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Meritocratic Labor Income Taxation

Abstract

Surveys and experiments suggest that people hold workers more responsible for income gains stemming from merit, such as education, than circumstances, such as parental education. This paper shows how to design income taxes that account for merits. First, we introduce social welfare functions that accommodate individual preferences and hold workers responsible for their merits. Second, we show how to map social welfare function primitives into empirically measurable statistics and exploit long-run Norwegian income and family relations register data to examine the relationship between merit and income. Third, we simulate optimal income tax implications of our meritocratic social welfare functions. The result is that accounting for merit leads to lower optimal marginal income tax rates than the utilitarian criterion recommends, but the difference is smaller when workers are not held responsible for merits that are explained by circumstances.

JEL-Codes: D310, D630, H210.

Keywords: equality of opportunity, meritocracy, optimal income taxation, welfare criteria.

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1 Introduction

Income differences are driven by multiple factors, such as education (Bhuller et al., 2017), gender (Goldin et al., 2017), and childhood neighborhood (Chetty et al., 2016). An extensive survey and experimental literature have established that social acceptance of income differences depends on which factors determine these differences (Konow, 2000, Fong, 2001, Almås et al., 2020, Hvidberg et al., 2023). In particular, Cappelen et al. (2007) and Cappelen et al. (2023) establish that *merit* is an important factor for redistributive preferences, where merit is defined as the effect on income of certain choices, such as education.[1] However, merit concerns are rarely included in criteria used for optimal policy evaluation.

The objective of this paper is to introduce one way of accounting for such social attitudes in welfare criteria and explore how it affects optimal policy. Specifically, we study the optimal tax policy implications of a social welfare function that holds people responsible for the part of their income that is due to merit. The paper makes three main contributions. First, we introduce novel meritocratic social welfare functions that combine the Pareto principle with holding people accountable for their merit. Second, we inform our social welfare function with detailed empirical measurement of merits and their relationship with labor income, leveraging detailed Norwegian register data. Third, as our criteria are designed to be applicable to second-best policy analysis, we simulate optimal income tax policies using our meritocratic social welfare functions and empirical measurement of merit.

The key point is that our meritocratic social welfare functions prioritize reducing after-tax income inequality across individuals, except for income differences that are explained by variation in merit. To construct these social welfare functions, we define ideal meritocratic allocations where incomes are adjusted for differences in merit. There are three key axioms that motivate our welfare criteria.[2] First, a transfer from individuals who receive more than their ideal allocation to individuals who receive less than their ideal allocation is an improvement. Second, the criteria choose the ideal allocation for all when it is feasible and Pareto undominated. Third, we compare individuals according to their relative deviations from the ideal allocation. Individuals have a larger ideal allocation when the measure of merit is higher for a given income, such that the criteria

[1]Inspired by the experimental literature and to avoid confusion with criteria and measurement from the equality of opportunity literature (Roemer, 2009), on which we build but differ in multiple ways, we use the term merit rather than effort for factors which individuals are held responsible for.

[2]The three other axioms that define our criteria are Monotonicity, Separability and Continuity, and are more standard in the literature.

attach higher weight to individuals with higher merit for a given income. This weight is necessary to reflect the view that for a given income, higher-merit people are more deserving.

To see the intuition of our approach, consider a simplified model where individuals consume a good c and are characterized by their pre-tax income z and merit m, with $z, m > 0$. Without loss of generality, we normalize the average values such that $\mathbb{E}[z] = \mathbb{E}[m] = 1$. Income and merit are related through $z = m + o$, where o is the part of the income that is not due to merit. A simplified version of our criteria is given by

$$W = \sum_i m_i \log c_i,$$

with marginal welfare weights $\partial W / \partial c_i = m_i / c_i$. The criterion is thus averse to consumption inequality for a given level of merit while putting more weight on high-merit individuals for a given level of consumption.

Consider now a situation where the government can redistribute consumption based on income *and* merit, subject to the government budget constraint, $\sum_i (c_i - z_i) \leq 0$. Putting $c_i = m_i = z_i - o_i$ for each individual solves the problem. That is, each individual gets to keep the part of their income that is due to merit.

If, instead, the government can only redistribute based on income, the optimal allocation depends on the correlation between merit and income. To see why, note that by the law of iterated expectations, our criteria can be re-expressed as

$$\hat{W} = \int \mathbb{E}[m|z] \log c(z) dF,$$

where F is the cumulative distribution function of incomes.[3] Maximizing the criterion subject to informational constraints and the government budget constraint implies that individuals with income z consume the average merit among those at the same income level, $c(z) = \mathbb{E}[m|z]$.

When $\mathbb{E}[m|z]$ is linear, a flat tax rate $t = 1 - \beta$ with $\beta = Cov(m, z)/Var(z)$ solves the optimal policy problem. Since β is the slope of $\mathbb{E}[m|z]$, the criteria's degree of inequality reduction depends crucially on the correlation between merit and income.[4] A lower

[3]This formulation clarifies our criteria's connection to the generalized marginal social welfare weights proposed by Saez and Stantcheva (2016), as our criteria's marginal welfare weights are given by the partial derivative of $\hat{W}$ with respect to consumption at a certain level of w. Thus, marginal welfare weights are decreasing in income as long as average merit does not increase "too fast." Strictly speaking, this is the case if and only if the elasticity of (conditional) average merit with respect to income is lower than for consumption. Formally, whenever $d \log \mathbb{E}[m \mid z] / d \log z < d \log c(z) / d \log z$.

[4]Correlation is the relevant statistical measure because $\mathbb{E}[m|z]$ is linear. Note also that a higher variance in w or a lower variance in m also implies higher tax rates.

correlation implies more redistribution, and in the special case where merit and income are uncorrelated, our criteria recommend the egalitarian allocation. Moreover, if merit and income are negatively correlated, the criteria imply redistribution beyond equality and implements allocations where consumption is decreasing in income. In the paper, we show how this simple model can be extended to endogenous income with costly redistribution and more general models of social welfare and merit.

Our meritocratic social welfare functions build on an influential literature in political philosophy and welfare economics on luck egalitarianism and equality of opportunity (Dworkin, 1981, Sen, 1985, Arneson, 1989, Roemer, 1993, Fleurbaey, 1995 and Kolm, 2004).[5] The innovation to this literature is to develop social welfare functions that account for individuals' merits while they respect individuals' preferences and are informed by empirical measurement. Our framework is related to equality of opportunity approaches, such as Roemer (2009), where income is separated into what is due to circumstance (beyond individuals' control) and what is due to effort (within individuals' control). The objective of the equality of opportunity approach is typically to equalize opportunity sets. In contrast, our criteria depend on individuals' outcomes, respect individuals' preferences, and prioritize people according to measures of how much of their incomes are determined by merit.

In the empirical analysis, we estimate the contribution of merit to the labor income of Norwegian wage earners.[6] By exploiting long-run register data on labor income, family relations, and observable characteristics, we run flexible regressions to identify the variance in earnings that can be explained by merit. The approach is inspired by empirical research related to equality of opportunity (Cowell and Jenkins, 1995, Roemer et al., 2003, Bourguignon et al., 2007, Aaberge et al., 2011, Almås et al., 2011, Corak, 2013, and Hufe et al., 2022) and intergenerational mobility (Black et al., 2005, Chetty et al., 2014, Bratberg et al., 2017, Boserup et al., 2018, Chetty et al., 2020, Fagereng et al., 2021, Berg and Hebous, 2021 and Kreiner and Olufsen, 2022).[7] Instead of including a broad set of circumstances such as parental education and income, we follow Mazumder (2008) and Björklund et al. (2009) in exploiting sibling-fixed effects to account for any family and childhood-related circumstances.[8] Gender and cohort-fixed effects are also added to circumstances.

[5]Certain philosophers, such as Sandel (2020), oppose meritocratic ideals partly due to the focus on individual choices rather than on participation in the community.

[6]We focus on wage earners and labor income because the determinants of capital and self-employment income may be different, and our tax analysis does not account for saving and dynamics.

[7]See Mogstad and Torsvik (2023) for a literature review focused on family background and neighborhoods.

[8]Björklund and Jäntti (2020) provide a comparison of sibling-fixed effects and a broad set of family cir-

We introduce two different versions of meritocracy. In a ”total meritocracy” version, we measure merit as the part of labor income that is explained by education, industry, and occupation on individuals' income conditional on sibling-fixed effects. [9] These merit indicators are chosen because they are observed, individuals may have some degree of choice over them, and they may be relevant determinants of earnings.[10] The unexplained part is considered undeserved.[11] In a ”partial meritocracy” version, we also account for the fact that observed merits partly mediate circumstances and measure only the part of merit factors that is unexplained by circumstances. Hence, if completing higher education is explained by the education of the parents, its effect on income is not considered deserved according to the partial version. Our main empirical result is that merit indicators explain a significant part of the variation in labor income of Norwegian wage earners (15 percent for partial meritocracy and 40 percent for total meritocracy). We also show how our criteria can be used to derive measures of meritocracy and study the evolution of the extent of meritocracy across cohorts growing up in the sixties and seventies.

With the criteria and empirical results, we explore optimal tax policy implications. Here, we build on the general optimal tax literature (Mirrlees, 1971, Saez, 2001 and Heathcote et al., 2017) and the optimal tax literature focused on fairness (Fleurbaey and Maniquet, 2006, Ooghe and Peichl, 2014, Lockwood and Weinzierl, 2015, Saez and Stantcheva, 2016, Fleurbaey and Maniquet, 2018, Weinzierl, 2018 and Berg and Piacquadio, 2022). To conduct optimal tax simulations, we non-parametrically estimate the Norwegian labor income distribution and rely on recent evidence on substitution and income effects from Graber et al. (2022) to calibrate our model. We conduct optimal tax simulations for a flat tax system with a lump sum transfer, a progressive tax system without a lump sum transfer (Heathcote et al., 2017), and an unrestricted tax system (Mirrlees, 1971).[12] The optimal

cumstances in explaining income during adulthood.

[9]Some may object to this measure that even though merit factors may be indicative of actual merit, circumstances partly explain these choices. Interestingly, Cappelen et al. (2023) find that third-party spectators in an experiment give primacy to merit in that they allocate more than what is caused by merit to those with higher degrees of merit.

[10]Alternatively, one could inform the choice of indicators by a survey of what people believe makes workers more deserving of their income.

[11]The Roemer (2009) approach instead measures the effects of circumstances and allocates the unexplained part to effort. In the Appendix, we consider how allocating the unexplained part to merit affects our results.

[12]We only consider income-based tax systems and do not investigate ”tagging” (Akerlof, 1978), which is to base the tax system on non-income factors such as demographic characteristics. The extent to which meritocratic and utilitarian social welfare functions exploit tags differently is an interesting topic that we leave to future research. Similar to utilitarianism, meritocratic social welfare functions would support some degree of tagging since there is no concern for horizontal equity, see the discussion in Berg (2023).

tax simulations show that for our measures of merit, the meritocratic criteria impose less redistribution than utilitarianism but still implement significant levels of taxation and more redistribution than in our calibration of the actual tax system. In our benchmark simulation of a flat tax system with a lump sum transfer, the meritocratic criteria recommend 5-15 percentage points lower tax rates (for partial and total versions of meritocracy, respectively) than the utilitarian optimal tax rate of 55 percent. We find similar rate differences for the unrestricted optimal marginal income tax at the high end of the income distribution.

We now clarify the relationship to some related papers. The construction of the social welfare function builds on a general approach of combining fairness concerns with the Pareto principle in Piacquadio (2017) and Berg and Piacquadio (2022), and extends it to notions of meritocracy.[13] Within the equality of opportunity approach, Roemer et al. (2003) apply Roemer's equality of opportunity measurement to a wide set of countries, Aaberge and Colombino (2012) study the tax policy implications of Roemer's equality of opportunity approach using a microeconometric model of labor supply, while Hufe et al. (2022) present an approach that combines poverty concerns with equality of opportunity. The key difference from our approach is that these papers do not develop social welfare functions that respect individuals' preferences and, therefore, do not apply their criteria to the Mirrleesian optimal tax problem.

Within the fair optimal taxation literature, Fleurbaey and Maniquet (2006), Ooghe and Peichl (2014) and Lockwood and Weinzierl (2015) study taxation with preference heterogeneity and when preferences determine a larger or smaller share of earnings through labor supply responses.[14] While our approach has a similar motivation to distinguish between deserved and undeserved income components, we focus on the extent to which individuals deserve their income potential rather than on variation in labor supply.[15]

In an influential paper, Saez and Stantcheva (2016) show how marginal welfare weights in optimal taxation can reflect a wide range of fairness views, such as equality of opportunity. Our approach is to derive optimal tax implications for specific merit-based criteria, and instead of basing it directly on local marginal welfare weights, the criteria are defined

[13]In Berg and Piacquadio (2022), a key determinant of equity is the individual-specific reference allocation to which individuals' actual allocations are compared. In the current paper, we show how the reference allocation can reflect an ideal of meritocracy, where each individual's merit determines their allocation, and how to empirically inform meritocratic reference points.

[14]Related, Trannoy (2019) studies the implications of compensation and reward for talent within the Mirrleesian optimal taxation model.

[15]Our criteria allow for heterogeneous preferences and hold individuals responsible for them. However, as our policy analysis is based on homogeneous preferences, it is not our main focus.

by fundamental axioms and are specified for any allocation.

The paper proceeds as follows. Section 2 presents the model, demonstrates how we establish welfare comparisons across individuals' preferences over consumption and labor supply, and derives our meritocratic welfare social welfare functions from axioms. In Section 3, we show how to connect the social welfare function to empirically measurable statistics and conduct the empirical analysis of the relationship between merit and income. In Section 4, we present the optimal tax problem, including how we determine preferences and wages and simulate optimal tax rates for three types of tax systems. Section 5 concludes.

2 Social welfare

2.1 Model

Let $\mathcal{I}$ denote the set of individuals. We assume that $|\mathcal{I}| = N \geq 3$. Individuals have preferences over income y_i. For now, income and consumption are the same. An allocation of income y is a collection of each individual's income $y \equiv \{y_i\}_{i \in \mathcal{I}}$. We let $Y \subseteq \mathbb{R}^N_{++}$ denote the collection of all possible allocations of income. All proofs are presented in Appendix A.

2.2 Social preferences

2.2.1 Single-commodity setting

Social preferences $\succsim$, is a binary relation defined over allocations of income Y. Its symmetric and asymmetric counterparts are denoted $\sim$ and $\succ$, respectively. We assume that $\succsim$ is complete and transitive. For the remainder of the section, we use the following notation: $y \geq y'$ means that $y_i \geq y'_i$ for each $i \in \mathcal{I}$. $y > y'$ means that $y_i \geq y'_i$ for each $i \in \mathcal{I}$ and $y_j > y_j$ for at least one $j \in \mathcal{I}$. $y \gg y'$ means that $y_i > y'_i$ for each $i \in \mathcal{I}$.

Since our first four axioms are standard in the literature, they are introduced briefly. The first axiom requires $\succsim$ to recommend Pareto improvements.

Axiom 1 (Monotonicity). *For each pair $y, y' \in Y$, if $y > y'$, then $y \succ y'$.*

The second axiom ensures that the resulting social welfare function is additive.

Axiom 2 (Separability). *For each $y, y' \in Y$, each $i \in \mathcal{I}$ and each $b_i > 0$, $(y_i, y_{-i}) \succsim (y_i, y'_{-i})$ if and only if $(b_i, y_{-i}) \succsim (b_i, y'_{-i})$*

Our next axiom implies that small changes in the allocation do not result in large jumps in social welfare.

Axiom 3 (Continuity)**.** *For each $y' \in Y$, the sets $\{y \in Y | y \succsim y'\}$ and $\{y \in Y | y' \succsim y\}$ are closed.*

The next axiom requires the ranking of allocations to remain invariant to proportional changes. The property is convenient as it implies that the ranking of two allocations is invariant to currency differences.

Axiom 4 (Scale Invariance)**.** *For each pair $y, y' \in Y$ and each $\alpha > 0$, $y \succsim y'$ implies $\alpha y \succsim \alpha y'$.*

Our fifth axiom is a central one and is a generalized version of a standard Pigou-Dalton transfer axiom.

Axiom 5 (Equitable Transfer)**.** *There exists a vector $\tilde{y} \in Y$, such that for each $y, y' \in Y$, each pair $i, j \in \mathcal{I}$ and each $\epsilon > 0$ where,*

- $y'_i - \epsilon = y_i \geq \tilde{y}_i$,
- $y'_j + \epsilon = y_j \leq \tilde{y}_j$,
- $y_k = y'_k$ *for each* $k \in \mathcal{I} \setminus \{i, j\}$,

then, $y \succ y'$.

Rather than requiring that transferring a dollar from a high-income individual to a low-income individual increases social welfare, Equitable Transfer states that transferring a dollar from an individual with income higher than some amount $\tilde{y}_i$ to some other individual with income lower than $\tilde{y}_j$ (possibly $\neq \tilde{y}_i$) would increase social welfare. If $\tilde{y}_i = \tilde{y}_j$ for each $i, j \in \mathcal{I}$, the axiom reduces to the standard Pigou-Dalton transfer axiom, and the equitable distribution of income is then equality.

2.2.2 Total and partial meritocracy

What is the equitable distribution of income? To define equitable distributions of income, we specify an environment in which individual incomes are shaped by two factors: circumstances and merit. The general principle is that society does not hold individuals accountable for income differences that are shaped by circumstances. Income differences generated by differences in merit, on the other hand, are acceptable. Formally, individuals are characterized by a pair (Γ_i, σ_i), where $\sigma_i \in \mathbb{R}$ and Γ_i is a real-valued function. Both σ_i and Γ_i are exogenous in our model. σ_i is interpreted as an individual's circumstances, and Γ represents individual merit.[16] Generally, we allow Γ to depend on σ, to account for the possibility that circumstances might affect merits, i.e., that education choices are shaped by parents' education choices. Together, Γ and σ determines individual income through $y_i = y(\Gamma_i(\sigma_i), \sigma_i)$. Define also a fixed level of circumstance σ_0.[17] Given this structure, we define two alternative equitable distributions of income.

Definition 1. ***Total Meritocracy.***
For some fixed σ_0, the total meritocratic income of individual i is given by

$$\tilde{y}_i^T \equiv y(\Gamma_i(\sigma_i), \sigma_0).$$

Moreover, the total meritocratic distribution is given by $\tilde{y}^T \equiv \{\tilde{y}_i^T\}_{i=1}^N$.

In other words, this means that we can calculate individual total meritocratic incomes by removing the direct impact of circumstances on income. Although this definition entails removing the direct effect of circumstances on earnings, there may still be an indirect effect of circumstances on income through merits, Γ_i. Since society might not hold individuals responsible for this indirect effect, a second definition of the equitable allocation of income is required.

Definition 2. ***Partial Meritocracy.***
For some fixed σ_0, the partial meritocratic income of individual i is given by

$$\tilde{y}_i^P \equiv y(\Gamma_i(\sigma_0), \sigma_0).$$

Moreover, the partial meritocratic distribution is given by $\tilde{y}^P \equiv \{\tilde{y}_i^P\}_{i=1}^N$.

This definition entails removing both the direct and indirect effects of circumstances. The variation left is due to variation in Γ_i for a fixed level of circumstance σ_0.

To ensure that the criterion ranks the ideal meritocratic allocation above other allocations, our next axiom states that among distributions with no more total income than in the *Total Meritocracy* distribution, the planner prefers the *Total Meritocracy* distribution.

Axiom 6 (Total Meritocracy Selection)**.** *Let $\bar{Y}^T = \{y \in Y | \sum_i y_i \leq \sum_i \tilde{y}_i^T\}$. Then $\tilde{y}^T$ maximizes $\succsim$ over $\bar{Y}^T$.*

The last axiom makes the corresponding claim for the *Partial Meritocracy* distribution.

Axiom 7 (Partial Meritocracy Selection)**.** *Let $\bar{Y}^P = \{y \in Y | \sum_i y_i \leq \sum_i \tilde{y}_i^P\}$. Then $\tilde{y}^P$ maximizes $\succsim$ over $\bar{Y}^P$.*

[16] This implies that redistribution is assumed to not affect merits or circumstances, but it may affect the extent to which individuals benefit according to their merits and circumstances.

[17] We discuss how to set the fixed level of circumstance in Section 3.

2.2.3 Results

We now introduce our two different social welfare functions and state our results. Before we present our social welfare criteria, defining the function $v(z)$ is useful.

$$v(z;\gamma) \equiv \begin{cases} (1-\gamma)^{-1} z^{1-\gamma}, & \text{if } \gamma \neq 1, \\ \log z & \text{if } \gamma = 1. \end{cases} \tag{1}$$

Our two meritocratic social welfare functions can now be defined.

Definition 3. ***Total meritocratic social welfare.***
The Total Meritocratic Social Welfare Function is given by

$$W = \sum_i \tilde{y}_i^T v\left(\frac{y_i}{\tilde{y}_i^T};\gamma\right). \tag{2}$$

Definition 4. ***Partial meritocratic social welfare.***
The Partial Meritocratic Social Welfare Function is given by

$$W = \sum_i \tilde{y}_i^P v\left(\frac{y_i}{\tilde{y}_i^P};\gamma\right). \tag{3}$$

Finally, we can state our two characterization results.

Proposition 1. *The preference relation $\succsim$ satisfies Monotonicity, Separability, Continuity, Scale Invariance, Equitable Transfer, and Total Meritocracy Selection if and only if it can be represented by the Total Meritocratic Social Welfare Function.*

Proposition 2. *The preference relation $\succsim$ satisfies Monotonicity, Separability, Continuity, Scale Invariance, Equitable Transfer, and Partial Meritocracy Selection if and only if it can be represented by the Partial Meritocratic Social Welfare Function.*

2.2.4 Illustration

Figure 1 illustrates the properties of the meritocratic criteria. There are two individuals, $i = 1, 2$, and the policy maker divides a given total income, Y, between them to select an allocation $\tilde{y} = (\tilde{y}_1, \tilde{y}_2)$ according to the adopted criterion. The line from the y- to the x-axis is the consumption possibility frontier, $y_2 = Y - y_1$. Without loss of generality, assume that individual 1 earns more than individual 2 in the laissez-faire (when there is no redistribution), $\tilde{y}_1^L > \tilde{y}_2^L$. For illustration, assume also that individual 1 has a higher level of merit but that the difference in merit between the individuals is smaller when meritocracy is partial, such that $\tilde{y}_1^L - \tilde{y}_2^L > \tilde{y}_1^T - \tilde{y}_2^T > \tilde{y}_1^P - \tilde{y}_2^P > \tilde{y}_1^E - \tilde{y}_2^E = 0$, where $\tilde{y}_i^T$, $\tilde{y}_i^P$ and $\tilde{y}_i^E$ are income levels for each individual under total meritocracy, partial meritocracy

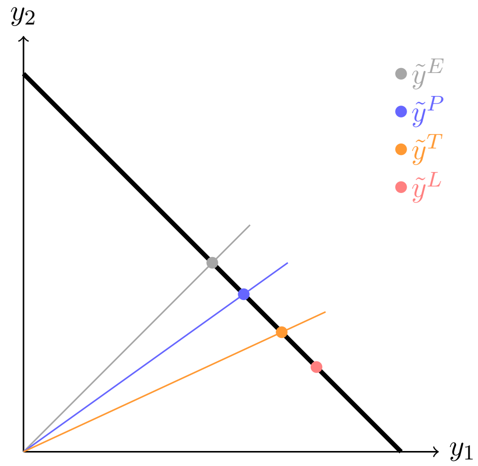


Figure 1: Two-person economy.

and equality, respectively. The upper line is the ray of equal incomes, $y_2 = y_1$, the middle line is the ray of partial meritocracy, $y_2 = \left(\tilde{y}_2^P / \tilde{y}_1^P\right) y_1$, and the lower line is the ray of total meritocracy, $y_2 = \left(\tilde{y}_2^T / \tilde{y}_1^T\right) y_1$. A higher point on a ray is preferred according to that criterion. The rays show how each criterion would distribute income between the two individuals for different levels of total income in the economy.

The meritocratic rays are continuous due to Continuity (Axiom 3), increasing due to Monotonicity (Axiom 1), straight lines due to Scale Invariance (Axiom 4), and pass through the consumption possibility frontier at the respective ideal meritocratic income distributions due to Total (Axiom 6) or Partial Meritocracy Selection (Axiom 7). If the initial allocation is off the ray, say $\tilde{y}^L$, Equitable Transfer (Axiom 5) dictates transfers towards the meritocratic criterion's ray while reaching the consumption possibility frontier, $y_2 = Y - y_1$ (due to Monotonicity). Separability (Axiom 2) implies that the meritocratic rays would be unchanged by the presence of an unaffected third individual with any level of income. In the rest of the paper, we show how to extend this analysis to a multi-commodity setting with second-best redistribution using our measurement of the role of merit.

2.3 A measure of meritocracy

We can use these social welfare functions to assess the extent of meritocracy in the distribution of income. Intuitively, the measure of meritocracy we propose measures how close the empirical distribution is to an equitable distribution according to a meritocratic social welfare function. For an equitable distribution of income $\tilde{y} \in \{\tilde{y}^T, \tilde{y}^P\}$ and a given income distribution $y \in Y$, we measure the extent of meritocracy in y by considering the following minimization problem

$$\min_{\{k_i\}_{i=1}^N} \frac{1}{N}\sum_{i=1}^{N} k_i \text{ subject to } \sum_{i=1}^{N} \tilde{y}_i v\left(\frac{k_i}{\tilde{y}_i}\right) \geq \sum_i \tilde{y}_i v\left(\frac{y_i}{\tilde{y}_i}\right), \tag{4}$$

where k_i is a level of income such that the optimization problem minimizes average income while keeping social welfare at least as high as in allocation y. Generally, it is possible to show that the k_is that solve Equation 4, k^*, is the equitable distribution scaled to satisfy the constraint of keeping welfare constant.

We propose to measure the extent of meritocracy by

$$M(y;\tilde{y}) \equiv \frac{\sum_{i=1}^N k_i^*}{\sum_{i=1}^N y_i}, \tag{5}$$

where $k^* \equiv \{k_i^*\}_{i=1}^N$ solves Equation 4. The measure is strictly positive since the social welfare function satisfies the Pareto principle and if $M(y;\tilde{y}) = 1$, the actual income distribution achieves the same level of meritocracy as the ideal meritocratic income distribution. Hence, $M(y;\tilde{y}) \in (0,1]$. Our measure of meritocracy is the average income at the meritocratic distribution as a share of average income in the actual distribution such that these distributions have equal social welfare. Since a move towards a larger extent of meritocracy improves social welfare according to a meritocratic social welfare function, the counterfactual meritocratic income distribution must have a lower average income level to keep social welfare constant. The higher is $M(y;\tilde{y})$, the closer is the actual distribution to the ideal meritocratic income distribution.

The measure is very much in the spirit of Atkinson (1970). Specifically, it is the mirror of a generalization of Atkinson's inequality measure, such that an inequity measure could be constructed by $1 - M(y;\tilde{y})$. To see why this is a generalization of Atkinson's inequality measure, consider the situation where $\tilde{y}_i = \tilde{y}_j$ for each i, j. It is straightforward to verify that k^* equals the equally distributed equivalent in this case.

Using the measure of meritocracy, $M(y;\tilde{y})E(y)$ provides a measure of social welfare with it being the lowest average income necessary to achieve the same level of social welfare as in the actual distribution.

2.4 Extension to multi-commodity setting

Above, we assumed that individuals only have preferences over income. We now show how our results can be extended to multi-commodity settings. We do so in two steps. First, we show how to represent individual preferences in a way that makes interpersonal comparisons of individual well-being reasonable. Second, we show how to define the total and partial meritocratic distributions in a more general setting. By replacing income with *equivalent consumption* and total (partial) meritocratic income with total (partial) meritocratic equivalent consumption, all results from above go through in a generalized form.

2.4.1 Model

Individuals have preferences over bundles X from a space $\bar{\mathcal{X}} = \mathbb{R}_+ \times \mathcal{X} \subset \mathbb{R}^K$. Their preferences are represented by (possibly heterogeneous) utility functions $U_i : \bar{\mathcal{X}} \to \mathbb{R}$. We assume that U_i is strictly increasing and concave in all arguments. Moreover, let $X = (x_0, x)$, where $x_0 \in \mathbb{R}_+$ and $x \in \mathcal{X}$. This allows us to write $U_i(X) \equiv u_i(x_0, x)$. We refer to the x_0-good as consumption and assume it is an essential good: $\lim_{x_0 \to 0} \partial U_i / \partial x_0 = \infty$.

Direct individual welfare comparisons from levels of U_i would be arbitrarily determined by the choice of functional forms and preference parameters. Instead, to compare individual welfare in the multi-commodity setting, we derive the *equivalent consumption* of each individual. Consider some fixed vector $\bar{x} \in \mathcal{X}$. Given a consumption bundle X, the *equivalent consumption* for individual i is the $e_i(X) \in \mathbb{R}_+$ that solves,

$$U_i(X) = u_i(e_i(X), \bar{x}). \tag{6}$$

Two properties of $e_i(.)$ are worth pointing out. First, given our restrictions on the individuals' utility functions, equivalent consumption is uniquely identified for a given consumption bundle X. Second, the income function $e_i(.)$ is a monotonic transformation of the utility function $U_i(.)$, so it represents the same preferences.

We now assume that social preferences $\succsim$ are defined over allocations of equivalent consumption $e \in \mathcal{E} \subset \mathbb{R}_+^N$. Axioms 1-5 from above are easily extended to this setting. *Monotonicity* can now be interpreted as *Pareto efficiency* since it requires $\succsim$ to recommend Pareto improvements whenever available. For completeness, we state the new version of this axiom here.

Axiom 8 (Pareto Efficiency)**.** *For each pair $e, e' \in \mathcal{E}$, if $e > e'$, then $e \succ e'$.*

How to modify Axiom 6 and 7 to this new setting is not obvious, however. The following section deals with this complication.

2.4.2 Generalized Total and Partial Meritocracy

We now turn to defining the total and partial meritocratic distributions of equivalent consumption. Similarly to the uni-commodity setting above, each individual has an associated pair (Γ_i, σ_i) of merit and circumstances. Together with a policy $\mathcal{P}$, an individual's merit and circumstances define their opportunity set $\Theta_i \equiv \Theta(\Gamma_i(\sigma_i), \sigma_i; \mathcal{P}) \subset \bar{\mathcal{X}}$.

For some fixed policy $\mathcal{P}_0$ and circumstance σ_0, we can define each individual's *total meritocratic opportunity set* $\Theta_i^T \equiv \Theta(\Gamma_i(\sigma_i), \sigma_0; \mathcal{P}_0)$. Corresponding to the definition of partial meritocracy above, the *partial meritocratic opportunity set* is defined by $\Theta_i^P \equiv \Theta(\Gamma_i(\sigma_i), \sigma_0; \mathcal{P}_0)$. These are the opportunity sets when the direct and both direct and indirect effects of circumstances are removed, respectively.

We are now ready to give our two generalized definitions.

Definition 5. ***Generalized Total Meritocracy.***
For some fixed circumstance σ_0 and policy $\mathcal{P}_0$, the total meritocratic equivalent consumption of individual i is given by

$$\tilde{e}_i^T \equiv \max_X e_i(X) \text{ subject to } X \in \Theta(\Gamma_i(\sigma_i), \sigma_0; \mathcal{P}_0).$$

Moreover, the Total Meritocratic Distribution is given by $\tilde{e}^T \equiv \{\tilde{e}_i^T\}_{i=1}^N$.

The Generalized Total Meritocratic Distribution is where each individual is assigned the equivalent consumption they would have if they were assigned their total meritocratic opportunity set. This definition corresponds to the definition in the income-setting by only removing the direct effect circumstances have on the opportunity sets.

The definition of the *partial meritocratic opportunity set* removes both the direct and the indirect effect of circumstances on the opportunity set that goes through merit. Formally,

Definition 6. ***Generalized Partial Meritocracy.***
For some fixed circumstance σ_0 and policy $\mathcal{P}_0$, the partial meritocratic equivalent consumption of individual i is given by

$$\tilde{e}_i^P \equiv \max_X e_i(X) \text{ subject to } X \in \Theta(\Gamma_i(\sigma_0), \sigma_0; \mathcal{P}_0).$$

Moreover, the Partial Meritocratic Distribution is given by $\tilde{e}^P \equiv \{\tilde{e}_i^P\}_{i=1}^N$.

The variation in partial meritocratic opportunity sets is due to variation in Γ_i for a fixed level of circumstance σ_0.

Given these definitions, we can now state our two last axioms.

Axiom 9 (Generalized Total Meritocracy Selection)**.** *Let $\bar{E}^T = \{e \in \mathcal{E} | \sum_i e_i \leq \sum_i \tilde{e}_i^T\}$. Then $\tilde{e}^T$ maximizes $\succsim$ over $\bar{E}^T$.*

The last axiom makes the corresponding claim for the *Genralized Partial Meritocracy* distribution.

Axiom 10 (Generalized Partial Meritocracy Selection)**.** *Let* $\bar{E}^P = \{e \in \mathcal{E} | \sum_i e_i \leq \sum_i \tilde{e}_i^P\}$*. Then* $\tilde{e}^P$ *maximizes* $\succsim$ *over* $\bar{E}^P$*.*

Axioms 9 and 10 collapse to Axioms 6 and 7, respectively, in the uni-dimensional case.

2.4.3 Results

We are now ready to introduce our generalized meritocratic criteria.

Definition 7. ***Generalized total meritocratic social welfare.***
The Generalized Total Meritocratic Social Welfare Function is given by,

$$W = \sum_i \tilde{e}_i^T v\left(\frac{e_i}{\tilde{e}_i^T}; \gamma\right), \tag{7}$$

with v *defined as in equation 1.*

Definition 8. ***Generalized partial meritocratic social welfare.***
The Generalized Partial Meritocratic Social Welfare Function is given by,

$$W = \sum_i \tilde{e}_i^P v\left(\frac{e_i}{\tilde{e}_i^P}; \gamma\right), \tag{8}$$

with v *defined as in equation 1.*

Proposition 3. *The preference relation* $\succsim$ *satisfies Pareto Efficiency, Separability, Continuity, Scale Invariance, Equitable Transfer, and Generalized Total Meritocracy Selection if and only if it can be represented by the Generalized Total Meritocratic Social Welfare Function.*

Proposition 4. *The preference relation* $\succsim$ *satisfies Pareto Efficiency, Separability, Continuity, Scale Invariance, Equitable Transfer, and Generalized Partial Meritocracy Selection if and only if it can be represented by the Generalized Partial Meritocratic Social Welfare Function.*

3 Measuring the extent of meritocracy

3.1 Measuring meritocratic income

The main building block of our meritocratic social welfare function is the distribution of meritocratic wages. Since our policy analysis in Section 4 is based on homogeneous preferences, we can back out wage rates from incomes. As income is what we can observe in the data, it is what this section focuses on, which we later transform into results for wages. Hence, this section defines meritocratic income and explains how to measure it. Section 4 shows how measured meritocratic incomes and wages vary over the income distribution.

The policymaker has the following model of how income is determined

$$\log y_i = \beta_0 + \sum_{k=1}^{K} \beta_k^m x_i^k + \sum_{l=1}^{L} \beta_l^c b_i^l + \varepsilon_i, \tag{9}$$

$$x_i^k = \alpha_0^k + \sum_{l=1}^{L} \alpha_l^k b_i^k + u_i^k \text{ for } k = 1, \ldots, K, \tag{10}$$

where the $x-$variables are measured merit-variables and the $b-$variables are measured circumstance-variables. A key measurement question is whether ε is part of merit or circumstance. In the main analysis, we treat the residual as part of the individual's circumstances. Admittedly, while the choice of treating the residual as a circumstance is arbitrary, we demonstrate in Appendix B that the difference between partial and total meritocracy matters more for optimal policy than whether or not to include the residual as a circumstance.

The model allows for both merit- and circumstance-variables to affect income directly. In addition, Equation 10 captures the possibility that the circumstance variables also indirectly affect income through the merit variables. How can we use this model to derive measures of merit and circumstances? A natural implementation of total meritocracy can be obtained by setting

$$\Gamma_i(\sigma_i) = \sum_{k=1}^{K} \beta_k^m x_i^k, \qquad \sigma_i = \sum_{l=1}^{L} \beta_l^c b_i^l + \varepsilon_i, \qquad \text{and} \qquad \tilde{y}_i^T = \exp\left(\Gamma_i(\sigma_i) + \sigma_0\right). \tag{11}$$

An advantage of this implementation is that our results are invariant to the choice of the fixed circumstance σ_0. Because of the scale invariance of the meritocratic social welfare functions, multiplying the ideal income distribution by any positive number does not affect the ranking of allocations. Thus, without loss of generality, we can set $\sigma_0 = 0$.

Partial meritocracy is implemented by substituting Equation 10 into 9, such that we obtain the reduced form,

$$\log y_i = \beta_0 + \sum_{k=1}^{K} \beta_k^m \left(\alpha_0^k + \sum_{l=1}^{L} \alpha_l^k b_i^k + u_i^k \right) + \sum_{l=1}^{L} \beta_l^c b_i^l + \varepsilon_i = \eta_0 + \sum_{l=1}^{L} \eta_l b_i^l + \nu_i, \tag{12}$$

where $\eta_0 = \beta_0 + \sum_{k=1}^{K} \beta_k^m \alpha_0^k$, $\eta_l = \beta_l^c + \sum_{k=1}^{K} \beta_k^m \alpha_l^k$ and $\nu_i = \varepsilon_i + \sum_{k=1}^{K} \beta_k^m u_i^k$. By noticing that ν_i is the sum of partial merit and the residual, we can subtract ε_i from ν_i to obtain each individual's partial merit. Moreover, $\sum_l \eta_l z_i^l$ captures both the direct and indirect effect of the circumstances variables on earnings. [18] We implement partial meritocracy

[18] This exercise is a form of mediation analysis, which aims to decompose effects into direct and indirect components, see Bolt et al. (2021) for a mediation analysis of the intergenerational earnings elasticity.

by setting

$$\Gamma_i(\sigma_0) = \nu_i - \varepsilon_i. \tag{13}$$

Table 1 summarizes the theoretical definition and implementations of our different merit- and circumstance concepts.

	Total meritocracy		Partial meritocracy	
	Theory	Implementation	Theory	Implementation
Merit	$\Gamma_i(\sigma_i)$	$\sum_k \beta_k^m x_i^k$	$\Gamma_i(\sigma_0)$	$\nu_i - \varepsilon_i$
Circumstance	σ_i	$\sum_l \alpha_l b_i^l + \varepsilon_i$	$\sigma_i + (\Gamma_i(\sigma_i) - \Gamma_i(\sigma_0))$	$\sum_l \eta_l b_i^l + \varepsilon_i$
Equitable income	$\exp(\Gamma_i(\sigma_i))$	$\exp\left(\sum_k \beta_k^m x_i^k\right)$	$\exp(\Gamma_i(\sigma_0))$	$\exp(\nu_i - \varepsilon_i)$

Table 1: Overview of the different definitions of merit and circumstance.

Notes: This table summarizes the theoretical concepts of total and partial merit, circumstances, and equitable income, and shows how we map these theoretical concepts to our empirical model.

3.2 Estimation

When taking the above approach to the data, we need to estimate the different merit and circumstance parameters. If we know the coefficients in Equation 10 and 12, we can identify both the total and partial meritocratic income distributions. This can be seen by noticing that only variables and coefficients from these two equations appear in Table 1. We follow the existing literature (such as Almås et al., 2011 and Hufe et al., 2022) and estimate Equation 10 and 12 using OLS.[19]

3.2.1 Data

We exploit detailed register data covering all sources of income for the universe of Norwegian income earners, in addition to several other data sources from Norway that we can link using a unique personal identifier. By linking these data sources, we obtain rich information regarding the individual's education, family background and job characteristics. The income data we use are from yearly tax returns and thus records all taxable

[19]Strictly speaking, our measures of merit are identified when residuals and merits are mean independent conditional on circumstances. By exploiting sibling-fixed effects rather than a wide set of circumstances we alleviate some of these identification concerns, as we can account for unobserved family factors. The role of residuals is also an issue in traditional equality of opportunity measurement, where residuals are assumed to measure effort/merit.

income on the individual level from 1993 to 2018. These data are of high quality and have several advantages over other data. First, they cover all individuals with no top- or bottom-coding of income variables. Second, most income components are third-party reported, so there is little non-compliance or attrition, especially for labor income.

In addition to the tax records we employ several other data sources for information on individuals' family relations, education and work characteristics. First, we use the population register ('Befolkningsregisteret') to obtain information about gender, age and family relations. Second, we use the national education database ('Nasjonal Utdanningsdatabase') for information on each person's highest obtained education. Finally, the employer-employee register ('A-ordningen') contains yearly information (provided by the employer) about the occupation and work sector of all employees.

3.2.2 Variable definitions

Income

Our income variable covers labor income from the tax records.[20] The labor income variable covers all work-related income and allowances, including sick pay, maternity and adoption benefits, and taxable fringe benefits. We focus on labor income rather than total income (which includes capital and self-employment income) because the Norwegian tax system applies separate tax rates on different types of income, the relationship between merit and income may differ across income types, and the optimal tax exercise is developed with labor rather than capital income in mind. We report income in 2018 US dollars. The final income variable is the mean income over a five year period centered around age 45 (between age 43 and 47) as the income at this age is most representative of lifetime income (Böhlmark and Lindquist, 2006 and Haider and Solon, 2006).

Merit variables

Education. The education variable is a categorical variable based on the NUS2000 classification of education which is a 6 digit number describing the level (bachelor, master or doctorate level) and precise field of education. We use the first 4-digits which give information about the level a slightly broader classification of field. The final variable

[20]Following the equality of opportunity literature (Roemer et al., 2003), we consider market income rather than the contribution each individual makes to society. Our framework could be extended to include different externalities from various occupations (such as in Lockwood et al., 2017) by accounting for these externalities in the measure of meritocratic income, but we would require estimates of variations in occupation externalities in the Norwegian context.

takes 571 different values in our sample and thus gives a very detailed account of the individual's education.

Job type. The job type variable is based on the STYRK08 job classification which is a 7-digit number giving a fairly detailed job description. Again we use the first 4 digits and get 349 unique values in our sample.

Sector. Based on the NACE sn07 classification of sectors. We use the full range of the 5-digit variable, resulting in 787 levels in our sample.

Descriptive statistics of merit variables are further described in Appendix B.

Circumstances

Sibling-fixed effects. Siblings are defined as individuals that have the same mother. Sibling-fixed effects are based on the unique identifier of mothers with more than one child.[21] For individuals where the father is also the same as for all siblings, this accounts for all circumstances related to the parents, such as their income, wealth, education and location. For individuals where this is not the case, differences in fathers between siblings with the same mother are not accounted for by our sibling-fixed effects.[22]

Gender. Gender is defined as the gender recorded in the population register which is either male or female.

Cohort-fixed effects. In addition to adjusting our income variable for inflation, we include cohort-fixed effects. This avoids that our measures of merit pick up changes in income that occur on the societal level.

3.2.3 Sample selection and summary statistics

We start by selecting all Norwegians born between 1958 and 1971 and observe their mean income in the five year period centered around 45. The choice of cohorts comes down to when we are able to observe income and job characteristics. First, we observe job characteristics like sector and job type between 2000 and 2018. The persons born in 1955 are thus the oldest that we can observe at age 45 (in year 2000). Second, those born in 1971 are the youngest persons whose income we can observe at age 47 in 2018. Table 2 displays key descriptive statistics for our sample.

[21] By employing sibling-fixed effects, we can account for much more of the unobserved family-related circumstances, such as parental investments, than if we controlled for observed circumstances. However, if merits are correlated within the family, we allocate this to circumstance.

[22] We have also done the analysis adding birth order effects, but since the effects were negligible given all other variables we include, we have omitted them.

The number of individuals born between 1958 and 1971 and alive in 2018 with non-missing parents is 858,521. We observe income in the relevant age range for 829,217. We introduce a few restrictions on the income variable. First, we drop individuals whose mean labor income between ages 43 and 47 is lower than the mean basic income in those years.[23] Then, to focus on labor income earners rather than capital income earners or the self-employed, we drop individuals whose labor income is lower than their capital and business income. Finally we also exclude people whose mean pension payments and social security benefits is higher than the mean labor income, to exclude individuals who do not have labor income as their main income source. These restrictions reduce the number of observations from 829,217 to 667,485. Because we use sibling-fixed effects, we keep only persons with at least one sibling. 224,591 individuals are excluded because they have no siblings, leaving us with a final sample of 442,894 individuals. We consider the logarithm of income to estimate effects that are more relevant for the part of the income distribution where there are more individuals.

Figure 2 shows the distribution of labor income for individuals with and without siblings. Individuals without siblings are slightly overrepresented below the median and underrepresented between the 50th and 75th percentile, after which the two distributions more or less coincide. Restricting our sample to children with siblings does not have large effects in terms of the resulting labor income distribution.

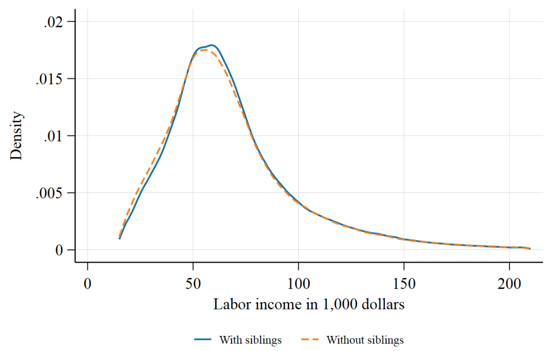


Figure 2: Labor income distribution

Notes: The figure shows the distribution of labor income below the 99th percentile (to make the graph more readable) for individuals with and without siblings. The bandwidth is based on a rule of thumb.

[23]The basic income ('grunnbeløp') is used by the tax authorities to determine the size of certain payments and benefits. It is adjusted yearly and is typically at around 20 percent of the median income.

Variable		Mean	Std. Dev.
Birth year		1963.3	4.56
Female (share)		0.493	0.500
Labor income (age 43-47, in 2018 USD)		67,797	42,626
Number of siblings			**Share**
	1		0.549
	2		0.305
	3		0.106
	4		0.029
	5 or more		0.011
Highest obtained education			
	Less than high school		0.225
	High school		0.387
	Bachelor's degree		0.285
	Master's degree		0.090
	PhD		0.011
Number of observations			442,894

Table 2: Descriptive statistics

Notes: Descriptive statistics for Norwegian individuals born between 1958 and 1971 with labor income earning as their main activity.

3.3 Results

3.3.1 Decomposing variation in income

We decompose the inequality in earnings into parts due to the merit and circumstance variables using the decomposition method in Shorrocks (1982). Figure 3 plots the share of the variance in log income explained by each variable.[24] Unsurprisingly, the residual has the largest contribution of any single factor at around 23 percent. The sibling-fixed effects explain almost as much, however. Including gender and cohort, the circumstance variables end up explaining about a third of the variation in log income. The merit variables together explain around 42 percent of the total variation. Occupational choice explains the most at around 17 percent. Industry - even conditional on occupation - explains around 15 percent. This indicates that there is space for maneuvering on the labor market even after choice of education and occupation. Finally, education explains only slightly more than gender at around 10 percent.

Figure 4 shows how partial and total meritocracy allocate these variances into merits, circumstances, and the residual. The decomposition in Figure 3 corresponds to panel (d) of Figure 4, where education, occupation, and industry are aggregated into merit. This is because the total meritocracy decomposition is also measured using 9. When we remove the indirect effect of the circumstance variables on the merit variables, this changes markedly. In a partial meritocracy, where the individuals are not held responsible for the differences in merit associated with circumstances, as seen in panel (a), more than 60 percent of the income variation is attributed to the circumstance variables, and only around 15 percent to the merit variables.

[24]We use the log transformation of income since the variance and covariance measures are sensitive to the tail of the distribution.

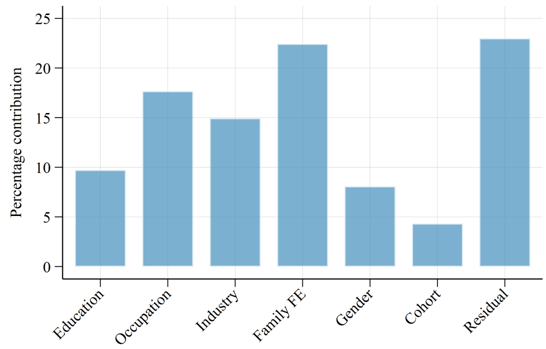


Figure 3: Variance decomposition of Equation 9.

Notes: This figure plots a Shorrocks (1982) decomposition of earnings into its different factors in Equation 9. The height of the bars refers to how large fractions of total inequality each is the components statistically explains.

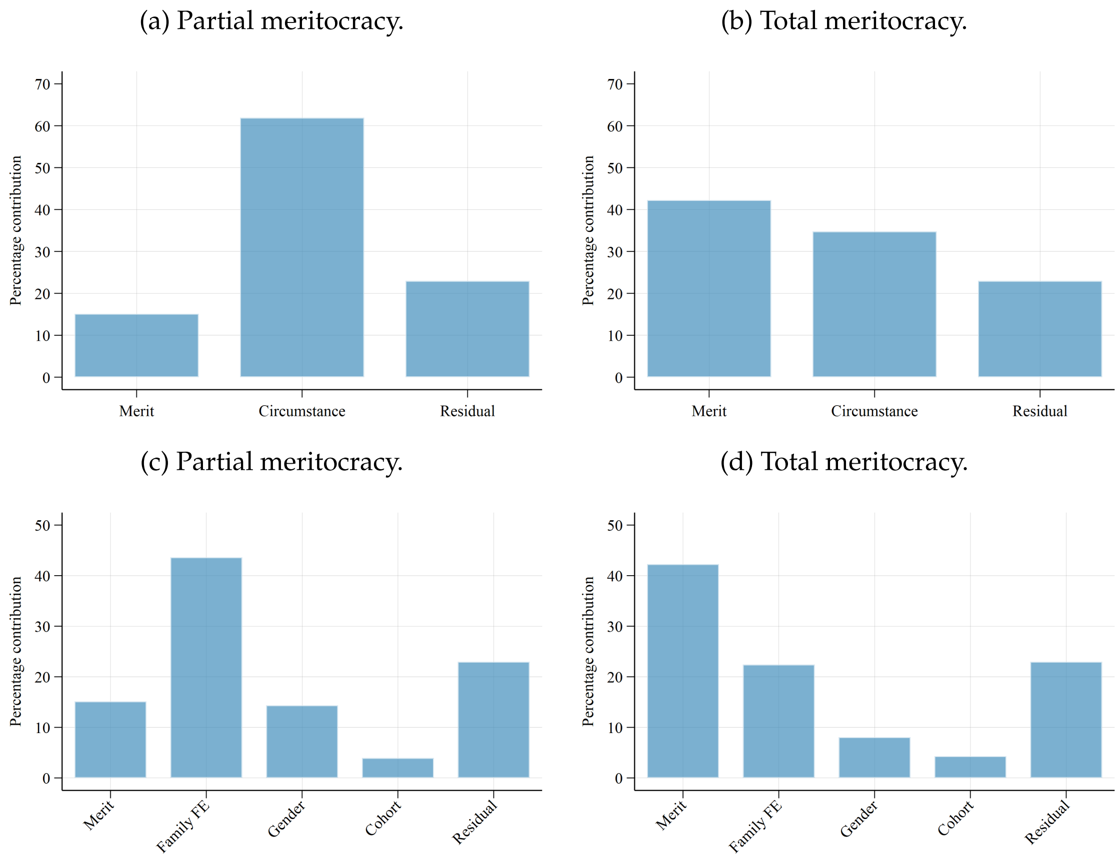


Figure 4: Decomposition of earnings into merit and circumstances.

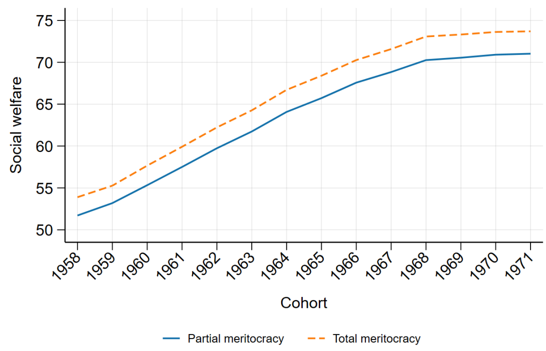
Notes: Panel (a) and (b) plot the decomposition of the variation in earnings into merit and circumstance according to our two different criteria. Panel (c) and (d) further unpack the circumstance component, demonstrating that circumstances might differentially explain earnings wether their impacts on the merit-variables are taken into account or not.

Compared to the equality of opportunity literature, our measurement approach allocates less of income inequality to merits and more to circumstances. For example, Hufe et al. (2022) show that their equality of opportunity approach implies that around 20 percent of total inequality is ”unfair inequality,” which is inequality driven by circumstances and poverty. By contrast, our approach allocates 60 percent (total meritocracy) or 85 percent (partial meritocracy) of the variation in earnings to circumstances (when the residual is included). This is because our approach is based on measuring merit variables directly rather than allocating the residual variation after accounting for circumstances to merit.

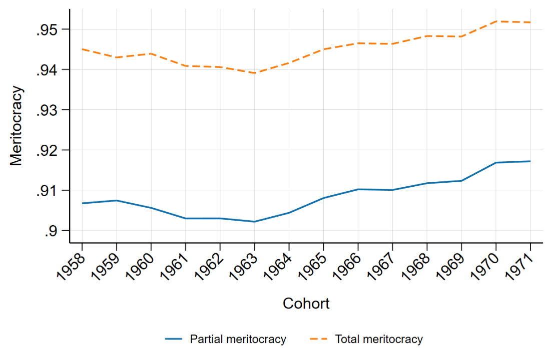
3.3.2 Meritocracy and social welfare over time

Our data cover cohorts born between 1958 and 1971. Is meritocracy and inequality different among younger cohorts? To answer this question, we start by estimating meritocratic incomes using the pooled sample. Then, we calculate the extent of social welfare, meritocracy and inequality within each cohort. Figure 5 plots social welfare, meritocracy and inequality over time for all the cohorts in our sample. We set inequity aversion to 1 and allocate the residual to circumstance. Panel (a) uses the inequity measure in Equation 5 combined with average income, $M(y; \tilde{y})E(y)$, as a measure of social welfare for each criterion's $\tilde{y}$. It shows that social welfare has increased, which is mainly due to increases in income over time. Panel (c) applies the Atkinson (1970) inequality measure to the actual, partial meritocratic and total meritocratic distributions of income. It shows that there is a small but consistent reduction in inequality occurring between the 1962 cohort and the 1971 cohort. We see traces of this development in the change in total and partial meritocracy over time in panel (b), which is based on Equation 5. The level of inequality would be significantly lower in the ideal meritocratic distributions of income, as seen in panel (c). Since the ideal meritocratic distributions have low level of inequality, the relatively low level of inequality in the Norwegian labor income distribution has the effect that the level of meritocracy is measured to be high, especially according to the total meritocracy criterion, which considers more of the inequality to be equitable. Appendix D shows how the measurement of meritocracy differs when inequality aversion is higher and when the residual is allocated to merit rather than to circumstance.

(a) Social welfare.



(b) Meritocracy.



(c) Inequality in actual and meritocratic allocations.

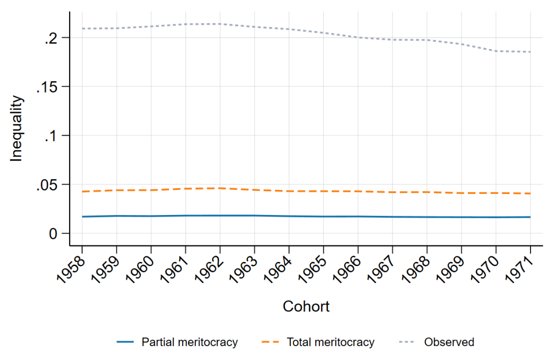


Figure 5: Social welfare, meritocracy and inequity.

Notes: Panel (a) plots the evolution of social welfare over time according to the two criteria. Panel (b) plots the measured level of meritocracy according to the two criteria criteria when $\gamma = 1$ over the same period. In Panel (c), we plot the evolution of inequality, measured by the Atkinson inequality measure, in the actual distribution and in the two ideal meritocratic allocations.

4 Optimal tax policy

4.1 The optimal tax problem

We now turn to the optimal tax problem. Here, we apply our welfare criterion to the optimal policy problem and build on our empirical findings in Section 3 to derive the key sufficient statistic, which is the distribution of meritocratic wages over the wage distribution. Consumption (after-tax income), c, and pre-tax income, z, now differ.

4.1.1 Individuals

Individual wage rates $w \in [w_b, w_t]$ are distributed according to $f_w(w)$. We assume the following common utility function represents individual preferences,

$$u(c, -l) = \frac{c^{1-\delta}}{1-\delta} - \frac{\alpha l^{\sigma}}{\sigma}, \tag{14}$$

where l is labor supply.

Individuals maximize Equation 14 subject to a budget constraint $c = wl - T(wl)$. Each individual's equivalent consumption, $e(c, -l)$, is defined as in Equation 6, and is a measure of the consumption level required to be equally well off as with the actual allocation under a different labor supply. We use a fixed labor supply level that we set to 0, $\bar{l} = 0$, which means that we compare individuals' consumption and labor allocations to an allocation of consumption and labor supply where labor supply is zero. Hence, given this utility function, equivalent consumption is,

$$e(c, -l) = \left(c^{1-\delta} - \frac{\alpha\,(1-\delta)}{\sigma} l^{\sigma} \right)^{\frac{1}{1-\delta}}.$$

We derive total and partial meritocratic equivalent consumption by following the procedure developed in the previous section with one important difference. Instead of using income as an outcome, we use productivity w. We then obtain, for each individual, their total and partial meritocratic wage rates. Given these wage rates, we compute their total and partial meritocratic equivalent consumption by considering what their equivalent consumption would be in a world where they had their meritocratic wage rate, and there were no taxes. Thus, the fixed policy, $\mathcal{P}_0$, we use to derive meritocratic equivalent consumption is simply no taxation. Labor supply and income at the no-tax allocation with a meritocratic wage rate, $\tilde{w} \in \{\tilde{w}^T, \tilde{w}^P\}$, are given by

$$l(\tilde{w}) = \tilde{w}^{\frac{1-\delta}{\delta+\sigma-1}} \left(\frac{1}{\alpha}\right)^{\frac{1}{\delta+\sigma-1}} \text{ and } z(\tilde{w}) = \tilde{w}^{\frac{\sigma}{\delta+\sigma-1}} \left(\frac{1}{\alpha}\right)^{\frac{1}{\delta+\sigma-1}}.$$

Thus, the meritocratic equivalent income for an individual with meritocratic wage rate, $\tilde{w}$, is defined by,

$$\tilde{e}(\tilde{w}) = \left(z(\tilde{w})^{1-\delta} - \frac{\alpha(1-\delta)}{\sigma} l(\tilde{w})^{\sigma} \right)^{\frac{1}{1-\delta}}.$$

Calibrating preferences and the productivity distribution

We now explain how we determine the parameter values in the utility function and how we are able to derive the productivity distribution from the income distribution. For an individual with productivity w, we can rewrite their utility function to

$$u(c, -z/w) = \frac{c^{1-\delta}}{1-\delta} - \frac{\alpha}{\sigma} \left(\frac{z}{w} \right)^{\sigma}. \tag{15}$$

In the current allocation, the worker faces a tax schedule T, with $T', T'' \geq 0$. Her first-order condition is given by

$$(z - T(z))^{-\delta} (1 - T'(z)) = \frac{\alpha}{w^{\sigma}} z^{\sigma-1}. \tag{16}$$

The objective is to use empirical estimates of the uncompensated elasticity of taxable income and income effect to calibrate our model. However, these parameters are defined relative to a linear budget constraint. For this reason, we introduce the standard virtual linear tax system (Saez, 2001) $z - \tilde{T}(z) = (1-t)z + B$. The virtual tax system at z satisfies $1 - T'(z) = 1 - t$ and $z - T(z) = (1-t)z + B$. We can now express the Slutsky quantities relative to the virtual tax system for each income level. Specifically, we define the uncompensated elasticity of taxable income and income effects in the standard way

$$\zeta^u(z) \equiv \frac{dz}{d1-t} \frac{1-t}{z},$$
$$\eta(z) \equiv \frac{dz}{dB}.$$

Implicit differentiation of (the log version of) Equation 16 with respect to the virtual tax system yields

$$-\delta \frac{zd(1-t) + (1-t)dz + dB}{c} + \frac{d(1-t)}{1-t} = (\sigma - 1)\frac{dz}{z},$$

where $c \equiv z - T(z)$. Rewriting,

$$\eta(z) = -\frac{\delta z}{(\sigma-1)c + \delta(1-t)z},$$
$$\zeta^u(z) = \frac{c - \delta(1-t)z}{(\sigma-1)c + \delta(1-t)z}.$$

As also noted in Graber et al. (2022), the current Norwegian tax system can be approximated fairly well by the parametric tax system used in Bénabou (2002) and Heathcote et al. (2017). This tax function implies that $c = \lambda z^{1-\tau}$ and $(1-t) = (1-\tau)\lambda z^{-\tau}$. Substituting this into the expressions yields,

$$\eta(z) = -\frac{\delta}{\lambda}\frac{z^{\tau}}{\sigma - (1-(1-\tau)\delta)},$$
$$\zeta^u(z) = \frac{1-(1-\tau)\delta}{\sigma - (1-(1-\tau)\delta)}.$$

Since our estimates are of the average uncompensated elasticity of taxable income (ζ^u) and income effect (η), we relate our preference parameters to these estimates by

$$\mathbb{E}[\zeta^u(z)] \equiv \zeta^u = \frac{1-(1-\tau)\delta}{\sigma - (1-(1-\tau)\delta)},$$
$$\mathbb{E}[\eta(z)] \equiv \eta = -\frac{\delta}{\lambda}\frac{\mathbb{E}[z^{\tau}]}{\sigma - (1-(1-\tau)\delta)}.$$

Solving for (δ, σ) yields

$$\delta = \frac{-\eta\lambda}{\zeta^u\mathbb{E}[z^{\tau}] - \eta\lambda(1-\tau)},$$
$$\sigma = \frac{(1+\zeta^u)\mathbb{E}[z^{\tau}]}{\zeta^u\mathbb{E}[z^{\tau}] - \eta\lambda(1-\tau)}.$$

Graber et al. (2022) estimate the following values for medium-income earners: $\zeta^u = -0.09, \eta = -0.43$. The tax system in 2018 is best approximated by $\lambda = 5.27$ and $\tau = 0.15$. Our empirical estimate of $\mathbb{E}[z^{\tau}]$ is 7.19. Taken together, this means that $\delta = 1.77$ and $\sigma = 5.13$. Putting $\alpha = 0.00004237$ ensures that the average labor supply under the current tax system equals one. The estimated tax system implies a revenue requirement of about $16,000$ dollars per capita.

4.1.2 Government

The social welfare function of the government is a continuous version of the ones introduced in Section 2. It is given by a weighted integral of individuals' equivalent consumptions, where the weights are determined by inequity aversion, γ, and the definition of the meritocratic wage rate, $\tilde{w}$,

$$W = \int_{w_b}^{w_t} f_w(w)\mathbb{E}[\tilde{e}^{\gamma}|w]\frac{e(w)^{1-\gamma}}{1-\gamma}dw.$$

The government maximizes W using taxes $T(wl) = wl - c$ such that tax revenue net of any lump sum transfer B is at least as large as the revenue requirement, R, $\int_{w_b}^{w_t} T(wl)f_w(dw)dw - B \geq R$. The social welfare function implies the following marginal welfare weights at each wage level

$$g(w) = \frac{\partial W}{\partial c(w)} = f_w(w)\frac{\mathbb{E}[\tilde{e}^{\gamma}|w]}{e(w)^{\gamma}}\left(\frac{e(w)}{c(w)}\right)^{\delta}. \quad (17)$$

The marginal welfare weights are the change in welfare for a marginal increase in consumption at wage level w, and compose of the number of individuals at the particular income level, $f_w(w)$, the change in welfare for a change in equivalent income, $\mathbb{E}[\tilde{e}^\gamma|w]/e(w)^\gamma$ and the change in equivalent income for a change in consumption, $(e(w)/c(w))^\delta$.

Sufficient statistics

To implement optimal meritocratic income taxes, the government needs to know two things besides the behavioral elasticities. First, as is standard for optimal income tax problems, they need to know the distribution of productivities, w. The distribution of productivities is not observed in the data. However, given our assumptions about individual preferences above, we can derive the distribution of productivities from the income distribution (Saez, 2001). To see why, consider the individual's first-order conditions in Equation 16. Knowing the tax system, we can solve this equation for the productivity, w,

$$w_i = \left(\alpha \frac{(z_i - T(z_i))^\delta}{1 - T'(z_i)} \right)^{\frac{1}{\sigma}} z_i^{1-1/\sigma}.$$

We use the same parametric tax function to approximate the tax system as above.

Figure 6, Panel (a) plots a kernel density estimate for both the earnings and productivity distribution. Since our measure of earnings is based on third-party reported data, there is no reason to believe that the top of the income distribution is poorly measured. Exploiting this, we estimate the entire productivity distribution non-parametrically. Since Saez (2001), it has been known that the thickness in the right tail of the income distribution is a key determinant of the top marginal tax rates. To examine the thickness in the tail, Figure 6, Panel (b) plots the thickness in both the productivity and earnings distribution, measured by,

$$a(x_m) \equiv \frac{\mathbb{E}[x \mid x \geq x_m]}{x_m},$$

where $x = z, w$. The thickness measure appears to stabilize at about 1.5 for incomes higher than $100,000$ dollars. This corresponds to a Pareto parameter of about 3, which is substantially thinner than similar measures for the US income distribution (Hendren, 2020).

Second, since taxes can only depend on earnings, it turns out that the relevant information for our criteria in this setting is simply the average equitable equivalent consumption to the power of γ at each level of productivity. We focus on the case where inequity aversion is log, $\gamma = 1$, since, in this case, the relevant conditional mean is simply average equitable equivalent consumption conditional on productivity w. Figure 7 plots the relationship in percentiles and levels. Individuals with higher productivity or pre-tax income, on average, have higher equitable equivalent consumption for both measures of merit. The relationship between the two is substantially steeper for total compared to partial meritocracy. The meritocratic criteria would collapse to utilitarianism if the relationship were a flat line, such that meritocratic equivalent consumption did not vary with productivity.

(a) Productivity and earnings distribution. (b) Local measure of thickness.

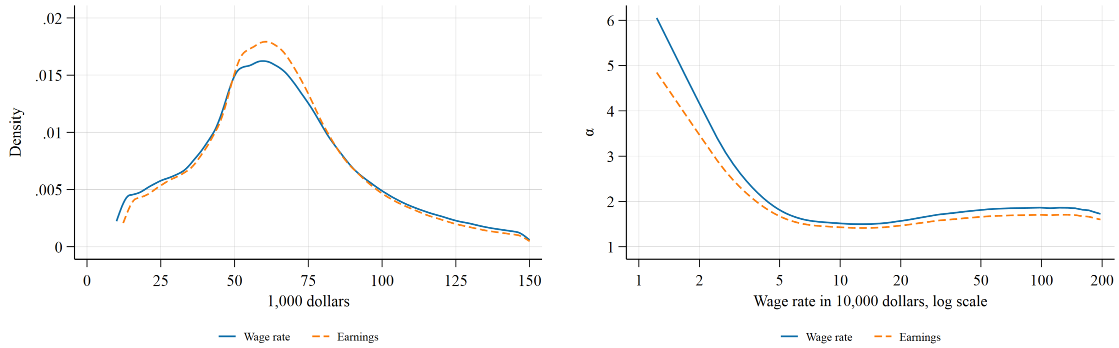


Figure 6: Productivity distribution sufficient statistics.

Notes: Panel (a) shows non-parametric kernel estimates of the density distribution of income and the wage rate for labor income earners earning more than the minimum amount and less than $150,000. Panel (b) shows the estimates of local thickness of the income and wage rate distribution up to $2,000,000.

(a) Percentiles of meritocratic equivalent consumption and earnings.

(b) Meritocratic equivalent consumption and productivity.

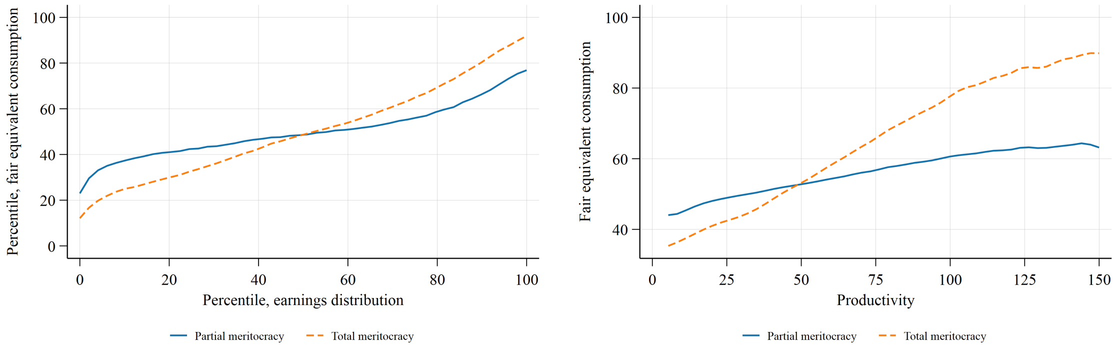


Figure 7: Marginal welfare weights sufficient statistics.

Notes: Panel (a) shows the relationship (in percentiles) between actual earnings and meritocratic equivalent income according to partial and total meritocracy. Panel (b) shows the relationship (in dollars) between the wage rate and meritocratic income according to partial and total meritocracy.

4.2 Parametric income taxes

4.2.1 Linear income tax

Before presenting the simulation of the Mirrleesian tax system, we study two different parametric tax systems. First, we consider the optimal flat income tax in combination with a lump sum transfer

$$T(z) = tz - B, \tag{18}$$

where t and B are constants. Note that this simple tax system is capable of significant redistribution because of the lump-sum grant B, which ensures that the average tax rate is typically increasing in income even if the marginal tax rate is constant.

The formula for the optimal flat income tax is well-known and given by

$$\frac{t}{1-t} = \frac{1-\bar{G}}{\varepsilon_w^u}, \tag{19}$$

where $\bar{G}$ is the wage-weighted average marginal welfare weight across the wage distribution, $\bar{G} = \int_{w_b}^{w_t} (g(\theta)/\lambda)\, f(\theta)\, d\theta$, λ is the shadow value of the government budget (which at the optimum is equal to the welfare change from giving one more dollar to each individual) and ε_w^u is the income-weighted uncompensated earnings elasticity.

We compare our criteria to the utilitarian one, where each individual has the same meritocratic equivalent consumption level. To find the optimal linear tax rate, we simply solve the model for a range of values of the marginal tax rate t and check which value maximizes social welfare, the algorithm is further described in Appendix C.

Results

Figure 8, Panel (a) plots the optimal marginal tax rates for the two different welfare functions for two different levels of inequity aversion $\gamma = 1, 2$. The partial meritocratic welfare function recommends a marginal tax rate between 50 and 60 percent, depending on the level of inequity aversion. The total meritocratic welfare function, on the other hand, recommends marginal tax rates between 40 and 50 percent. The results are consistent with the observation that a larger positive slope between the average meritocratic equivalent consumption and wage rates entails less redistribution. Utilitarianism implies no correlation between average meritocratic equivalent consumption and wage rates since everyone is entitled to the same level of equivalent consumption.

4.2.2 HSV tax function

Second, we follow Heathcote et al. (2017) in computing an optimal parametric income tax without lump-sum transfers of the form

$$T(z) = z - \lambda z^{1-\tau}, \tag{20}$$

where τ measures the progressivity of the tax system and λ determines the average tax rate. This parametric tax function is convenient in that it allows for closed-form solutions in our labor-supply model. Consequently, for a given progressivity τ, we only need to find the λ that ensures a balanced budget. By doing this for each $\tau \in [0, 1)$, we obtain the optimal progressivity for each criterion. For this tax function, we only consider the welfare functions with inequity aversion $\gamma = 1$.

Results

Figure 8, Panel (b) plots the optimal progressivity parameter τ according to the HSV parametric form. The optimal HSV tax system leads to the same ranking of criteria in terms of progressivity. The optimal HSV tax system according to the total meritocracy criterion, is most similar to the actual tax system. As shown in Appendix B, the variant of total meritocracy where the unexplained component of wages is considered a merit comes even closer to the actual tax system.

(a) Linear system. (b) HSV system.

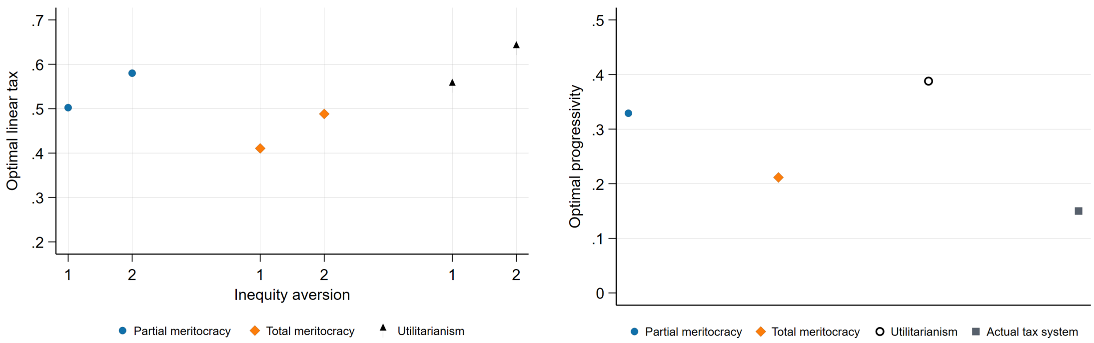


Figure 8: Optimal flat tax rates and HSV progressivity.

Notes: Panel (a) plots the marginal tax rates under the optimal flat tax system. Panel (b) plots the progressivity measure in the optimal Heathcote-Storesletten-Violante tax system.

Figure 9, Panel (a) plots the marginal tax rates associated with the three optimal tax systems, while Panel (b) plots the average tax rates over the distribution of income. For the optimal partial meritocratic and utilitarian criteria, individuals with earnings below approximately $35,000$ dollars are subsidized since they face a negative average tax rate. At $100,000$ dollars the average tax rates span 27 percent under total meritocracy to $33-34$ percent under utilitarianism. This difference continues to grow as income increases.

(a) Marginal tax rates. (b) Average tax rates.

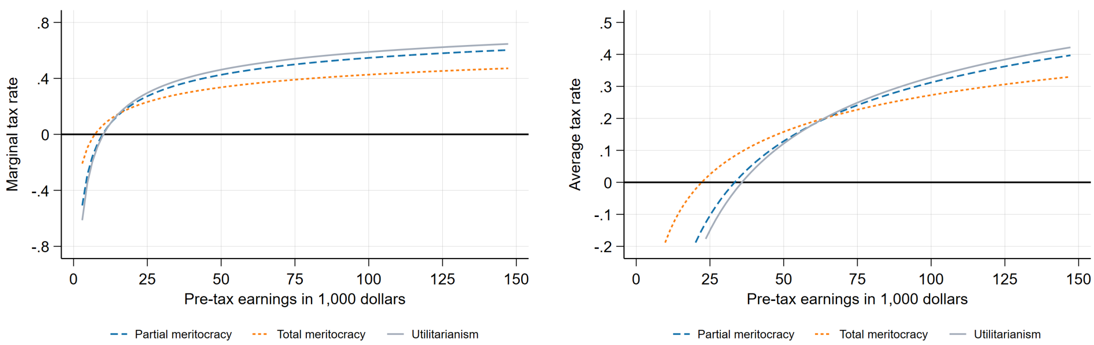


Figure 9: Optimal HSV tax rates.

Notes: Panel (a) plots the marginal tax rates under the optimal HSV tax system. Panel (b) plots the average tax rates.

4.3 A Mirrleesian income tax

Third, following Saez (2001) and a separable utility function, we characterize optimal Mirrleesian non-linear income taxes (no assumptions about the shape of the tax function), $T(y)$. Since we assume a separable utility function and the welfare criterion is separable in individuals and respects individuals' preferences over consumption and labor supply, the optimal policy rule is standard. The necessary condition for the optimal tax rate at income level $y(w)$ can be written as follows,

$$\frac{T'\left(z_w\right)}{1-T'\left(z_w\right)} = A\left(w\right)B\left(w\right), \tag{21}$$

such that $A(w)$ describes the effects of behavioral and $B(w)$ describes welfare changes given these behavioral effects,

$$A\left(w\right) \equiv \frac{1+\varepsilon_w^u}{\varepsilon_w^c}\frac{1}{wf\left(w\right)} \text{ and } B\left(w\right) \equiv \int_w^{w_t}\left(1-\frac{g(\theta)}{\lambda}\right)\frac{u_c(w)}{u_c(\theta)}f\left(\theta\right)d\theta.$$

The standard results of zero marginal tax rate at the upper limit and no negative tax rates also hold here, as our criterion respects the Pareto principle, no wage level can be assigned a negative marginal welfare weight for any level of merit. The necessary condition is also sufficient whenever pre-tax income is non-decreasing in wages, which we confirm ex-post.

To derive further policy implications, we simulate optimal Mirrleesian tax rates by building on the algorithm developed in Mankiw et al. (2009) and our flat income tax algorithm described in Appendix C.[25]

(a) Marginal tax rates. (b) Average tax rates.

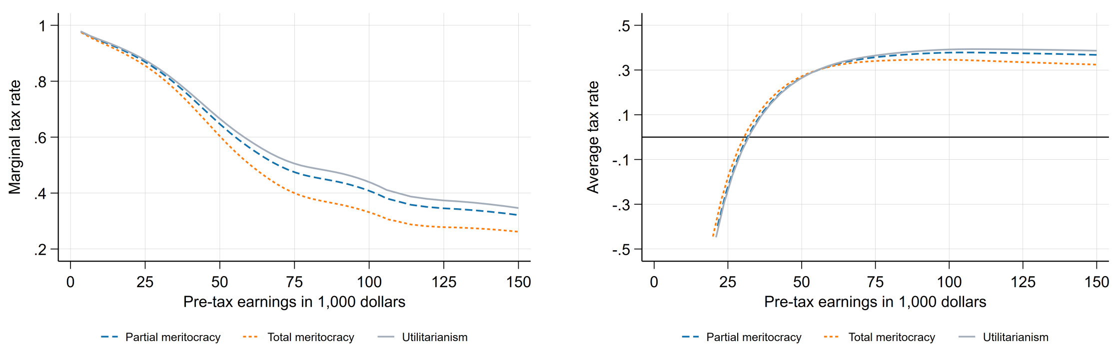


Figure 10: Optimal Mirrleesian tax rates.

Notes: Panel (a) plots the optimal marginal tax rates. Panel (b) plots the optimal average tax rates.

[25] We thank Gregory Mankiw, Matthew Weinzierl and Danny Yagan for making their code publicly available.

Results

Figure 10 describes optimal tax rates according to the partial and total versions of the meritocratic criterion compared to the utilitarian tax schedule. Optimal lump sum transfers are 48 percent of median income for utilitarianism, 46 percent for partial meritocracy and 44 percent for total meritocracy. Interestingly, marginal tax rates are falling over the income distribution for all our criteria, as in Mirrlees (1971) original study of optimal income taxation. This is due to the low thickness (Pareto parameter) found for the top of the labor income distribution in Norway. Figure A2 in Appendix shows that optimal tax rates would follow the standard u-shape had the Norwegian labor income distribution been similarly thick at the top as the US income distribution. See Appendix D.2 for further sensitivity analysis to higher levels of inequity aversion and the impact of allocating residuals to circumstances.

5 Conclusion

This paper has shown how a meritocratic policymaker can implement income taxes that respect the Pareto principle, prioritize individuals with higher measures of merit, and are applicable to second-best policy analysis. The main results are that, in our setting, merit factors explain a significant part of wage differences, that merit factors increase with wage rates, and that optimal policy according to meritocratic criteria differs from optimal policy according to other criteria, such as utilitarianism. The optimal meritocratic tax system is a redistributive one, albeit less redistributive than the utilitarian tax system.

We have also shown how to empirically inform the choice of optimal meritocratic taxation. With long-run comprehensive Norwegian register data, we are able to account for sibling-fixed effects together with detailed levels of education and labor market factors. Still, further empirical work on the role of merit is needed, in particular in settings where education is costly and family support is common, where the difference between total and partial meritocracy could be more substantial than for Norwegian workers.

While our approach to meritocracy aims to be pragmatic and empirically informed, there are relevant objections to any specific welfare criterion. In particular, if the motivation for designating a factor as merit is that it derives from an individual's choice, there may be other restrictions on choices that our framework does not address. Instead of accounting for all choice restrictions, our aim has been to provide applicable welfare criteria that reflects the extensive survey and experimental evidence of widespread meritocratic concerns for the studying of second-best tax policy.

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A Proofs

A.1 Proposition 3.

We start by proving the more general Proposition 3.

If-part

Equation (7) is increasing in each e_i, satisfying Pareto Efficiency. It is also continuous, satisfying Continuity. Since

$$\tilde{e}_i^T v\left(\frac{a}{\tilde{e}_i^T}\right) + \sum_{j\neq i} \bar{e}_j v\left(\frac{e_j}{\bar{e}_j}\right) \geq \tilde{e}_i^T v\left(\frac{a}{\tilde{e}_i^T}\right) + \sum_{j\neq i} \bar{e}_j v\left(\frac{e'_j}{\bar{e}_i}\right)$$

$$\Leftrightarrow$$

$$\tilde{e}_i^T v\left(\frac{b}{\tilde{e}_i^T}\right) + \sum_{j\neq i} \bar{e}_j v\left(\frac{e_j}{\bar{e}_j}\right) \geq \tilde{e}_i^T v\left(\frac{b}{\tilde{e}_i^T}\right) + \sum_{j\neq i} \bar{e}_j v\left(\frac{e'_j}{\bar{e}_i}\right),$$

the social welfare function also satisfies Separability. Moreover, for any $\alpha > 0$, since

$$\sum_i \tilde{e}_i^T v\left(\frac{\alpha e_i}{\tilde{e}_i^T}\right) = \begin{cases} \alpha^{1-\gamma} \sum_i \tilde{e}_i^T v\left(\frac{e_i}{\tilde{e}_i^T}\right) & \text{if } \gamma \neq 1 \\ \sum_i \tilde{e}_i^T v\left(\frac{e_i}{\tilde{e}_i^T}\right) + \log\alpha \sum_i \tilde{e}_i^T & \text{if } \gamma = 1, \end{cases}$$

then

$$\sum_i \tilde{e}_i^T v\left(\frac{\alpha e_i}{\tilde{e}_i^T}\right) \geq \sum_i \tilde{e}_i^T v\left(\frac{\alpha e'_i}{\tilde{e}_i^T}\right)$$

$$\Leftrightarrow$$

$$\sum_i \tilde{e}_i^T v\left(\frac{e_i}{\tilde{e}_i^T}\right) \geq \sum_i \tilde{e}_i^T v\left(\frac{e'_i}{\tilde{e}_i^T}\right).$$

proving that Scale Invariance is satisfied.

For Generalized Total Meritocracy Selection, consider the following maximization problem

$$\max_{e\in \bar{E}^T} \sum_i \tilde{e}_i^T v\left(\frac{e_i}{\tilde{e}_i^T}\right).$$

The Lagrangian and corresponding first-order conditions associated with this problem is

$$\mathcal{L} = \sum_i \tilde{e}_i^T v\left(\frac{e_i}{\tilde{e}_i^T}\right) - \lambda \sum_i \left(e_i - \tilde{e}_i^T\right),$$

$$\frac{\partial \mathcal{L}}{\partial e_i} = (\tilde{e}_i^T)^\gamma e_i^{-\gamma} - \lambda = 0.$$

This implies that the optimal e_i is proportional to $\tilde{e}_i^T$ for each $i \in \mathcal{I}$. Inserting this into the constraint implies that $e_i = \tilde{e}_i^T$.

Finally, consider two profiles $e, e' \in \mathcal{E}$ and some $\varepsilon > 0$ such that

- $e_i' + \varepsilon = e_i \leq \tilde{e}_i^T$,

- $e_j' - \varepsilon = e_j \geq \bar{e}_j$,

- $e_k = e_k'$ for each $k \in \mathcal{I} \setminus \{i, j\}$.

The welfare change of this transfer is (up to a first-order approximation):

$$\left[\left(\frac{\tilde{e}_i^T}{e_i'}\right)^{\gamma} - \left(\frac{\bar{e}_j}{e_j'}\right)^{\gamma}\right]\varepsilon > 0,$$

demonstrating that Equitable Transfer is satisfied and thus concludes the if-part of the proof.

Only if-part

We prove this part in 5 steps.

Step 1. For each $i \in \mathcal{I}$, there exists continuous and strictly increasing functions $\bar{v}_i$ such that $\succsim$ is represented by:

$$W\left(e\right) = \sum_i \bar{v}_i\left(e_i\right). \tag{22}$$

Proof.
Completeness and continuity imply the existence of a continuous representation $V : \mathcal{E} \to \mathbb{R}$ of $\succsim$. Efficiency implies "strict essentiality," and by assumption there are at least 3 individuals (sectors). Thus, by the Theorem in Gorman (1968), separability implies that $W(y) = \sum_i \bar{v}_i(e_i)$, where the functions are continuous and strictly increasing. □

Step 2. $\succsim$ is convex.

Proof.
Consider two allocations $e, e' \in \mathcal{E}$ satisfying the following conditions for some $\varepsilon > 0$, such that

- $e_i' + \varepsilon = e_i = \tilde{e}_i$,

- $e_j' - \varepsilon = e_j = \tilde{e}_j$,

- $e_k = e_k'$ for each $k \in \mathcal{I} \setminus \{i, j\}i$.

By Equitable Transfer, $e \succsim e'$. Step 1 implies that

$$W(e) - W(e') = \bar{v}_i(\tilde{e}_i) - \bar{v}_i(\tilde{e}_i - \varepsilon) + \bar{v}_j(\tilde{e}_j + \varepsilon) - \bar{v}_j(\tilde{e}_j) \geq 0.$$

Dividing by ε and taking the limit as it to goes to zero, implies that $\bar{v}_i'(\tilde{e}_i) \geq \bar{v}_j'(\tilde{e}_j)$, provided the derivatives exist. Given that the functions are continuous and strictly monotone, they are indeed differentiable almost everywhere.

By considering the mirror situation, we see that $\bar{v}_j'(\tilde{e}_j) \geq \bar{v}_i'(\tilde{e}_i)$, proving that $\bar{v}_i'(\tilde{e}_i) = \bar{v}_j'(\tilde{e}_j)$.

For each $i \in \mathcal{I}$ and the vector (fixed) $\tilde{e} \in \mathcal{E}$, define

$$v_i\left(\frac{e_i}{\tilde{e}_i}\right) \equiv \frac{\bar{v}_i(e_i)}{\tilde{e}_i}.$$

Differentiating both sides with respect to e_i implies that $\bar{v}_i'(e_i) = v_i'\left(\frac{e_i}{\tilde{e}_i}\right)$. Thus,

$$v_i'\left(\frac{\tilde{e}_i}{\tilde{e}_i}\right) = v_i'(1) = v_j'\left(\frac{\tilde{e}_j}{\tilde{e}_j}\right) = v_j'(1).$$

By Scale Invariance, $v_i'(a) = v_j'(a)$ for any $a > 0$, proving that

$$\bar{v}_i(e_i) = \tilde{e}_i\tilde{v}\left(\frac{e_i}{\tilde{e}_i}\right) + \chi_i.$$

Consider an allocation $e \in \mathcal{E}$ where

- $e_i < \tilde{e}_i$,
- $e_j > \tilde{e}_j$.

By Equitable Transfer, redistributing $\varepsilon \in (0, \min\{\tilde{e}_i - e_i, e_j - \tilde{e}_j\})$ from individual j to individual i should increase social welfare. By Step 1

$$\tilde{v}'\left(\frac{e_i}{\tilde{e}_i}\right) > \tilde{v}'\left(\frac{e_j}{\tilde{e}_j}\right),$$

which is true whenever $\frac{e_i}{\tilde{e}_i} < \frac{e_j}{\tilde{e}_j}$. Thus, $\tilde{v}_i'(a) > \tilde{v}_i'(b)$ whenever $a < b$. Since its derivatives are decreasing in its argument, $\tilde{v}$ is concave, and since V is a sum of concave functions it is concave as well. This implies that $\succsim$ is convex. □

Step 3. The function W is of the following form:

$$W(e) = \sum_i \alpha_i v(e_i),$$

where $\alpha_i > 0$ for each $i \in \mathcal{I}$ and $v(z) = (1-\gamma)^{-1}z^{1-\gamma}$ for $\gamma > 0$ and $\gamma \neq 1$ and $v(z) = \log z$ if $\gamma = 1$.

Proof.

Since $\succsim$ is convex, continuous, additive, and homothetic, and $\succ$ is increasing, Theorem 2.4-4 in Katzner (1970) applies. The result is immediate. □

Step 4. For each $i \in \mathcal{I}$, α_i is proportional to $\tilde{e}_i^{\gamma}$.

Proof.

For some α, consider the maximization problem

$$\max_{e \in \bar{E}} \sum_i \alpha_i v(e_i).$$

The Lagrangian and corresponding first-order conditions associated with this problem are

$$\begin{aligned}\mathcal{L} &= \sum_i \alpha_i v(e_i) - \lambda \sum_i (e_i - \tilde{e}_i), \\ \frac{\partial \mathcal{L}}{\partial e_i} &= \alpha_i e_i^{-\gamma} - \lambda = 0.\end{aligned}$$

Since v is strictly increasing, the constraint will be binding and $\lambda > 0$. By Generalized Total Meritocracy Selection, $\bar{e}$ solves this problem, implying that $\alpha_i = (\lambda \tilde{e}_i^T)^{\gamma}$. □

Step 5. $W(e) = \sum_i \tilde{e}_i^T v\left(\frac{e_i}{\tilde{e}_i^T}\right)$.

Proof.

From Step 3 and 4 we have that $W(e) = \sum_i \alpha_i v(e_i) = \sum_i b(\tilde{e}_i^T)^{\gamma} v(e_i)$ for some $b > 0$. Clearly, the ranking of any two alternatives is independent of b. Rewriting yields

$$W = \sum_i \tilde{e}_i^T v\left(\frac{e_i}{\tilde{e}_i^T}\right), \tag{23}$$

which concludes the proof. ■

A.2 Propositions 1,2 and 4.

The proofs for propositions 1,2 and 4 are entirely analogous to the one above. The proof of Proposition 1 is obtained by replacing all e's with y's, $\mathcal{E}$ with Y and Generalized Total Meritocracy Selection with Total Meritocracy Selection. Proposition 4 follows by replacing $\tilde{e}^T$ with $\tilde{e}^P$ and Generalized Total Meritocracy Selection with Generalized Partial Meritocracy Selection. Proposition 2 follows by first replacing all $\tilde{e}^T$ with $\tilde{e}^P$, then replacing all e's with y's, $\mathcal{E}$ with Y, and Generalized Total Meritocracy Selection with Partial Meritocracy Selection. ■

B Descriptive statistics

B.1 Tables

Occupation	**Frequency**	**Percent**
Military occupations and unspecified occupations	3,196	0.72
Administrative leaders and politicians	68,429	15.45
Academic occupations	81,517	18.41
Occupations with shorter university and college education, and technicians	89,003	20.10
Office and customer service occupations	27,487	6.21
Sales, service, and care occupations	66,577	15.03
Occupations in agriculture, forestry, and fishing	1,744	0.39
Craftsmen and similar occupations	35,011	7.91
Process and machine operators, transport workers, etc.	30,208	6.82
Occupations without educational requirements	39,722	8.97
Total	442,894	100.00

Note: The table shows the distribution of occupations in the sample. The categories shown are the main categories (first-digit) of the STYRK08 occupation classification.

Table A1: Employment by occupation

Education Level	**Frequency**	**Percent**
Primary education	40	0.01
Lower secondary education	68,674	15.51
Upper secondary education, basic level	31,073	7.02
Upper secondary education, final level	148,278	33.48
Post-secondary education	23,083	5.21
Tertiary education, lower level	126,396	28.54
Humanities and Arts	*9,707*	*7.68*
Teacher education and pedagogy	*31,197*	*24.68*
Social sciences and law	*4,759*	*3.77*
Business and administrative studies	*26,250*	*20.77*
Natural sciences, crafts, and technical studies	*17,117*	*13.54*
Health, social services, and sports	*31,165*	*24.66*
Primary industries	*389*	*0.31*
Transport and safety services and other services	*4,609*	*3.65*
Unspecified field of study	*1,203*	*0.95*
Tertiary education, higher level	39,837	8.99
Humanities and Arts	*3,959*	*9.94*
Teacher education and pedagogy	*1,927*	*4.84*
Social sciences and law	*7,853*	*19.71*
Business and administrative studies	*4,684*	*11.76*
Natural sciences, crafts, and technical studies	*14,111*	*35.42*
Health, social services, and sports	*4,542*	*11.4*
Primary industries	*1,048*	*2.63*
Transport and safety services and other services	*1,709*	*4.29*
Unspecified field of study	*4*	*0.01*
Research education	4,977	1.12
Unspecified	536	0.12
Total	442,894	100

Note: The table shows the education level (first-digit) of the sample based on the NUS2000 classification. For two of the education levels (corresponding to bachelor's and master's level) we include information about the field of study (indicated by the indented rows).

Table A2: Education statistics

Sector	Frequency	Percent
Agriculture, forestry, fishing	3,676	0.84
Mining and quarrying	10,579	2.42
Manufacturing	52,304	11.97
Electricity, gas, steam, and hot water supply	5,090	1.16
Water supply, sewerage, waste management, and remediation activities	2,924	0.67
Construction	22,326	5.11
Wholesale and retail trade and repair of motor vehicles	47,572	10.89
Transportation and storage	33,604	7.69
Accommodation and food service activities	5,731	1.31
Information and communication	19,562	4.48
Financial and insurance activities	13,931	3.19
Real estate activities	2,805	0.64
Professional, scientific, and technical activities	40,226	9.21
Administrative and support service activities	22,691	5.19
Public administration and defense, and compulsory social security	23,989	5.49
Education	55,787	12.77
Human health and social work activities	61,502	14.08
Arts, entertainment, and recreation	7,546	1.73
Other service activities	5,029	1.15
Activities of households as employers of domestic personnel	38	0.01
Total	436,912	100.00

Note: The table shows the distribution across sectors for our sample. The categories shown are the main categories of the NACE classification.

Table A3: Employment by sector

C More on the optimal tax problem

C.1 Optimal linear income tax algorithm

1. Pick a value for the marginal tax rate t_0 and some initial guess of the lump-sum grant B_0. Given t_0, we guess $B_0 = t_0\mathbb{E}[z] - R$, where R is the government's revenue requirement, and the expectation is taken with respect to the actual income distribution.

   (a) Given (t_k, B_k), solve the first order condition for each level of wages w. We solve these equations using the Newton-Raphson method.

   (b) Check if the government budget constraint is satisfied. If it is not, update the guess of the lump-sum grant to $B_{k+1} = t_0\mathbb{E}[z] - B_k - R$, where the expectation is taken with respect to the distribution of earnings under the tax system (t_k, B_k).

(c) Iterate a) and b) until B_k converges to $B(t_0)$.

2. Having obtained the equilibrium tax system $(z_0, B(\tau))$, derive each individual's equivalent consumption.

3. Evaluate the resulting distribution of equivalent consumption according to the two different welfare criteria.

4. Move on to the next marginal tax rate t_1 and repeat.

The algorithm for the unrestricted problem is similar to the one above, where the main difference is that Step 4 is replaced by applying new tax rates for each income level using Equation 21.

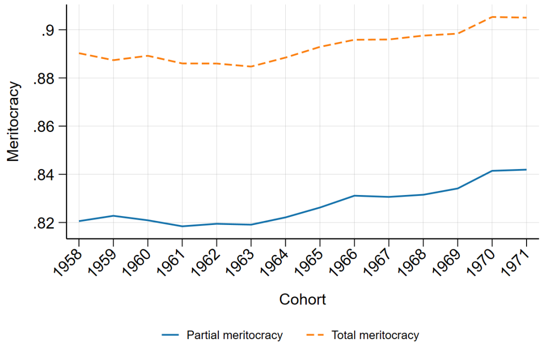
D Further results

D.1 Alternative measures of merit

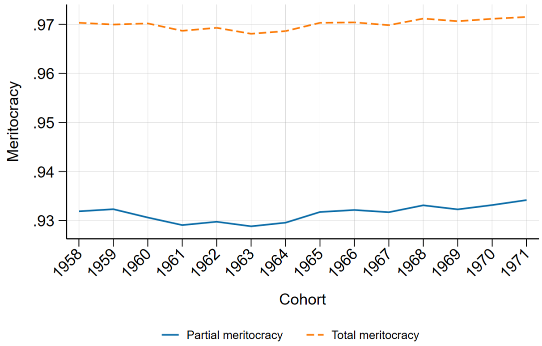
Here we show how the measurement of meritocracy would differ when we, first, increase inequity aversion, $\gamma = 2$, and, second, allocate the residual to merit rather than to circumstance.

Figure A1 shows that the level of meritocracy is lower when inequity aversion is higher and higher when the residual is allocated as merit. Panel (c) shows that the combination of the increase in inequity aversion and the residual allocated as merit decreases the level of merit compared to the baseline result in Figure 5.

(a) Meritocracy with higher inequity aversion.



(b) Meritocracy with residual as merit.



(c) Meritocracy with residual as merit and higher inequity aversion.

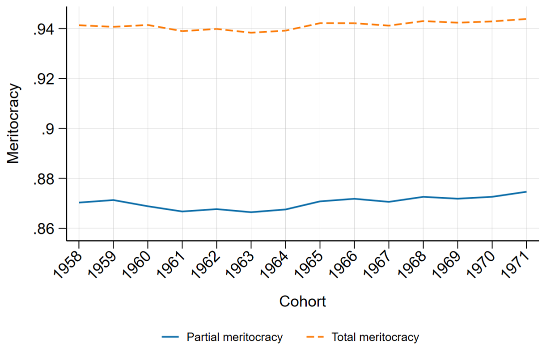


Figure A1: Alternative measures of meritocracy.

Notes: Panel (a) plots the measured level of meritocracy according to the two criteria criteria when $\gamma = 2$. Panel (b) plots the measured level of meritocracy according to the two criteria criteria when the residual is allocated to merit and $\gamma = 1$. Panel (c) plots the measured level of meritocracy according to the two criteria criteria when the residual is allocated to merit and $\gamma = 2$.

D.2 Alternative simulations

First, we show that the standard u-shaped pattern (Saez, 2001) for optimal marginal income tax rates would have been the case had the Pareto tail among Norwegian wage earners been thicker. In Figure A2, we replace the income distribution above the 95th percentile with a Pareto distribution where the Pareto parameter is set equal to 2.

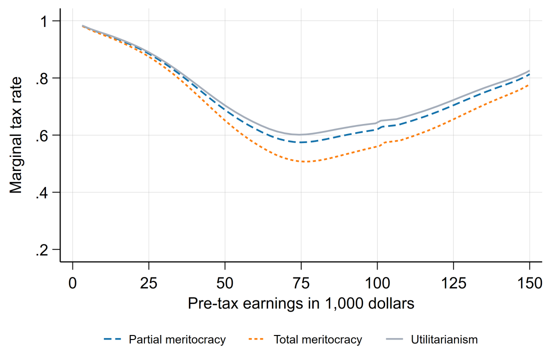


Figure A2: Optimal marginal tax rates with a (counterfactual) thick Pareto tail.

Next, we consider an alternative way of accounting for the residuals in the measurement of merit. Figure A3 shows optimal tax rates when residuals are added to merit rather than to circumstance.

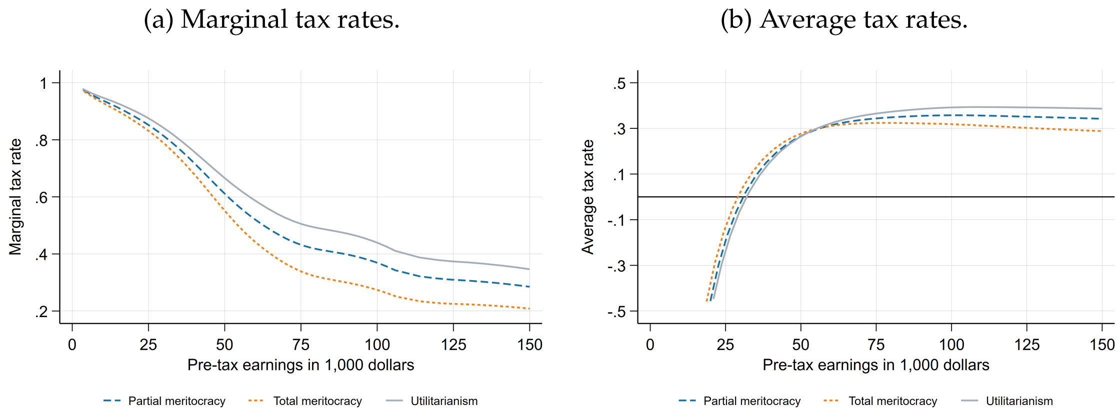


Figure A3: Optimal tax rates with alternative measures of merit.

Notes: Panel (a) plots the optimal unrestricted marginal tax rates. Panel (b) plots the optimal unrestricted average tax rates.

In Figure A4, we change inequity aversion, γ, from 1 to 2 for partial and total meritocracy when residuals are added to circumstance.

(a) Marginal tax rates. (b) Average tax rates.

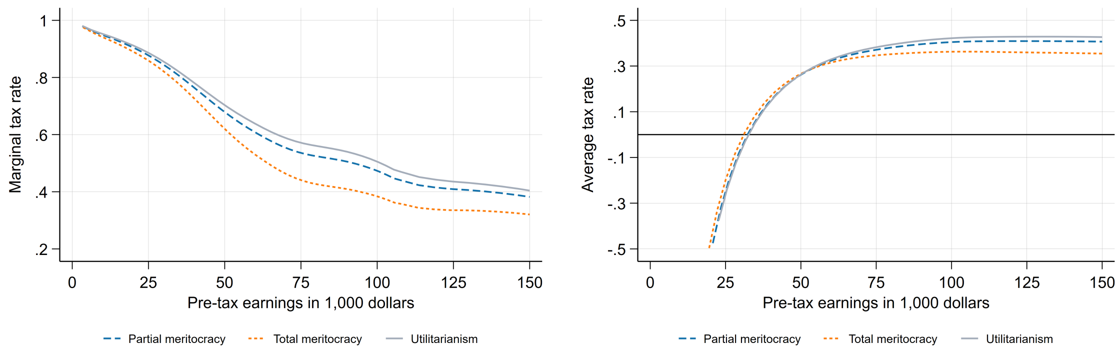


Figure A4: Optimal tax rates with high inequality aversion.

Notes: Panel (a) plots the optimal unrestricted marginal tax rates. Panel (b) plots the optimal unrestricted average tax rates.

Finally, In Figure Figure A5, set $\gamma = 2$ also when residuals are added to merit.

(a) Marginal tax rates. (b) Average tax rates.

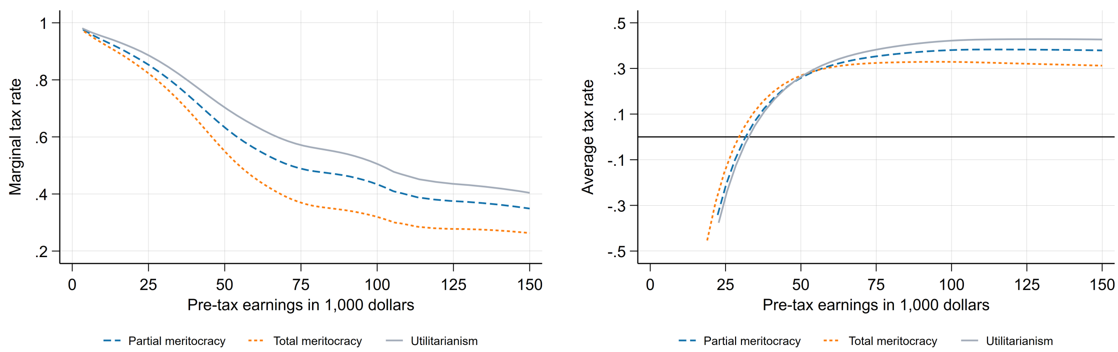


Figure A5: Optimal tax rates with high inequality aversion and alternative measures of merit.

Notes: Panel (a) plots the optimal unrestricted marginal tax rates. Panel (b) plots the optimal unrestricted average tax rates.