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Revealed social preferences of Dutch political parties☆

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ABSTRACT

We measure the redistributive preferences of Dutch political parties using unique, detailed information from their election proposals. By employing the inverse optimal-tax method, we calculate the political weights across the income distribution for each political party. We find that all Dutch political parties give a higher political weight to middle incomes than to the poor. Moreover, the political weights of the rich are close to zero. Furthermore, we detect a strong political status quo bias as the political weights of all political parties hardly deviate from the weights implied by the pre-existing tax system. We argue that political-economy considerations are key in understanding these results.

"*Don't tell me what you value. Show me your budget, and I will tell you what you value.*"

Joe Biden – US Presidential Elections, September 15, 2008

1. Introduction

As income and wealth inequality have been rising in many countries during recent decades (Atkinson et al., 2011; Piketty, 2014), policies to reduce income inequality have returned to the top of the political agenda. Indeed, President Obama (2013) has called inequality the 'defining challenge of our time' and political disputes over income redistribution have become more polarized and ideologically charged. Republicans accuse the Democrats of 'taxing job creators' (Romney, 2012), while Democrats often accuse the Republican Party of only cutting taxes for the very rich (Obama, 2015). Debates concerning redistribution are also polarized in The Netherlands. Conservative-liberal Prime Minister Mark Rutte (2012) considers all left-wing parties 'socialist' that 'destroy wealth' by ' letting

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the government take away more than half of every euro you make'.[1] Conversely, the socialist party has blamed the right-wing parties of pursuing 'neo-liberal' policies that only 'make the rich richer and the poor poorer' (Socialist Party, 2014). Similar examples can be found in many other countries. However, despite heated political rhetoric, no one has – to the best of our knowledge – ever tried to *measure* the redistributive preferences of political parties.

In this paper we measure the redistributive preferences of political parties by exploiting data on the tax-benefit proposals of political parties in their election programs. In a process unique in the world, CPB Netherlands Bureau for Economic Policy Analysis (CPB) makes an extensive analysis of the effects of election programs on public expenditures and tax revenues, key macro-economic variables, and the income distribution for every national election in The Netherlands since 1986.[2] To conduct this analysis, all major Dutch political parties voluntarily provide CPB with detailed policy proposals. CPB acts as a disciplinary device by preventing political parties presenting free lunches in their election programs. Moreover, CPB is widely considered, by political parties and the media alike, to be the single most important non-partisan judge regarding the economic consequences of political parties' policy proposals. The publication containing the economic outcomes of the election programs, *Charted Choices*, plays an important role in the election campaign. Politicians use the figures from *Charted Choices* to back up their arguments in election debates. Moreover, the election programs of Dutch political parties are not cheap talk. CPB's analyses of the different party programs are the basis for the negotiations among coalition parties forming a government after the elections. 92 percent of all measures of the 2012–2017 coalition agreement were previously announced in the election programs (Suyker, 2013).

By using the data supplied to CPB, we are able to reveal the political preferences for income redistribution with the inverse optimal-tax method, pioneered by Bourguignon and Spadaro (2000, 2012). For any given tax schedule, the inverse optimal-tax method derives the social preferences that make that particular tax schedule the optimal one. The main idea of this paper is that each political party sets its tax system so as to optimize its political objectives. By exploiting the detailed information on the proposed tax systems, and assuming that Dutch political parties indeed optimize the tax system according to their political preferences, we are able to calculate political parties' political weights for all income groups and the non-employed. Thus, to paraphrase former Vice-President Joe Biden, by showing their budgets, Dutch political parties tell us who they value. Throughout this paper we speak of political weights of the political parties rather than social welfare weights to avoid the impression that political parties optimize a standard social welfare function. They do not, as we will demonstrate later. Political weights are analytically equivalent to social welfare weights. However, political weights do not only tell us something about parties' redistributive preferences, but also about their strategic (influencing the election or government formation) and opportunistic (gaining voters) motives.

We base our calculations on an inversion of the optimal income tax model of Jacquet et al. (2013), which allows for both an intensive (hours or effort) and an extensive (participation) decision margin. We derive political weights from a structural model to address the potential endogeneity of the elasticities, the income distribution, and the employment rates with respect to the policy proposals of political parties. Our main analysis focuses on individual tax payers. We calibrate the model using detailed information on: i) the earnings distribution, including an estimate of the Pareto tail for the top; ii) marginal and participation taxes derived from an advanced tax-benefit calculator incorporating all taxes and transfers in The Netherlands; iii) CPB-estimates of intensive and extensive elasticities that are used in the calculation of the long-run economic effects of the election programs. These estimates are in line with most recent causal evidence of the elasticity of taxable income and participation elasticities in the literature, including those for The Netherlands. The inverse optimal-tax method allows us to recover the political weights implied by the detailed proposals for the tax system of Dutch political parties in the elections of 2002. We focus on four political parties that fit into the 'left-wing' and 'right-wing' taxonomy regarding preferences for income redistribution: the socialist party (SP), the labor party (PvdA), the Christian-democratic party (CDA), and the conservative-liberal party (VVD).

Our main findings are fourfold. First, our results show that political preferences for redistribution are partly congruent with standard social welfare functions.[3] In particular, all parties roughly give a higher political weight to the poor than to the rich and left-wing parties give a higher political weight to the poor and a lower political weight to the rich than right-wing parties do. Second, we detect an important and robust anomaly in the political weights: for all parties they are *increasing* from the poor to the middle-income groups. This result arises from the fact that both effective marginal tax rates, and the elasticity of the earnings density increase with income up to modal income. Several other papers also find that (for all households, for subgroups or for specific countries) social welfare weights need not be monotonically declining in income (e.g. Petersen, 2007; Blundell et al., 2009; Bargain and Keane, 2010; Bargain et al., 2014b,c; Lockwood, 2016). Third, all political parties soak the rich by setting the top rate of the income tax close to the revenue-maximizing rate. Indeed, welfare weights are slightly negative in the baseline. This is found as well in Petersen (2007) and Bourguignon and Spadaro (2012). However, this finding is not universal. Since the Reagan administration, US social welfare weights are not much lower for top incomes than for average incomes, see Hendren (2014) and Lockwood (2016). Similarly, during the Thatcher administration, UK social welfare weights are relatively large for the highest incomes, see Bargain and Keane (2010). Fourth, we uncover a strong status quo bias in redistributive politics in The Netherlands. Specifically, the differences in the political weights between parties are all small and the political weights are close to the weights of the pre-existing tax system.[4] Therefore, we argue that the political process is important in shaping tax policy outcomes.

We conducted several robustness checks. First, political parties may have different views on the behavioral elasticities. Although there appears to be little disagreement regarding the elasticities used by CPB in the analysis of the election proposals, there may be 'elasticity optimists' and 'elasticity pessimists' (Stiglitz, 2000, p. 554).[5] In a robustness check we show that the first anomaly – increasing political weights to the mode – is completely robust to changes in the elasticities. However, the second anomaly – negative political

[1] In Europe, liberal parties are not left-wing oriented parties, but classical liberal, pro-market, small-government parties that generally take conservative positions on non-economic matters. That is why we consistently use the terminology 'conservative-liberal' parties in this paper.

[2] See CPB (2017) for the analysis of the 2017 elections, and the contributions in Graafland and Ros (2003) and the analysis in Bolhuis (2017) for the advantages and disadvantages of this practice.

[3] It is typically assumed that social welfare weights are positive and monotonically declining in income due to positive but diminishing marginal utility of private income or concavity in the social welfare function (Bourguignon and Spadaro, 2012).

[4] We show this for the 2002 elections. Bolhuis (2017, p. 110) argues that this is true in all elections in which election proposals have been analyzed by CPB: "… the parties hardly want to change overall government spending and overall tax burdens … compared to the status quo". Moreover, Gielen et al. (2009) demonstrate that marginal tax rates barely changed between 2001 and 2011, implying that political weights do not change much over time. During this period, The Netherlands had 6 different governments and 5 general elections.

[5] Bolhuis (2017, p. 30) concludes that "… the publication *Charted Choices* and the analysis of the coalition agreement … are treated as 'objective truth' … ".

weights at the top – is sensitive to the elasticity of taxable income at the top, and would disappear if the elasticity would be lower.

Second, we also verify whether the results are robust to the unit of observation. The baseline focuses on individual tax payers. We find the same qualitative results when separately analyzing childless singles, single parents, primary earners without children, primary earners with children, secondary earners without children, and secondary earners with children. We further show that results are very similar if we employ a structural model to fully account for the endogeneity of the earnings distribution and the behavioral elasticities or if we employ a sufficient-statistics approach where these are kept at baseline levels. Finally, our findings are robust to the inclusion of in-kind transfers, such as subsidies for public transportation, culture, and arts.

Our main findings – increasing welfare weights to the middle, top rates that soak the rich, and a strong status quo bias – suggest that the Dutch democracy serves the interests of the middle class over those of the low and high incomes. This finding can be explained by political economics, and provides support to median voter theories (Romer, 1975; Roberts, 1977; Meltzer and Richard, 1981), citizen candidate models (Röell, 2012; Brett and Weymark, 2014), Director's law (Stigler, 1970), probabilistic-voting models (Persson and Tabellini, 2000; Bierbrauer and Boyer, 2016), models of within-party conflict (Roemer, 1998, 1999), post-election considerations (Persson and Tabellini, 2000), and vested interests resulting in a strong status quo (Olson, 1982). As such, our paper provides a bridge between political economics and normative public finance.

Our paper is related to a number of recent papers that apply the inverse optimal-tax method to derive social welfare weights.[6] Pioneering work has been done by Bourguignon and Spadaro (2000, 2012), who recover the social welfare weights for the tax system of France. Subsequently, many studies have derived social welfare weights: Petersen (2007) for Denmark, Blundell et al. (2009) for single mothers in Germany and the UK, Bargain and Keane (2010) for childless singles in Ireland and the UK over several decades, Bargain et al. (2014b,c) for childless singles in 17 European countries and the US, Hendren (2014) for the US, Lockwood and Weinzierl (2016) for the US over the period 1979–2010, and Lockwood (2016) for the US if individuals have present bias. Finally, Lorenz and Sachs (2016) use the inverse optimal-tax method to identify Pareto-improving tax reforms in Germany.

We make a number of contributions to this literature. First, to the best of our knowledge we are the first to apply the inverse optimal-tax method to political parties. This allows us to objectively measure their political preferences for income redistribution. We argue that political considerations are key to explain our findings. Second, we derive social welfare weights in a model with continuous types, intensive and extensive margins and by allowing for income effects. Earlier literature with both intensive and extensive margins generally analyzed the discrete-choice model of Saez (2002) without income effects (e.g. Blundell et al., 2009; Bargain and Keane, 2010; Bourguignon and Spadaro, 2012; Bargain et al., 2014c).[7] Our simulations demonstrate that the political weights are primarily driven by the distribution of gross earnings and the tax-benefit schedules, and not by participation or income effects. Third, we extend the analysis of Lorenz and Sachs (2016) by decomposing social welfare weights into their main determinants. Under some simplifying assumptions, we derive analytically how the social welfare weights change with gross earnings, much in the spirit of the analysis in Diamond (1998) on the optimal non-linear tax schedule. This is – to the best of our knowledge – new in this literature. Fourth, by comparing our structural model with a model based on sufficient statistics, we demonstrate that the sufficient-statistics approach provides an excellent approximation to the welfare weights obtained from the structural model. Hence, the sufficient-statistics formulae allow researchers to calculate the social welfare weights implied by any tax system using data on the earnings distribution, tax rates, and elasticities for earnings-supply and participation, without the need to specify a full-fledged structural model.

The outline of the paper is as follows. Section 2 introduces the optimal tax model, derives the expressions for optimal taxes and social welfare weights, and explains the conditions under which the social welfare weights are non-negative and monotonically declining in income. Section 3 discusses the calibration of the model. Section 4 analyzes the tax-benefit proposals of the political parties. Section 5 derives the social welfare weights in the pre-existing tax system, the political weights derived from the proposals of Dutch political parties, and a number of robustness checks. Section 6 discusses how political-economy and other economic considerations may explain the patterns in the social welfare weights. Section 7 concludes. An Appendix contains the proofs of the propositions, background information regarding the Dutch tax system and the Dutch political system, and the estimation, calibration and simulation procedures.

2. Model

This section introduces the model, derives the optimal tax system and the formulae for the social welfare weights using the optimal-tax model of Jacquet et al. (2013) with both intensive and extensive responses to taxation.

In order to relate our paper to the existing literature, this section derives all results using the terminology of social welfare weights. In later sections, when we analyze the election programs, we will refer to political weights instead to make explicit that the political weights are derived from a political objective function and not from a social welfare function.

2.1. Individuals

Following Jacquet et al. (2013), individuals differ in their earnings ability n, and utility costs of participation φ. Both characteristics are private information and their joint density function is given by $k(n,\varphi)$ with support $[\underline{n},\overline{n}] \times [\underline{\varphi},\overline{\varphi}]$, where $0 < \underline{n} < \overline{n} \leq \infty$ and $-\infty \leq \underline{\varphi} < \overline{\varphi} \leq \infty$. Earnings ability reflects the productivity per hour worked, as in Mirrlees (1971). φ is an idiosyncratic utility cost (or benefit), which reflects an individual-specific cost from participation, for example foregone leisure time or household production, or the cost of commuting to work, see also Diamond (1980). Participation costs can also be negative, for example because of the value of social contacts at work or by avoiding the stigma of being non-employed. We will express all optimal tax rules in terms of the observable earnings distribution $F(z)$, with its corresponding density function $f(z)$, rather than in terms of the unobserved distribution $k(n,\varphi)$.

Employed individuals with ability n derive utility from consumption c_n, disutility from earnings supply z_n, and disutility from participation φ. The utility function of a working individual with ability n and participation costs φ equals

$$U_{n,\varphi} \equiv u(c,z,n) - \varphi, \quad u_c, -u_z > 0, \quad u_{cc}, u_{zz} \leq 0, \quad \forall n, \varphi, \tag{1}$$

where $u(\cdot)$ is differentiable, increasing, and weakly concave in consumption c and differentiable, decreasing, and concave in earnings supply z. If labor earnings are the product of labor supply l and ability n, so that $z \equiv nl$, individuals with a higher ability n obtain a given level of earnings z with lower labor supply l.

[6] Studying the dual problem of optimal taxation has a long history in public economics, see e.g. Stern (1977), Christiansen and Jansen (1978), Ahmad and Stern (1984), and Decoster and Schokkaert (1989).

[7] Hendren (2014) also analyzes continuous-type models with intensive and extensive margins. However, his analysis builds on an earlier version of our analysis, see Hendren (2014, p. 19, footnote 38).

Labor earnings and employment status are verifiable to the government. Hence, the government can condition taxes and transfers on gross labor income z and an individual's employment status. The income tax function is non-linear, continuous, differentiable, and denoted by $T(z)$, where $T'(z) \equiv \mathrm{d}T(z)/\mathrm{d}z$ is the marginal tax rate. All net labor income is spent on consumption c. Consequently, the individual budget constraint is $c = z - T(z)$. Non-employed workers receive a non-employment benefit b, which generally differs from the net income of employed workers earning zero income $-T(0)$. Hence, the non-employed enjoy consumption $c = b$, while they do not provide any earnings effort ($z = 0$). The maximization problem for employed individuals is given by: $\max_z u(z - T(z), z, n)$, where we have substituted the budget constraint in the utility function. The first-order condition is the same as in the standard Mirrlees (1971) model:

$$\frac{-u_z(\cdot)}{u_c(\cdot)} = 1 - T'(z), \quad \forall n. \tag{2}$$

A non-employed individual derives utility from consuming non-employment benefits b: $v(b)$. Consequently, an individual decides to participate in the labor market if her maximized utility when working is larger than the utility obtained from being non-employed: $u_n - \varphi > v(b)$. The employment rate at each income level z equals the employment rate at each ability level n in view of the perfect mapping between ability n and earnings z for workers: $E_z \equiv E_n \equiv \int_{\underline{\varphi}}^{u_n - v(b)} k(n,\varphi)\mathrm{d}\varphi$. E_z thus depends on the joint distribution $k(n,\varphi)$, the benefit level b, and the tax function $T(z)$. For later reference, we define the participation tax rate τ_z at income level z as $\tau_z \equiv (T(z) + b)/z$.

2.2. Incentive compatibility

The allocation is incentive compatible if the following first-order incentive-compatibility constraint holds:

$$\frac{\mathrm{d}u_n}{\mathrm{d}n} = \frac{\partial u(c,z,n)}{\partial n}. \tag{3}$$

This condition can be derived by totally differentiating utility Eq. (1) with respect to ability n and using the first-order condition for earnings supply Eq. (2). The incentive-compatibility constraint Eq. (3) does not depend on participation costs. Intuitively, a worker with ability n has to incur participation cost φ irrespective of whether the worker self-selects in the consumption-income bundle for type n or decides to mimic a worker of type m to obtain the consumption-income bundle intended for type m.

We use the first-order approach using Eq. (3), assuming that the second-order conditions are satisfied. Second-order sufficiency conditions for utility maximization are met if the Spence-Mirrlees and monotonicity constraints are satisfied: $\mathrm{d}\left(\frac{u_z(\cdot)}{u_c(\cdot)}\right)/\mathrm{d}n \leq 0$ and $\mathrm{d}z_n/\mathrm{d}n > 0\ \forall n$, see also Ebert (1992). In our simulations, we check ex post whether the second-order sufficiency conditions are respected, which is always the case. As a result, bunching due to violations of second-order conditions is not optimal for any employed individual, and the first-order approach indeed characterizes the policy optimum in our simulations.

2.3. Government

The government's redistributive preferences are captured by a set of exogenously given marginal social welfare weights g for all individuals, as in Saez and Stantcheva (2016). g_z measures the monetized gain in social welfare of providing one unit of income to a particular individual with income z. Similarly, g_0 is the welfare weight of the non-employed. The average social welfare weight of all working individuals at income level z is represented by $g_z \equiv \int_{\underline{\varphi}}^{u_n - v(b)} g_{z,\varphi} k(n,\varphi)\mathrm{d}\varphi / \int_{\underline{\varphi}}^{u_n - v(b)} k(n,\varphi)\mathrm{d}\varphi$, where $g_{z,\varphi}$ is the social welfare weight of an individual with earnings z and participation costs φ.[8]

The government budget constraint states that total tax revenue from individuals that are employed equals outlays on transfers b for the non-employed and an exogenous revenue requirement R:

$$\int_{\underline{n}}^{\overline{n}} \int_{\underline{\varphi}}^{u_n - v(b)} T(z)k(n,\varphi)\mathrm{d}\varphi \mathrm{d}n = (1-E)b + R, \tag{4}$$

where $E \equiv \int_{\underline{n}}^{\overline{n}} \int_{\underline{\varphi}}^{u_n - v(b)} k(u_n,\varphi)\mathrm{d}\varphi \mathrm{d}n$ is the aggregate employment rate.

The government minimizes resources R in Eq. (4) by optimally choosing the non-linear tax function $T(z)$ and the non-employment benefits b subject to incentive constraints Eq. (3) and a distributional constraint, which specifies an exogenously given level of utility for each individual, see Jacquet et al. (2013).

2.4. Optimal tax-benefit schedule and social welfare weights

2.4.1. Optimal tax system

The optimal non-linear income tax and participation tax rates are given in the following proposition.

Proposition 1. *The optimal non-linear income tax schedule and the optimal participation tax rate are determined by*

$$\frac{T'(z)}{1-T'(z)} = \underbrace{\frac{1}{\varepsilon_z^c}}_{\equiv A_z} \underbrace{\frac{\int_z^{\bar{z}} \left(1 - g_{\tilde{z}} + \eta_{\tilde{z}} \frac{T'(\tilde{z})}{1-T'(\tilde{z})} - \zeta_{\tilde{z}}^T \frac{\tau_{\tilde{z}}}{1-\tau_{\tilde{z}}}\right) f(\tilde{z})\mathrm{d}\tilde{z}}{1-F(z)}}_{\equiv B_z} \underbrace{\frac{1-F(z)}{f(z)z}}_{\equiv C_z}, \quad \forall z, \tag{5}$$

$$E \int_{\underline{z}}^{\bar{z}} \zeta_{\tilde{z}}^b \frac{\tau_{\tilde{z}}}{1-\tau_{\tilde{z}}} f(\tilde{z})\mathrm{d}\tilde{z} = (1-E)(g_0 - 1), \tag{6}$$

where $\varepsilon_z^c \equiv -\frac{\partial z}{\partial T'}\frac{1-T'}{z} > 0$ is the compensated elasticity of taxable income with respect to the marginal income tax rate, $\eta_z \equiv -(1-T')\frac{\partial z}{\partial \rho} \geq 0$ is the income elasticity of earnings supply with respect to non-labor income ρ, $\zeta_z^T \equiv -\frac{\partial E_z}{\partial \tau_z}\frac{1-\tau_z}{E_z}$ is the participation elasticity with respect to the participation tax rate when the income tax changes, $\zeta_z^b \equiv -\frac{\partial E_z}{\partial \tau_z}\frac{1-\tau_z}{E_z}$ is the participation elasticity with respect to the participation tax rate when the benefit level changes.

Proof. See Appendix A. ■

Eq. (5) is a simplification of the original optimal-tax formula in Jacquet et al. (2013). We contribute to their analysis by expressing the optimal-tax formula entirely in terms of measurable sufficient statistics. We also generalize the *ABC*-formula of Diamond (1998) and Saez (2001) to include the extensive margin. Moreover, we do not need to rely on virtual densities for earnings as in Saez (2001), since we do not derive the behavioral elasticities along a linearized tax schedule. If tax schedules are non-linear, the change in marginal tax rates affects behavioral elasticities. To see why, suppose that the non-linear tax schedule features increasing (decreasing) marginal

[8] For example, if social welfare is given by a Bergson-Samuelson social welfare function $W(U_{n,\varphi})$, where $W' > 0, W'' \leq 0$, then the social welfare weight of a worker with earning ability n and participation costs φ equals $g_{n,\varphi} \equiv W'(\cdot)u_c(\cdot)/\lambda$, where λ denotes the shadow value of public funds.

tax rates with income, so that $T''(z) > 0$ ($T''(z) < 0$). Then, a reduction in the marginal tax rate at some income level – keeping all other marginal tax rates constant – results in an increase in earnings supply at that income level. This increase in earnings supply is dampened (exacerbated) if marginal tax rates are increasing (decreasing) with income. Intuitively, as individuals increase their earnings supply, their earnings increase, and they will face a higher (lower) marginal tax rate if $T''(z) > 0$ ($T''(z) < 0$). This change in the marginal tax rate affects the total behavioral response of earnings supply to taxation, and is referred to as the 'circular process' by Jacquet et al. (2013). We take the non-linearity of the tax schedule fully into account in deriving the behavioral elasticities, see Appendix C.1.[9] The intuition for the optimal income tax expression is not discussed here, since it is well explained in Diamond (1998), Saez (2001, 2002), and Jacquet et al. (2013).

Eq. (6) gives the optimality condition for the optimal participation tax in terms of sufficient statistics, which resembles the optimal participation tax in the discrete-type model of Saez (2002). $g_0 - 1$ on the right-hand side represents the marginal benefits of raising the non-employment benefit b with one unit: the mechanical welfare gain g_0 minus its resource cost. The welfare weight of the non-employed g_0 is typically larger than 1, since the average welfare weight is approximately one.[10] Redistribution towards the non-employed is more valuable if there are more non-employed individuals, i.e. if E is lower. $\zeta_z^b \frac{\tau_z}{1-\tau_z}$ on the left-hand side gives the participation distortion at income level z if the non-employment benefit b is raised with one unit. Some individuals stop paying taxes and start collecting non-employment benefits. Participation distortions increase in the participation elasticity ζ_z^b and the participation tax rate τ_z.[11] Participation distortions are more important if there are more employed workers, i.e. if E is larger.

2.4.2. Social welfare weights

The inverse optimal-tax method asks the question: which set of social welfare weights makes a particular tax system the optimal one (Bourguignon and Spadaro, 2012)? The answer is found by solving the expressions for the optimal income tax and benefit levels in Proposition 1 for social welfare weights g_z and g_0 in Proposition 2.

Proposition 2. *The social welfare weights associated with any optimized tax system satisfy*

$$g_z = 1 + \frac{1}{f(z)}\frac{\partial DWL_z}{\partial z} + \eta_z \frac{T'(z)}{1-T'(z)} - \zeta_z^T \frac{\tau_z}{1-\tau_z}, \quad \forall z, \tag{7}$$

$$\frac{1}{f(z)}\frac{\partial DWL_z}{\partial z} \equiv (\xi_z + \theta_z)\varepsilon_z^c \frac{T'(z)}{1-T'(z)} + \varepsilon_z^c \frac{zT''(z)}{(1-T'(z))^2}, \quad \forall z, \tag{8}$$

$$g_0 = 1 + \frac{E}{1-E}\int_{\underline{z}}^{\bar{z}} \zeta_{\tilde{z}}^b \frac{\tau_{\tilde{z}}}{1-\tau_{\tilde{z}}} f(\tilde{z})\mathrm{d}\tilde{z}, \tag{9}$$

where $DWL_z \equiv \varepsilon_z^c \frac{T'(z)}{1-T'(z)} zf(z)$ *is the marginal deadweight loss on tax base* $zf(z)$, $\xi_z \equiv \frac{\partial \varepsilon_z^c}{\partial z}\frac{z}{\varepsilon_z^c}$ *is the elasticity of the compensated elasticity of taxable income, and* $\theta_z \equiv 1 + \frac{zf'(z)}{f(z)}$ *denotes the elasticity of the local tax base* $zf(z)$ *with respect to income* z.

Proof. See Appendix B. ■

Eq. (7) shows that the social welfare weights are based on sufficient statistics only: marginal and participation tax rates, compensated and income elasticities of earnings supply, participation elasticities, and the earnings distribution. Social welfare weights for the non-employed g_0 in Eq. (9) are larger the more the government distorts participation, since participation is distorted only to redistribute income from the employed to the non-employed. Note that all welfare weights are equal to one ($g_z = 1$) if marginal and participation tax rates are zero. If the government does not engage in any income redistribution through distortionary taxation, it must attach the same welfare weight to everyone.

In the analysis that follows we are particularly interested in whether social welfare weights are: i) monotonically declining in income, so that the government always cares more about poorer than richer individuals, ii) always positive, since otherwise Pareto-improving tax reforms exist, and iii) feature discontinuous jumps, so that large differences in social welfare weights exist for individuals differing only marginally in income, which, too, suggests the possibility of welfare-improving tax reforms.

Behavior of social welfare weights with income. The first determinant of the social welfare weights in Eq. (7) is the *change* of the deadweight loss DWL_z with earnings z. In our empirical analysis, we show that this term is the *main* determinant of the social welfare weights. $\varepsilon_z^c \frac{T'(z)}{1-T'(z)}$ stands for the marginal deadweight loss per unit of tax base at income level z, and $zf(z)$ is the size of the tax base at z. Intuitively, if the deadweight losses are increasing at income level z, then the government redistributes from individuals with incomes higher than z to individuals with income levels below z. Consequently, social welfare weights for individuals at income z are higher than for individuals above income z.[12] The change in the deadweight loss is larger if marginal tax rates $T'(z)$ or elasticities ε_z^c are higher – for given θ_z and ξ_z.

To gain more insight into the behavior of social welfare weights with income, we follow Diamond (1998). We suppose that income and participation effects are zero ($\eta_z = \zeta_z^T = 0$).[13] Our quantitative results below show that these terms have a negligible impact on the social welfare weights. Moreover, intensive earnings-supply elasticities are assumed to be constant ($\varepsilon_z^c = \varepsilon^c$).[14] The social welfare weights can then be simplified to:

$$g_z = 1 + \theta_z \varepsilon^c \frac{T'(z)}{(1-T'(z))} + \varepsilon^c \frac{zT''(z)}{(1-T'(z))^2}, \quad \forall z, \tag{10}$$

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9 Saez (2001) conjectures and Jacquet and Lehmann (2015) prove that the Mirrlees model is applicable as well under preference heterogeneity. In that case, the elasticities at each income level represent the averages of the elasticities over all individuals at each income level. Hendren (2014) demonstrates that our model preserves this property.

10 The average social welfare weight is exactly one in the absence of income effects.

11 Due to income effects in participation choices the participation elasticity of a benefit increase ζ_z^b is generally not equal to the participation elasticity of a tax increase ζ_z^T. Both elasticities coincide when utility is quasi-linear or when participation costs are monetary.

12 Alternatively, if the welfare weights are expressed in terms of the Diamond (1975)-based social marginal value of income $g_z^* \equiv g_z - \eta_z \frac{T'(z)}{1-T'(z)} + \varepsilon_z^P \frac{\tau_z}{1-\tau_z}$ – which includes the income and participation effects on taxed bases – optimality of the tax system implies that $g_z^* = 1 + \frac{1}{f(z)}\frac{\partial DWL_z}{\partial z}$ so that the Diamond-based social welfare weights are only determined by the change in the deadweight loss.

13 Income effects on the intensive margin $\eta_z \frac{T'(z)}{1-T'(z)}$ raise the distributional benefits of a higher marginal tax rate, and thus raise social welfare weights – ceteris paribus. Participation distortions $\zeta_z^T \frac{\tau_z}{1-\tau_z}$ can either be positive or negative depending on whether the government taxes or subsidizes participation at income z. If $\tau_z > 0$, participation distortions reduce the redistributional benefits of a higher marginal tax rate, hence social welfare weights are lower – ceteris paribus. The reverse is true if $\tau_z < 0$.

14 If $\xi_z > 0$ the government attaches a higher welfare weight to individuals with income z than to those above z– ceteris paribus. Appendix D shows that intensive elasticities are roughly constant with income in our calibration. Hence, ξ_z is approximately zero and is not important to explain the behavior of the social welfare weights.

and the change of the social welfare weights with respect to gross earnings equals:

$$\frac{\partial g_z}{\partial z} = (1+\theta_z)\varepsilon^c \frac{T''(z)}{(1-T'(z))^2} + \varepsilon^c \frac{T'(z)}{1-T'(z)}\frac{\partial \theta_z}{\partial z} + \varepsilon^c z\left(\frac{T'''(z)}{(1-T'(z))^2} + 2\frac{(T''(z))^2}{(1-T'(z))^3}\right). \quad (11)$$

From this we see that the behavior of social welfare weights with income is determined by two variables: the elasticity of the local tax base θ_z $\left(\text{and its derivative } \frac{\partial \theta_z}{\partial z}\right)$ and the marginal tax rate $T'(z)$ (and its first and second derivative, $T''(z)$ and $T'''(z)$, respectively). A higher elasticity of taxable income ε^c does not change the comparative statics, only their size. Hence, the patterns of social welfare weights become more pronounced if the elasticity of taxable income increases.

The behavior of the elasticity of the local tax base θ_z is the key determinant of the social welfare weights. If θ_z is larger, marginal tax rates generate larger deadweight losses. Hence, the government attaches a higher social welfare weight to individuals with income above z then to individuals at z – ceteris paribus. Fig. 1 plots the behavior of θ_z against gross income for The Netherlands in 2006. θ_z changes non-monotonically with income: it first increases until it reaches a maximum at around the 25th percentile, after which it starts to decrease until it becomes a constant when the Pareto tail starts (at about 60,000 euro).[15] Fig. 1 shows that for the Dutch income distribution, θ_z is larger than -1 up to the 50th percentile, hence $1+\theta_z > 0$ until the median. In The Netherlands, marginal tax rates also increase with earnings (i.e., $T'(z) > 0$) up to the median. Therefore, the first term in Eq. (11) is positive up to the median. The second term in Eq. (11), the derivative of the elasticity of the tax base, is roughly positive up to the 30th percentile, and negative thereafter, see Fig. 1, where θ_z first increases and then decreases with income. Finally, the third term in Eq. (11) captures how changes in the marginal tax rates affect social welfare weights. The contribution of these terms is generally small, except around spikes in marginal tax rates. Therefore, in The Netherlands one expects to find social welfare weights that are increasing up to at least the 30th percentile of the earnings distribution.[16]

Negative social welfare weights. Whether social welfare weights are positive is especially relevant for the top-income earners. Atkinson et al. (2011) show that the Pareto distribution with parameter a generally gives an excellent fit for the right tail of the income distribution. If we realistically assume that participation elasticities are negligible for top earners ($\zeta_z^T = 0$), and that compensated and income elasticities are constant ($\varepsilon_z^c = \varepsilon^c$, $\eta_z = \eta$, $\xi_z = 0$), optimal top rates are constant, and social welfare weights for top earners g_∞ are given by:

$$g_\infty = 1 - (a\varepsilon^c - \eta)\frac{T'(\infty)}{1-T'(\infty)}. \quad (12)$$

[15] The empirical earnings distribution is supplemented with an estimated Pareto tail for the top income earners. If the earnings distribution $f(z)$ is Pareto with parameter a, then it can be written as $f(z) = a\hat{z}^a z^{-1-a}$, where $\hat{z}$ is the income level at which the Pareto distribution starts. Consequently, the elasticity of $zf(z)$ equals $-a$ if the earnings distribution is Pareto.

[16] Hendren (2014, Fig. 7) shows that in the US the elasticity $\theta_z \equiv 1 + \frac{f'(z)z}{f(z)}$ is nearly continuously declining with income – except at the very top of the earnings distribution. Moreover, θ_z is much smaller at middle income levels. This explains why social welfare weights in his analysis are always declining, despite the continuous rise of the marginal tax rates with income. The Netherlands, in contrast, has a much larger middle class than the US, so that welfare weights can be increasing.

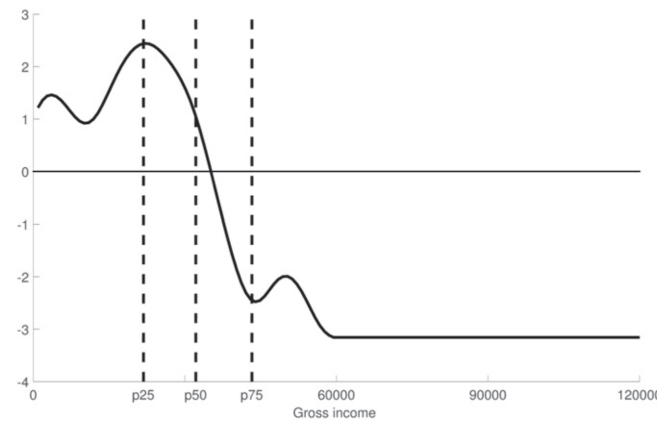

Fig. 1. Elasticity $\theta_z \equiv 1 + \frac{f'(z)z}{f(z)}$ of the local tax base $zf(z)$.

Social welfare weights for top income earners are non-negative, i.e. $g_\infty \geq 0$, if the marginal tax rate satisfies $T'(\infty) \leq \frac{1}{1+a\varepsilon^c-\eta}$. If the latter holds with equality, marginal tax rates are set at the top of the Laffer curve. Setting top rates beyond the Laffer rate is non-Paretian, since a reduction of top rates would both raise utility for top income earners, and raise tax revenue, which can be redistributed to make other individuals better off (Werning, 2007; Brendon, 2013; Lorenz and Sachs, 2016).

Spikes in social welfare weights. Social welfare weights display discontinuities if tax schedules generate spikes in marginal tax rates over small income intervals. These spikes are anomalous, since they generate large differences in social welfare weights for individuals differing only slightly in their earnings. The term $\frac{T'''(z)}{(1-T'(z))^2} + 2\frac{(T''(z))^2}{(1-T'(z))^3}$ in Eq. (11) captures the influence of spikes in marginal tax rates on social welfare weights. There will be large changes in welfare weights if marginal tax rates change a lot in narrow income intervals. If marginal tax rates do not change much with income, this term is small, since then we have $(T''(z))^2 \approx T'''(z) \approx 0$.

3. Calibration

This section explains in detail the data used in our analysis and the calibration of our model. We develop a structural version of the model by calibrating the primitives of the Jacquet et al. (2013) model to Dutch data. The reason to use a structural model is that the elasticities, the income distribution and the employment rates are all endogenous to the policy proposals of political parties. Failing to take these changes into account could potentially bias our calculations of the political weights, see also Chetty (2009). The downside of using a structural model is that it may be misspecified. Therefore, we also perform our analysis on the basis of sufficient statistics where we keep elasticities, the income distribution and the employment rates constant when recovering the political weights of the political party proposals (see the robustness checks).

Appendix C shows that the utility function $u(c, z, n)$, the joint distribution function of ability and participation costs $k(n, \varphi)$, and the allocation $\{c, z\}$ yield the necessary information to calculate the political weights associated with any tax-benefit system $\{T(z), b\}$. We identify the structural model by estimating the joint distribution of ability and participation costs $k(n, \varphi)$ and calibrating the utility function $u(c, z, n)$ on the intensive and extensive elasticities used by CPB in the analysis of the party proposals, and using the tax-benefit system in the baseline.

We make two important assumptions. First, we assume that ability and participation costs are independent. Hence, the joint distribution can be written as $k(n,\varphi) \equiv \hat{k}(n)h(\varphi)$, where $\hat{k}(n)$ is the density function of ability and $h(\varphi)$ is the density function of participation costs. We invert the individuals' first-order conditions to solve for their ability n. Then, we estimate a non-parametric kernel regression for the distribution of ability $\hat{k}(n)$. Second, we assume that $h(\varphi)$ follows a non-standardized t-distribution, which we estimate using data on employment rates by education and participation elasticities by income. More details on the exact calibration procedure can be found in Appendix C.

The remainder of this section describes the calibration of the model: i) the earnings distribution, ii) the tax system, iii) intensive elasticities, and iv) participation costs and extensive elasticities.

3.1. Earnings distribution

We calibrate the distribution of ability $\hat{k}(n)$ by inverting the individuals' first-order condition for earnings supply in the spirit of Saez (2001). To do so, we need information on earnings, tax rates, and elasticities. We use the micro dataset and elasticities of taxable income used by CPB in the analysis of the 2002 election proposals. The 2002 election proposals concern the cabinet period 2003–2006. We recover the political weights for 2006, the final year of the analysis when the full reform packages were projected to be implemented.

The unit of observation is the individual tax payer. Later, we explore the robustness of our findings for different household types (childless singles, single parents, primary earners without children, primary earners with children, secondary earners without children, and secondary earners with children). Data on individual earnings come from the Housing Demand Survey (HDS) (1998) – in Dutch: *Woningbehoefteonderzoek* – collected by Statistics Netherlands (1999). HDS 1998 contains sampling weights, which we use throughout the analysis. For the 2002 elections, CPB has updated the income data from the HDS 1998 to the year 2006, which we use as the baseline. We employ gross wage income as our definition of income and restrict the sample to employees. Our data set consists of 29,229 individuals. Fig. 2 provides a plot of a kernel density estimate of the earnings distribution, using a bandwidth of 3500 euro.

Since there are relatively few observations in the top tail of the earnings distribution in HDS 1998, we replace the top of the earnings distribution by a Pareto distribution. We use the method of Clauset et al. (2009) to simultaneously estimate the starting point of the Pareto distribution and the Pareto parameter, on the (uncensored) Income Panel 2002 – in Dutch: *Inkomenspanel 2002* – from Statistics Netherlands (2007). The estimated Pareto parameter is 3.158 and the estimated start of the Pareto distribution is 56,571 euro. The Pareto-parameter for the skill distribution is then calculated as $a(1+\varepsilon^u)$,

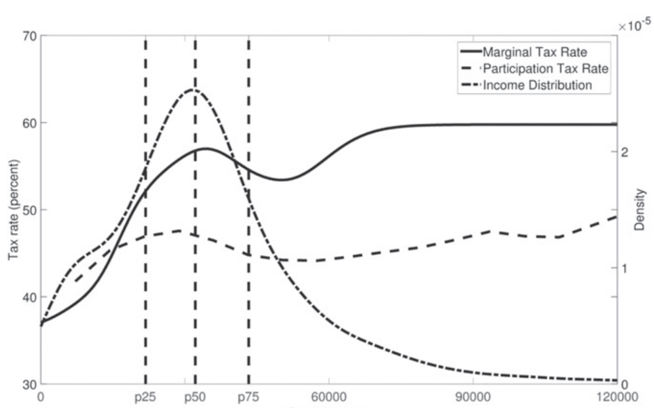

Fig. 2. Kernel estimate of marginal tax rates (left axis), participation tax rates (left axis) and the income distribution (right axis).

where $\varepsilon^u \equiv \frac{\partial z}{\partial n}\frac{n}{z}$ is the uncompensated elasticity of earnings z with respect to the skill level n (wage per hour worked), see also Saez (2001, p. 222).

3.2. Tax system

The political weights are critically determined by the parameters of the tax system. Therefore, it is important to use precise estimates for marginal tax rates and participation tax rates.[17] We calculate effective marginal tax rates (EMTRs) and participation tax rates (PTRs) using MIMOS-2, the official tax-benefit calculator of CPB used in the analysis of the 2002 election proposals, see Terra-Pilaar (1999) for a detailed description (in Dutch). To calculate the EMTR we first increase individual gross wage income by 3%. Next, we determine the corresponding increase in disposable income. Finally, the EMTR is calculated as 1 minus the increase in disposable income over the increase in gross wage income. MIMOS-2 takes into account all relevant income-dependent tax rates, tax credits and subsidies to calculate the EMTRs in The Netherlands.[18] Furthermore, we also include indirect taxes into our measure of EMTRs.[19] According to the input-output tables in the National Accounts, indirect taxes on private consumption are 12.0% of private consumption in 2006 (Statistics Netherlands, 2015). We assume that indirect taxes – of which the VAT is the most important one – are a constant fraction of consumption, which equals net disposable income in our static setup. Bettendorf and Cnossen (2014) show that this is a good approximation, since consumption of low-VAT and high-VAT commodities are nearly proportional in net disposable income in The Netherlands.[20]

We use a kernel estimate with a bandwidth of 3500 euro to smooth out the variation in individual EMTRs at each income level, and across individuals at different income levels. Online Appendix D gives a scatter plot of EMTRs showing that there is substantial variation in EMTRs at a given income level for a large part of the income distribution. For a given level of income, EMTRs differ because income support is conditioned on other characteristics than income, such as the presence of children, use of rental housing or health care, and outlays on child care.[21] Fig. 2 gives a kernel estimate of the resulting EMTRs. This and all other figures in this

17 Moreover, by precisely calculating marginal tax rates, we also improve on Saez (2001) and Jacquet et al. (2013). They assume a flat marginal tax rate to retrieve the ability distribution when inverting the individual first-order conditions. Since actual tax schedules are not linear, this procedure may bias the estimate for the ability distribution.

18 The calculations account for statutory tax rates, the general tax credit, the general earned-income tax credit, the tax credit and earned-income tax credit for single parents, the earned-income tax credit for working parents, health-insurance premiums, housing subsidies, and subsidies to families with dependent children. We also include employees' social-security contributions. See Gielen et al. (2009) for a decomposition of the EMTRs into income taxes, income-dependent tax credits, transfers and subsidies.

19 Denote the effective direct marginal tax rate by t_d, the marginal indirect tax rate by t_i and the effective total marginal tax rate by t_e. We calculate the effective total marginal tax rate as $t_e = \frac{t_d+t_i}{1+t_i}$.

20 We do not include the tax-deductibility of interest on mortgages and imputed rent on owner-occupied housing. Evidence in Vermeulen and Rouwendaal (2007) suggests that housing supply is nearly completely inelastic in The Netherlands. If housing supply is largely inelastic, then larger demand for housing translates into higher housing prices, and leaves net, after-subsidy housing prices largely unaffected. The tax treatment of housing then has little effect on effective marginal tax rates on labor earnings.

21 Jacquet and Lehmann (2015) demonstrate that the Mirrlees (1971) framework can be generalized to allow for individuals differing in multiple characteristics as long as they make only an earnings-supply choice. Their results carry over to Jacquet et al. (2013) and thus our paper, see also Hendren (2014). This implies that all our derivations remain valid, except that we should take averages of all tax rates and elasticities at each income level. Furthermore, as a robustness check we have calculated the social welfare weights for different household types and we then averaged the social welfare weights using population weights. This gives nearly the same results – available on request – as in the baseline.

paper are plotted for gross earnings in 2006. Moreover, p_x denotes the x-th percentile of the earnings distribution. We observe that EMTRs essentially follow the progressive statutory rates, with one major exception. EMTRs are much higher than statutory rates close to the mode of the income distribution (approximately 30 thousand euro), which is where income-dependent subsidies are phased out, in particular rent subsidies and subsidies for families with dependent children.

To determine the PTRs, we first calculate disposable income if the individual works. Next, we determine disposable income if the individual does not work. The PTR is calculated as in Brewer et al. (2010) and OECD (2014): the participation tax rate equals 1 minus the increase in disposable income as a fraction of gross wage income if the individual moves from non-employment to work. In this way, the PTR accounts for both taxes paid on gross wage income and the loss in social-assistance benefits (if applicable) when exiting non-employment.[22] We do not include unemployment benefits in the calculations of participation tax rates. Including the latter would raise the average non-employment benefit (b) with 3%,[23] and the resulting welfare weights are almost identical to the weights in the base calibration (available on request).[24]

Fig. 2 gives a kernel estimate of the resulting PTRs. PTRs are relatively low for low incomes because a substantial part of low-income earners are secondary earners. Secondary earners typically do not qualify for social assistance if they do not work because the income of their partner is too high. Also, in the PTRs there is a 'hump' close to the mode of the income distribution, because income-dependent subsidies are phased out.

In the baseline, we calibrate the non-employment benefit b and the demogrant $-T(0)$ such that the model-predicted average participation tax equals the observed average participation tax and the government budget constraint holds. Online Appendix D provides a comparison of the model-predicted participation taxes and the observed participation taxes by income levels. The government collects 9.5% of total labor earnings (i.e. total output) to finance exogenous government consumption.[25] With the government revenue requirement set at 9.5% of total output, the government budget balances under the current tax system with a non-employment benefit of approximately 9400 euro. This is in between the 2006 (disposable) social assistance level of 9316 euro for singles without children and 15,760 euro for couples with children.

3.3. Intensive elasticity

We calibrate the elasticity on the intensive margin by adopting the following utility function:

$$U = \frac{c^{1-\alpha}}{1-\alpha} - \gamma \frac{(z/n)^{1+\frac{1}{\varepsilon}}}{1+\frac{1}{\varepsilon}} - \mathrm{I}(z > 0)\varphi, \quad \alpha, \gamma, \varepsilon > 0, \tag{13}$$

where α governs the marginal utility of consumption, ε is the Frisch elasticity of earnings supply on the intensive margin, and γ is an innocuous scaling parameter.[26] $z/n = l$ stands for earnings effort. φ is the idiosyncratic fixed cost (or benefit) of participation and $\mathrm{I}(\cdot)$ is an indicator function.

The preference parameters α and ε are calibrated to reproduce the intensive-margin elasticities of the MIMIC model that is used by CPB in the 2002 elections to simulate the long-run employment effects of the reform proposals.[27] We thus estimate the political weights of political parties based on the same information regarding behavioral responses of taxes as the political parties had in 2002. The income-weighted uncompensated intensive-margin elasticity in our simulations equals 0.2, which is the employment-weighted average of the uncompensated elasticity in MIMIC across different demographic groups (Graafland et al., 2001, Table 3.2). In our model, the (un)compensated elasticity for the intensive margin is roughly constant across the income distribution in the baseline calibration, see online Appendix D.[28] In addition, we assume that the average income elasticity is −0.05, which corresponds to the employment-weighted average in MIMIC across different demographic groups.[29,30]

3.4. Distribution of participation costs and participation elasticities

Finally, the distribution of participation costs $h(\varphi)$ determines the participation elasticity in our model. We estimate this distribution such that the average participation elasticity and the distribution of participation elasticities by income in our model match with the data. In the calibration of our model, we emulate the average participation elasticity with respect to the wage rate in the MIMIC model of CPB. Graafland et al. (2001, Table 10.1, Columns 1–3) find that the aggregate participation response is about 80% of the aggregate intensive-margin response (0.20). Hence, the average participation elasticity is targeted at 0.16. To ensure that the model-predicted elasticities decrease with income, we target the extensive-margin elasticities by income quartiles to be consistent with the evidence in Mastrogiacomo et al. (2017).

In contrast to our calibration, much of the empirical labor-supply literature suggests that the extensive-margin response is larger than the intensive-margin response (Heckman, 1993; Blundell and MaCurdy, 1999; Bargain et al., 2014a). However, recent evidence by Chetty (2012) suggests that intensive-margin elasticities may not be that different from extensive-margin elasticities. Furthermore, estimates of the elasticity of taxable income suggest much larger intensive-margin responses than are documented in labor-supply studies. For example, Jongen and Stoel (2016) present evidence on the intensive-margin elasticity of taxable income for The Netherlands that is comparable with extensive-margin responses in labor supply.

[22] Here, we assume that individuals receive social-assistance benefits when they do not work, provided that there is insufficient income from a potential partner and insufficient household wealth. In doing so, we follow official rules of the tax authority and the municipalities.

[23] In 2006, 12% of the non-employed workers receives unemployment benefits, which are on average 26% higher than average social assistance benefits (own calculations using the Labour Market Panel of Statistics Netherlands).

[24] This finding is consistent with the findings in Immervoll et al. (2007, Table 5). They find that the welfare effects of a hypothetical tax reform are very similar when they do or do not explicitly account for unemployment benefits (next to social assistance).

[25] As government consumption we count expenditures on public administration, police, justice, defense and infrastructure minus non-tax revenues (from e.g. natural gas) as a percentage of GDP, all taken from the Dutch National Accounts in Statistics Netherlands (2015).

[26] The Frisch elasticity ε is a parameter and should not be confused with the compensated elasticity of earnings supply ε_z^c.

[27] See Graafland et al. (2001) for a description of the MIMIC model, the calibration and a large number of simulations.

[28] Graafland et al. (2001) do not report intensive-margin elasticities for different income groups. Using data for the period 1999–2005, Mastrogiacomo et al. (2017) estimate intensive-margin elasticities for hours worked that are declining in income for singles and single parents, whereas intensive-margin elasticities for hours worked are rather constant for primary and secondary earners in couples. Jongen and Stoel (2016) estimate (intensive) taxable income elasticities using data for the period 1999–2005 for different income groups in The Netherlands. They find that the elasticity of taxable income is very similar across income groups, which is consistent with our model.

[29] The uncompensated intensive-margin elasticity for primary earners (in couples), secondary earners, childless singles, single parents and 'older' workers (55–64 years of age, treated as a separate group) is 0.1, 0.25, 0.25, 0.5 and 0.15, respectively. The income elasticities for the same demographic groups are assumed to be 0.0, −0.2, −0.05, −0.1 and 0.0, respectively (Graafland et al., 2001, pp. 76–78).

[30] The estimates for the uncompensated elasticities and income elasticities are in line with the estimates surveyed in Blundell and MaCurdy (1999), Evers et al. (2008), and Meghir and Phillips (2010), and with recent estimates of the elasticity of taxable income (ETI) in the international literature and in The Netherlands, see Saez et al. (2012) and Jongen and Stoel (2016).

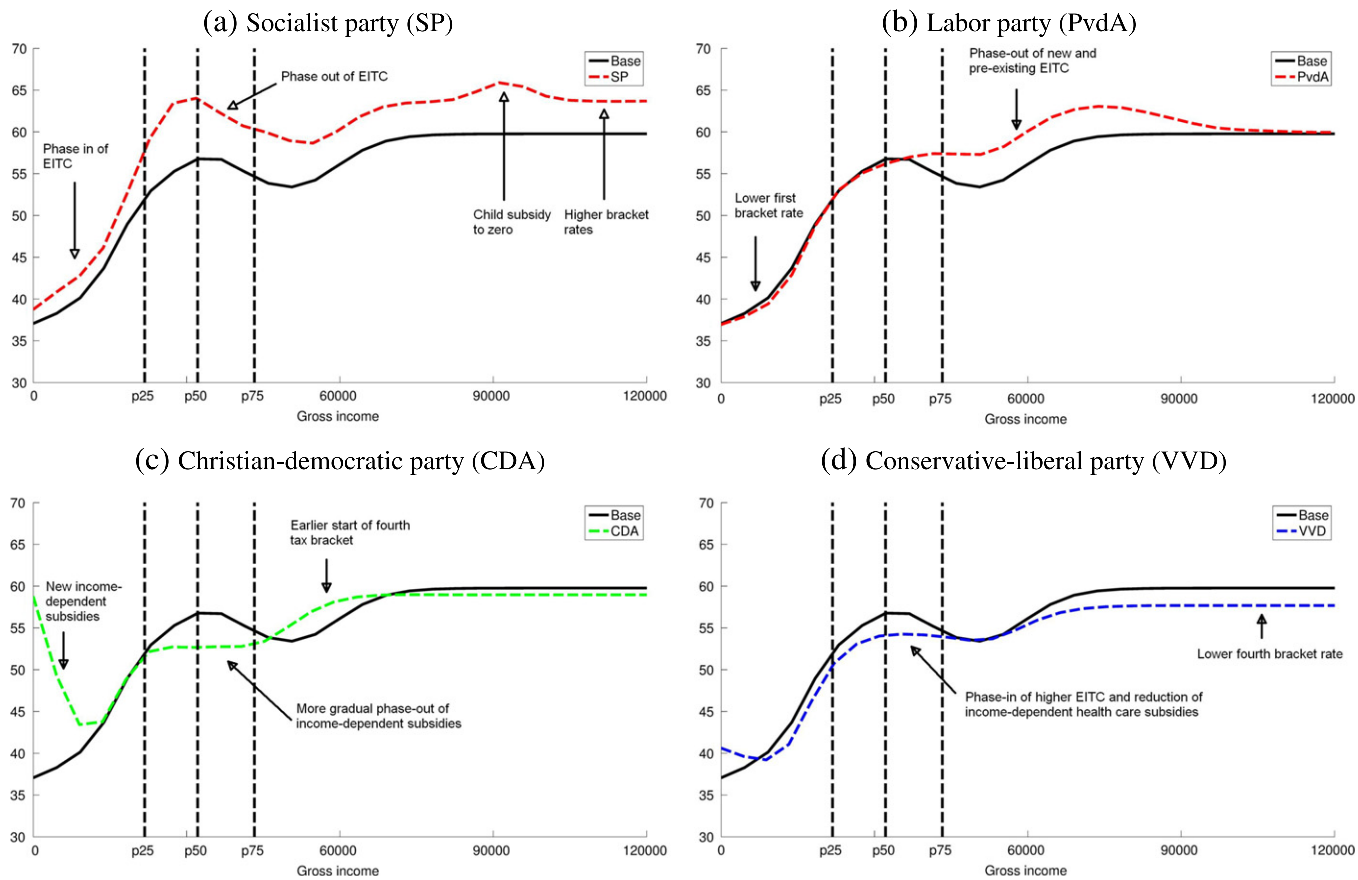

Fig. 3. Kernel estimate of marginal tax rates of proposed tax system by political party. Note: The dashed line gives a kernel estimate of marginal tax rates by income in the proposed tax system of each of political party. The solid line represents marginal tax rates in the baseline tax system.

We estimate $h(\varphi)$ with a non-linear least-squares regression using the participation elasticities and data on education-specific employment rates. See Appendix C for more details on the estimation procedure.

4. Proposals political parties

We focus on the four largest political parties in the Dutch parliament after the 2002 elections that fit into the 'left-wing' and 'right-wing' taxonomy regarding political preferences for redistribution: the left-wing socialist party (SP), the center-left labor party (PvdA), the center-right Christian-democratic party (CDA) and the right-wing conservative-liberal party (VVD). We do not consider the populist party of Pim Fortuyn, because they did not submit a tax-benefit plan to CPB in the 2002 elections.[31]

Changes in the tax system result in changes in the EMTRs and PTRs for each political party. Since the changes in EMTRs are the main drivers of the changes in political weights we plot the EMTRs for each party and only discuss the changes in PTRs. Our calculations of changes in EMTRs also take into account proposed changes in indirect taxes and corporate taxes. In line with the MIMIC model, we assume that the incidence of taxes on firms is the same as for the personal income tax.[32] In particular, the change in the EMTR due to a corporate tax change equals the percentage change in (ex ante) corporate tax revenue as a fraction of the wage bill. We do not account for the changes in taxes on capital income or wealth, since The Netherlands has a dual tax system where labor and capital incomes are taxed separately and our focus is on the taxation of labor income. This is in line with CPB (2002b), which also ignores the effects of changes in capital income or wealth taxes on labor market outcomes and the income distribution in *Charting Choices*. Online Appendix F provides an exhaustive list of all tax and benefit measures taken by each political party and provides the scatterplots of EMTRs on which our kernel estimates are based. This section only highlights the main changes proposed by each political party.

We first consider the proposed changes by the left-wing socialist party (SP). Fig. 3 (panel a) plots the resulting kernel of EMTRs for the SP in comparison to the baseline. The SP raises EMTRs across the

[31] Online Appendix E gives a brief introduction to the Dutch political system and the Dutch political parties that participated in the 2002 elections. CPB (2002b) gives an extensive overview of the proposed policy changes and the resulting effects (in Dutch). Online Appendix F contains the detailed list of proposals for the tax system. Clearly, the proposals of the political parties are not confined to the tax-benefit system. A brief English summary of the full analysis of the election proposals can be found in CPB (2002a). Furthermore, Graafland and Ros (2003) and Bolhuis (2017) consider the pros and cons of this unique Dutch exercise.

[32] The extent to which business taxes are borne by firms, workers and consumers is discussed in the public finance literature (Fuchs et al., 1998; de Mooij, 2005). A recent meta-analysis by Melguizo and González-Páramo (2013) suggests that workers bear 74% of employers' social-security contributions. Jacobs (2015) estimates that more than 90% of employer taxes are borne by workers in The Netherlands.

board due to higher marginal tax rates on labor income, higher indirect taxes, and higher corporate taxes. The SP abolishes health-care premiums, which is financed by an increase in the first-bracket rate with 2.3 percentage points, and an increase in the second-, third- and fourth-bracket rates by 3 percentage points. This shift from health-care premiums to statutory tax rates raises EMTRs for middle and higher incomes. In the baseline, health-care premiums rise up to an income of approximately 30 thousand euro, for incomes beyond 30 thousand euro they are income independent, see Gielen et al. (2009). The SP also proposes a fifth, top bracket with a rate of 72% for gross incomes above 213,358 euro. This is not visible in our graphs, since we only plot incomes up to 120 thousand euro. The SP further introduces an additional earned-income tax credit (EITC). This EITC is phased in between 100 and 130% of the annual minimum wage of 16,484 euro in 2006. It reaches a maximum of 1,017 euro. It is completely phased out between 130% and 170% of the minimum wage. The phase-in of the EITC limits the rise in marginal tax rates at the bottom, but significantly raises marginal tax rates in the phase-out range, around 25 thousand euro. The SP raises the (lump-sum) general child subsidy for lower incomes, cuts it in half at 45,000 euro, and completely withdraws it at 90,000 euro. Marginal tax rates increase at these income thresholds. The SP raises social-assistance benefits by 5%. Furthermore, they introduce a tax credit for non-workers which raises benefits for the non-employed by another 3%.

Next, consider the tax-benefit reforms proposed by the center-left labor party (PvdA), see also Fig. 3 (panel b). Marginal tax rates increase for the upper-middle and top incomes, which is due to changing the pre-existing EITC and introducing a new, additional EITC. The PvdA proposes to phase out the EITC – which is not phased out in the baseline tax system – between 240 and 400% of the minimum wage. The additional EITC features a phase-in range between 90 and 100% of the minimum wage, where it reaches a maximum of 353 euro, and is phased-out between 180 and 240% of the minimum wage. The PvdA also reforms the financing of health insurance, but this hardly affects the EMTRs. Finally, the PvdA raises indirect taxes, but reduces corporate taxation at the same time. These changes roughly cancel out.

Fig. 3 (panel c) gives the resulting kernel of EMTRs for the center-right Christian-democratic party (CDA). The most notable change is the rise in the marginal tax burden at the lower end of the income scale due to targeting income support more at low-income families by introducing income-dependent subsidies for health-care costs and children and by raising housing subsidies. The CDA-proposals also result in a more gradual phase-out of the overall system of income-dependent subsidies for housing and dependent children. This results in a noticeable drop in EMTRs around the mode of the income distribution. Furthermore, the earlier start of the fourth tax bracket raises EMTRs beyond the middle incomes. The CDA lowers the starting point of the fourth tax bracket by 4440 euro, which effectively raises marginal tax rates over this income range. The CDA increases the pre-existing EITC with 72 euro. The CDA reforms the financing of health insurance, but this hardly affects the EMTRs. The CDA increases the refundable tax credit for non-working partners. Furthermore, the CDA reduces corporate taxes by lowering employers' social-security contributions and leaves indirect taxes virtually unchanged.

Finally, we consider the proposals by the right-wing conservative-liberal party (VVD), see Fig. 3 (panel d). Most notable are the reductions in EMTRs for the middle- and top-income groups. The VVD phases out income-dependent subsidies and tax credits more slowly with income and it reduces the fourth bracket (top) rate by 3 percentage points. EMTRs are lower than in the baseline around the mode because the VVD increases the EITC (by 232 euro) and because the VVD converts the income-dependent health-care premiums to a lump-sum amount. Furthermore, the VVD does not phase out the EITC, contrary to the left-wing parties SP and PvdA. The VVD leaves benefits for non-workers virtually unchanged, and increases indirect and corporate taxes somewhat. The VVD abolishes employer subsidies targeted at low-wage workers and abolishes the exemption of corporate taxation for pension funds.

5. Political weights

5.1. Baseline

Fig. 4 gives the social welfare weights of the baseline tax system. We observe that these weights are only roughly in line with a standard social welfare function featuring gradually diminishing welfare weights. Indeed, although welfare weights are generally higher for low- than for high-income individuals, they are not monotonically declining in income and they are even slightly negative at high income levels. Furthermore, the social welfare weight for the non-employed is only slightly higher than that of the working poor. This means that the government values redistribution towards these groups roughly equally. Striking is the anomaly that the political weights rise with income until the 25th percentile, then it reaches a 'plateau' until the mode of the earnings distribution around the 50th percentile. Other studies also document that social welfare weights need not be monotonically declining in income for several countries (Petersen, 2007; Blundell et al., 2009; Bargain and Keane, 2010; Bargain et al., 2014b,c; Lockwood, 2016).

As explained in the theory section, the rise in welfare weights towards the mode is a direct result of rising marginal tax rates in the lower part of the income distribution in combination with the increase in the elasticity of the local tax base θ_z. This pattern of marginal tax rates can only be optimal when the government attaches a higher social welfare weight to the middle-income groups than to the low-income groups. This anomaly would imply that the government redistributes 'too much' to middle incomes, as long as a marginal euro is indeed worth more to the poor than to the middle-income groups. Also, higher up the income distribution, close to 60,000 euro, political weights rise with income, because of the drop and subsequent rise in marginal tax rates around 60,000 euro. Apparently, the government values an additional euro for individuals with an income of 60,000 euro a bit more than an additional euro for individuals with a somewhat lower income. A second anomaly is that

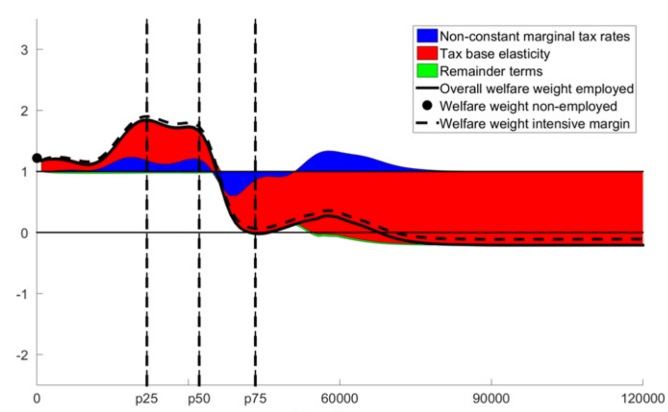

Fig. 4. Social welfare weights by income in baseline tax system. Note: The solid line represents social welfare weights as a function of income in the baseline tax system. The dashed line represents social welfare weights if extensive-margin responses are ignored. The colored areas decompose the social welfare weights into their main determinants, see Eq. (7). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

top-income earners get a slightly negative political weight, since the top tax rate is set somewhat beyond the Laffer rate, which maximizes tax revenue. This result is also found in Denmark (Petersen, 2007) and France (Bourguignon and Spadaro, 2012), but not in the US (Hendren, 2014; Lockwood, 2016) and the UK (Bargain and Keane, 2010).

Proposition 2 in the theory section derived that there are four factors that explain the behavior of welfare weights with income. Fig. 4 decomposes the welfare weights into the contribution of these factors: the tax-base elasticity, non-constant marginal tax rates, and the remaining terms: non-constant intensive elasticities, income effects and participation effects. The red part in Fig. 4 reveals that the most important driver of the social welfare weights is the elasticity of the local tax base θ_z with income. Also, changes in marginal tax rates matter as indicated by the blue part, but to a much lesser degree. The baseline marginal tax schedule does not feature spikes, hence these are not very important. This finding can be partly attributed to the smoothing of individual marginal tax rates in our model. There is a trade off in choosing the optimal bandwidth: a too small bandwidth only generates noise in marginal tax rates, while a too large bandwidth does not allow us to detect spikes in marginal tax rates. Using a bandwidth of 3500 allows us to detect important spikes in tax rates, while still being able to estimate clear patterns in social welfare weights. Our results remain very similar using bandwidths of 2000–5000 euro.

Income effects, participation responses and non-constant intensive elasticities have a minor quantitative effect on political weights as indicated by the tiny green part. Our findings thus imply that results from earlier studies that ignore income effects and participation responses give a good approximation. Indeed, the dotted line in Fig. 4 shows that the political weights are nearly the same when the extensive margin is switched off completely. The reason that the extensive margin has such a small effect on welfare weights is that welfare weights depend on the extensive margin through both the extensive-margin elasticity and the participation tax rate, see the final term of Eq. (7). In The Netherlands, the participation tax rate increases with income, while the participation elasticity declines with income, and both are relatively low. As a result, the participation term is relatively small at all income levels, see also Fig. 3 in online Appendix D.

5.2. Political parties

Fig. 5 reveals the political preference for income redistribution for each political party. Each panel compares the political weights of each party to the welfare weights from the pre-existing tax system. Online Appendix G provides the decomposition of the political weights for each party into its main determinants. No new insights are obtained from this analysis compared to the baseline, hence it is not discussed in this section.

As expected, all political parties roughly attach higher weights to the poor than to the rich. The left-wing parties SP and PvdA attach a relatively higher political weight to the poor than the right-wing parties CDA and VVD. The reverse applies to the high-income earners. The SP is the only party that proposes to raise benefits for the non-employed, which raises the average participation tax, and increases the political weight for the non-employed. For all other parties, the welfare weight for the non-employed remains nearly constant, because they hardly change the average participation tax, see also Eq. (9).

The SP exacerbates the first anomaly of the baseline by raising the political weight on incomes close to the middle-income groups even further relative to the 'working poor'. This is the result of the phase-out of the EITC just above the minimum wage. The proposals of the PvdA do not exacerbate the first anomaly, but they do not reduce it either. The proposals of the SP and PvdA both exacerbate the second anomaly – that political weights are negative at the top – by pushing the top rate further beyond the Laffer rate. Note that the graph excludes individuals earning more than 213,358 euro, who face a 72 percent top rate in the SP proposals. For the PvdA it is also surprising that they attach a higher political weight to the 'very rich' (beyond 100,000 euro) than to the 'rich' (between 70,000 and 100,000 euro). This is the result of the phase-out of the EITC programs. For the SP we see a sudden rise and drop in the political weights for incomes close to 90,000 euro, which is due to the withdrawal of the child subsidy at that income level. This spike suggests that the SP cares much more about families with children somewhat below 90,000 euro than somewhat above 90,000 euro.

The proposals of the right-wing parties CDA and VVD do not exacerbate, but reduce the pre-existing anomaly of giving a higher political weight to middle-incomes than to the working poor. Especially the CDA reduces the political weights on the middle-income groups, which is due to the stronger phase out of income-dependent programs for rent, children and health care. Perhaps surprisingly, the increase in marginal tax rates at the bottom in the CDA program does not result in higher political weights for the poor. The reason is that, on the one hand, the marginal tax rate T' indeed increases, which leads – ceteris paribus – to a higher political weight at the bottom. However, on the other hand, the marginal tax rates declines fast, i.e., $T'' \ll 0$, which leads – ceteris paribus – to a lower political weight at the bottom, see also the theory section. Both effects cancel out. If the CDA wants to increase the political weight of the poor, it should more slowly phase out the income-dependent programs with income, so that T'' becomes less negative (see also the decomposition for CDA in online Appendix Fig. G.1, panel c). The VVD also slightly reduces the first anomaly, but the effects are less pronounced than for the CDA. However, the VVD more strongly alleviates the second anomaly – negative political weights for the rich – because it reduces the top rate of the income tax.

The most striking finding or our analysis is that all political parties attach the highest political weight to middle incomes. What is also striking is that most political parties hardly change the pre-existing tax system. To quantify this status quo bias, we calculate the variance of the political weights within and between political parties in online Appendix H. We calculate the change in the variance of the political weights relative to the variance of the weights in the baseline. The change in the variance is just 2 to 3% for the PvdA and VVD, and just a bit higher with 5% for the CDA. The most 'radical' changes are found at the SP, which deviates 14% from the baseline. From this we conclude that the political weights of the different political parties hardly deviate from those in the pre-existing tax system.

Our results contrast sharply with the heated political rhetoric during the elections. Indeed, political parties strongly profile themselves as caring more about the poor (SP) or the rich (VVD) and make promises that things will be very different once they are elected. However, we find that all parties mainly serve the large group of middle-income voters. Furthermore, there appears to be a strong status quo bias in the proposals of Dutch political parties, since their proposals hardly change the net income distribution.

5.3. Robustness checks

Elasticity 'optimists' vs. 'pessimists'. We check the robustness of our findings using different assumptions regarding the behavioral responses. Elasticity 'optimists' might argue that behavioral elasticities are much smaller, and elasticity 'pessimists' might argue the opposite (Stiglitz, 2000). In online Appendix I, we plot the political weights for all political parties if we increase or decrease the elasticities with 50%. In particular, in the high-elasticity scenario we raise the compensated (uncompensated) elasticity to 0.38 (0.30), the income elasticity to 0.08, and the participation elasticity to 0.23. In

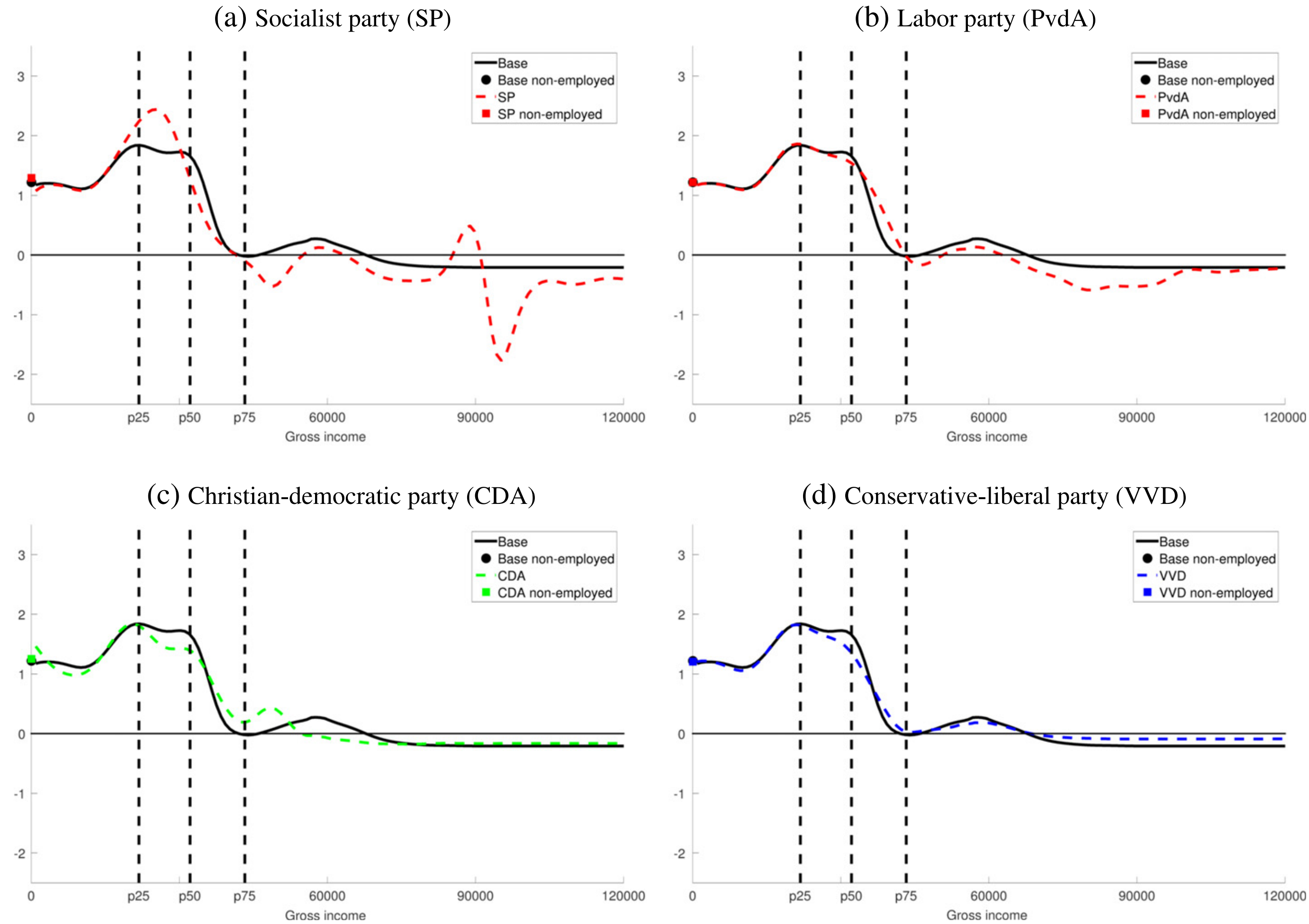

Fig. 5. Political weights by income for different political parties. Notes: The figures show political weights by income under the proposed tax system of each of the political parties in our baseline model (dashed line). For comparison, the solid line represents social welfare weights in the baseline tax system.

the low-elasticity scenario we lower the compensated (uncompensated) elasticity to 0.13 (0.10), the income elasticity to 0.03, and the participation elasticity to 0.08. We find that the first anomaly is completely robust to changes in the elasticities, although the patterns in political weights become less pronounced if we assume low elasticities, as predicted from our theoretical analysis.[33] Therefore, if one believes that the left-wing parties are stronger elasticity 'optimists' than right-wing parties, it is still not possible to explain why welfare weights increase towards the mode. However, elasticity optimism could explain why left-wing parties raise top rates. Indeed, the second anomaly – negative political weights – is preserved only under the high-elasticity scenario and disappears in the low-elasticity scenario. Finally, the status quo bias becomes stronger (weaker), i.e., deviations from the baseline become smaller (larger), if we assume smaller (larger) extensive and intensive elasticities. However, the similarities across parties still remain more striking than their differences.[34]

Differences between household types. In the baseline we do not distinguish between different household types. In Appendix J, we calculate the political weights separately for childless singles, single parents, primary earners without children, primary earners with children, secondary earners without children, and secondary earners with children for the baseline and each political party. In these calculations, we use group-specific income distributions, EMTRs and PTRs, and extensive and intensive elasticities. The results show that our first anomaly – political weights that increase from low to middle incomes – is completely robust across different household types. The second anomaly – negative political weights at the top – remains for childless singles, single parents, and secondary earners, but the political weights at the top are positive for primary earners because of their relatively low intensive-margin elasticity. The results further show that political parties hardly want to deviate from the status quo, even if we look at the household level. Online Appendix J gives a brief discussion of the results by household type.

Structural model vs. sufficient statistics. Online Appendix K compares the political weights for all political parties derived under the structural approach and the political weights that are obtained using sufficient statistics. The sufficient-statistics approach keeps the income distribution, employment rates and elasticities constant at the baseline levels, and uses Eq. (7) to calculate the political weights from the tax schedule proposed by the political parties.

[33] Lockwood and Weinzierl (2016) find as well that the US patterns of social welfare weights with income become more pronounced if elasticities are larger.

[34] Furthermore, the differences between the structural model and the sufficient-statistics approach (using the sufficient statistics for the baseline income distribution and elasticities) remain very small despite the different allocations, see also online Appendix I.

From this exercise we conclude that the structural model and the sufficient-statistics approach provide very similar results for the political weights. This implies that misspecification of the structural model is not likely to bias our findings. Moreover, one can forego calibrating a complicated structural model, and derive the social welfare weights of any tax system using sufficient statistics only as long as tax changes remain small.

Transfers in kind. As a final robustness check, we also verify whether our results could be sensitive to redistribution via transfers in kind. If the benefits from in-kind transfers differ across income groups, the EMTRs are affected, and our calculations of the political weights could be biased. Our calculations already include the distributional impact of the government expenditures with the largest distributional impact: health care and rent assistance. Kuhry and Pommer (2006) provide estimates of the use of other in-kind transfers by deciles of net disposable household income, such as public transportation, museums, culture and arts, sport facilities, parks and other recreational goods. Using these data, online Appendix L shows that including in-kind transfers has only a small impact on EMTRs. The changes in EMTRs range between −2.2 and +3.5% of disposable household income. It is not feasible to adjust our baseline EMTRs for the redistributive component of in-kind transfers, and recalculate the social welfare weights, since we cannot map the changes in EMTRs in terms of disposable household income into changes in EMTRs in terms of individual gross earnings. Nevertheless, since the EMTRs based on disposable household income change very little, accounting for the redistributional component of in-kind transfers will have only a small effect on estimated social welfare weights in the baseline.

6. Discussion

Our analysis reveals that political weights are increasing until modal income. In addition, top rates are at or slightly over the top of the Laffer curve, implying that the Dutch tax system soaks the rich. Moreover, the political weights look remarkably similar across parties and compared to the welfare weights of the pre-existing tax system. In particular, none of the political parties alleviate the pre-existing anomalies in a significant manner. The status quo bias suggests that our findings are deeply rooted in Dutch redistributive politics. This section argues that most results can be explained by political-economy considerations. We also consider a number of caveats to this interpretation by discussing some economic interpretations.

6.1. Political-economy considerations

Our results suggest that political-economy considerations could play an important role in shaping the tax-benefit system. Several inverse optimal-tax studies have hinted at this. For example, Bourguignon and Spadaro (2012, p. 100) state that "[I]ndeed, tax-benefit schedules in the real world might result more from political economy forces than from the pursuit of some well-defined social objective." Bargain et al. (2014c) write in their conclusion: "[F]inally, it is natural to think that real world tax-benefit schedules result from complex historical and political economy forces." And Lockwood and Weinzierl (2016, p. 46) note: "[A]t first blush it appears that the best empirical case can be made for the possibility that policy is sub-optimal; that bias in the political system makes policy depart systematically from society's true preferences." By studying the behavior of political parties, our study provides evidence for the idea that political economy forces affect the tax-benefit system. In particular, our results are in line with theories that are prominent in the political-economy literature.

Median voter models. The rise in political weights from the working poor to the middle-income groups and the subsequent sharp drop in these weights thereafter can be understood by median voter models of income redistribution, see also Romer (1975), Roberts (1977), and Meltzer and Richard (1981). Although the tax system in The Netherlands is determined by coalition governments, these political-economy models still have intuitive appeal since political parties want to attract votes from the densely populated middle-income groups. Röell (2012) and Brett and Weymark (2014) generalize these models to the political economy of non-linear income taxation using citizen-candidate models. Brett and Weymark (2014) demonstrate that the median citizen candidate soaks both the low-income and the high-income groups by setting a maxi-min tax schedule for the individuals above her and maxi-max tax schedules for individuals below her. This is what we find empirically. The patterns of the political weights – increasing to modal incomes and decreasing thereafter – are also consistent with Director's law (Stigler, 1970), according to which the middle-income groups can form a successful, stable political coalition to extract resources from both the low-income and the high-income groups.

Probabilistic voting models. Probabilistic voting models could explain why left-wing parties sacrifice on their preference to redistribute income so as to gain voters on other, ideological positions, see also Persson and Tabellini (2000) and Bierbrauer and Boyer (2016). Alternatively, Roemer (1998, 1999) analyzes models of two-dimensional political competition. He shows that the poor – having a larger electorate – may not want to soak the rich through redistributive tax systems if this helps to achieve larger electoral success by attracting more voters on their non-economic, ideological position.

Post-election concerns. Post-election considerations could explain the large status quo bias that we observe in our analysis. Indeed, political parties may not want to deviate too much from the status quo given that they need to form a coalition government with other political parties after elections are held. See also Persson and Tabellini (2000).

Vested interests. The strong status quo bias could also be explained by collective-action problems. Vested interests among the middle-income groups could be effective in blocking welfare-improving tax-benefit reforms. See also Olson (1982).

6.2. Economic considerations

Although political-economy considerations offer a plausible explanation for the anomalies we find, we also want to point out some potential economic explanations for our findings.

Non-welfarist motives. We do not consider non-welfarist motives that might explain why the government and political parties optimally set lower marginal tax rates for low-income workers. If work is seen as intrinsically valuable to promote social inclusion and dignity, or if the poor work too little to maximize their well-being, then there are positive externalities associated with work (Kanbur et al., 2006; Gerritsen, 2016). These externalities and internalities imply that political weights of the poor are underestimated. Similarly, fairness concerns may justify a lower, and possibly even negative, marginal tax rates for the working poor (Fleurbaey and Maniquet, 2006). The reason is that – for the same earning ability – the government does not wish to redistribute from individuals that work hard to individuals that do not.

Multidimensional heterogeneity. Middle-income groups could have higher weights if there is heterogeneity not only in earning ability, but also in the opportunity costs of work (Choné and Laroque, 2010). The middle-income groups may have higher opportunity costs of work than the low-income groups, e.g. due to the presence of children. In that case, their average marginal welfare weight increases relative to the low-income groups – ceteris paribus. If this effect is strong enough, it can counter the decline in welfare weights arising from the heterogeneity in earning abilities. We consider heterogeneity in opportunity costs of work a less likely explanation for increasing welfare weights, since we find the same anomaly for all different household types – all having different opportunity costs of work – in our robustness checks, see online Appendix J.

Present bias. If workers suffer from 'present bias', and low-income workers suffer more from present bias than middle- and high-income workers, then optimal marginal tax rates can be hump-shaped rather than U-shaped, see Lockwood (2016). Consequently, welfare weights of the poor may be under-estimated. Earnings-supply elasticities should follow a U-shape with income if present bias is mainly concentrated at low-income workers (Lockwood, 2016, pp. 23–24). However, this is not the relevant case for The Netherlands. Empirical estimates of the labor-supply elasticity and the elasticity of taxable income in The Netherlands do not feature a U-shape with income (Jongen and Stoel, 2016; Mastrogiacomo et al., 2017). Therefore, we consider it unlikely that present bias plays an important role.

Intra-household redistribution. By ignoring intra-household redistribution, we could overestimate the social welfare weights for the low-income earners, since secondary earners with low incomes receive intra-household transfers from primary earners. Similarly, the welfare weights for top income earners could be underestimated, due to household transfers towards partners. However, corrections for intra-household transfers cannot be made, since there is no information on intra-household transfers and there is not yet an inverse optimal-tax method for families.[35]

Externalities and internalities top income earners. Political parties may want to set higher top rates for non-redistributive reasons to correct negative externalities associated with 'rat races' (Akerlof, 1976), 'keeping up with the Joneses' (Layard, 1980), internalities associated with working too hard (Gerritsen, 2016), to mitigate rent seeking by top executives (Piketty et al., 2014) or to alleviate democratic failures as a result of wealth concentration (Stiglitz, 2000). In these cases, we also underestimate the political weights for top income earners. Most behavioral arguments could be relevant, also in The Netherlands.[36] However, the Dutch evidence is not consistent with rent seeking of top executives or democratic failures resulting from wealth concentration. In particular, concentration of top incomes in The Netherlands is among the lowest in the world and has not increased in recent decades, see Atkinson and Salverda (2005) and the World Top Income Database. Moreover, party financing in The Netherlands is not important from an international perspective (Poguntke et al., 2016). Furthermore, CEO compensation is relatively low in The Netherlands.[37]

Lifetime versus yearly income. One may interpret our model as capturing the trade off between equity in lifetime income (consumption) and efficiency. However, the focus in our analysis is on annual, rather than lifetime income. This is more natural given that the election programs of political parties focus on annual rather than lifetime income. Moreover, CPB only reports the effects on annual income. It is not clear in which directions our results would change if we focused on lifetime income instead of annual income, which is an interesting extension for future research.

7. Conclusions

In this paper we have used the inverse optimal-tax method to reveal the redistributive preferences of Dutch political parties. We exploit unique data on the proposed tax system of Dutch political parties in their election programs. Only part of our findings confirm prior expectations. First, all political parties roughly give a higher political weight to the poor than to the rich. Second, left-wing parties generally give a higher political weight to the poor and a lower political weight to the rich than right-wing parties do. We uncover two important anomalies in the current tax system and *all* election programs of Dutch political parties. Political weights are found to be increasing from the working poor to the middle class. This anomaly is completely robust. Second, the political weight of the rich is slightly negative, hence Dutch political parties want to 'soak the rich' completely. However, this finding is sensitive to the elasticity of taxable income for top-income earners. Moreover, the left-wing parties increase the political weight of the middle class even further and reduce the political weight of the top-income earners even more below zero. The right-wing parties do the reverse: they reduce the welfare weights of the middle classes, while raising the political weight for the top-income earners. A striking finding is also the closeness of the political weights to weights in the pre-existing tax system and similarity of political weights across political parties. Dutch political preferences for income redistribution are therefore deeply rooted in a political status quo. Political-economy considerations offer a plausible explanation for the anomalies that we uncover. Indeed, our results suggest that the political process plays an important role in shaping the tax-benefit system.

We conclude with some directions for future research. Our sufficient-statistics approach foregoes the need to develop complex structural models and can be readily applied to estimate social welfare weights for other countries and time periods using information only on tax rates, income distributions, and behavioral elasticities. Furthermore, by explicitly deriving social welfare weights from revealed political preferences, governments can make interpersonal welfare comparisons, since social welfare weights can be used to measure the distributional costs and benefits of policies in social cost-benefit analysis, see also Hendren (2014).

Moreover, future research could extend this paper to analyze the joint taxation of labor and capital income to derive welfare weights in such more realistic models. Similarly, our model could be reframed in terms of household taxation as in Kleven et al. (2009). Also, our research can be extended to develop inverse optimal-tax models to estimate social welfare weights for different household types (e.g. singles/couples or households with/without children). Further, future research can derive social welfare weights using the fairness approach to optimal taxation of Fleurbaey and Maniquet (2006). The political-economy models with optimal taxation, such as the ones analyzed by Brett and Weymark (2014), can be inverted to derive political weights. Finally, our analysis rests on the assumption that by showing their budgets, political parties reveal their preferences. However, just like individuals, political parties may be subject to behavioral biases. For example, politicians may have difficulties understanding the difference between marginal and average tax rates, just like voters. If behavioral political biases are important, then revealed political preferences are no longer informative of true political preferences for income redistribution. Future research may thus develop 'behavioral political economics' and apply this to the inverse-optimum approach.

[35] See Boskin and Sheshinski (1983), Apps and Rees (1998), Schroyen (2003), Kleven et al. (2009) and Alesina et al. (2011) for the optimal taxation of families.

[36] On the other hand, Alesina et al. (2005) argue that rivalry in leisure (a 'leisure multiplier') exacerbates the distortions of income taxation. Consequently, top tax rates could also create negative externalities and should then optimally be set lower.

[37] Fernandes et al. (2012) show that CEO compensation in The Netherlands (on average 2.4 million dollar) is below the average of 14 Western economies (2.8 million dollar on average for the non-US countries) and much below CEO compensation in the US (on average 5.5 million dollar). Fernandes et al. (2012) also report corporate governance indicators that are much higher in The Netherlands than in the US or the UK.

Appendix A. Proof Proposition 1

A.1. Optimal non-linear tax schedule

In Jacquet et al. (2013) the government minimizes total resources subject to a set of constraints on the distribution of utilities and incentive compatibility constraints. Eq. (28) of Jacquet et al. (2013) gives the optimal marginal tax rate for working individuals:

$$\frac{T'(z_n)}{1-T'(z_n)} = \frac{\alpha_n}{\varepsilon_n^c} \frac{\left(\int_n^{\bar{n}} 1 - g_m + \eta_m \frac{T'(z_m)}{1-T'(z_m)} - \zeta_{z_m}^T \frac{\tau_{z_m}}{1-\tau_{z_m}}\right) \tilde{k}(m)\mathrm{d}m}{\tilde{K}(\bar{n}) - \tilde{K}(n)} \frac{\tilde{K}(\bar{n}) - \tilde{K}(n)}{n\tilde{k}(n)}, \quad \forall n. \tag{A.1}$$

In this expression, $\alpha_n \equiv \frac{\partial z_n}{\partial n}\frac{n}{z_n} > 0$ denotes the elasticity of gross earnings z_n with respect to ability n. $\varepsilon_n^c \equiv -\frac{\partial z_n}{\partial T'}\frac{1-T'(z_n)}{z_n} > 0$ is the compensated elasticity of taxable income. $\eta_n = -(1-T'(z_n))\frac{\partial z_n}{\partial \rho} \geq 0$ is the income effect on gross earnings of workers with ability n, where ρ is an exogenous change in income. $\tilde{k}(n) \equiv \int_{\underline{\varphi}}^{u_n - v(b)} k(n,\varphi)\mathrm{d}\varphi$, denotes the density of individuals with ability n that participate in the labor market. $\tilde{K}(n)$ is the fraction of employed workers with ability less than or equal to n in the population, where $\tilde{K}(n) \equiv \int_{\underline{n}}^{n} \tilde{k}(m)\mathrm{d}m$. Finally, $\zeta_{z_m}^T \equiv \frac{k(n,u_n - v(b))}{\tilde{k}(n)} u_c(\bullet)(z - (T(z)+b)) > 0$ is the participation elasticity with respect to a change in participation taxes.[38]

It will be impossible to bring Eq. (A.1) to the data, since ability and disutility of participation are unobservable. Hence, we cannot measure $\tilde{K}(n)$. Moreover, while the monotonicity of the optimal second-best allocation guarantees a one-to-one mapping between the ability of employed workers and their gross earnings, such a mapping does not exist for the non-employed. However, Bayes' theorem allows us to decompose $\tilde{K}(n)$ into the distribution of income among the employed and the employment rate. Since both are observable from the data, we can rewrite Eq. (A.1) in terms of sufficient statistics. In particular, note that by definition we can write $\tilde{K}(n)$ as:

$$\tilde{K}(n) = \int_{\underline{n}}^{n}\int_{\underline{\varphi}}^{u_n - v(b)} k(m,\varphi)\mathrm{d}\varphi\mathrm{d}m \equiv P(n_i \leq n, e_i = 1), \quad \forall n, \tag{A.2}$$

where e_i is an indicator variable, which takes value 1 if individual i is employed, and zero if the individual is not employed. $P(n_i \leq n, e_i = 1)$ denotes the probability that a random individual i in the population has an ability n_i smaller than or equal to n and is employed. In words: the fraction of the population that is employed and has ability smaller than n equals the joint probability that a random individual is employed *and* has ability smaller than or equal to n. By Bayes' theorem we can rewrite this probability as:

$$P(n_i \leq n, e_i = 1) = P(n_i \leq n | e_i = 1)P(e_i = 1), \quad \forall n, \tag{A.3}$$

where $P(n_i \leq n | e_i = 1)$ denotes the probability that a random individual i in the population has ability smaller than or equal to n_i conditional on being employed, and $P(e_i = 1)$ is the unconditional probability that a random person i is employed. Note that $P(e_i = 1)$ equals the employment rate $E \equiv \int_{\underline{n}}^{\bar{n}}\int_{\underline{\varphi}}^{u_n - v(b)} k(m,\varphi)\mathrm{d}\varphi\mathrm{d}m$. Using $\tilde{K}(n) = \int_{\underline{n}}^{n}\int_{\underline{\varphi}}^{u_n - v(b)} k(m,\varphi)\mathrm{d}\varphi\mathrm{d}m$, the conditional probability $P(n_i \leq n | e_i = 1)$ is thus equal to:

$$P(n_i \leq n | e_i = 1) = \frac{\int_{\underline{n}}^{n}\int_{\underline{\varphi}}^{u_n - v(b)} k(m,\varphi)\mathrm{d}\varphi\mathrm{d}m}{\int_{\underline{n}}^{\bar{n}}\int_{\underline{\varphi}}^{u_n - v(b)} k(m,\varphi)\mathrm{d}\varphi\mathrm{d}m}. \tag{A.4}$$

Since there is a monotonic mapping between ability n and gross earnings z_n among employed individuals, the probability that an individual has ability smaller than n conditional on employment equals the probability that an individual has an income below z_n conditional on employment: $P(n_i \leq n | e_i = 1) \equiv P(z_i \leq z_n | e_i = 1)$. Hence, we can decompose $\tilde{K}(n)$ entirely into observables $F(z_n)$ and E:

$$\tilde{K}(n) = F(z_n)E, \quad \forall n, z_n. \tag{A.5}$$

Further, to find an expression for $\tilde{k}(n)$ in terms of observables, take the derivative of Eq. (A.5) with respect to ability:

$$\tilde{k}(n) \equiv \frac{\mathrm{d}\tilde{K}(n)}{\mathrm{d}n} = \frac{\mathrm{d}F(z_n)}{\mathrm{d}n}E = f(z_n)\frac{\mathrm{d}z_n}{\mathrm{d}n}E = f(z_n)\alpha_n\frac{z_n}{n}E, \quad \forall n, z_n. \tag{A.6}$$

In the second step, we have used the definition of $\tilde{K}(n)$ and α_n, and the fact that the overall employment rate is independent of ability. We can simplify Eq. (A.1) by substituting Eqs. (A.5) and (A.6) to arrive at:

$$\frac{T'(z_n)}{1-T'(z_n)} = \frac{1}{\varepsilon_n^c} \frac{\left(\int_{z_n}^{\bar{z}} 1 - g_m + \eta_m \frac{T'(z_m)}{1-T'(z_m)} - \zeta_{z_m}^T \frac{\tau_{z_m}}{1-\tau_{z_m}}\right) f(z_m)\mathrm{d}z_m}{1 - F(z_n)} \frac{1 - F(z_n)}{f(z_n)z_n}, \quad \forall z_n, \tag{A.7}$$

[38] Note that we use slightly different definitions of the income and participation elasticities than Jacquet et al. (2013). In particular, their income elasticity is defined as $\eta_n = -\frac{\partial z_n}{\partial \rho} \geq 0$ and their participation elasticity is defined as: $\kappa_n = \frac{k(n,u_n - b)}{\tilde{k}(n)} u_c(\bullet)$.

where $\bar{z} \equiv z_{\bar{n}}$, and we have used the fact that $F(\bar{z}) = 1$. Moreover, for the term inside the integral we have used that Eq. (A.6) can be rewritten as $\tilde{k}(n)\mathrm{d}n = f(z_n)\mathrm{d}z_n E$. Note that by the substitution rule for integration, the bounds of the integrals change.

We can write Eq. (A.7) completely in terms of earnings z. Due to the monotonic mapping from n to z_n there exists (with slight abuse of notation) an x_{z_n} such that $x_{z_n} \equiv x_n$ for all parameters $x = \{g, \eta, \kappa, \varepsilon^c\}$ and for all z_n. In addition, we can rewrite the expression for any particular $z \in [\underline{z}, \bar{z}]$, because Eq. (A.7) holds for all $z_n \in [\underline{z}, \bar{z}]$. Using these results and dropping the n-subscripts allows us to write expression (A.7) as Eq. (5) in the main text.

A.2. Optimal participation tax

The optimality condition for the participation tax is given by Eq. (18d) in Jacquet et al. (2013):

$$(g_0 - 1)\int_{\underline{n}}^{\overline{n}}\int_{u_n - v(b)}^{\bar{\varphi}} k(n,\varphi)\mathrm{d}\varphi \mathrm{d}n = \int_{\underline{n}}^{\overline{n}} (T(z_n) + b)\, v'(b) k\,(n, u_n - v(b))\,\mathrm{d}n. \tag{A.8}$$

Note that this equation is, again, written in terms of the unobservable joint density function $k(n,\varphi)$.

To express the equation in terms of the income distribution among workers and the employment rate, note that the non-employment rate equals $1 - E = \int_{\underline{n}}^{\overline{n}}\int_{u_n - v(b)}^{\bar{\varphi}} k(n,\varphi)\mathrm{d}\varphi \mathrm{d}n$. Moreover, using the definition of the participation elasticity with respect to a change in benefits, i.e., $\zeta_z^b \equiv \frac{k(n,u_n - v(b))}{\tilde{k}(n)} v'(b)\,(z - (T(z) + b))$, we find:

$$k\,(n, u_n - v(b)) = \frac{\zeta_{z_n}^b \tilde{k}(n)}{v'(b)\,(z_n - (T(z_n) + b))}. \tag{A.9}$$

Consequently, we can write the optimal participation tax as:

$$(g_0 - 1)(1 - E) = \int_{\underline{n}}^{\overline{n}} \zeta_{z_n}^b \frac{\tau_{z_n}}{1 - \tau_{z_n}} \tilde{k}(n)\mathrm{d}n. \tag{A.10}$$

Now, use $\tilde{k}(n) = f(z_n)\frac{\mathrm{d}z_n}{\mathrm{d}n}E$, change the variables of integration and drop the subscripts n to arrive at Eq. (6) for the optimal participation tax in the main text.

Appendix B. Proof Proposition 2

Using Leibniz' rule we can differentiate the optimal income tax Eq. (5) with respect to z:

$$\begin{aligned}\frac{1}{f(z)}\frac{\mathrm{d}\left(\frac{T'(z)}{1-T'(z)}\varepsilon_z^c f(z) z\right)}{\mathrm{d}z} &= \varepsilon_z^c z \frac{\mathrm{d}\left(\frac{T'(z)}{1-T'(z)}\right)}{\mathrm{d}z} + \frac{zT'(z)}{1-T'(z)}\frac{\mathrm{d}\varepsilon_z^c}{\mathrm{d}z} + \frac{\varepsilon_z^c T'(z)}{f(z)\,(1-T'(z))}\frac{\mathrm{d}\,(f(z)z)}{\mathrm{d}z},\\ &= (\theta_z + \xi_z)\,\varepsilon_z^c \frac{T'(z)}{1-T'(z)} + \varepsilon_z^c \frac{zT''(z)}{(1-T'(z))^2}.\end{aligned} \tag{B.1}$$

Use Eq. (B.1) to arrive at Eq. (7) in the main text. Finally, reorder Eq. (A.10) to arrive at Eq. (9) in the main text.

Appendix C. Calibration of the model

C.1. Social welfare weights in terms of structural parameters

In this Appendix we express the social welfare weights in terms of structural parameters. Once we have calibrated the structural model, we can easily calculate the social welfare weights. After that, we describe the calibration procedure to fit the structural model to the data. This Appendix speaks of social welfare weights to connect our model to the literature. Our application to political parties adopts the terminology of political weights to clearly distinguish the two.

Eq. (A.1) gives the formula for the optimal tax schedule. By inverting this expression we can solve for the welfare weights of working individuals in terms of structural model parameters:

$$g_n = 1 + \eta_n \frac{T'(z_n)}{1 - T'(z_n)} - \zeta_n^T \frac{\tau_{z_n}}{1 - \tau_{z_n}} + \frac{1}{\tilde{k}(n)}\frac{\mathrm{d}\left[\frac{\varepsilon_m^c}{\alpha_m}\frac{T'(z_m)}{1-T'(z_m)} m\tilde{k}(m)\right]}{\mathrm{d}m}, \quad \forall n. \tag{C.1}$$

In addition, we find the welfare weight for non-participants by solving Eq. (A.10) for g_0:

$$g_0 = 1 + \frac{\int_{\underline{n}}^{\overline{n}} \zeta_n^b \frac{\tau_{z_n}}{1-\tau_{z_n}} \tilde{k}(n)\mathrm{d}n}{1 - E}. \tag{C.2}$$

We express the behavioral elasticities in Eqs. (C.1) and (C.2) in terms of structural parameters as follows:[39]

$$\alpha_n = \frac{\frac{n}{z_n}\left(\frac{u_l}{n^2} + \frac{l u_{ll}}{n^2}\right)}{\frac{u_{ll}}{n^2} + (1 - T'(z_n))^2 u_{cc} - T''(z_n) u_c}, \tag{C.3}$$

$$\eta_n = \frac{(1 - T'(z_n))^2 u_{cc}}{\frac{u_{ll}}{n^2} + (1 - T'(z_n))^2 u_{cc} - T''(z_n) u_c}, \tag{C.4}$$

$$\varepsilon_n^c = \frac{\frac{u_l}{n z_n}}{\frac{u_{ll}}{n^2} + (1 - T'(z_n))^2 u_{cc} - T''(z_n) u_c}, \tag{C.5}$$

$$\zeta_n^T = \frac{k\left(u_n - v(b), n\right)}{\tilde{k}(n)}\left(z_n - T(z_n) - b\right) u_c, \tag{C.6}$$

$$\zeta_n^b = \frac{v'(b)}{u_c}\zeta_n^T. \tag{C.7}$$

Before we turn to the calibration algorithm, we employ a number of structural assumptions to simplify the expression for the social welfare weights in Eq. (C.1). First, under the specific form of our utility function, Eq. (13), $\frac{\varepsilon_n^c}{\alpha_n}$ in Eq. (C.1) simplifies to:

$$\frac{\varepsilon_n^c}{\alpha_n} = \frac{\varepsilon}{1+\varepsilon}. \tag{C.8}$$

Second, we assume n and φ are distributed independently. This allows us to write $k(n,\varphi) \equiv h(n)\hat{k}(\varphi)$ where $h(n)$ is the unconditional probability density function of n and $\hat{k}(\varphi)$ is the probability density function of φ. Using the definition of $\tilde{k}(n)$, we can therefore write:

$$\tilde{k}(n) \equiv \int_{-\infty}^{u_n - v(b)} k(n,\varphi)\mathrm{d}\varphi = h(n)\int_{-\infty}^{u_n - v(b)} \hat{k}(\varphi)\mathrm{d}\varphi = h(n)\,\hat{K}(u_n - v(b)), \tag{C.9}$$

where $\hat{K}(\varphi) \equiv \int_{-\infty}^{\varphi}\hat{k}(\varphi')\mathrm{d}\varphi'$ is the cumulative density function of participation costs. This, in turn, allows us to simplify the expression for the participation elasticity as follows:

$$\zeta_n^T = \frac{\hat{k}\left(u_n - v(b)\right)}{\hat{K}\left(u_n - v(b)\right)}\left(z_n - T(z_n) - b\right) u_c. \tag{C.10}$$

Using Eqs. (C.8) and (C.9), we can rewrite the final term in Eq. (C.1) in the following way:

$$\begin{aligned}
\frac{1}{\tilde{k}(n)}\frac{\mathrm{d}\left[\frac{\varepsilon_m^c}{\alpha_m}\frac{T'(z_m)}{1-T'(z_m)}m\tilde{k}(m)\right]}{\mathrm{d}m} &= \frac{1}{h(n)\hat{K}\left(u_n - v(b)\right)}\frac{\mathrm{d}\left[\frac{\varepsilon}{\varepsilon+1}\frac{T'(z_m)}{1-T'(z_m)}mh(m)\,\hat{K}(u_m - v(b))\right]}{\mathrm{d}m} \\
&= \frac{\varepsilon}{(1+\varepsilon)}\frac{T'(z_n)}{1-T'(z_n)}\left(\frac{n}{\hat{K}\left(u_n - v(b)\right)}\frac{\mathrm{d}\,\hat{K}(u_m - v(b))}{\mathrm{d}m} + \theta_n^n\right) \\
&\quad + \frac{n\varepsilon}{(1+\varepsilon)}\frac{\mathrm{d}\left[\frac{T'(z_m)}{1-T'(z_m)}\right]}{\mathrm{d}m},
\end{aligned} \tag{C.11}$$

where $\theta_n^n \equiv 1 + \frac{\mathrm{d}h(m)}{\mathrm{d}m}\frac{n}{h(n)}$ is the local elasticity of the tax base. The first step follows from substituting Eqs. (C.8) and (C.9), and the second step follows from application of the product rule.

C.2. Algorithm

The algorithm that calculates the political weights for the political parties uses four steps.

1. Calculate the allocation $\{z_n, c_n\}$ associated with the baseline marginal tax rates and income levels $\{T(z_n), b\}$.
2. Calibrate the parameters of the utility function $\{\alpha, \varepsilon, \gamma\}$, and estimate the conditional distribution of earnings ability for the working population $h(n|e_i = 1)$ on the baseline data.
3. Estimate the distribution of participation costs $\hat{k}(\varphi)$ and the distribution of earnings ability for the entire population $h(n)$, again using baseline data.
4. Calculate the political weights g_n and g_0 based on the tax systems proposed by political parties using Eqs. (C.1) and (C.2).

[39] See Eqs. (7), and (25a–c) in Jacquet et al. (2013) for the derivation, where we assume $u(c_n, z_n, n) = u(c_n, l_n)$ and $u_{cl} = 0$, which is consistent with our utility function in Eq. (13).

To determine the allocation and to find the tax function in the current tax system $T(z_n)$ we estimate a kernel regression of income on marginal tax rates to obtain a smoothed estimate of the marginal tax rate $T'(z_n)$ at each income level. We subsequently calculate the total tax burden at each income level, excluding $T(0)$, using $\int_{\underline{z_n}}^{z_n} T'(z_n)\mathrm{d}z_n$. We employ the government budget constraint Eq. (4) to find $T(0)$ and b, where $T(0)$ and b are chosen such that i) the government budget constraint is satisfied, and ii) the average model-predicted participation tax rate equals the average participation tax rate calculated by CPB in the baseline. We then calculate total tax burdens $T(z_n)$ and obtain $c_n = z_n - T(z_n)$.

In steps 2 and 3 of our algorithm we employ the baseline allocation to calibrate $u(c_n, l_n)$, $h(n)$ and $\hat{k}(\varphi)$. We first choose starting values for the utility parameters α, γ and ε. We then find the ability level of each individual in the sample by inverting their first-order condition, see also Saez (2001). This provides us with the following solution for individual ability in terms of their income level z_n, the tax function $T(z_n)$ and the utility parameters α, γ and ε:

$$n = \frac{\gamma^{\frac{\varepsilon}{1+\varepsilon}} z_n^{\frac{1}{1+\varepsilon}} (z_n - T(z_n))^{\frac{\alpha\varepsilon}{1+\varepsilon}}}{(1 - T'(z_n))^{\frac{\varepsilon}{1+\varepsilon}}}. \tag{C.12}$$

To find the distribution of earnings ability we estimate a kernel density function for ability. We will denote this distribution by $h(n|e_i = 1)$, which is the distribution of ability conditional on employment. We approximate the top 10% of the ability distribution with a Pareto distribution. Since the top of the income distribution follows a Pareto distribution with a Pareto parameter of 3.158, it follows that the Pareto parameter for the ability distribution at the top is given by $a_n^n = 3.158(1 + \varepsilon^u)$, see Saez (2001, p. 222). When we paste the Pareto tail to the ability distribution, we scale the resulting distribution by two constants which ensure that i) the probability density function of ability is continuous around the cutoff, and ii) the integral over the distribution equals 1. We evaluate the resulting distribution of ability at 750 linearly spaced points between the lowest and the highest ability level in our sample. Note that the estimated ability distribution at this stage is conditional on employment, since we cannot infer earnings ability for non-participants in the labor market. We denote the ability distribution conditional on employment by $h(n|e_i = 1)$.

Next, we calculate the compensated and income earnings supply elasticities for all working individuals using Eqs. (C.4) and (C.5). The average earnings supply and income elasticities among workers are given by $\bar{\varepsilon}^c = \int \varepsilon_n^c h(n|e_i = 1)\mathrm{d}n$ and $\bar{\eta} = \int \eta_n h(n|e_i = 1)\mathrm{d}n$. We iterate over different values of α, γ and ε, while updating the ability distribution through Eq. (C.12) at each iteration until: i) the model produces average elasticities that are equal to their empirical estimates, and ii) the average ability level equals the average income level in the sample. Although ε_n^c and η_n may theoretically depend on ability as well as on the tax schedule with our utility function, we find that the elasticities are roughly constant in both dimensions in our calibrated model, see online Appendix D.

In the third step, we estimate the distribution of participation costs $\hat{k}(\varphi)$. Ideally, we would like to estimate the parameters of $\hat{k}(\varphi)$ using ability-specific employment rates and extensive-margin elasticities. Unfortunately, these data are not available. Instead, we use empirical evidence from Mastrogiacomo et al. (2017) to target extensive-margin elasticities by income quartile, ensuring that the average extensive-margin elasticity equals 0.16 consistent with MIMIC.[40] Since there is a one-to-one mapping between income and ability in our model, we can employ this information to calibrate $\hat{k}(\varphi)$.

The empirical literature uses a slightly different definition of the extensive-margin elasticity than our theoretical model. In our model, ζ_n^T measures the elasticity of participation with respect to a change in the participation tax rate. Instead, Graafland et al. (2001) and Mastrogiacomo et al. (2017) report the elasticity of participation with respect to a change in the wage rate n, $\zeta_n^n \equiv \frac{\mathrm{d}E_n}{\mathrm{d}n}\frac{n}{E_n}$. To ensure the distribution $\hat{k}(\varphi)$ is consistent with these empirical estimates we adopt this definition in our calibration. Afterwards, we use the calibrated distribution $\hat{k}(\varphi)$ to calculate ζ_n^T to calculate the welfare weights.

We calibrate our model to match empirical estimates as follows. The model-predicted average extensive-margin elasticity for individuals between ability level n_1 and n_2 is given by:

$$\zeta_{n_1,n_2}^n = \frac{\int_{n_1}^{n_2} \zeta_n^n h(m)\mathrm{d}m}{\int_{n_1}^{n_2} h(m)\mathrm{d}m}. \tag{C.13}$$

We compare the predicted elasticity to the empirical estimate for this elasticity in each quartile.

Moreover, we have education-specific employment rates for 5 different levels of education. When we assume there is also a one-to-one relationship between education and ability, the data provide us with the empirical employment rate at 5 points in the ability distribution. Our model predicts the following ability-specific employment rate:

$$E_n = \hat{K}\left(u_n - v(b)\right). \tag{C.14}$$

Hence, the predicted average employment rate between ability level n_1 and n_2 is given by:

$$\bar{E}_n = \frac{\int_{n_1}^{n_2} \hat{K}\left(u_m - v(b)\right) h(m)\mathrm{d}m}{\int_{n_1}^{n_2} h(m)\mathrm{d}m}. \tag{C.15}$$

The predicted employment rates by education level can, again, be compared to participation rates for the corresponding education group.

Overall we thus have 4 data points on the extensive-margin elasticity and 5 data points on the employment rates. The distribution of participation costs $h(\varphi)$ is assumed to follow a non-standardized t-distribution with mean μ, scale-parameter σ, and degrees of freedom ν.[41] We estimate parameters μ, σ, and ν of $\hat{k}(\varphi)$ using a non-linear least squares regression, where the error term consists of the difference between actual, and model-predicted extensive-margin elasticities and participation rates.

[40] To be more precise, we take the empirical elasticities by quartile reported in Mastrogiacomo et al. (2017), divide them by the average elasticity and multiply them with 0.16.

[41] When the degrees of freedom converge to infinity, the distribution converges to a normal distribution with mean μ and standard deviation σ. Due to the extra parameter the non-central t-distribution allows us to obtain a better fit of employment rates and elasticities than with the normal distribution.

The predicted elasticities depend on $h(n)$ rather than $h(n|e_i = 1)$, since extensive-margin elasticities depend both on responses of employed and non-employed individuals. We initially assume that $h(n|e_i = 1) = h(n)$. Subsequently, we use the estimated $\hat{k}(\varphi)$ to retrieve the ability distribution $h(n)$ as follows. Let e_i be an indicator equal to 1 when random individual i is employed. Then, we find using Bayes' theorem:

$$P(e_i = 1|n)h(n) = h(n|e_i = 1)P(e_i = 1). \tag{C.16}$$

The probability of being employed, conditional on employment is the ability-specific employment rate: $P(e_i = 1|n) = E_n$. The unconditional employment probability is the overall employment rate $P(e_i = 1) = E$. We can thus rewrite Eq. (C.16) to arrive at:

$$h(n) = \frac{h(n|e_i = 1)E}{E_n}, \tag{C.17}$$

which gives us an updated estimate of $h(n)$. With this updated value we rerun the algorithm to determine updated values of μ, σ and ν. The loop ends when the absolute value of the update on the parameters is below 0.1%. After step 3 we have thus calibrated $u(c_n, l_n)$, $h(n)$, and $\hat{k}(\varphi)$. The final step of the algorithm calculates political weights using Eq. (C.1) for the welfare weights of the employed, and Eq. (C.2) for the non-employed.

Appendix D–L. Supplementary data

Appendices D–L to this article can be found online at https://doi.org/10.1016/j.jpubeco.2017.08.002.

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