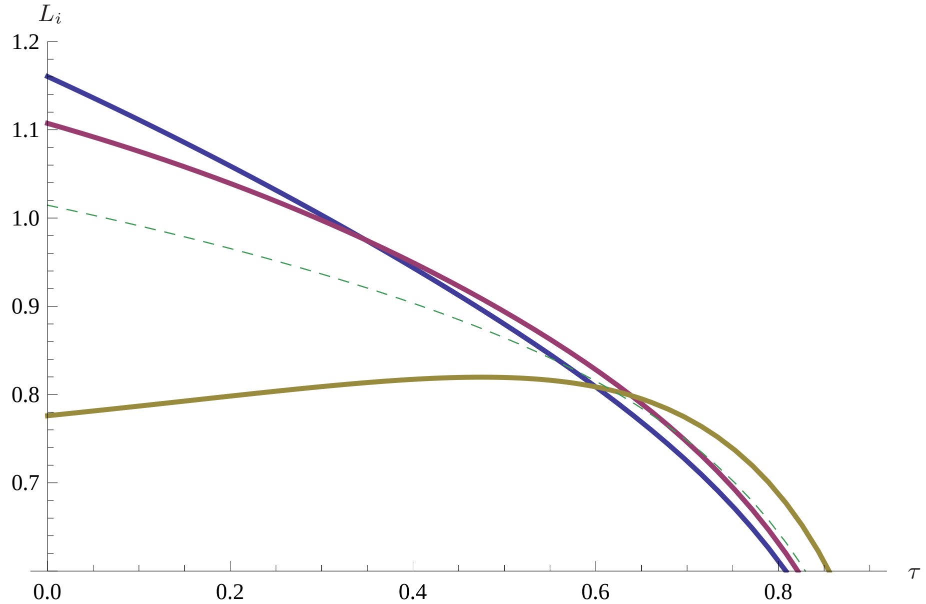


Figure 1: Labor supply $L_i(\tau)$ for $\alpha = 10$

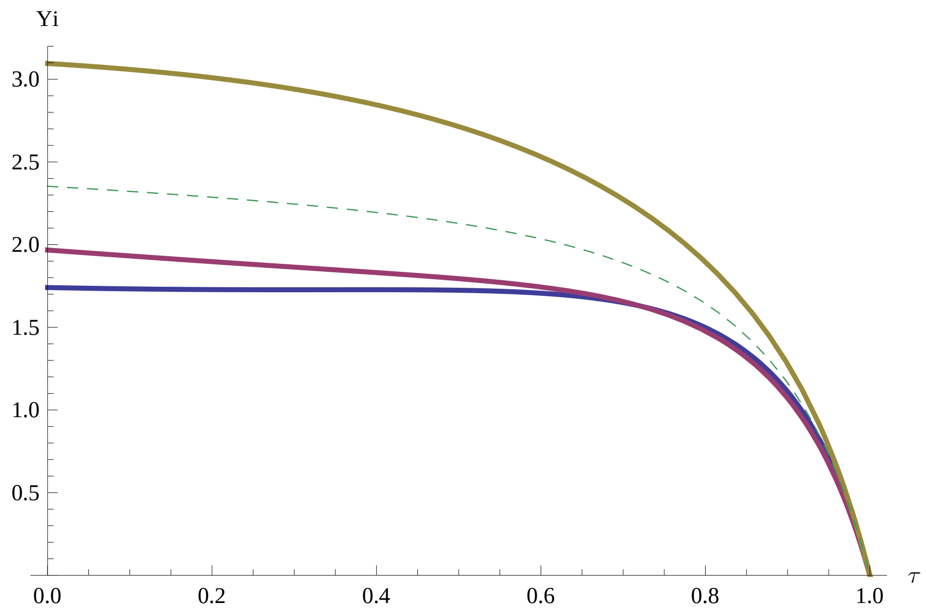


Figure 2: Post-tax incomes $Y_i(\tau)$ for $\alpha = 10$

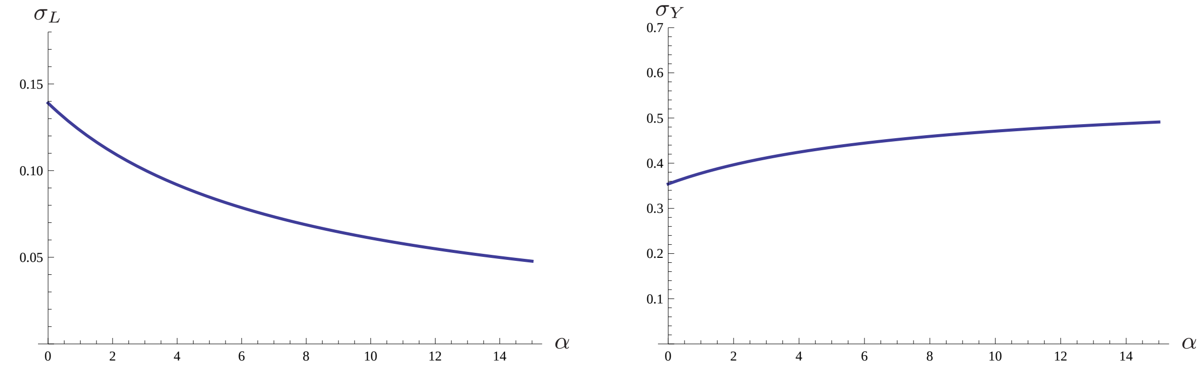


Figure 3: Labor supply dispersion σ_L and Post-tax income inequality σ_Y for $\tau = 0.4$

(i) *reduces the average post-tax income* ($\frac{\partial \mu_Y}{\partial \tau} < 0$),

(ii) *enlarges the post-tax income inequality* ($\frac{\partial \sigma_Y}{\partial \tau} > 0$),

(iii) *reduces the average labor supply* ($\frac{\partial \mu_L}{\partial \tau} < 0$),

(iv) *reduces the labor supply dispersion* ($\frac{\partial \sigma_L}{\partial \tau} < 0$),

if τ is not too large.[13] Thus, we obtain the results of Eichner (2002) as a special case of our approach.[14] The effects (i) and (ii) establish the marginal cost of taxation. (i) As individual utility is increasing with the post-tax income a decrease in average post-tax income is welfare reducing. (ii) We supposed individuals to behave inequity averse. Consequently, the tax-induced rise in post-tax income inequality reduces welfare. By contrast, the effects (iii) and (iv) constitute the marginal benefit of taxation. (iii) Since individuals dislike working a tax-induced reduction in average labor supply is welfare enhancing. (iv) Furthermore, due to the labor disutility a smaller labor supply dispersion induces utilitarian welfare to rise. If the marginal cost and benefit of taxation are balanced the first-best tax rate τ^* results. For $\tau < \tau^*$ the marginal benefit dominates the marginal cost. The opposite holds for $\tau > \tau^*$.

Introducing the work effort norm ($\alpha > 0$) affects the marginal cost and benefit of redistributive taxation. This is illustrated by the solid curves in fig. 4-7 where we set $\alpha = 10$. We can directly see that the work effort norm dampens the income-reducing effect (i) if the tax rate is not too large. This is illustrated by fig. 4 where

$$\left.\frac{\partial \mu_Y}{\partial \tau}\right|_{\alpha=0} < \left.\frac{\partial \mu_Y}{\partial \tau}\right|_{\alpha=10} < 0,$$

for tax rates smaller than $\tau \approx 0.63$. Further, effect (ii) turns into a marginal benefit as taxation reduces post-tax income inequality in the presence of the work norm, cf. fig. 5. We obtain $\left.\frac{\partial \sigma_Y}{\partial \tau}\right|_{\alpha=10} < 0$ for any tax rate. For tax rates smaller than $\tau \approx 0.8$ it can be seen that

$$\left.\frac{\partial \sigma_Y}{\partial \tau}\right|_{\alpha=10} < \left.\frac{\partial \sigma_Y}{\partial \tau}\right|_{\alpha=0}.$$

[13] The results hold for tax rates below $\tau \approx 0.45$.

[14] See the appendix for the absolute values of μ_Y, σ_Y, μ_L and σ_L as functions of the tax rate which could be directly compared to the exposition of Eichner (2002).

Since indiviuals are supposed to be inequity averse a ceteris paribus reduction in post-tax income inequality is welfare enhancing. Third, introducing the work effort norm impairs the marginal benefit (iii), as captured by fig. 6. The tax-induced reduction in the average labor supply becomes weaker, formally represented by

$$\left.\frac{\partial \mu_L}{\partial \tau}\right|_{\alpha=0} < \left.\frac{\partial \mu_L}{\partial \tau}\right|_{\alpha=10} < 0.$$

Eventually, the work effort norm tempers the marginal benefit (iv) as the reduction in the labor supply dispersion gets smaller. This effect is illustrated by fig. 7. We can directly observe

$$\left.\frac{\partial \sigma_L}{\partial \tau}\right|_{\alpha=0} < \left.\frac{\partial \sigma_L}{\partial \tau}\right|_{\alpha=10} < 0,$$

for tax rates smaller than $\tau \approx 0.6$. It deserves to be mentioned that in presence of the work norm reducing the labor supply dispersion exhibits an additional effect on utilitarian welfare. This norm-induced reduction in the dispersion of labor supply then goes along with less (aggregated) stigma as the deviations of each group from the average work effort diminishes.

In a nutshell, introducing the work effort norm causes

- the marginal cost of taxation to decrease,
- the marginal benefit of taxation to decrease.

Per se, it is not clear whether the cost-reducing effects overcompensate the benefit-reducing effects of redistributive taxation and therefore how the norm affects the socially optimal tax rate. However, the numerical simulation in the next paragraph suggests that introducing the work effort norm renders income redistribution more desirable at the margin.

Majority voting. After having characterized the first-best taxation, we turn to the case of majority voting. Again, let us consider $\alpha = 0$ as a benchmark case. Then, we can identify two partial effects of taxation on median voter utility. Both effects ground on the aspect that the median voter $m = 2$ earns a post-tax income below the average.

(I) Individuals of group 2 retrench their work effort $L_2(\tau)$ in response to higher taxation ($\frac{\partial L_2}{\partial \tau} < 0$), cf. the dashed curve in fig. 8. The tax-induced reduction in labor supply is utility enhancing since individuals dislike working. This marginal benefit is referred to as *labor supply effect of taxation.*

(II) Further, raising taxation affects the difference between average and median post-tax income. Let us define $\Delta_{Y_2}^{\bar{Y}}(\tau) = \bar{Y}(\tau) - Y_2(\tau) > 0$ as income difference, which is positive as the median voter earns a below-average income. We denote this effect as *income redistribution effect of taxation.* The median voter benefits from income redistribution if taxation reduces the income difference $\Delta_{Y_2}^{\bar{Y}}(\tau)$. This is in line with the approach of Meltzer and Richard (1981). The derivative of $\Delta_{Y_2}^{\bar{Y}}(\tau)$ with respect to τ is represented by the dashed curve in fig. 9.

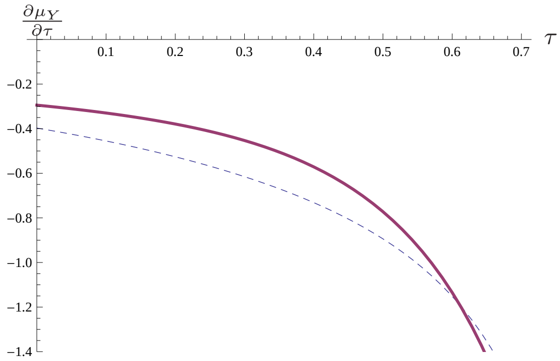


Figure 4: Effect (i) on average post-tax income for $\alpha = 0$ and $\alpha = 10$

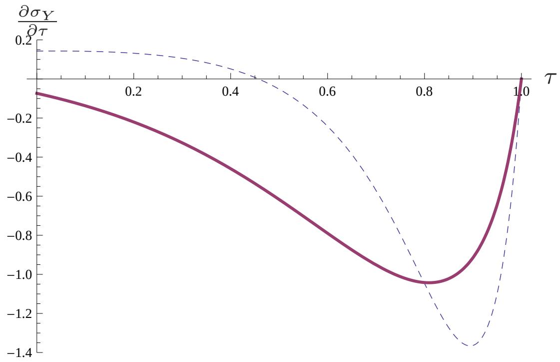


Figure 5: Effect (ii) on Post-tax income inequality for $\alpha = 0$ and $\alpha = 10$

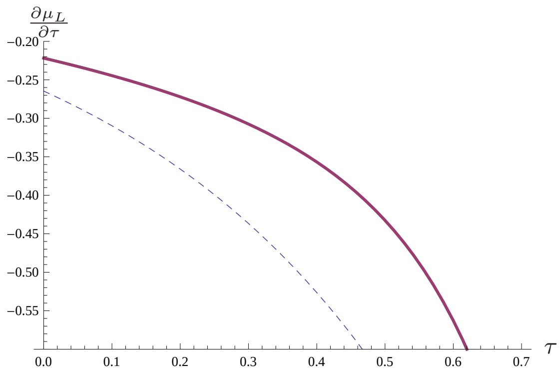


Figure 6: Effect (iii) on average labor supply for $\alpha = 0$ and $\alpha = 10$

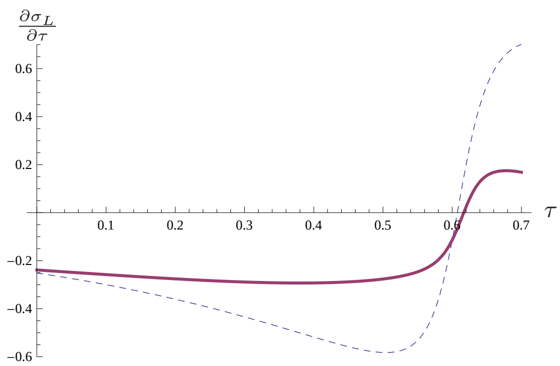


Figure 7: Effect (iv) on labor supply dispersion for $\alpha = 0$ and $\alpha = 10$

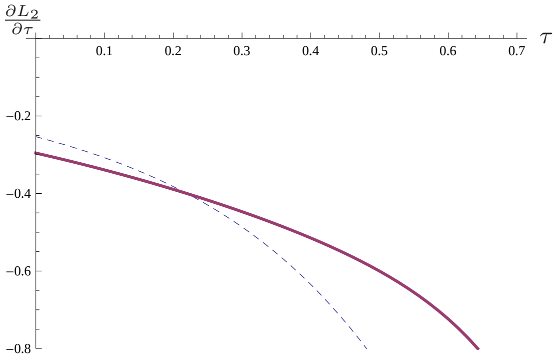


Figure 8: Partial derivative of Labor supply L_2 with respect to τ for $\alpha = 0$ and $\alpha = 10$

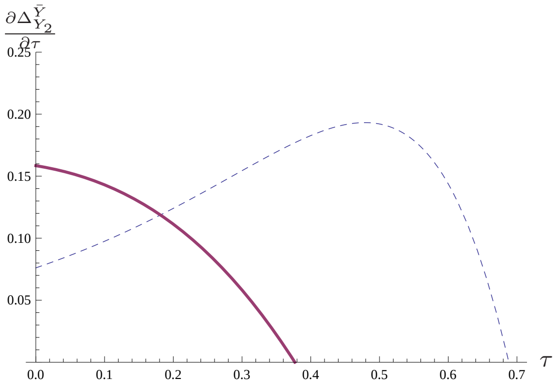


Figure 9: Derivative of $\Delta^{\bar{Y}}_{Y_2}(\tau)$ with respect to τ for $\alpha = 0$ and $\alpha = 10$

We can directly observe that increasing the tax rate first enlarges the difference $\Delta^{\bar{Y}}_{Y_2}(\tau)$ between average and median post-tax income. This reduces utility and therefore the income redistribution effect constitutes a marginal cost for tax rates below $\tau \approx 0.68$. However, for larger tax rates the income redistribution effect turns into a marginal benefit as the difference $\Delta^{\bar{Y}}_{Y_2}(\tau)$ is decreasing with taxation.

Introducing the work effort norm ($\alpha > 0$) then alters the marginal cost and benefit of taxation. To illustrate this, we set $\alpha = 10$. As the norm leads to a lower labor supply of group 2 for any tax rate, the tax-induced work effort reduction becomes smaller, cf. the solid curve in fig. 8. Formally, this is represented by

$$\left.\frac{\partial L_2}{\partial \tau}\right|_{\alpha=0} < \left.\frac{\partial L_2}{\partial \tau}\right|_{\alpha=10} < 0,$$

for tax rates above $\tau \approx 0.22$. Thus, increasing the strength of the work effort norm tempers the marginal benefit (I). Further, the solid curve in fig. 9 sketches effect (II) when the norm is present. It can be seen that the negative income effect becomes stronger for small tax rates and turns into a marginal benefit at a smaller tax rate than without the norm.[15] The cost-enhancing effect could be driven by the labor supply decision of group 3. As high-productivitiy individuals are working less than the average, the incentive to increase labor supply in the presence of the norm tempers the tax-induced cut in average post-tax income. Consequently, the post-tax income of group 2 decreases more than the average for small tax rates.

[15]The marginal cost could be weakened by introducing the work effort norm, e.g. for $w_2 = 1.7$.

(III) Beyond that, introducing the work effort norm gives rise to an additional marginal benefit which is referred to as *stigma effect of taxation*. Stigma depends on the difference between average labor supply and the individual labor supply. Let us define $\Delta_{L_2}^{\bar{L}}(\tau) = \bar{L}(\tau) - L_2(\tau)$ from the median voter's perspective. As shown before, group 2 works more than the average. Hence, labor supply $L_2(\tau)$ is decreasing with taxation. Then, fig. 10 shows that raising the tax rate leads to a smaller deviation of median work effort from the average. This reduction holds for tax rates below $\tau \approx 0.7$ and reduces stigma.

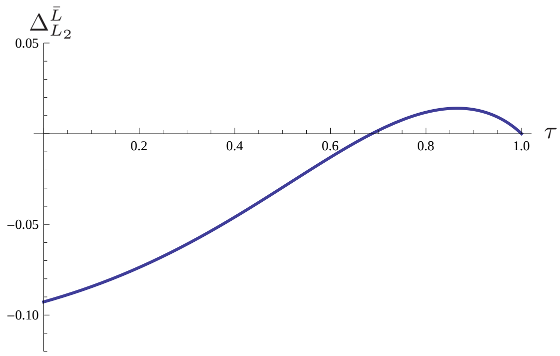


Figure 10: Difference of labor supply $L_2(\tau)$ and average labor supply $\bar{L}$ for $\alpha = 10$

In sum, introducing the work effort norm

- reduces the marginal benefit via the labor supply effect of taxation
- could enlarge the marginal cost for small tax rates through the income effect of taxation
- gives rises to an additional marginal benefit, i.e. stigma effect of taxation .

Again, it is per se not clear which of these effects prevail. The numerical simulation in the next paragraph suggests that depending on the median voters wage rate the marginal cost of taxation via increasing the difference between average and median income together with the smaller marginal benefit in reducing labor supply could dominate the marginal benefit through reducing stigma. Hence, in this case taxation gets less desirable at the margin.

Simulation results. In the sequel, we aim to explore the efficiency properties of the tax rate implemented through majority voting. Thereby, we analyze whether the work effort norm is able to reduce inefficiency. It deserves to be mentioned that the results of Eichner (2002) reveal as a special case of our approach (for $\alpha = 0$). According to Eichner (2002) the first-best tax rate τ^* increases in the pre-tax income inequality while the tax rate τ^m preferred by the median voter is mainly influenced by the wage distribution. The lines 1, 2 and 3 from table 6 where the median wage is raised from $w_2 = 1.7$ to $w_2 = 1.8$ and then to $w_2 = 2.0$ show that reductions in pre-tax income inequality $\sigma_X = \sigma_Y(\tau = 0)$ are associated with a lower socially optimal tax rate τ^*. In contrast, the majority tax rate mainly depends on the wage distribution. More precisely, τ^m decreases in the difference $\bar{w} - w_2$. The intuition behind this result is as follows. The median voter considers the difference of her wage rate to the wage rates of the other groups. Ceteris paribus raising w_2 reduces the difference $\bar{w} - w_2$ between the average and the median wage. As a consequence, the median voter benefits less from redistributive taxation. More income would be redistributed from group 2 to group 1 while group 2 receives less transfer payments from group 3. Hence, holding the other wage rates constant, the difference between average and median wage plays a decisive role for the majority tax rate.

We can confirm these results even when the work effort norm is introduced (cf. eg. lines 4, 11 and 18). Beyond that, it can be observed that the tax rate resulting from majority voting could be inefficiently low or high. This is also in line with the findings of Eichner (2002).

Next, we strive to consider how the work effort norm affects both tax rates τ^* and τ^m. We can show that the socially optimal tax rate τ^* unambiguously increases with the norm strength α. This is illustrated by the lines 4-10 for $w_2 = 1.7$, lines 11-17 for $w_2 = 1.8$ and lines 18-24 for $w_2 = 2.0$. In all cases the cost-reducing effects of the social norm regarding the partial effects (i) and (ii) dominate the benefit-tempering effects with respect to the partial effects (iii) and (iv). Thus, redistributive taxation gets more desirable at the margin. More intuitively, the norm-induced changes in individual work incentives ceteris paribus lead to a larger pre-tax income inequality σ_X. As individuals are inequity averse the social planner sets a higher tax rate τ^* in order to reduce post-tax income inequality. Hence, we can state the following result.

Result 2 *Introducing or strengthening the work effort norm unambiguously induces a higher socially optimal tax rate.*

By contrast, introducing the work effort norm does not unambiguously prompts the median voter to prefer a more intense redistributive taxation τ^m. The tax rate τ^m is increasing with α for the wage rate $w_2 = 1.7$ as shown by lines 4-10 and for $w_2 = 1.8$ which is captured by the lines 11-17. If, however, the median voter receives a wage of $w_2 = 2.0$ the tax rate τ^m is first decreasing in α in case of a weak norm strength (lines 18-21). For a sufficiently large norm intensity τ^m is increasing with α (lines 22 and 24). To provide a further intuition for these results, we focus on the marginal effects (I), (II) and (III) of taxation from the perspective of the median voter. Which of these effects prevail depends on the difference $\bar{w} - w_2$ between the average and the median wage rate. For $w_2 = 1.7$ and $w_2 = 1.8$ the additional positive stigma effect (III) of taxation outweighs the norm-induced reduction in the labor supply effect (I) as well as the cost-enhancing effect regarding the income redistribution effect (II). Subsequently, redistributive taxation gets more desirable at the margin and therefore τ^m increases with α. In case of $w_2 = 2.0$ the difference $\bar{w} - w_2$ gets smaller. At this, the tax-induced raise in the difference $\Delta^{\bar{Y}}_{Y_2}(\tau)$ between average and median income becomes large if α is small. Hence, the cost-enhancing effect regarding the income redistribution effect (II) together with the benefit-reducing effect with repect to (I) dominate the positive stigma effect (III). Then, the median voter prefers a lower tax rate τ^m for a sufficiently weak norm. If, however, α is sufficiently large the income redistribution effect (II) turns into a marginal benefit of taxation. In this case, the median voter preferes higher taxation τ^m when α is raised.

Result 3 *If the difference between the average and median wage is small, the median voter prefers lower taxation in the presence of the work effort norm.*

Eventually, we consider how the difference $\Delta^{\tau^*}_{\tau^m} := \tau^* - \tau^m$ between both tax rates changes with the norm strength α. As τ^* characterizes first-best taxation, this difference provides a

No.	α	w_2	$\bar{w}$	$\bar{w} - w_2$	σ_X	τ^*	τ^m	$\Delta_{\tau^m}^{\tau^*}$
1.	0	1.7	2.4	0.7	0.322180	0.383370	0.463081	-0.079711
2.	0	1.8	2.43	0.63	0.313744	0.374551	0.332358	0.042193
3.	0	2.0	2.5	0.5	0.305719	0.372702	0.103601	0.269101
4.	1	1.7	2.4	0.7	0.366179	0.434908	0.498359	-0.063451
5.	2	1.7	2.4	0.7	0.404740	0.463267	0.519746	-0.056479
6.	3	1.7	2.4	0.7	0.438861	0.480055	0.532385	-0.052330
7.	6	1.7	2.4	0.7	0.521329	0.503904	0.549868	-0.045964
8.	10	1.7	2.4	0.7	0.600212	0.516184	0.558574	-0.042390
9.	100	1.7	2.4	0.7	0.924459	0.535918	0.572081	-0.036163
10.	1000	1.7	2.4	0.7	1.00469	0.538114	0.573543	-0.035429
11.	1	1.8	2.43	0.63	0.356949	0.425392	0.367008	0.058384
12.	2	1.8	2.43	0.63	0.394640	0.454504	0.411438	0.043066
13.	3	1.8	2.43	0.63	0.427902	0.472212	0.447852	0.024360
14.	6	1.8	2.43	0.63	0.508148	0.497955	0.498821	-0.000866
15.	10	1.8	2.43	0.63	0.584976	0.511444	0.521165	-0.009721
16.	100	1.8	2.43	0.63	0.905356	0.533374	0.551370	-0.017996
17.	1000	1.8	2.43	0.63	0.986271	0.535829	0.554358	-0.018259
18.	1	2.0	2.5	0.5	0.348268	0.418836	0.070944	0.347892
19.	2	2.0	2.5	0.5	0.384840	0.446233	0.039596	0.406637
20.	3	2.0	2.5	0.5	0.416776	0.463610	0.009585	0.454024
21.	6	2.0	2.5	0.5	0.492926	0.490142	0	0.490142
22.	10	2.0	2.5	0.5	0.565252	0.504709	0.361353	0.143356
23.	100	2.0	2.5	0.5	0.871698	0.529357	0.500634	0.028723
24.	1000	2.0	2.5	0.5	0.952039	0.532185	0.508898	0.023287

Table 1: Simulation results

measure of the inefficency of the majority voting. First, we can observe that the changes in taxation gets small for a large α. This seems plausible as raising α goes along with a smaller labor supply dispersion σ_L since individual work effort converges to the average labor supply. If α is large, the norm-induced changes in individual work incentives and the income distribution are weak. Analogously, the median voter's response to a stronger work effort norm becomes weaker, too. This leads to only slight changes in both tax rates. Subsequently the difference $\Delta^{\tau^*}_{\tau^m}$ stabilizes if the norm prefence α is sufficiently large.

For $w_2 = 1.7$ in lines 4-10 the difference $\Delta^{\tau^*}_{\tau^m}$ decreases monotonically in α according to amount. Turning to the case of $w_2 = 2.0$ as captured by the lines 18-24, the difference initially raises in α for a weak norm before it becomes decreasing in α for a sufficiently large norm strength. Thus, in these cases both tax rates seem to converge if the prefence regarding the work effort norm is strong. However, for $w_2 = 1.8$ in lines 11-17 the tax difference $\Delta^{\tau^*}_{\tau^m}$ shrinks when α is raised. The sign of $\Delta^{\tau^*}_{\tau^m}$ turns from positive to negative for a sufficiently large norm intensity. Nevertheless, the deviation from first-best taxation is smaller than in case of a weak norm preference.

Result 4 *A sufficiently strong work effort norm can reduce the difference between the socially optimal tax rate and the tax rate preferred by the median voter.*

We can observe another interesting aspect. As mentioned before, the sign of $\Delta^{\tau^*}_{\tau^m}$ changes for $w_2 = 1.8$, cf. lines 11-17. For a small preference intensity the majority tax rate τ^m is inefficiently low while it becomes inefficiently high if α gets sufficiently large. Since we face continuous functions there seems to exist a preference strength $\tilde{\alpha} \approx 6$ at which the difference becomes zero. Hence, we can conclude the following result.

Result 5 *For specific wage distributions exists a preference strength at which the tax rate from majority voting is socially optimal.*

To put Result 4 and 5 differently, we can state that the work effort norm is capable to reduce the inefficiency resulting from majority voting if the norm strength is supposed to be sufficiently strong. It deserves to be mentioned that Result 2 and 3 derived in this section seem to be robust to changes in the parameters of the utility function. However, Result 4 becomes a little weaker for some parameter variations. Nevertheless, in most cases the tax difference is smaller for a large preference strength than without the norm.[16]

6 Conclusion

In this paper we aim to analyze the effects of a work effort norm in the vein of Aronsson and Sjögren (2010) on socially optimal taxation as well as on the tax rate chosen by means of majority voting. In presence of the work effort norm, working more or less than the average

[16] A detailed sensitivity analysis with respect to variations in a, b and c is delegated to the appendix.

gives rise to stigma. We introduce the social norm into the basic framework of Eichner (2002) where three groups differing in productivity decide on labor supply.

We show that introducing a work effort norm leads to a smaller dispersion in individual labor supply across the three groups in the society. The norm-induced changes in individual work incentives then lead to a larger post-tax income inequality. A numerical simulation of our model illustrates that first-best taxation increases with the strength of the social norm. In contrast, if the difference between the average and the median wage rate is small, the tax rate preferred by the majority could decrease when the work effort norm is introduced. Furthermore, for a sufficiently strong social norm the tax difference proves to be smaller than without the social norm. Beyond that, for specific wage distributions there seems to exist a norm preference strength for which the tax rate resulting from majority voting is socially optimal. Subsequently, the work effort norm can weaken the inefficiency implemented by majority voting.

Unfortunately, by assuming particular quadratic utility functions we derive these results at the cost of less generality. Though our findings prove to be robust with respect to changes in the parameters of the utility function. As already pointed out by Eichner (2002) there seems to be no feasible alternative to avoid this specific analysis. Furthermore, there are some aspects we have abstracted from in our analysis and which could be tackled in future research. First, we assumed preferences for the work effort norm to be homogenous across the groups in the society. Beyond, it would be possible to set another reference value regarding work effort, e.g. the modal work effort in the population (see Aronsson and Sjögren, 2010). Thereby, the question how changes in the population distribution affect the results could be adressed. Finally, a participation norm or welfare stigma (see e.g. Lindbeck et al., 1999 or Aronsson and Sjögren, 2010) could be incorporated in order to consider the interrelations between both norm types.

References

Aronsson, T. and Sjögren, T. (2010), 'Optimal income taxation and social norms in the labor market', *International Tax and Public Finance* 17(1), 67–89.

Clark, A.E. (2003), 'Unemployment as a social norm: Psychological evidence from panel data', *Journal of Labor Economics* 21(2): 323–351.

Conlin, M. and Lynn, M. and O'Donoghue, T. (2003), 'Unemployment as a social norm: Psychological evidence from panel data', *Journal of Economic Behavior and Organization* 52(3): 297–321.

Eichner, T. (2002), 'Constitutional and postconstitutional taxation', *European Journal of Political Economy* 18(4), 615–630.

Eichner, T. and Wagener, A. (2004), 'The Welfare State in a Changing Environment', *International Tax and Public Finance* 11(3), 313–331.

Elster, J. (1989), 'Social Norms and Economic Theory', *Journal of Economic Perspectives* 3(4), 99–117.

Harms, P. and Zink, S. (2003), 'Limits to redistribution in a democracy: a survey', *European Journal of Political Economy* 19(4), 651?668.

Lindbeck, A. (1995), 'Hazardous welfare-state dynamics', *American Economic Review* 85(2): 9–15.

Lindbeck, A. and Nyberg, S. and Weibull, J.W. (1999), 'Social norms and economic incentives in the welfare state', *Quarterly Journal of Economics* 114(1), 1–35.

Meltzer, A.H. and Richard, S.F. (1981), 'A rational theory of the size of government', *Journal of Political Economy* 89(5), 914–927.

Mirrlees, J.A. (1971), 'An exploration in the theory of optimum income taxation', *Review of Economic Studies* 38(2): 175–208.

Roberts, K. (1977), 'Voting over income tax schedules', *Journal of Public Economics* 8(3): 329–340.

Sinn, H.-W. (1995), 'A theory of the welfare state', *Scandinavian Journal of Economics* 97(4), 495–526.

Sinn, H.-W. (1996), 'Social insurance, incentives and risk taking', *International Tax and Public Finance* 3(3), 259–280.

Stern, N. (1982), 'Optimum taxation with errors in administration', *Journal of Public Economics* 17(2): 181–211.

Stiglitz, J.E. (1982), 'Self-selection and Pareto efficient taxation', *Journal of Public Economics* 17(2): 213–240.

Stutzer, A. and Lalive, R. (2004), 'The Role of Social Work Norms in Job Searching and Subjective Well-Being', *Journal of the European Economic Association* 2(4), 696–719.

Traxler, C. (2010), 'Social norms and conditional cooperative taxpayers', *European Journal of Political Economy* 26(1), 89–103.

Tridimas, G. and Winer, S.L. (2005), 'The political economy of government size', *European Journal of Political Economy* 21(3), 643?666.

Varian, H.R. (1980), 'Redistributive taxation as social insurance', *Journal of Public Economics* 14(1): 49–68.

Appendix (only for the referees)

Well-defined utility function

Exemplarily, this function is presented for the parameters $a = 12$, $b = 2$, $c = 2$ as well as $p_1 = p_2 = p_3 = 1/3$ in fig. 11. As the utility function is concave in its arguments the problem

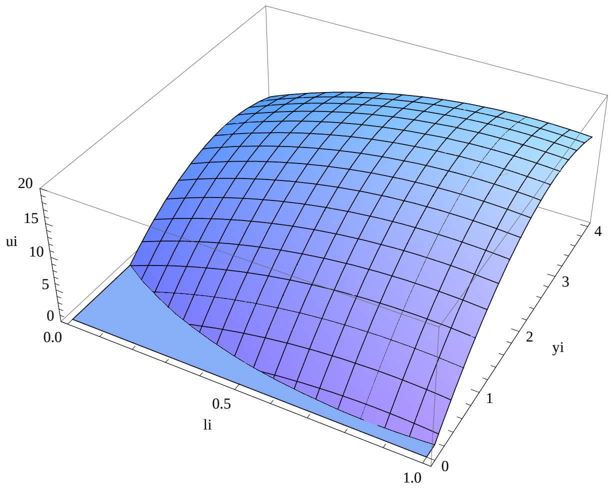


Figure 11: Individual utility (for $\alpha = 10$ and $\bar{\ell} = 1$)

is well-defined.

Equivalence of utilitarian welfare and μ-σ-approach

By defining $E[\cdot]$ as mean operator we can write

$$E[u_i] = aE[y_i] - bE[y_i^2] - cE[\ell_i^2] - \alpha E[(\bar{\ell} - \ell_i)^2] \tag{A1}$$

for mean utility. Inserting $E[y_i^2] = V[y_i] + (E[y_i])^2$ and $E[\ell_i^2] = V[\ell_i] + (E[\ell_i])^2$ where $V[\cdot]$ is the variance operator we obtain:

$$E[u_i] = aE[y_i] - bV[y_i] - b(E[y_i])^2 - cV[\ell_i] - (E[\ell_i])^2 - \alpha E[(\bar{\ell} - \ell_i)^2]. \tag{A2}$$

Further, we use $V[\ell_i] = E[(\bar{\ell} - \ell_i)^2]$ in order to write:

$$E[u_i] = aE[y_i] - bV[y_i] - b(E[y_i])^2 - cV[\ell_i] - c(E[\ell_i])^2 - \alpha V[\ell_i]. \tag{A3}$$

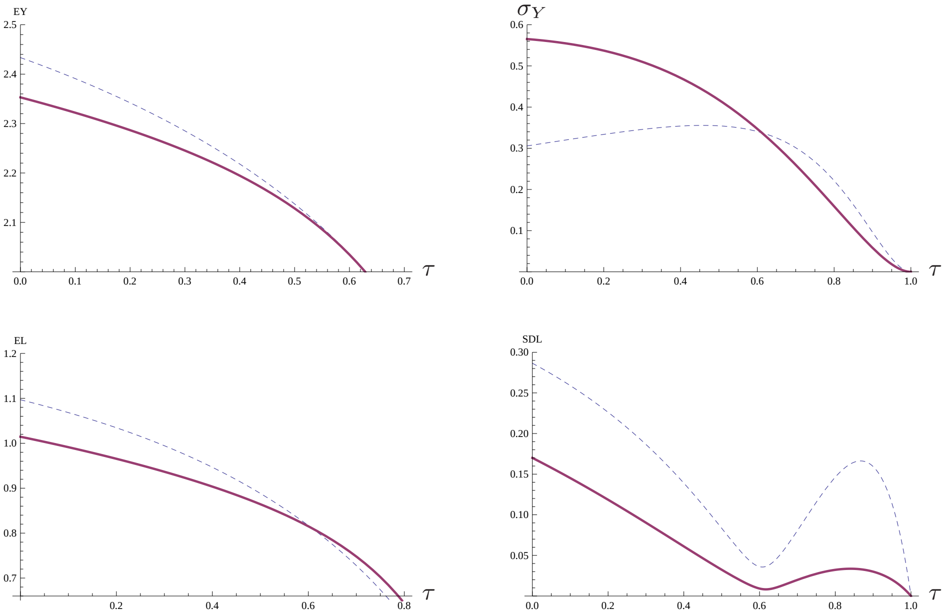
Finally, substituting $E[y_i] = \mu_Y$, $E[\ell_i] = \mu_L$, $V[y_i] = \sigma_Y^2$ as well as $V[\ell_i] = \sigma_L^2$ yields mean utility or utilitarian welfare

$$W[\mu_Y, \sigma_Y, \mu_L, \sigma_L] = a\mu_Y - b(\sigma_Y^2 + b\mu_Y^2) - c(\sigma_L^2 + \mu_L^2) - \alpha\sigma_L^2. \tag{A4}$$

as a function of mean income μ_Y, income inequality σ_Y, average labor supply μ_L as well as labor supply dispersion σ_L. This reflects the equivalence of expected utility and the μ-σ-approach for quadratic utility functions as already pointed out by the literature. However, we interpret expected utility from an ex-post perspective as individual utility sum or utilitarian welfare, respectively. It deserves to be mentioned that the welfare effects of taxation are partial effects. Hence, we neglect that work effort affects income.

Absolute values of the partial effects of taxation

For the sake of completeness the following figures depict the absolute values of μ_Y, σ_Y, μ_L and σ_L depending on the tax rate. Again, while the dashed curves represent the benchmark case $\alpha = 0$ the thick curves capture the case $\alpha = 10$.



These curves describe the effects (i)-(iv) in a similar way to Eichner (2002) which then allows for a direct comparison.

Sensitivity analysis regarding the numerical simulation

We aim to explore the robustness of our simulation results. By doing this we consider variations of $[0.7x, 1.3x]$ regarding the utility function parameters a, b and c.

i) $a = 8.4$ *and* $a = 15.6$: Obviously, we obtain the same results as for $a = 12$. This is not surprising. The parameter a represents the marginal utility of post-tax income. A change in a works like an income effect which only shifts utility. Hence, the labor supply decision and therefore the optimal tax rates remain unchanged.

ii) $b = 1.4$ and $b = 2.6$: From table we can constitute that our results hold even for a smaller b as well as for a larger b. The parameter b captures the inequity aversion of the individuals. Hence, the taxation tends to be higher for a larger inequality aversion.

iii) $c = 1.4$ and $c = 2.6$: Eventually, our results remain for changes in the work propensity c.

Thus, we can show that our results regarding the effects of the work effort norm on both tax rates seem to be robust with respect to changes in the individual utility parameters.

No.	α	w_2	τ^*	τ^m	$\Delta^{\tau^*}_{\tau^m}$
1.	0	1.7	0.38337	0.463081	-0.079711
2.	1	1.7	0.434908	0.498359	-0.063451
6.	10	1.7	0.516184	0.558574	-0.04239
7.	100	1.7	0.535918	0.572081	-0.036163
8.	0	1.8	0.374551	0.332358	0.042193
9.	1	1.8	0.425392	0.367008	0.058384
13.	10	1.8	0.511444	0.521165	-0.009721
14.	100	1.8	0.533374	0.55137	-0.017996
15.	0	2.0	0.372702	0.1036010	0.269101
16.	1	2.0	0.418836	0.0709438	0.3478922
20.	10	2.0	0.504709	0.361353	0.143356
21.	100	2.0	0.529357	0.500634	0.028723

Table 2: Simulation results for $a = 8.4$ and $a = 15.6$

No.	α	w_2	τ^*	τ^m	$\Delta_{\tau^m}^{\tau^*}$
1.	0	1.7	0.381375	0.507780	-0.126405
2.	1	1.7	0.410883	0.513734	-0.102851
6.	10	1.7	0.458384	0.523323	-0.064939
7.	100	1.7	0.471632	0.526011	-0.054379
8.	0	1.8	0.369849	0.408803	-0.038954
9.	1	1.8	0.400598	0.435687	-0.035089
13.	10	1.8	0.453447	0.488864	-0.035417
14.	100	1.8	0.468809	0.502744	-0.033935
15.	0	2.0	0.360476	0.162830	0.197646
16.	1	2.0	0.389779	0.161743	0.228036
20.	10	2.0	0.446102	0.378771	0.067331
21.	100	2.0	0.464300	0.446125	0.018175

Table 3: Simulation results for $b = 1.4$

No.	α	w_2	τ^*	τ^m	$\Delta_{\tau^m}^{\tau^*}$
1.	0	1.7	0.379615	0.410009	-0.030394
2.	1	1.7	0.447657	0.457126	-0.009469
6.	10	1.7	0.556793	0.584824	-0.028031
7.	100	1.7	0.580428	0.606768	-0.026340
8.	0	1.8	0.373769	0.281859	0.091910
9.	1	1.8	0.439463	0.292100	0.147363
13.	10	1.8	0.552251	0.544222	0.008029
14.	100	1.8	0.578098	0.587970	-0.009873
15.	0	2.0	0.378557	0.073985	0.304572
16.	1	2.0	0.437479	0.027221	0.410258
20.	10	2.0	0.546038	0	0.546038
21.	100	2.0	0.574449	0.541745	0.032704

Table 4: Simulation results for $b = 2.6$

No.	α	w_2	τ^*	τ^m	$\Delta_{\tau^m}^{\tau^*}$
1.	0	1.7	0.377512	0.391134	-0.013622
2.	1	1.7	0.472832	0.457870	0.014962
6.	10	1.7	0.578882	0.602622	-0.023740
7.	100	1.7	0.596637	0.620002	-0.023365
8.	0	1.8	0.372852	0.266837	0.106015
9.	1	1.8	0.464866	0.272515	0.192351
13.	10	1.8	0.575091	0.570236	0.004855
14.	100	1.8	0.594467	0.602458	-0.007991
15.	0	2.0	0.380110	0.065498	0.314612
16.	1	2.0	0.462494	0	0.462494
20.	10	2.0	0.569707	0.180198	0.389509
21.	100	2.0	0.591064	0.559853	0.031211

Table 5: Simulation results for $c = 1.4$

No.	α	w_2	τ^*	τ^m	$\Delta_{\tau^m}^{\tau^*}$
1.	0	1.7	0.382828	0.500044	-0.117216
2.	1	1.7	0.411756	0.510364	-0.098608
6.	10	1.7	0.469671	0.530993	-0.061322
7.	100	1.7	0.488423	0.537737	-0.049314
8.	0	1.8	0.371843	0.390011	-0.018168
9.	1	1.8	0.401307	0.416444	-0.015137
13.	10	1.8	0.464217	0.492021	-0.027804
14.	100	1.8	0.485586	0.514693	-0.029107
15.	0	2.0	0.364228	0.144667	0.219561
16.	1	2.0	0.391683	0.135571	0.256112
20.	10	2.0	0.456399	0.343896	0.112503
21.	100	2.0	0.481082	0.457964	0.023118

Table 6: Simulation results for $c = 2.6$