Appendix for Online Publication: Politically feasible reforms of non-linear tax systems

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A. Proofs

A.1. Proof of Theorem 1

Step 1. By the envelope theorem

$$V_\tau(\tau, h, \omega) = R_\tau(\tau, h) - h(y^*(\tau, h, \omega)) \ , \tag{A.1}$$

where $R_\tau(\tau, h, \omega)$ is the derivative of tax revenue with respect to $\tau > 0$. The validity of the envelope theorem follows from Corollary 4 in Milgrom and Segal (2002).

Step 2. Suppose that h is a non-decreasing function. An analogous argument applies if h is non-increasing. We show that $V_\tau(\tau, h, \omega^M) > 0$ implies $V_\tau(\tau, h, \omega) > 0$ for a majority of individuals. By Step 1, $V_\tau(\tau, h, \omega^M) > 0$ holds iff $R_\tau(0, h) - h(y^*(\tau, h, \omega^M)) > 0$. As h and $y^*(\tau, h, \cdot)$ are non-decreasing functions, this implies $R_\tau(\tau, h) - h(y^*(\tau, h, \omega)) > 0$, for all $\omega \leq \omega^M$, and hence $V_\tau(\tau, h, \omega) > 0$ for all $\omega \leq \omega^M$.

Step 3. Suppose that h is a non-decreasing function. An analogous argument applies if h is non-increasing. We show that $V_\tau(\tau, h, \omega^M) \leq 0$ implies $V_\tau(\tau, h, \omega) \leq 0$ for a majority of individuals. By Step 1, $V_\tau(\tau, h, \omega^M) \leq 0$ holds iff $R_\tau(\tau, h) - h(y^*(\tau, h, \omega^M)) \leq 0$. As h and $y^*(\tau, h, \cdot)$ are non-decreasing functions, this implies $R_\tau(\tau, h) - h(y^*(\tau, h, \omega)) \leq 0$, for all $\omega \geq \omega^M$, and hence $V_\tau(\tau, h, \omega) \leq 0$ for all $\omega \geq \omega^M$.

A.2. Proof of Proposition 1

To prove the first statement in the Proposition, let

$$V_\tau(\tau, h, \omega^M) = R_\tau(\tau, h) - h(y^*(\tau, h, \omega^M)) < 0 \ ,$$

so that the median voter benefits from a small decrease of tax rate $\tau < 0$. With h non-decreasing for $y \geq y^*(\tau, h, \omega^M)$, this implies that

$$V_\tau(\tau, h, \omega) = R_\tau(\tau, h) - h(y^*(\tau, h, \omega) < 0 \ ,$$

for all $\omega \geq \omega^M$. Hence a majority of the population benefits from the tax cut.

The second statement in the Proposition follows from the same argument: If the poorest individual benefits from a tax cut and individuals with incomes closer to the median also benefit as h is non-decreasing for below median incomes, then there is majority support for the reform.

A.3. Proof of Theorem 2

For a simple reform (τ, ℓ, y_a) the envelope theorem implies that

$$V_\tau(0, \ell, y_a, \omega) = R_\tau(0, \ell, y_a) - h(y^*(0, \ell, y_a, \omega)) \ . \tag{A.2}$$

To prove the first statement in Theorem 2, suppose that $y_a < y_0^M = y^*(0, \ell, y_a, \omega^M)$. Choose ℓ so that $y_a + \ell < y_0^M$. Then $h(y^*(0, \ell, y_a, \omega)) = \ell$, for all $\omega \geq \omega^M$. Since $R_\tau(0, \ell, y_a) < \ell$, it follows that $V_\tau(0, \ell, y_a, \omega) < 0$, for all $\omega \geq \omega^M$, which implies that a small tax cut, $\tau < 0$, makes a majority of individuals better off. To prove the second statement, suppose that $y_a > y_0^M$. Then $h(y^*(0, \ell, y_a, \omega)) = 0$, for all $\omega \leq \omega^M$. Hence, if $R_\tau(0, \ell, y_a) > 0$, then $V_\tau(0, \ell, y_a, \omega) > 0$, for all $\omega \leq \omega^M$, which implies that a small raise of marginal tax rate, $\tau > 0$, makes a majority of individuals better off.

A.4. Proof of Proposition 2

Preliminaries. Let $T_1 = T_0 + \tau\ h$. We consider a perturbation that affects marginal tax rates in a bracket that starts at income level y_a and has length ℓ. The function $h : (y, \ell) \mapsto h(y, \ell)$ is assumed to have the following properties, for any given ℓ:

(i) It is a continuously differentiable and non-decreasing function of y.

(ii) $h(y, \ell) = 0$, all $y \leq y_a$.

(iii) $h(y, \ell) = \ell$, for all $y \geq y_a + \ell$.

(iv) $h_y(y, \ell) = 1$ for $y \in [y_a + \epsilon\ \ell, y_a + (1 - \epsilon)\ell]$, where $\epsilon > 0$ is a fixed parameter.

(v) $h_y(y, \ell) > 0$ for $y \in (y_a, y_a + \ell)$.

Note that $T_1'(y) = T_0'(y) + \tau\ h_y(y, l)$. Thus, marginal tax rates change by $\tau\ h_y(y, l)$, and this change is different from zero only for incomes in the bracket. There, they change by τ, except for incomes in the neighborhood of the bracket's endpoints. In these neighborhoods the changes of marginal tax rates are, respectively, phased in and phased out in a smooth way. We continue to summarize such a reform by the triple (τ, ℓ, y_a)

We first analyze how tax revenue is affected by a simple reform and then turn to the proof of statements (1.) and (2.) in Proposition 2.

Tax revenue. The additional tax revenue that is generated by a reform (τ, ℓ, y_a) is given by

$$R(\tau, \ell, y_a) := \int_{\underline{\omega}}^{\overline{\omega}} \Big(T_1(y^*(\tau, \ell, y_a, \omega)) - T_0(y_0(\omega)) \Big) f(\omega)\ d\omega\ ,$$

where $y_0(\omega) := y^*(0, \ell, y_a, \omega)$ is a shorthand for the income of type ω in the status quo. We are interested in clarifying the conditions under which a small tax cut raises revenue, i.e. the conditions under which $R_\tau(0, \ell, y_a) < 0$ holds, for some level of income y_a and some $\ell > 0$.

Let $\omega_a(\tau, \ell, y_a)$ be the smallest type with an income larger or equal to y_a given a reform (τ, ℓ, y_a). Likewise let $\omega_b(\tau, \ell, y_a)$ be the largest type with an income below $y_b = y_a + \ell$. In the absence of income effects, the reform does not affect the behavior of individuals with earnings below y_a or above y_b. For these individuals, marginal tax rates do not change. Since $h(y) = 0$, for $y \leq y_a$, there is also no effect on the tax liability of individuals with earnings below y_a. By contrast, the tax liability of individuals with earnings above y_b increase by $\tau\,\ell$. Thus, we can write

$$\begin{aligned} R(\tau,\ell,y_a) &= \int_{\omega_a(\tau,\ell,y_a)}^{\omega_b(\tau,\ell,y_a)} \Big(T_0(y^*(\tau,\ell,y_a,\omega)) + \tau\, h(y^*(\tau,\ell,y_a,\omega)) - T_0(y_0(\omega))\Big) f(\omega) d\omega \\ &+ \tau\,\ell\,\Big(1 - F(\omega_b(\tau,\ell,y_a))\Big)\,. \end{aligned} \tag{A.3}$$

Computing the derivative with respect to τ, using Leibnitz' rule, and evaluating at $\tau = 0$ yields

$$\begin{aligned} R_\tau(0,\ell,y_a) &= \int_{\omega_0(y_a)}^{\omega_0(y_a+\ell)} \Big(T_0'(y_0(\omega))\; y_{0\tau}(\omega) + h(y_0(\omega))\Big) f(\omega) d\omega \\ &+ \ell\,\Big(1 - F(\omega_0(y_a+\ell))\Big)\,, \end{aligned} \tag{A.4}$$

where $y_{0\tau}(\omega) := y^*_\tau(\tau,\ell,y_a,\omega)\mid_{\tau=0}$ is the derivative of y^* with respect to τ, evaluated at the status quo, i.e. for $\tau = 0$.

The assumption that income in the status quo is a continuous function of ω plays a role in the derivation of equation (A.4): A change of τ implies a change of $\omega_b(\tau,\ell,y_a)$ which enters both as the upper limit of the integral in the first line of (A.3) and via the term in second line of (A.3). These marginal effects exactly cancel at $\tau = 0$ if the function y_0 is continuous.

Computing the derivative of $R_\tau(0,\ell,y_a)$ with respect to ℓ and evaluating at $\ell = 0$ yields

$$R_{\tau\ell}(0,0,y_a) = T_0'(y_a)\; y_{0\tau}(\omega_0(y_a))\; f(\omega_0(y_a))\; \omega_{0\ell}(y_a) + 1 - F(\omega_0(y_a))\,,$$

where $\omega_{0\ell}(y_a) := \frac{d}{d\ell}\;\omega_0(y_a+\ell)\;\;\mid_{\ell=0}$. Note that $\omega_0(y_a + l)$ solves $y_a + l = y_0(\omega_0(y_a + l))$. Hence, $\omega_{0\ell}(y_a) = y_{0\omega}(\omega_0(y_a))^{-1}$, where, for any ω', $y_{0\omega}(\omega') := y^*_\omega(\tau,\ell,y_a,\omega)\mid_{\tau=0,\omega=\omega'}$. The assumption that y_0 is a strictly monotonic function plays a role here. It ensures that $y_{0\omega}(\omega_0(y_a)) \neq 0$ and hence that $\omega_{0\ell}(y_a)$ is well-defined. We can therefore write,

$$R_{\tau\ell}(0,0,y_a) = T_0'(y_a)\; f(\omega_0(y_a))\; \frac{y_{0\tau}(\omega_0(y_a))}{y_{0\omega}(\omega_0(y_a))} + 1 - F(\omega_0(y_a))\,, \tag{A.5}$$

Given a simple reform (τ,ℓ,y_a), the first order condition characterizing $y^*(\tau,\ell,y_a,\omega)$ is given by

$$1 - T_0'(y^*(\cdot)) - \tau h'(y^*(\cdot)) - \omega^{-\left(1+\frac{1}{\varepsilon}\right)} y^*(\cdot)^{1+\frac{1}{\varepsilon}} = 0\,.$$

For any given ℓ, we focus on ω so that $y^*(\cdot,\omega) \in [y_a + \epsilon\;\ell, y_a + (1-\epsilon)\ell]$ and $h'(y^*(\cdot) = 1$. Hence,

$$1 - T_0'(y^*(\cdot)) - \tau - \omega^{-\left(1+\frac{1}{\varepsilon}\right)} y^*(\cdot)^{1+\frac{1}{\varepsilon}} = 0\,. \tag{A.6}$$

Starting from this equation, one can use the implicit function theorem to solve for $y^*_\tau(\cdot)$ and $y^*_\omega(\cdot)$. This allows to compute the ratio $\frac{y^*_\tau(\cdot)}{y^*_\omega(\cdot)}$. At $\tau = 0$, and for $\omega = \omega_0(y_a)$, this ratio equals

$$\frac{y_{0\tau}(\omega_0(y_a))}{y_{0\omega}(\omega_0(y_a))} = -\frac{1}{1+\frac{1}{\varepsilon}}\,\omega_0(y_a)\,\frac{1}{1-T_0'(y_a)}\,. \tag{A.7}$$

We can now use (A.7) to substitute for $\frac{y_{0\tau}(\omega_0(y_a))}{y_{0\omega}(\omega_0(y_a))}$ in (A.5). This yields

$$R_{\tau\ell}(0,0,y_a) \quad = \quad -\frac{T_0'(y_a)}{1-T_0'(y_a)}\,f(\omega_0(y_a))\,\omega_0(y_a)\,\frac{1}{1+\frac{1}{\varepsilon}} + 1 - F(\omega_0(y_a))\,. \tag{A.8}$$

Proof of (1.). It follows from (A.4) that $R_\tau(0,0,y_a) = 0$: a small change of marginal tax rates has no effect on overall tax revenue if the change applies to a bracket with length 0. If $R_{\tau\ell}(0,0,y_a) > 0$, then a slight increase of the bracket length implies that $R_\tau(0,\ell,y_a)$ turns positive – indicating a possible to increase revenue by means of higher marginal tax rates. Analogously, $R_{\tau\ell}(0,0,y_a) < 0$ implies that revenue can be increased by means of lower marginal tax rates. Thus, if $R_{\tau\ell}(0,0,y_a) < 0$ there is a possibility of a Pareto-improving tax cut. From (A.8) it is now straightforward to verify that $R_{\tau\ell}(0,0,y_a) < 0$ holds if and only if (8) holds.

Proof of (2.). A Pareto-improving tax raise requires that $R_\tau(0,\ell,y_a) - \ell \geq 0$. Again, it follows from (A.4) that $R_\tau(0,\ell,y_a) - l = 0$ for $l = 0$. If however, $R_{\tau\ell}(0,0,y_a) - 1 > 0$ then a slight increase of the bracket length implies that $R_\tau(0,\ell,y_a) - \ell$ turns positive. From (A.8) it is now straightforward to verify that $R_{\tau\ell}(0,0,y_a) - 1 > 0$ holds if and only if (9) holds.

A.5. *A characterization of welfare-improving tax reforms*

The welfare implications of a generic reform (τ, h) are given by

$$W(\tau,h) := \int_{\underline{\omega}}^{\overline{\omega}} g(\omega)\;V(\tau,h,\omega) f(\omega)\;d\omega\,.$$

We assume without loss of generality that $\mathbb{E}[g(\omega)] = 1$. Using the envelope theorem, the marginal effect of a small reform is given by

$$W_\tau(0,h) = R_\tau(0,h) - \int_{\underline{\omega}}^{\overline{\omega}} g(\omega)\;h(y_0(\omega))\;f(\omega)\;d\omega\,.$$

For the special case of a simple reform (τ, ℓ, y_a) this becomes

$$\begin{aligned} W_\tau(0,\ell,y_a) &= R_\tau(0,\ell,y_a) \\ &\quad - \int_{\omega_0(y_a)}^{\omega_0(y_a+\ell)} g(\omega)\ (y_0(\omega)-y_a)\ f(\omega)\, d\omega \\ &\quad -\ell\ (1-F(\omega_0(y_a+\ell)))\ \mathcal{G}(\omega_0(y_a+\ell)) \end{aligned} .$$

Taking the derivative with respect to ℓ and evaluating at $\ell = 0$ yields

$$W_{\tau\ell}(0,0,y_a) = R_{\tau\ell}(0,0,y_a) - (1-F(\omega_0(y_a)))\ \mathcal{G}(\omega_0(y_a))$$

Using equation (A.8) this can also be written as

$$\begin{aligned} W_{\tau\ell}(0,0,y_a) &= -\tfrac{T_0'(y_a)}{1-T_0'(y_a)}\, f(\omega_0(y_a))\, \omega_0(y_a) \left(1+\tfrac{1}{\varepsilon}\right)^{-1} \\ &\quad + (1-F(\omega_0(y_a)))\ (1-\mathcal{G}(\omega_0(y_a))) \end{aligned} .$$

Since $W_\tau(0,0,y_a) = 0$, $W_{\tau\ell}(0,0,y_a) > 0$ indicates that $W_\tau(0,\ell,y_a) > 0$ for ℓ close to zero. Hence, when

$$\frac{T_0'(y_a)}{1-T_0'(y_a)} < \frac{1-F(\omega_0(y_a))}{f(\omega_0(y_a))\ \omega_0(y_a)} \left(1+\frac{1}{\varepsilon}\right)\ (1-\mathcal{G}(\omega_0(y_a))) \tag{A.9}$$

a small tax increase for incomes close to y_a yields a welfare gain. Analogously, when

$$\frac{T_0'(y_a)}{1-T_0'(y_a)} > \frac{1-F(\omega_0(y_a))}{f(\omega_0(y_a))\ \omega_0(y_a)} \left(1+\frac{1}{\varepsilon}\right)\ (1-\mathcal{G}(\omega_0(y_a))) \tag{A.10}$$

a small tax cut for incomes close to y_a yields a welfare gain.

B. Welfare-maximizing tax schedules

B.1. Preliminaries

We use a mechanism design approach to characterize welfare-maximizing income taxes. With an appeal to the revelation principle we limit attention to direct mechanisms. Let $c : \omega \mapsto c(\omega)$ and $y : \omega \mapsto y(\omega)$ be the functions that specify the pre- and after-tax incomes of individuals as functions of their types. Let

$$u(\omega) = c(\omega) - k(y(\omega), \omega) \quad \text{with} \quad k(y(\omega), \omega) = \frac{1}{1+\frac{1}{\varepsilon}} \left(\frac{y(\omega)}{\omega} \right)^{1+\frac{1}{\varepsilon}} ,$$

be the utility realized by a type ω-individual under the direct mechanism.

As is well-known, such a direct mechanism is incentive compatible if and only if the following two conditions are satisfied: First,

$$u(\omega) = \underline{u} - \int_{\underline{\omega}}^{\omega} k_2(y(s), s) ds , \tag{B.1}$$

where $\underline{u} = u(\underline{\omega})$ is a shorthand for the utility realized by the lowest type, and k_2 is the derivative of the cost function k with respect to its second argument. With an isoelastic cost function

$$k_2(y(\omega), \omega) = -\frac{1}{\omega} \left(\frac{y(\omega)}{\omega} \right)^{1+\frac{1}{\varepsilon}} .$$

Second, the function y is non-decreasing.

The resource constraint requires that aggregate consumption must not exceed aggregate production

$$\mathbb{E}[c(\omega)] \leq \mathbb{E}[y(\omega)] ,$$

where the expectations operator $\mathbb{E}$ indicates the computation of a population average; e.g. $\mathbb{E}[c(\omega)] = \int_{\underline{\omega}}^{\overline{\omega}} c(\omega)\ f(\omega)\ d\omega$. Using that

$$\begin{array}{rcl} c(\omega) & = & u(\omega) + k(y(\omega), \omega) \\ & = & \underline{u} - \int_{\underline{\omega}}^{\omega} k_2(y(s), s) ds + k(y(\omega), \omega) \end{array}$$

and with an integration by parts we can write aggregate consumption also as

$$\mathbb{E}[c(\omega)] = \underline{u} + \mathbb{E}[k(y(\omega), \omega)] - \mathbb{E}\left[\frac{1 - F(\omega)}{f(\omega)}\ k_2(y(\omega), \omega) \right] .$$

Upon substituting this expression into the resource constraint, we find that resource feasibility holds provided that

$$\text{(B.2)} \qquad \underline{u} \quad \leq \quad \mathbb{E}\left[y(\omega) - k(y(\omega),\omega) + \frac{1-F(\omega)}{f(\omega)}\; k_2(y(\omega),\omega)\right] \; .$$

The term on the right hand side of (B.2) is also known as the virtual surplus. It is the regular surplus of aggregate output over effort costs, $\mathbb{E}[y(\omega) - k(y(\omega),\omega)]$ minus the information rents that higher types realize in the presence of incentive constraints and which are given by $-\mathbb{E}\left[\frac{1-F(\omega)}{f(\omega)} k_2(y(\omega),\omega)\right] > 0$. Thus, resource feasibility requires that the lowest type's utility does not exceed the virtual surplus.

We consider a class of additive social welfare functions

$$S = \mathbb{E}[g(\omega)\; u(\omega)]$$

and assume without loss of generality that $\mathbb{E}[g(\omega)] = 1$. Using (B.1), and after another integration by parts, welfare can be written as

$$\text{(B.3)} \qquad S = \underline{u} - \mathbb{E}\left[\frac{1-F(\omega)}{f(\omega)}\; \mathcal{G}(\omega)\; k_2(y(\omega),\omega)\right] \; ,$$

where $\mathcal{G}(\omega) := \mathbb{E}[g(s) \mid s \geq \omega]$ is the average welfare weight among those with a type above ω. At an optimal allocation, the resource constraint (B.2) holds as an equality. Thus, welfare can also be written as

$$\text{(B.4)} \qquad S = \mathbb{E}\left[y(\omega) - k(y(\omega),\omega) + \frac{1-F(\omega)}{f(\omega)}\; (1-\mathcal{G}(\omega))\; k_2(y(\omega),\omega)\right] \; .$$

B.2. Optimal mechanism design and optimal taxation

We can state the mechanism design problem now as one that only involves the function $y : \omega \mapsto y(\omega)$. This function has to be chosen so as to maximize the objective (B.4) subject to the constraint that its derivative y' is everywhere non-negative. This problem is also known as the *full* problem. When the monotonicity constraint is dropped, the problem is referred to as the *relaxed* problem. Obviously, if the solution to the relaxed problem satisfies the monotonicity constraint then it is also a solution to the full problem. If not, the the solution of the full problem involves bunching, i.e. subsets of types who choose the same level of income. For ease of exposition, we focus on the relaxed problem in what follows. It is well known how the resulting optimal tax formulas need to be modified if bunching is an issue, see e.g. Hellwig (2007).

Note that, once y is determined by the optimality conditions, we can use (B.2) and the fact that the resource constraint binds to solve for $\underline{u}$. We can use (B.1) to solve for the function u. And finally, we can use the fact that $c(\omega) = u(\omega) + k(y(\omega),\omega)$ to characterize the function c. Thus, we obtain a complete characterization of an optimal allocation.

A solution to the relaxed problem is obtained by a pointwise maximization of (B.4). The first order condition characterizing $y(\omega)$ is given by

$$1 - k_1(y(\omega), \omega) + \frac{1 - F(\omega)}{f(\omega)} (1 - \mathcal{G}(\omega))\, k_{21}(y(\omega), \omega) = 0, \tag{B.5}$$

where k_1 is the derivative of the cost function k with respect to its first argument and k_{21} is the cross-derivative with respect to the first and the second argument. With an isoelastic cost function

$$k_{21}(y(\omega), \omega) = -\left(1 + \frac{1}{\varepsilon}\right) \frac{1}{\omega}\, k_1(y(\omega), \omega)$$

so that the first order condition can also be written as

$$\frac{1 - k_1(y(\omega), \omega)}{k_1(y(\omega), \omega)} = \frac{1 - F(\omega)}{f(\omega)\, \omega} \left(1 + \frac{1}{\varepsilon}\right) (1 - \mathcal{G}(\omega)) \ . \tag{B.6}$$

Suppose that the welfare-maximizing allocation is decentralized by means of a non-linear income tax schedule T. Then, type ω solves the following problem:

$$max_y \quad y - T(y) - k(y, \omega) \ .$$

Denote the solution to this problem by $y^*(\omega)$. It is characterized by the first order condition

$$1 - T'(y^*(\omega)) = k_1(y^*(\omega), \omega)$$

As $y^*(\omega)$ is also the solution to the mechanism design problem, the first order condition in (B.6) can now be written as

$$\frac{T'(y^*(\omega))}{1 - T'(y^*(\omega))} = \frac{1 - F(\omega)}{f(\omega)\, \omega} \left(1 + \frac{1}{\varepsilon}\right) (1 - \mathcal{G}(\omega)) \ . \tag{B.7}$$

Equation (B.7) is also known as Diamond's formula, see Diamond (1998). It shows that marginal taxes on the income earned by type ω are increasing in the inverse hazard rate, decreasing in the elasticity ε and decreasing in the welfare weight of individuals richer than type ω.

The Rawlsian schedule. The Rawlsian schedule is the special case with $\mathcal{G}(\omega) = 0$, for all $\omega > \underline{\omega}$. In this case the, the first order condition in (B.7) becomes

$$\frac{T'(y^*(\omega))}{1 - T'(y^*(\omega))} = \frac{1 - F(\omega)}{f(\omega)\, \omega} \left(1 + \frac{1}{\varepsilon}\right) \ . \tag{B.8}$$

The Rawlsian tax schedule is also often referred to as the *maxi-min schedule.* It is the schedule that maximizes $\underline{u}$, the well-being of the worst off individual, i.e. of type $\underline{\omega}$.

B.3. The maxi-max schedule

The maxim-max schedule is the one that maximizes the well-being of the best off individual, i.e. of type $\overline{\omega}$. Since the welfare weights are now concentrated at the top, this can now longer be viewed as a special case of social welfare-maximization with weights that are higher for poorer people. This case is still of interest as it helps to interpret the lower Pareto bound for marginal tax rates in the main text, and therefore the scope for politically feasible reforms. We present a derivation of the maxi-max schedule along lines that are similar to our characterization of welfare-maximizing tax schedules above. An alternative derivation can be found in Brett and Weymark (2017).

The envelope theorem implies, that under an incentive compatible allocation,

$$u'(\omega) = -k_2(y(\omega), \omega) \ .$$

Therefore

$$u(\omega) = \overline{u} + \int_{\omega}^{\overline{\omega}} k_2(y(s), s) \ ds \ ,$$

where $\overline{u} := u(\overline{\omega})$ is a shorthand for the utility realized by the highest type.

Using $c(\omega) = u(\omega) + k(y(\omega), \omega)$ and after an integartion by parts we can write aggregate consumption as

$$\mathbb{E}[c(\omega)] = \overline{u} + \mathbb{E}[k(y(\omega, \omega))] + \mathbb{E}\left[\frac{F(\omega)}{f(\omega)} \ k_2(y(\omega), \omega)\right] \ .$$

Substituting this expression into the resource constraint and rearranging yields

$$\overline{u} = \mathbb{E}\left[y(\omega) - k(y(\omega, \omega)) - \frac{F(\omega)}{f(\omega)} \ k_2(y(\omega), \omega)\right] \tag{B.9}$$

The (relaxed) maxi-max problem is to choose the function y so as to maximize this expression. Pointwise maximization yields the following first order condition

$$1 - k_1(y(\omega), \omega) - \frac{F(\omega)}{f(\omega)} \ k_{21}(y(\omega), \omega) = 0 \ .$$

Using one more time that, with an isoelastic cost function,

$$k_{21}(y(\omega), \omega) = -\left(1 + \frac{1}{\varepsilon}\right) \ \frac{1}{\omega} \ k_1(y(\omega), \omega)$$

allows to rewrite the first order condition as

$$\frac{1-k_1(y(\omega),\omega)}{k_1(y(\omega),\omega)} = -\frac{F(\omega)}{f(\omega)\,\omega}\left(1+\frac{1}{\varepsilon}\right) \, . \tag{B.10}$$

Again, if this solution is decentralized by means of an income tax schedule, then

$$\frac{T'(y^*(\omega))}{1-T'(y^*(\omega))} = -\frac{F(\omega)}{f(\omega)\,\omega}\left(1+\frac{1}{\varepsilon}\right) \, . \tag{B.11}$$

where $y^*(\omega)$ is now the income earned by type ω under the maxi-max schedule.

C. From theory to data

In our empirical analysis in Section V.A, we check to what extent actual tax reforms are monotonic. We also provide an answer to the question whether the median voter actually was a beneficiary of these reforms. Here, we describe in more detail how we operationalize these questions.

Suppose that there is a set of individuals and that, for each individual i, we observe taxable income y_0^i prior to the reform. We also observe the average tax rate t_0^i and the marginal tax rate τ_0^i that are relevant for this individual prior to the reform. Finally, we observe the post-reform counterparts t_1^i and τ_1^i.

Monotonicity. Checking to what extent reforms are monotonic then amounts to checking whether, for any pair of individuals i and j, $y_0^i < y_0^j$ implies $(t_1^i - t_0^i)y_0^i < (t_1^j - t_0^j)y_0^j$. If this relation holds, then the reform is monotonic in the sense that the tax burden of richer individuals increases more than the tax burden of poorer individuals. Alternatively, if $y_0^i < y_0^j$ implies $(t_1^i - t_0^i)y_0^i > (t_1^j - t_0^j)y_0^j$, then the reform is monotonic as the additional taxes of poorer individuals exceed those of richer individuals. In Section V.B we report on the extent to which we find such relations in our data.

Did the median voter gain? Checking whether the median voter gained requires an assessment of whether or not the inequality

$$R(\tau, h) - \int_0^\tau h(y^*(s, h, \omega^M))\, ds \geq 0$$

holds true. Remember that $R(\tau, h)$ is the revenue (per capita) generated by the reform and $\int_0^\tau h(y^*(s, h, \omega^M))\, ds$ is the reform's effect on the median voter's indirect utility. As shown in Section III, a sufficient condition which ensures that this inequality holds is that

$$\text{(C.1)} \qquad R(\tau, h) - \max\left\{(t_1^M - t_0^M)\, y_1^M, (t_1^M - t_0^M)\, y_0^M\right\} \quad \geq \quad 0\,,$$

where t_1^M and t_0^M are, respectively, the average tax rates for the median voter after the reform and in the status quo.

Revenue effect. For the revenue effect, we compute the revenue change for each individual separately and then take an average. The revenue change due to individual i is

$$\text{(C.2)} \qquad R^i = t_1^i\, y_1^i - t_0^i\, y_0^i\,,$$

where y_1^i is the individual's income after the reform. In the presence of behavioral responses y_1^i will usually be different from y_0^i. We do not observe y_1^i and hence have to come up with an estimate for this quantity.

Our assumptions on preferences imply that behavioral responses are driven entirely by changes of the marginal tax rates that individuals face. Thus, using a first order Taylor approximation,

$$y_1^i = y_0^i + (\tau_1^i - \tau_0^i)\, y_\tau^i \ ,$$

where y_τ^i is the marginal effect that an infinitesimal change of the marginal tax rate has on i's taxable income (in the status quo). Using that $y_\tau^i = -y_{1-\tau}^i$, we can express this also via the marginal effect associated with a change of the net of tax rate $1-\tau$. Hence,

$$y_1^i = y_0^i - (\tau_1^i - \tau_0^i)\, y_{1-\tau}^i \ ,$$

Using the definition of the ETI, $\varepsilon^i := y_{1-\tau}^i \, \frac{1-\tau_0^i}{y_0^i}$, we can rewrite this as well as

$$y_1^i = \left(1 - \frac{\tau_1^i - \tau_0^i}{1-\tau_0^i}\, \varepsilon^i\right) y_0^i \ .$$

Upon substituting this expression into (C.2) we obtain

$$R^i = \left(t_1^i - t_0^i - t_1^i \frac{\tau_1^i - \tau_0^i}{1-\tau_0^i} \varepsilon^i\right) y_0^i \ , \tag{C.3}$$

The revenue effect per capita is then given by

$$R(\tau, h) = \frac{1}{n} \sum_i R^i \ , \tag{C.4}$$

where n is the number of individuals.

Did the median voter gain? To answer this question, we check whether or not

(C.5)
$$R(\tau, h) - \max\left\{ (t_1^M - t_0^M)\ \left(1 - \frac{\tau_1^M - \tau_0^M}{1-\tau_0^M}\ \varepsilon^M\right) y_0^M, (t_1^M - t_0^M)\ y_0^M \right\} \quad \geq \quad 0 \ .$$

This inequality follows from (C.1) upon replacing y_1^M by

$$\left(1 - \frac{\tau_1^M - \tau_0^M}{1-\tau_0^M}\ \varepsilon^M\right) y_0^M \ ,$$

where τ_1^M and τ_0^M are, respectively, the marginal tax rates for the median voter after the reform and in the status quo, and ε^M is the median voter's elasticity of taxable income.

D. Tax reforms in OECD countries

We provide more details on the descriptive statistics in the main text that document the frequency of monotonic reforms in OECD countries, see Table 2.

The OECD provides annual data on key parameters of the statutory personal income tax systems of its member countries (central governments).[1] In particular, it documents personal income tax rates for wage income and the taxable income thresholds at which these statutory rates apply. The information is applicable for a single person without dependents. We use this information to construct the corresponding tax function. A reform takes place if this tax function changes from one year to the next. The OECD also reports personal allowances and tax credits, and we include these parameters in our tax functions. In many countries these allowances are equivalent to having a first bracket with a marginal tax rate of zero, see, for instance, Belgium, Estonia, Japan, Spain, the United Kingdom, or the United States. In other countries tax credits are equivalent to a first bracket with a marginal tax rate of zero, see, for instance, the Czech Republic, Italy, or the Netherlands.[2] In the supplementary material for this paper we present separate statistics for different OECD countries. More specifically, the following countries are covered: Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States. We excluded Slovenia because of an inconsistency in the OECD database for this country and Germany because of an incorrect representation of the German tax system in the OECD database.[3]

[1] The database provided by the OECD is Table I.1. on Central government personal income tax rates and thresholds (OECD Tax Database, 2000-2016) accessible on `http://stats.oecd.org/Index.aspx?DataSetCode=TABLE_I1`.

[2] Additional details on the methodology applied by the OECD is accessible on `http://www.oecd.org/ctp/tax-policy/personal-income-tax-rates-explanatory-annex.pdf`.

[3] By and large, this does not affect the overall frequency of monotonic reforms. If we include Germany and base the analysis on data from the German Federal Ministry of Finance, accessible on `https://www.bmf-steuerrechner.de/index.xhtml;jsessionid=46D8EC6083BF2573A42C23A2B03B49DF`, then 80% of the reforms in OECD countries are found to be monotonic. When Germany is excluded the number is 78%.

E. Empirical analysis: Additional results

	Average	Relative	At Median
RA64	-73.1	-2.2	-40.6
TRA69	-1.2	-0.0	1.7
RA78	-79.1	-0.9	-54.0
ERTA81	-167.3	-1.5	-43.2
TRA86	-149.6	-1.0	-134.3
OBRA90	11.8	0.1	-7.0
OBRA93	106.5	0.5	-2.7
EGTRRA01	-357.6	-1.3	-345.2
JGTRRA03	-485.6	-1.7	-147.4
ATRA12	477.1	1.3	13.5
TCJA17	-554.7	-1.3	-526.2

Table E.1: Revenue implications of US tax reforms.

Notes: Table E.1 reports the revenue implications for major reforms of the US federal personal income tax (see Table H.1 for details). To be precise, the first column shows the average counterfactual change in tax liability $T_1(\hat{y}_0^i) - T_0(y_0^i)$, column 2 shows this change as a percentage of average income, while column 3 reports this change at median income. Note that the average value in column 1 corresponds to the revenue effect $R(\tau, h)$ in the absence of behavioral responses and hence shows the amount that is redistributed to achieve balanced budget reforms in Figure 5 (for ETI=0). Median income is based on pre-tax income without capital gains while tax base includes capital gains. All computations are on the individual level. For this, the income of couples filing jointly is allocated equally to each spouse. In order to simulate counterfactual tax payments $T_1\left(\hat{y}_0^i\right)$, income from year 0 are inflated to year 1 using the CPI-U-RS deflator as uprating factor.
Source: Authors' calculations based on NBER TAXSIM and IRS-SOI PUF.

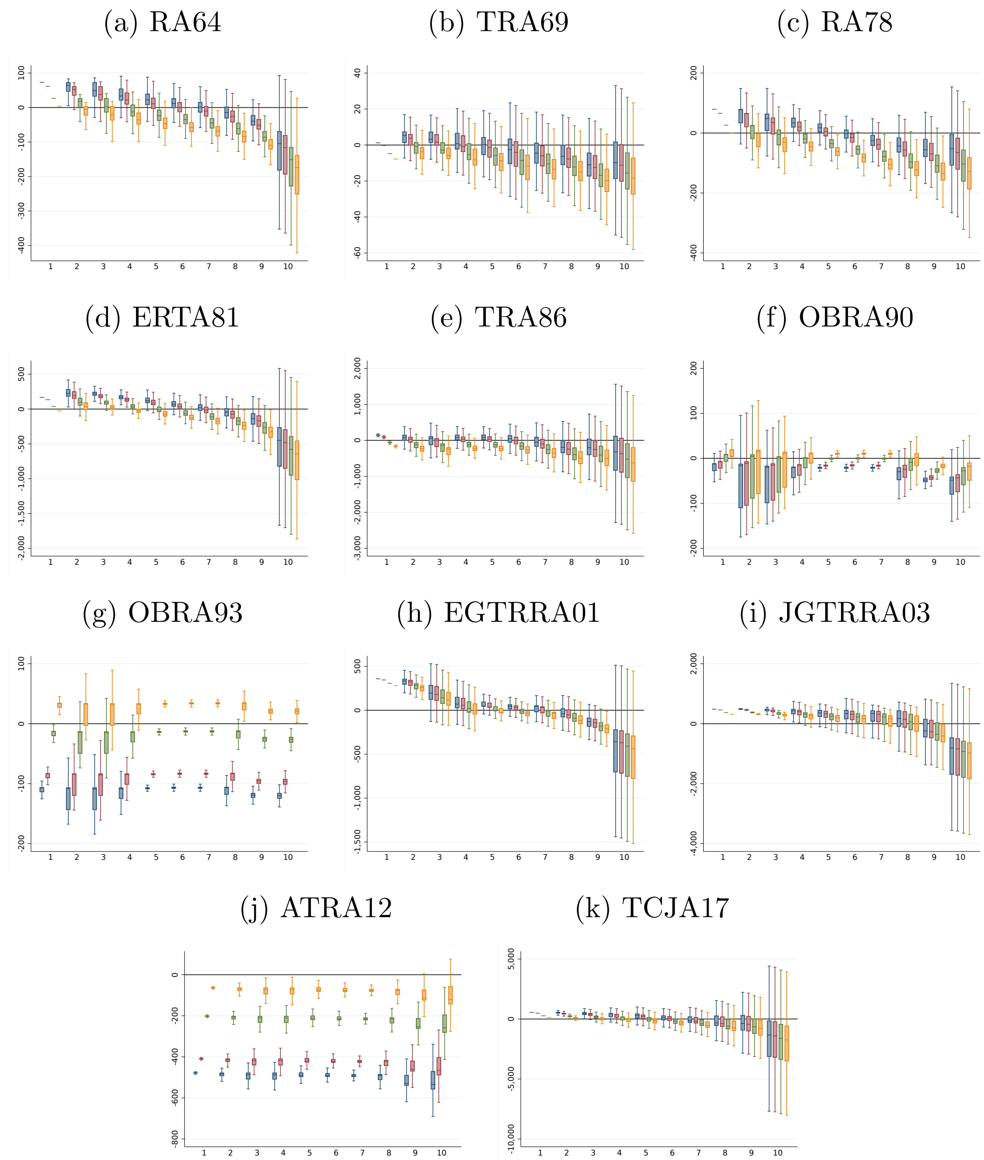


Figure E.1: Winners and losers of major US tax reforms: Heterogeneity within deciles

Notes: Figure E.1 shows the cross-sectional distribution by decile of the counterfactual change in tax liability $T_1(\hat{y}_0^i) - T_0(y_0^i) - R(\tau, h)$ for reforms of the US federal personal income tax (see Table H.1 for details) for four different values of the elasticity of taxable income (ETI): 0 (blue), 0.25 (red), 1 (green) and 1.5 (yellow), by means of box-plots. Deciles are computed based on pre-tax income without capital gains while tax base includes capital gains. All computations are on the individual level. For this, the income of couples filing jointly is allocated equally to each spouse. In order to simulate counterfactual tax payments $T_1\left(\hat{y}_0^i\right)$, income from year 0 are inflated to year 1 using the CPI-U-RS deflator as uprating factor. The vertical lines show different locations for the median voter: the dashed line to the left imputes non-filers to the tax return data while the dashed line to the right accounts for differential turnout by income. The solid line in the middle represents both the original median in the data as well as the one accounting for both modifications simultaneously.
Source: Authors' calculations based on NBER TAXSIM and IRS-SOI PUF.

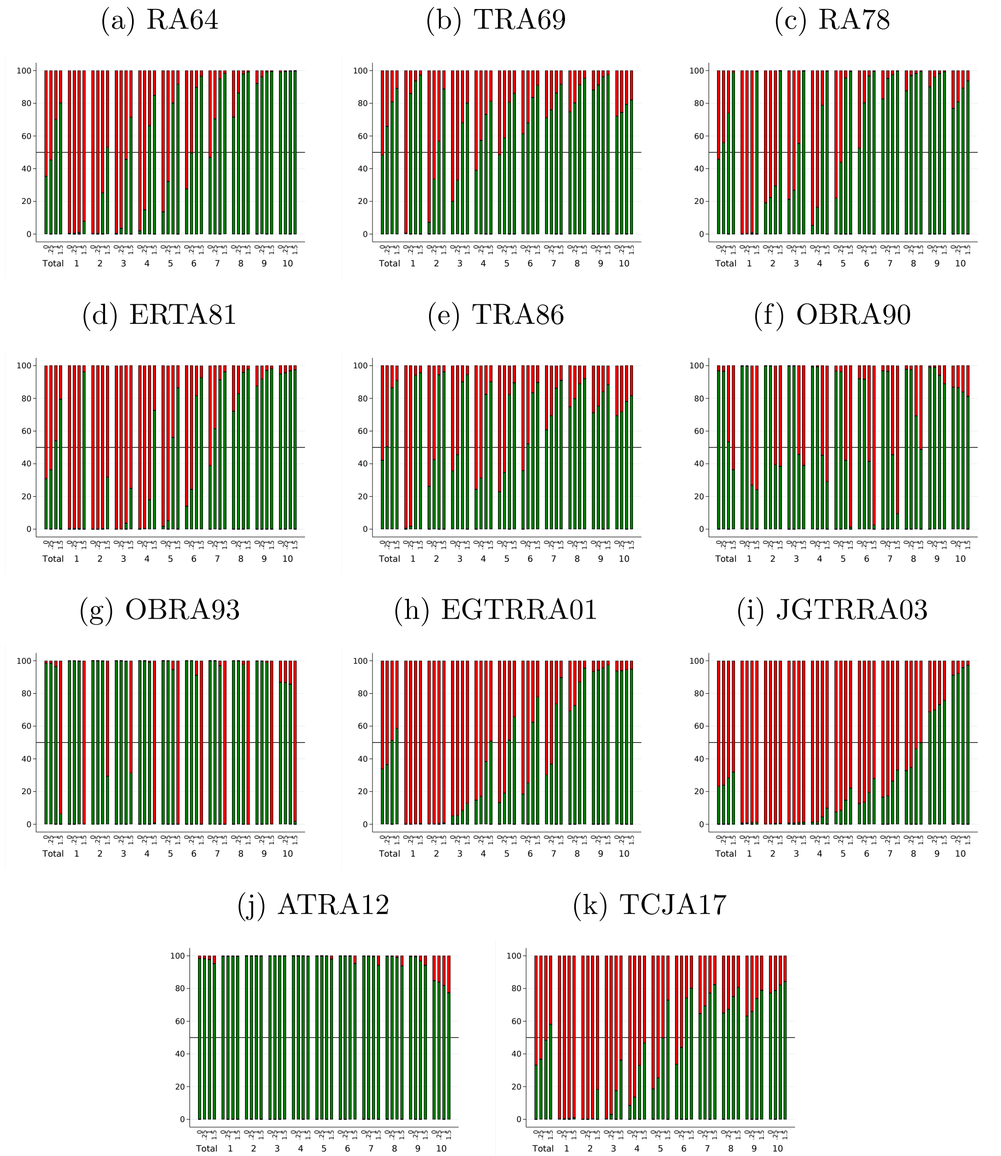
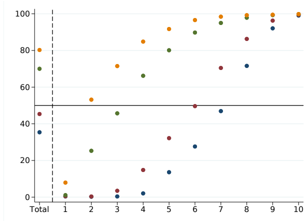


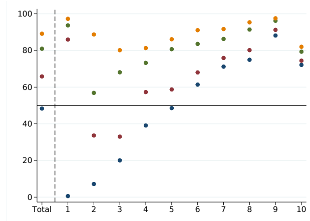
Figure E.2: Shares of winners and losers by decile

Notes: Figure E.2 shows the shares of reform winners (green) versus reform losers (losers) for major reforms of the US federal personal income tax (see Table H.1 for details), by income decile and for four different values of the elasticity of taxable income (ETI): 0, 0.25, 1 and 1.5 (from left to right). The first four bars ("Total") show the shares for the full population. The first bar shows the shares for the full population. Deciles are computed based on pre-tax income without capital gains while tax base includes capital gains. All computations are on the individual level. For this, the income of couples filing jointly is allocated equally to each spouse. In order to simulate counterfactual tax payments $T_1\left(\hat{y}_0^i\right)$, income from year 0 are inflated to year 1 using the CPI-U-RS deflator as uprating factor.
Source: Authors' calculations based on NBER TAXSIM and IRS-SOI PUF.

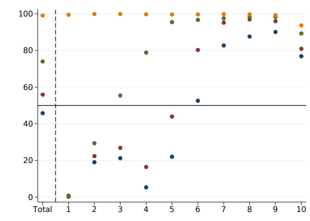
(a) RA64



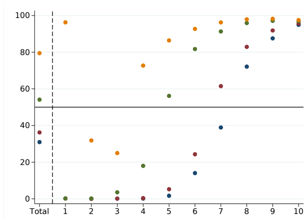
(b) TRA69



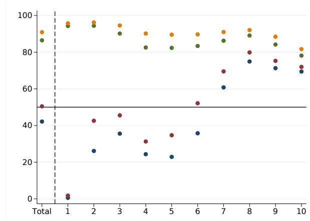
(c) RA78



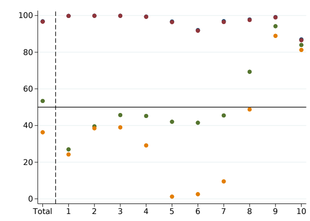
(d) ERTA81



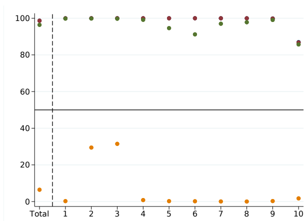
(e) TRA86



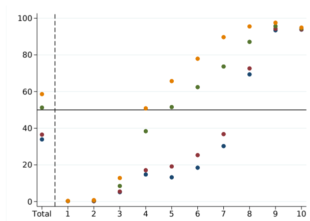
(f) OBRA90



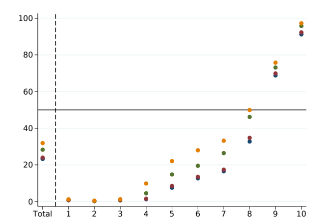
(g) OBRA93



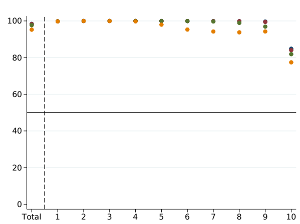
(h) EGTRRA01



(i) JGTRRA03



(j) ATRA12



(k) TCJA17

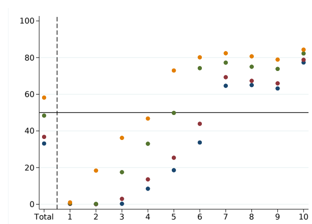


Figure E.3: Shares of winners by decile

Notes: Figure E.3 shows the shares of reform winners for major reforms of the US federal personal income tax (see Table H.1 for details), by income decile and for four different values of the elasticity of taxable income (ETI): 0 (blue), 0.25 (red), 1 (green) and 1.5 (yellow). The first four dots ("Total") show the shares for the full population. Deciles are computed based on pre-tax income without capital gains while tax base includes capital gains. All computations are on the individual level. For this, the income of couples filing jointly is allocated equally to each spouse. In order to simulate counterfactual tax payments $T_1\left(\hat{y}_0^i\right)$, income from year 0 are inflated to year 1 using the CPI-U-RS deflator as uprating factor.

Source: Authors' calculations based on NBER TAXSIM and IRS-SOI PUF.

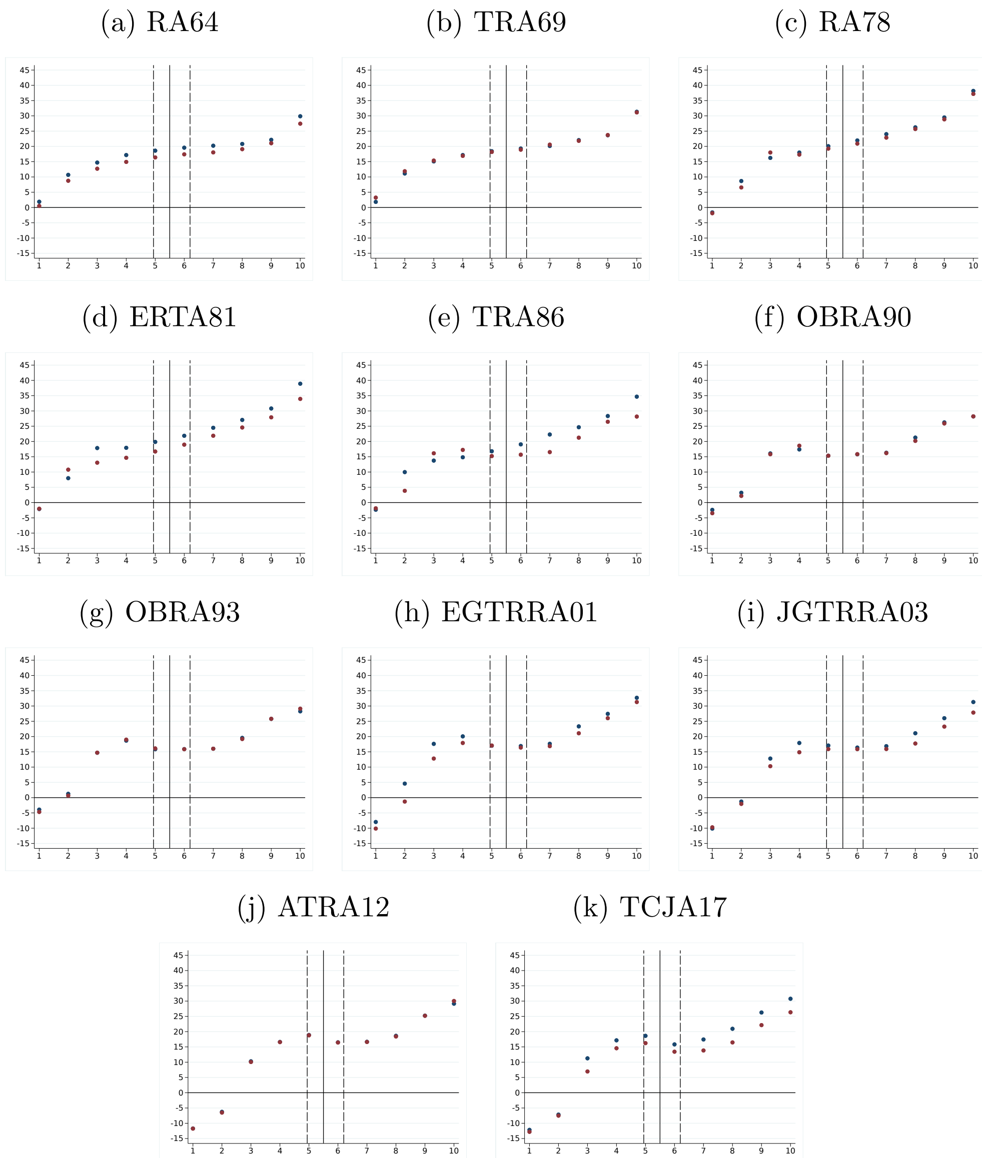


Figure E.4: Effective marginal tax rates by decile before and after each reform

Notes: Figure E.4 shows, separately for each decile effective marginal tax rates (EMTRs) T' before (blue) and after (red) major reforms of the US federal personal income tax (see Table H.1 for details). Deciles are computed based on pre-tax income without capital gains while tax base includes capital gains. All computations are on the individual level. For this, the income of couples filing jointly is allocated equally to each spouse. In order to simulate counterfactual tax payments $T_1\left(\hat{y}_0^i\right)$, income from year 0 are inflated to year 1 using the CPI-U-RS deflator as uprating factor.
Source: Authors' calculations based on NBER TAXSIM and IRS-SOI PUF.

F. Empirical analysis: Sensitivity checks

In this section, we conduct sensitivity checks of our empirical results with respect to several choices made. More precisely, we reproduce Figure 2 with the following variations:

(i) Tax units (instead of equal split couples) – see Figure F.1;

(ii) Statutory tax rates (instead of effective tax rates) – see Figure F.2;

(iii) Different bin sizes (50 instead of 10) – see Figure F.3;

(iv) Different income definitions: gross income including capital gains (see Figure F.4) and adjusted gross income (see Figure F.5), respectively;

(v) Including state-level and payroll taxes – see Figure F.6.

To preview the findings below: Figures F.1 – F.6 reveal the same message as Figure 2, namely that reforms are by and large monotonic. The main differences are reported below. Given that the value of $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ depicted in these Figures is the key ingredient for all other computations, it is not surprising that these sensitivity checks also do not affect the other figures reported in the paper. For brevity reasons, we refrain from showing these variations here but they are available upon request.

An interesting observation for TRA69 and RA78 is that the effects reported in Figure F.2 based on statutory tax rates differ from using effective tax rates instead as in Figure 2: this shows the importance of accounting for tax base changes. The same is true for other reforms albeit to a smaller extend. This shows the importance of using a micro data based microsimulation approach for the evaluation of tax reforms.

As reported in Figure F.6, the monotonicity pattern is different when we include state-level and payroll taxes for the three oldest reforms only (RA64, TRA69, RA78).

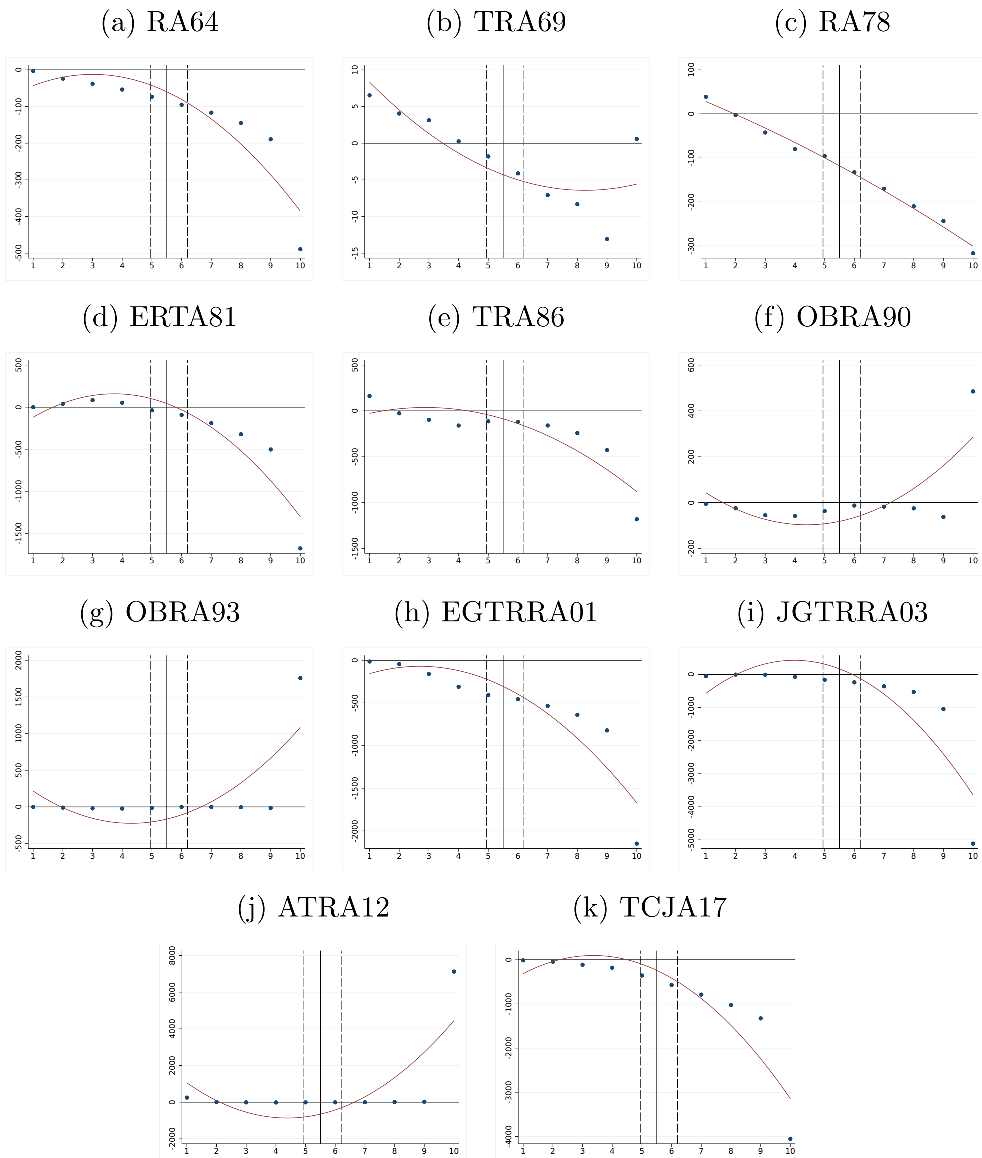


Figure F.1: Changes in tax liability: Average values per tax unit decile

Notes: Figure F.1 replicates Figure 2 with tax units instead of individual taxpayers. It shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reforms of the US federal personal income tax (see Table H.1 for details) by income decile. The red line represents a quadratic fit based on the underlying micro data. Deciles are computed based on pre-tax income without capital gains while tax base includes capital gains. All computations are on the tax unit level. In order to simulate counterfactual tax payments $T_1\left(\hat{y}_0^i\right)$, income from year 0 are inflated to year 1 using the CPI-U-RS deflator as uprating factor. The vertical lines show different locations for the median voter: the dashed line to the left imputes non-filers to the tax return data while the dashed line to the right accounts for differential turnout by income. The solid line in the middle represents both the original median in the data as well as the one accounting for both modifications simultaneously.
Source: Authors' calculations based on NBER TAXSIM and IRS-SOI PUF.

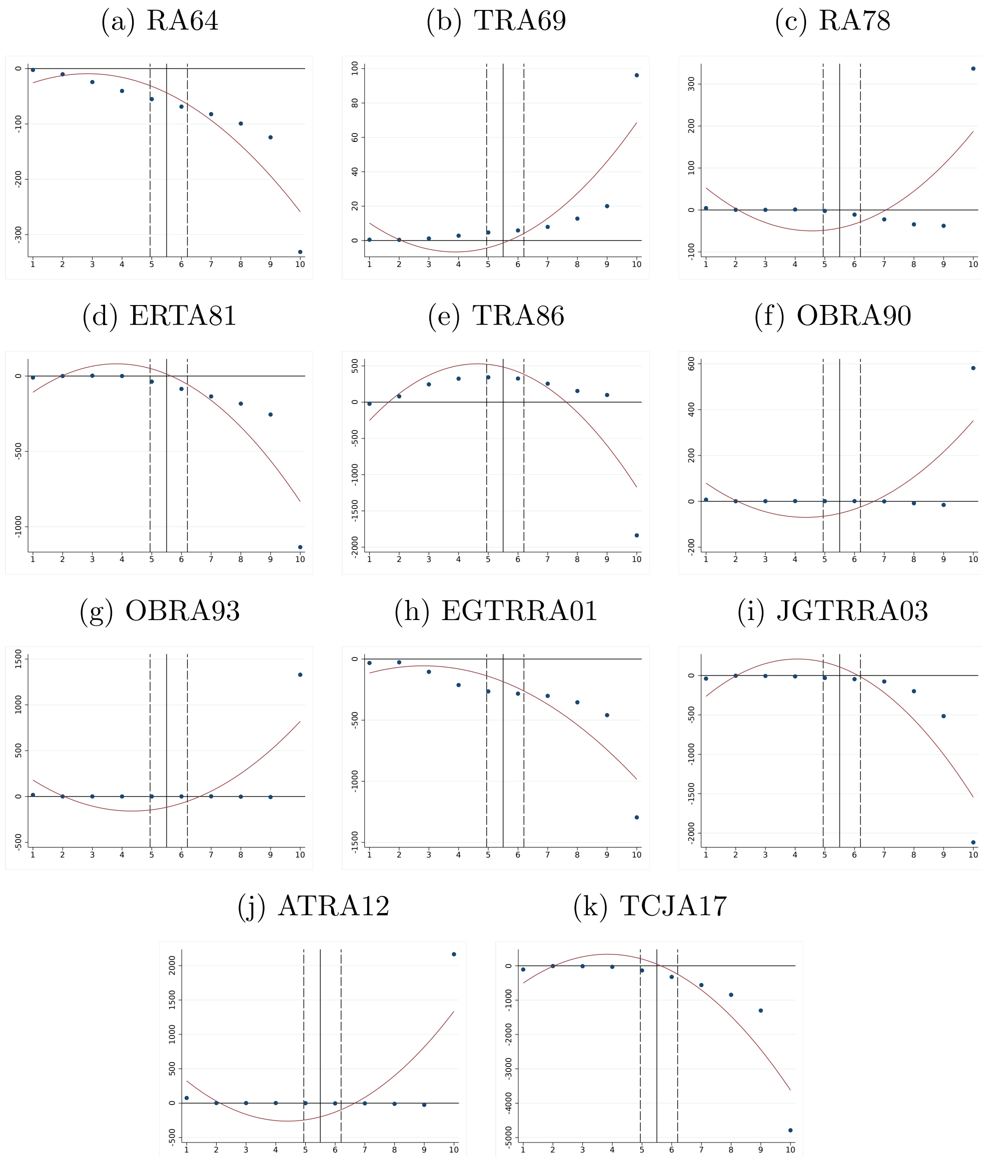


Figure F.2: Changes in statutory tax liability: Average values per decile

Notes: Figure F.2 replicates Figure 2 using statutory tax rates instead of effective tax rates. It shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reforms of the US federal personal income tax (see Table H.1 for details) by income decile. The red line represents a quadratic fit based on the underlying micro data. Deciles are computed based on pre-tax income without capital gains while tax base includes capital gains. All computations are on the individual level. For this, the income of couples filing jointly is allocated equally to each spouse. In order to simulate counterfactual tax payments $T_1\left(\hat{y}_0^i\right)$, income from year 0 are inflated to year 1 using the CPI-U-RS deflator as uprating factor. The vertical lines show different locations for the median voter: the dashed line to the left imputes non-filers to the tax return data while the dashed line to the right accounts for differential turnout by income. The solid line in the middle represents both the original median in the data as well as the one accounting for both modifications simultaneously.
Source: Authors' calculations based on NBER TAXSIM and IRS-SOI PUF.

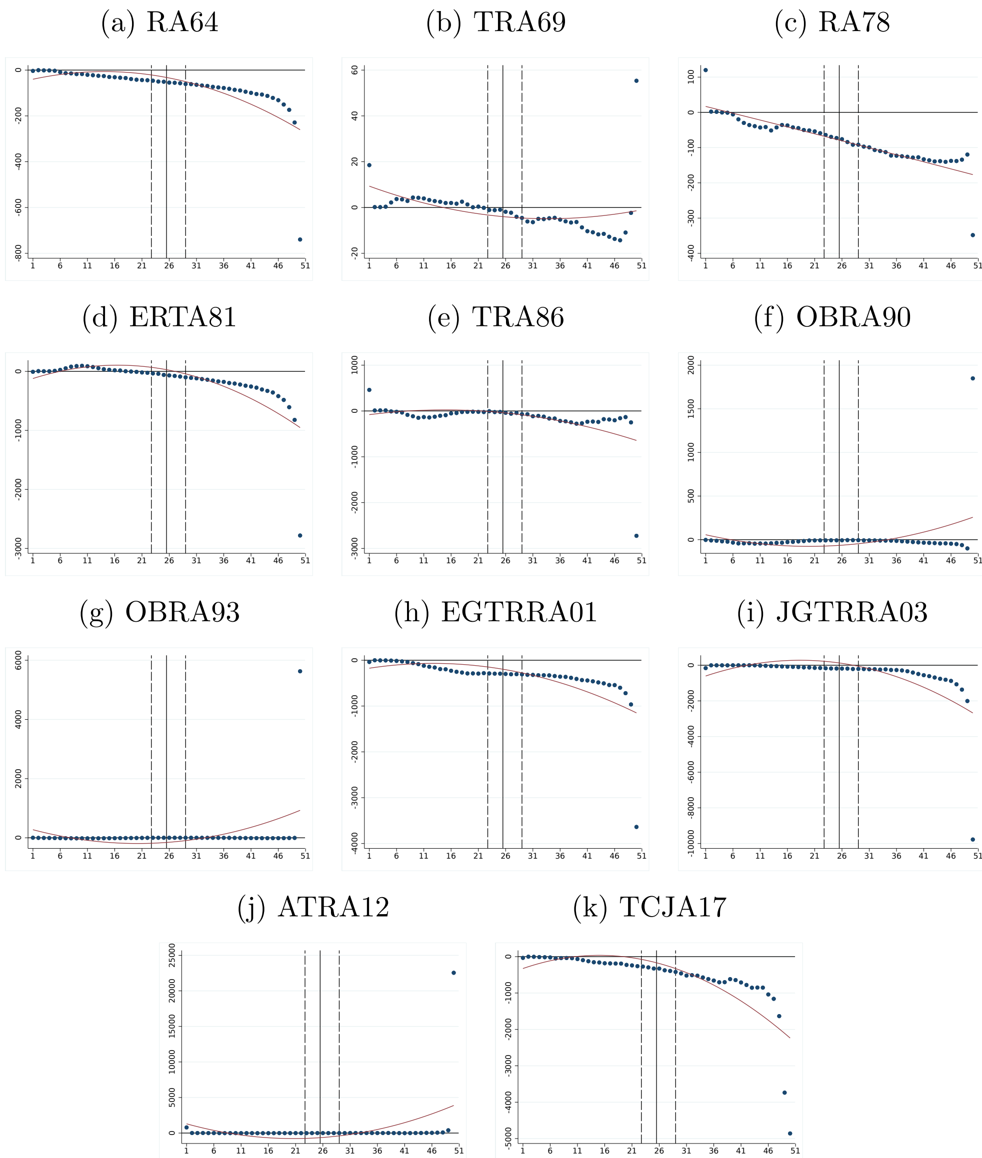
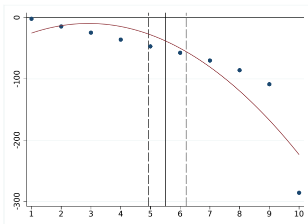


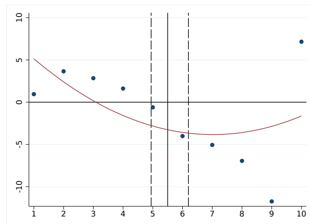
Figure F.3: Changes in tax liability: Average values per 50 income bins

Notes: Figure F.3 replicates Figure 2 using 50 income bins instead of deciles. It shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reforms of the US federal personal income tax (see Table H.1 for details) by income bin. The red line represents a quadratic fit based on the underlying micro data. Deciles are computed based on pre-tax income without capital gains while tax base includes capital gains. All computations are on the individual level. For this, the income of couples filing jointly is allocated equally to each spouse. In order to simulate counterfactual tax payments $T_1\left(\hat{y}_0^i\right)$, income from year 0 are inflated to year 1 using the CPI-U-RS deflator as uprating factor. The vertical lines show different locations for the median voter: the dashed line to the left imputes non-filers to the tax return data while the dashed line to the right accounts for differential turnout by income. The solid line in the middle represents both the original median in the data as well as the one accounting for both modifications simultaneously.
Source: Authors' calculations based on NBER TAXSIM and IRS-SOI PUF.

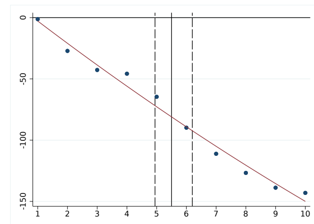
(a) RA64



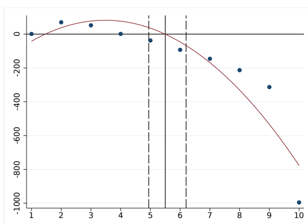
(b) TRA69



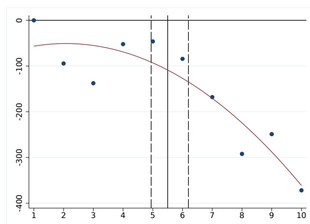
(c) RA78



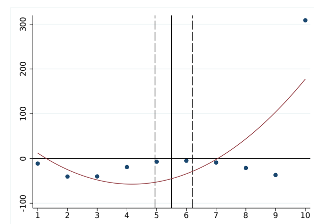
(d) ERTA81



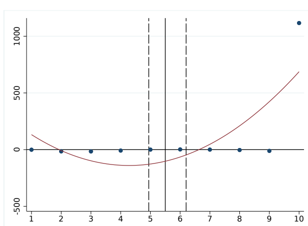
(e) TRA86



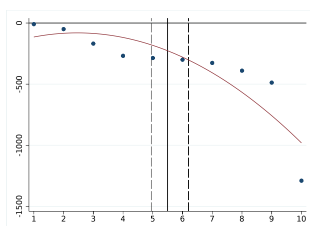
(f) OBRA90



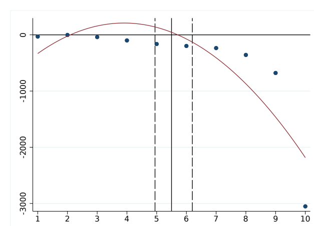
(g) OBRA93



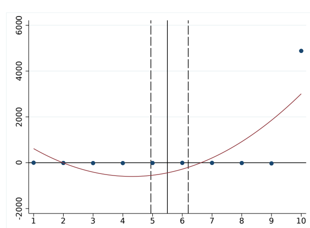
(h) EGTRRA01



(i) JGTRRA03



(j) ATRA12



(k) TCJA17

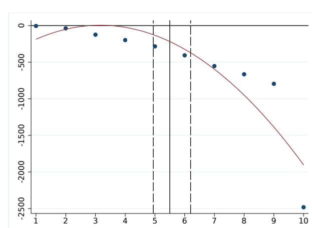


Figure F.4: Changes in tax liability: Average values per decile including capital gains

Notes: Figure F.4 replicates Figure 2 using deciles including capital gains. It shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reforms of the US federal personal income tax (see Table H.1 for details) by income bin. The red line represents a quadratic fit based on the underlying micro data. All computations are on the individual level. For this, the income of couples filing jointly is allocated equally to each spouse. In order to simulate counterfactual tax payments $T_1\left(\hat{y}_0^i\right)$, income from year 0 are inflated to year 1 using the CPI-U-RS deflator as uprating factor. The vertical lines show different locations for the median voter: the dashed line to the left imputes non-filers to the tax return data while the dashed line to the right accounts for differential turnout by income. The solid line in the middle represents both the original median in the data as well as the one accounting for both modifications simultaneously.
Source: Authors' calculations based on NBER TAXSIM and IRS-SOI PUF.

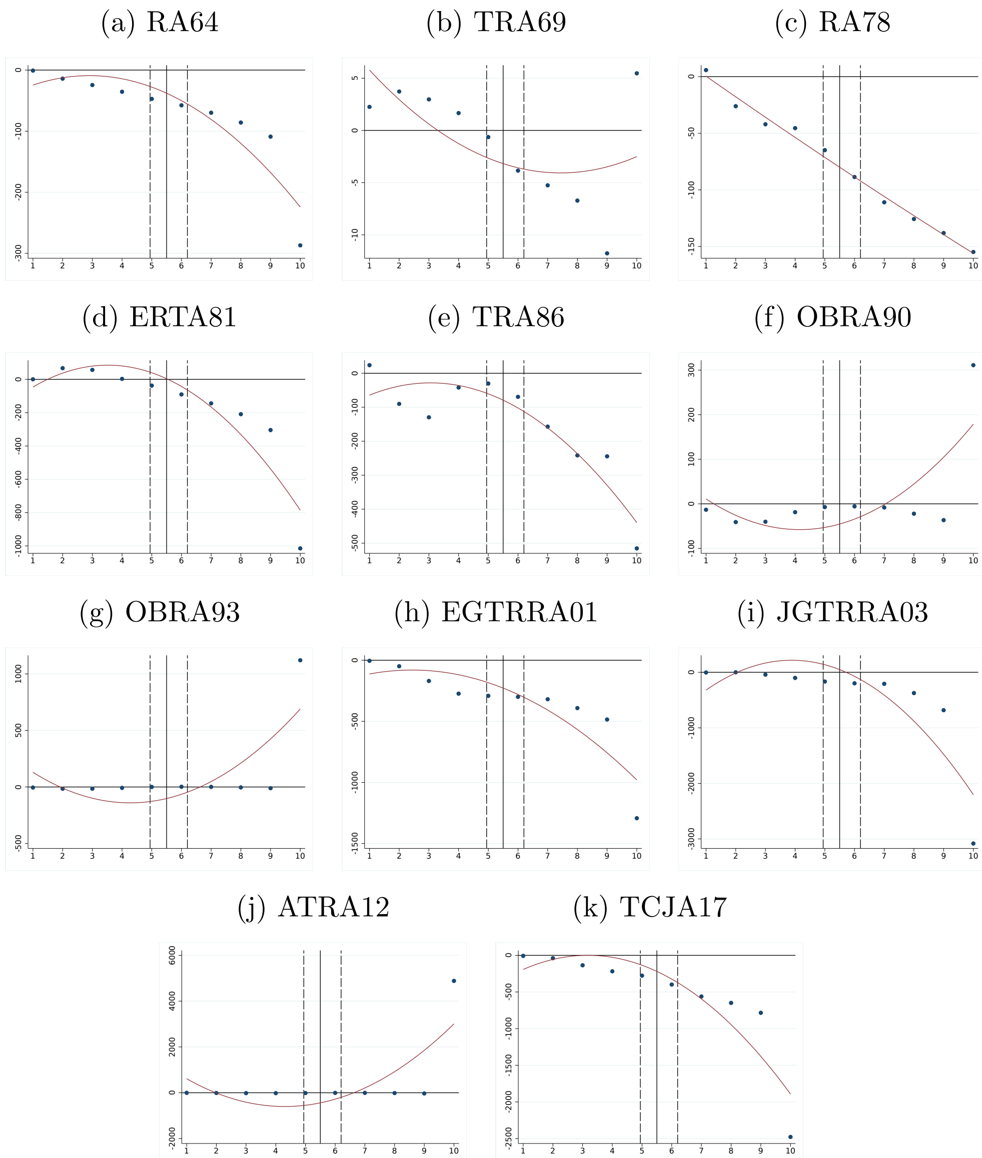


Figure F.5: Changes in tax liability: Average values per adjusted gross income (AGI) decile

Notes: Figure F.5 replicates Figure 2 using deciles based on adjusted gross income (AGI). It shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reforms of the US federal personal income tax (see Table H.1 for details) by income bin. The red line represents a quadratic fit based on the underlying micro data. All computations are on the individual level. For this, the income of couples filing jointly is allocated equally to each spouse. In order to simulate counterfactual tax payments $T_1\left(\hat{y}_0^i\right)$, income from year 0 are inflated to year 1 using the CPI-U-RS deflator as uprating factor. The vertical lines show different locations for the median voter: the dashed line to the left imputes non-filers to the tax return data while the dashed line to the right accounts for differential turnout by income. The solid line in the middle represents both the original median in the data as well as the one accounting for both modifications simultaneously.
Source: Authors' calculations based on NBER TAXSIM and IRS-SOI PUF.

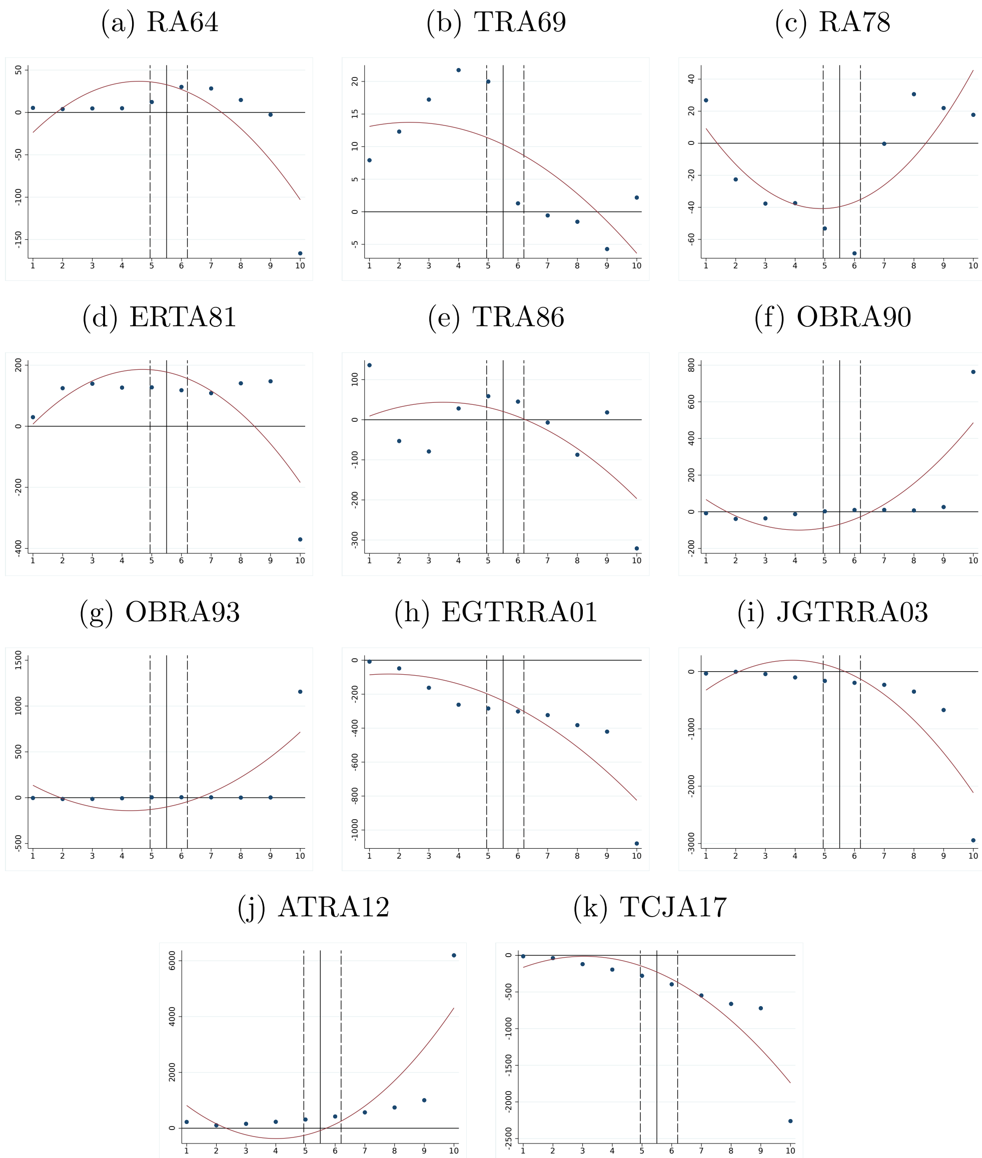


Figure F.6: Changes in tax liability including state-level and payroll taxes: Average values per decile

Notes: Figure F.6 replicates Figure 2 by including state-level and payroll taxes. It shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reforms of the US federal personal income tax (see Table H.1 for details) by income bin. The red line represents a quadratic fit based on the underlying micro data. Deciles are computed based on pre-tax income without capital gains while tax base includes capital gains. All computations are on the individual level. For this, the income of couples filing jointly is allocated equally to each spouse. In order to simulate counterfactual tax payments $T_1\left(\hat{y}_0^i\right)$, income from year 0 are inflated to year 1 using the CPI-U-RS deflator as uprating factor. The vertical lines show different locations for the median voter: the dashed line to the left imputes non-filers to the tax return data while the dashed line to the right accounts for differential turnout by income. The solid line in the middle represents both the original median in the data as well as the one accounting for both modifications simultaneously.
Source: Authors' calculations based on NBER TAXSIM and IRS-SOI PUF.

	Correlation	Rank Correlation
RA64	0.829	0.957
TRA69	0.270	0.765
RA78	0.318	0.716
ERTA81	0.641	0.871
TRA86	0.681	0.794
OBRA90	0.931	0.836
OBRA93	0.952	0.828
EGTRRA01	0.820	0.842
JGTRRA03	0.853	0.887
ATRA12	0.855	0.845
TCJA17	0.741	0.857

Table F.1: Monotonicity of reforms – correlation analysis

Notes: This table shows the (rank) correlation between the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ (see Figure 2) and pre-tax income for reforms of the US federal personal income tax (see Table H.1 for details). All computations are on the individual level. For this, the income of couples filing jointly is allocated equally to each spouse. In order to simulate counterfactual tax payments $T_1\left(\hat{y}_0^i\right)$, income from year 0 are inflated to year 1 using the CPI-U-RS deflator as uprating factor.
Source: Authors' calculations based on NBER TAXSIM and IRS-SOI PUF.

G. Tax Reform Proposals

In order to answer the question whether the finding that tax reforms are, by and large, monotonic, extends to tax reforms proposals which are publicly debated, but not enacted, we invoke the systematic analysis of reform proposals in the US that is provided by the Tax Policy Center. The data is taken from the Tax Policy Center's ex ante analysis of each reform proposal. Details on the underlying data, methods and simulation model can be found here: `https://www.taxpolicycenter.org/resources/brief-description-tax-model`. For each proposal, there is a code ("Source") corresponding to the source document from the Tax Policy Center's webpage.[4]

We identified 69 reform proposals that were made in the period 2003-2019: some proposals were made during presidential campaigns and primaries, others were proposed by the Administration during the legislative process. Figures G.1 – G.8 and Tables G.1 – G.8 below synthesize the Tax Policy Center's ex-ante analyses of the absolute (dollar) tax payment changes by income quantiles of reform proposals of the federal personal income tax between 2003 and 2019. All tables provide a code corresponding to the source document from the Tax Policy Center, the year of the projection, the type of taxes underlying the analysis and the employed baseline. The selection criteria for the proposals/reforms were that (1) they concern personal income taxes, (2) they significantly impact all

[4]See, e.g, for TCJA17 `https://www.taxpolicycenter.org/model-estimates/individual-income-tax-provisions-tax-cuts-and-jobs-act-tcja-february-2018/t18-0024`.

income percentiles and (3) they were formal proposals from the Administration, Candidates, Political Parties, or particular Congress members. In case there are several projections available for one proposal and different years, only the one that is closest to the date of the proposal is included. Estimations using different baselines are included if changing the baseline significantly affects the estimates (due to many temporary taxes).

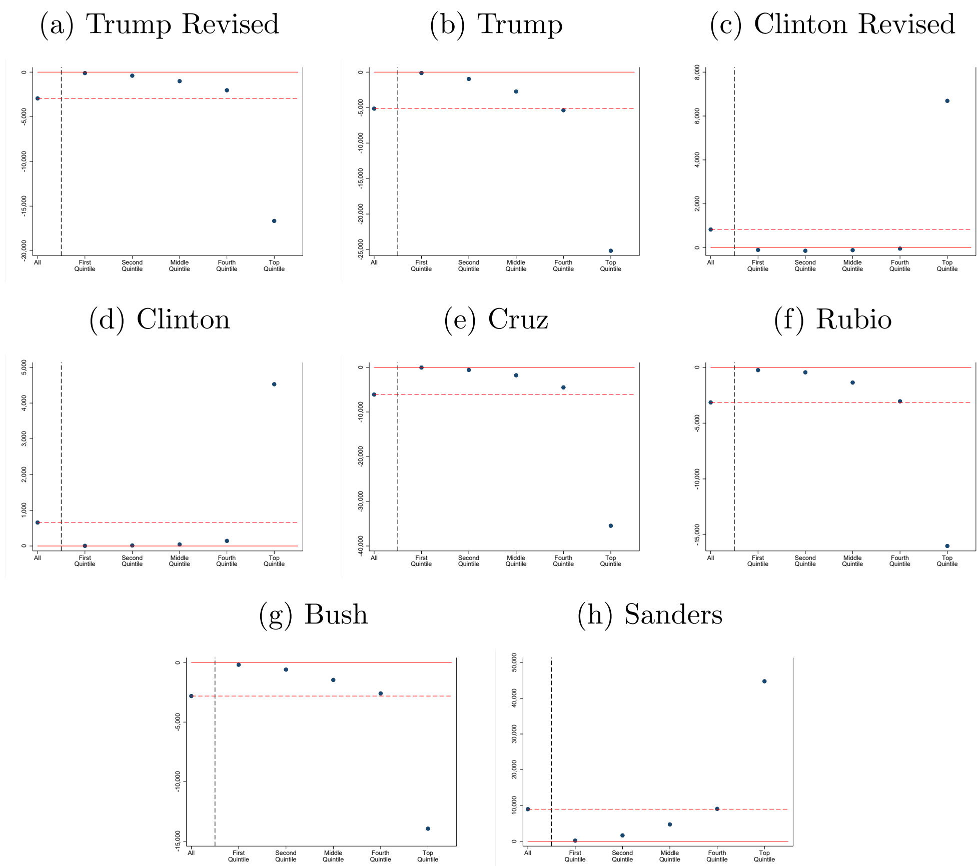


Figure G.1: Change in tax liability by quintile, 2016 US Presidential campaign

Notes: Figure G.1 shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reform proposals of the US federal personal income tax by income quintile. The first column shows the overall counterfactual tax change. The dashed horizontal line shows the revenue neutral benchmark (via lump sum redistribution) for an ETI of zero. The data is taken from the Tax Policy Center's ex ante analysis of each reform proposal (see Table G.1 for details).
Source: Authors' calculations based on Tax Policy Center.

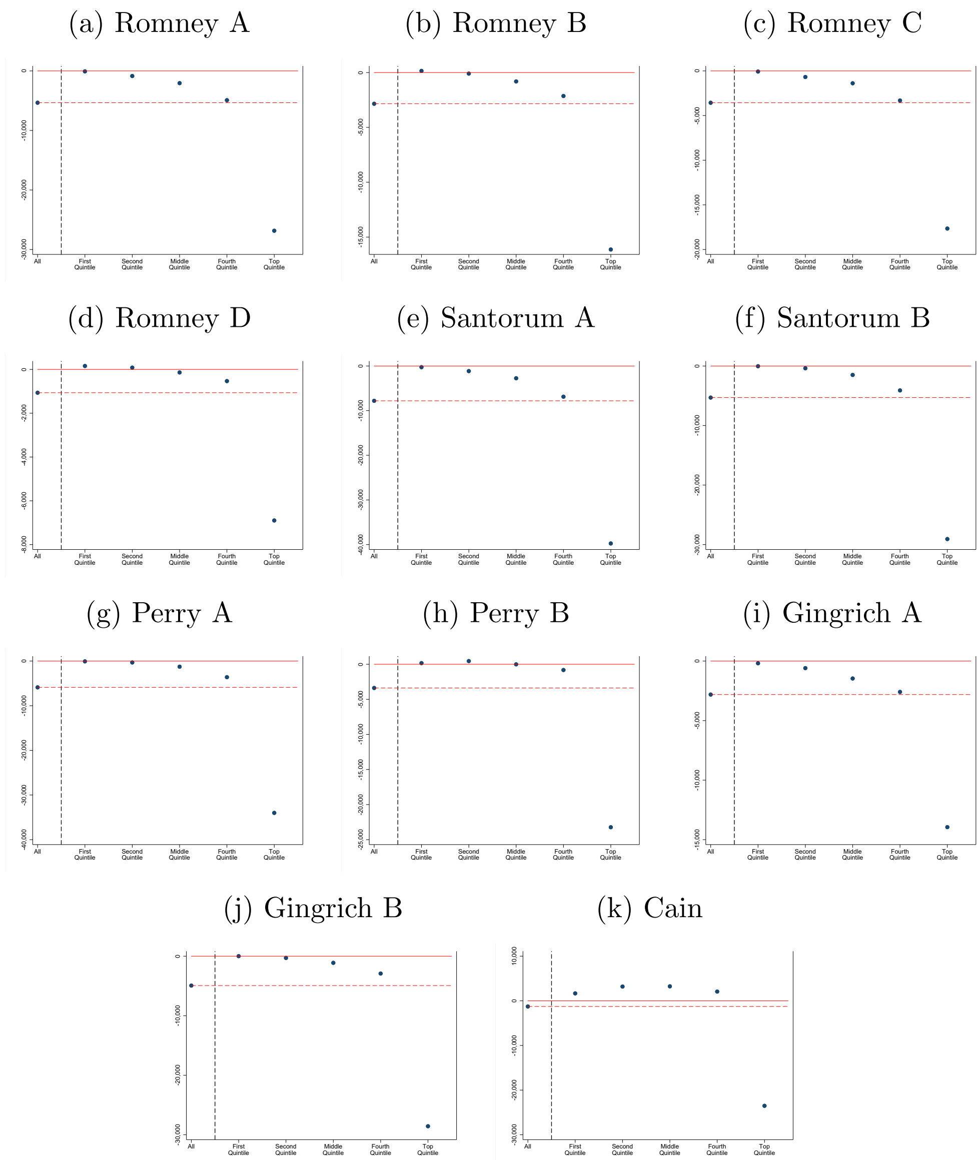


Figure G.2: Change in tax liability by quintile, 2012 US Presidential campaign

Notes: Figure G.2 shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reform proposals of the US federal personal income tax by income quintile. The first column shows the overall counterfactual tax change. The dashed horizontal line shows the revenue neutral benchmark (via lump sum redistribution) for an ETI of zero. The data is taken from the Tax Policy Center's ex ante analysis of each reform proposal (see Table G.2 for details).
Source: Authors' calculations based on Tax Policy Center.

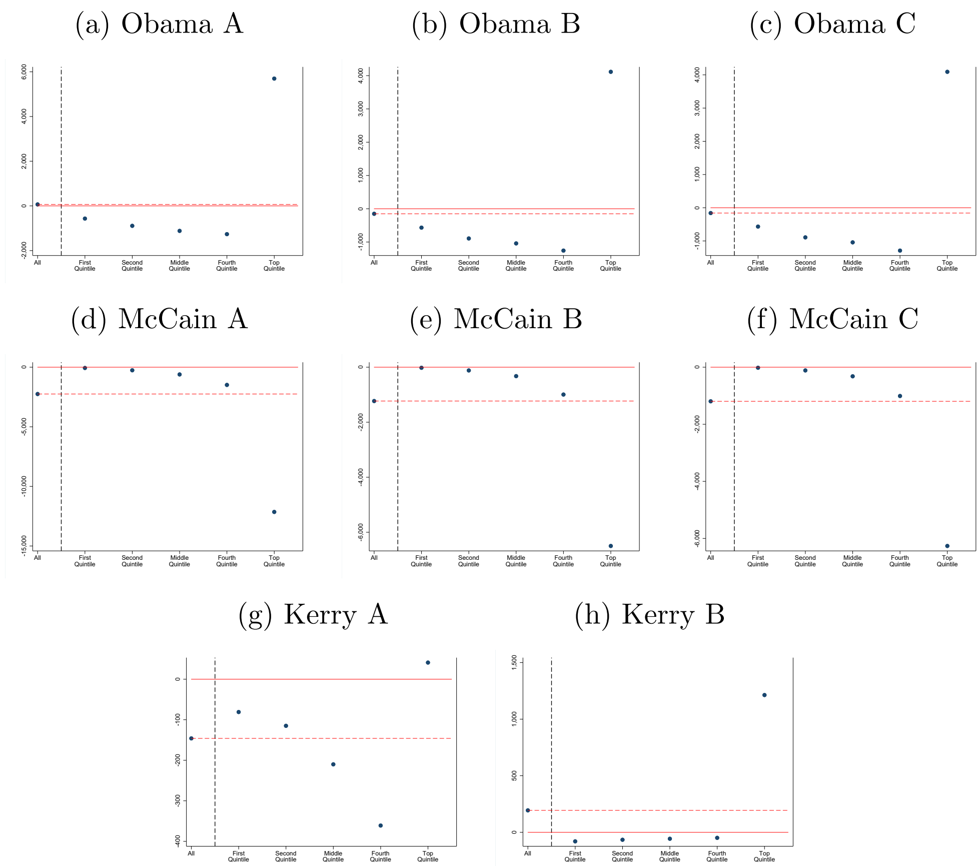
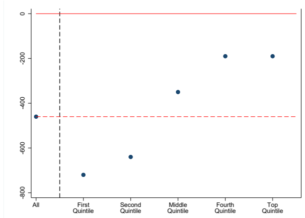


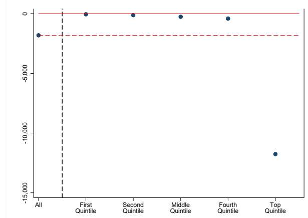
Figure G.3: Change in tax liability by quintile, 2008 and 2004 US Presidential campaigns

Notes: Figure G.3 shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reform proposals of the US federal personal income tax by income quintile. The first column shows the overall counterfactual tax change. The dashed horizontal line shows the revenue neutral benchmark (via lump sum redistribution) for an ETI of zero. The data is taken from the Tax Policy Center's ex ante analysis of each reform proposal (see Table G.3 for details).
Source: Authors' calculations based on Tax Policy Center.

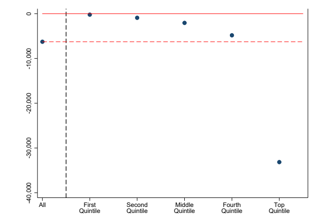
(a) Working Families Tax Relief Act



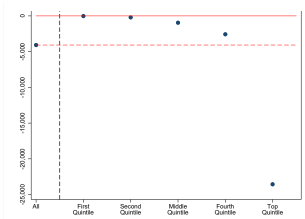
(b) House GOP Tax Plan



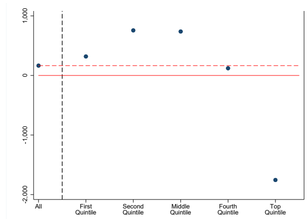
(c) Gov. Pawlenty Proposal A



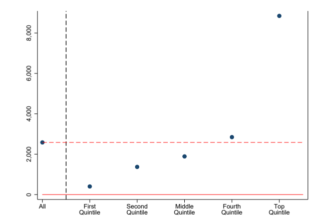
(d) Gov. Pawlenty Proposal B



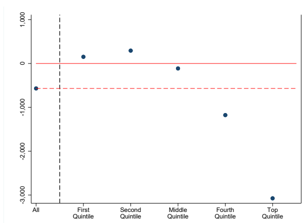
(e) Bowles-Simpson Plan A



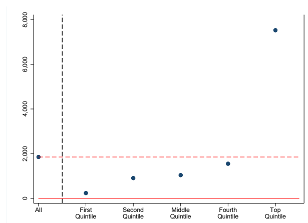
(f) Bowles-Simpson Plan B



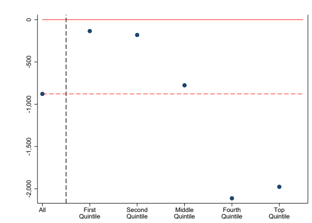
(g) Bowles-Simpson Plan C



(h) Bowles-Simpson Plan D



(i) Bowles-Simpson Plan E



(j) Bowles-Simpson Plan F

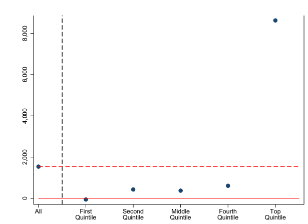
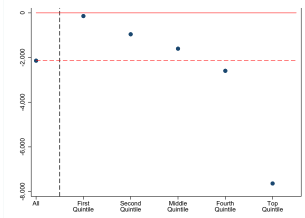


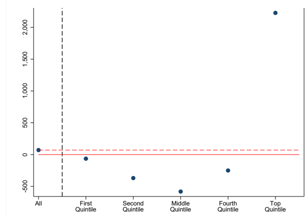
Figure G.4: Change in tax liability by quintile for reform proposals

Notes: Figure G.4 shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reform proposals of the US federal personal income tax by income quintile. The first column shows the overall counterfactual tax change. The dashed horizontal line shows the revenue neutral benchmark (via lump sum redistribution) for an ETI of zero. The data is taken from the Tax Policy Center's ex ante analysis of each reform proposal (see Table G.4 for details).
Source: Authors' calculations based on Tax Policy Center.

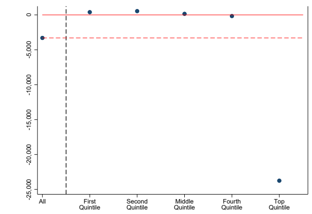
(a) Wyden-Gregg Act A



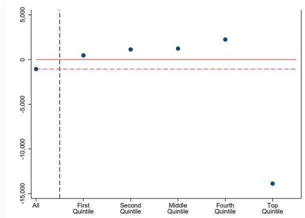
(b) Wyden-Gregg Act B



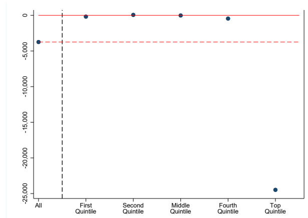
(c) Roadmap for America's Future Act A



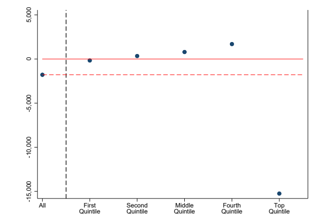
(d) Roadmap for America's Future Act B



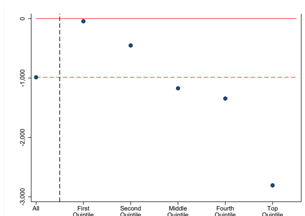
(e) Roadmap for America's Future Act C



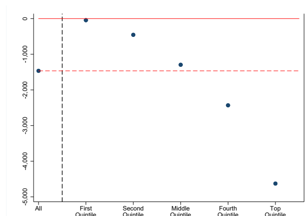
(f) Roadmap for America's Future Act D



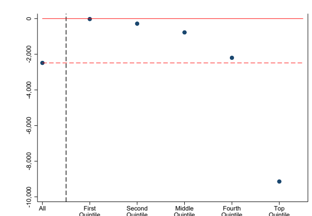
(g) House Republican Stimulus Proposal A



(h) House Republican Stimulus Proposal B



(i) Sen. Thompson's Tax Plan



(j) Democratic Stimulus Proposal

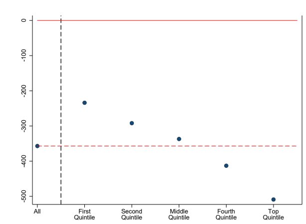
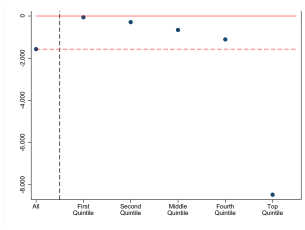


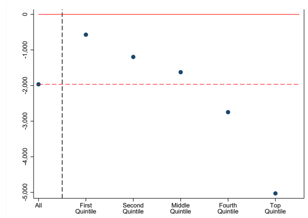
Figure G.5: Change in tax liability by quintile for reform proposals

Notes: Figure G.5 shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reform proposals of the US federal personal income tax by income quintile. The first column shows the overall counterfactual tax change. The dashed horizontal line shows the revenue neutral benchmark (via lump sum redistribution) for an ETI of zero. The data is taken from the Tax Policy Center's ex ante analysis of each reform proposal (see Table G.5 for details).
Source: Authors' calculations based on Tax Policy Center.

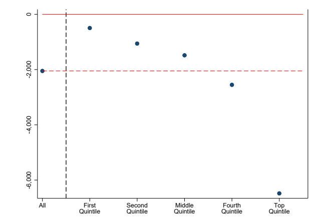
(a) Unified Framework



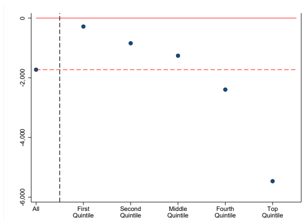
(b) Proposal for Budget FY2010 A



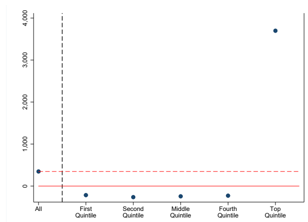
(c) Proposal for Budget FY2010 B



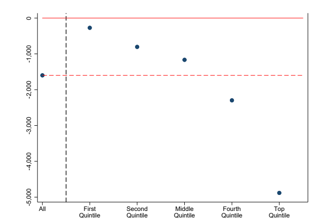
(d) Proposal for Budget FY2011 A



(e) Proposal for Budget FY2011 B



(f) Proposal for Budget FY2012 A



(g) Proposal for Budget FY2012 B

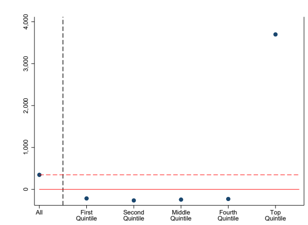
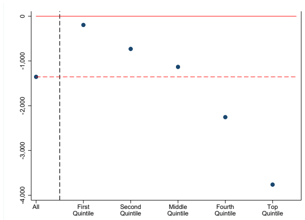


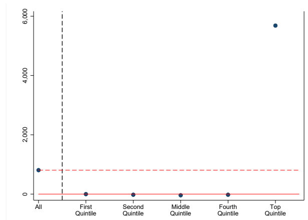
Figure G.6: Change in tax liability by quintile for reform proposals

Notes: Figure G.6 shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reform proposals of the US federal personal income tax by income quintile. The first column shows the overall counterfactual tax change. The dashed horizontal line shows the revenue neutral benchmark (via lump sum redistribution) for an ETI of zero. The data is taken from the Tax Policy Center's ex ante analysis of each reform proposal (see Table G.6 for details).
Source: Authors' calculations based on Tax Policy Center.

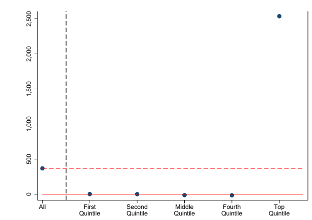
(a) Proposal for Budget FY2013 A



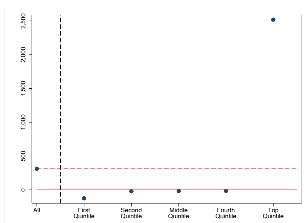
(b) Proposal for Budget FY2013 B



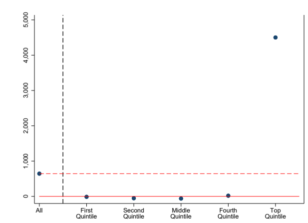
(c) Proposal for Budget FY2014



(d) Proposal for Budget FY2015



(e) Implement a Simplified Tax System



(f) Integrated Payroll Tax Plan

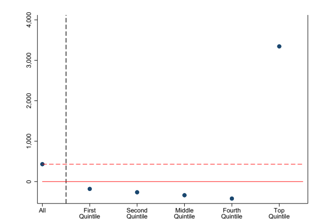
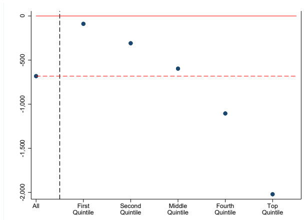


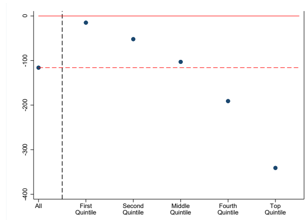
Figure G.7: Change in tax liability by quintile for reform proposals

Notes: Figure G.7 shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reform proposals of the US federal personal income tax by income quintile. The first column shows the overall counterfactual tax change. The dashed horizontal line shows the revenue neutral benchmark (via lump sum redistribution) for an ETI of zero. The data is taken from the Tax Policy Center's ex ante analysis of each reform proposal (see Table G.7 for details).
Source: Authors' calculations based on Tax Policy Center.

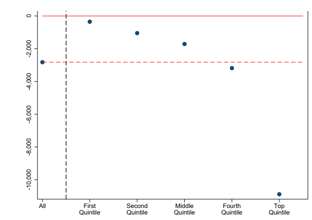
(a) Middle Class Tax Relief and Job Creation Act



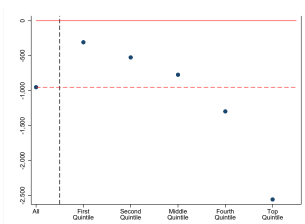
(b) Temporary Payroll Tax Cut Continuation Act



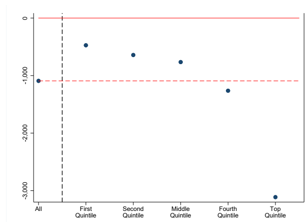
(c) Tax Relief, UI Reauthorization, and Job Creation Act A



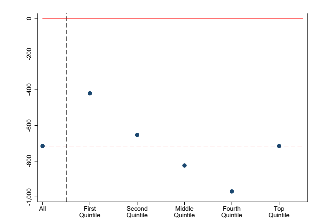
(d) Tax Relief, UI Reauthorization, and Job Creation Act B



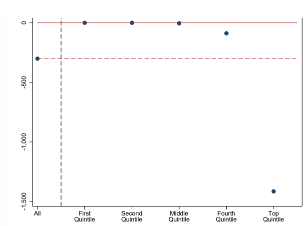
(e) American Recovery and Reinvestment Act



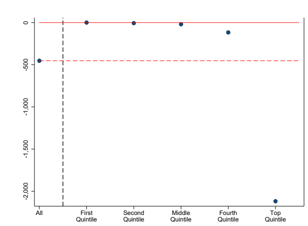
(f) Economic Stimulus Act



(g) Tax Increase Prevention Act



(h) Tax Increase Prevention and Reconciliation Act



(i) Working Families Tax Relief Act B

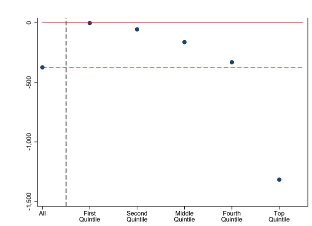


Figure G.8: Change in tax liability by quintile for reform proposals

Notes: Figure G.8 shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reform proposals of the US federal personal income tax by income quintile. The first column shows the overall counterfactual tax change. The dashed horizontal line shows the revenue neutral benchmark (via lump sum redistribution) for an ETI of zero. The data is taken from the Tax Policy Center's ex ante analysis of each reform proposal (see Table G.8 for details).
Source: Authors' calculations based on Tax Policy Center.

Table G.1: Counterfactual change in tax liability of 2016 Presidential Campaign Tax Proposals

	Trump Revised	**Trump**	**Clinton Revised**	**Clinton**	**Cruz**	**Rubio**	**Bush**	**Sanders**
Year of projection	2017	2017	2017	2017	2017	2017	2017	2017
Party Affiliation	Republican	Republican	Democratic	Democratic	Republican	Republican	Republican	Democratic
Source	T16-0212	T15-0234	T16-0225	T16-0041	T16-0021	T16-0003	T15-0171	T16-0054
Baseline	Current Law	Current Law	Current Law	Current Law	Current Law	Current Law	Current Law	Current Law
Lowest Quintile	-110	-128	-100	4	-46	-251	-185	165
Second Quintile	-400	-969	-140	15	-588	-450	-593	1625
Middle Quintile	-1010	-2732	-110	44	-1783	-1365	-1464	4692
Fourth Quintile	-2030	-5369	-40	143	-4504	-3043	-2593	9051
Top Quintile	-16660	-25180	6690	4527	-35471	-16008	-13947	44759
All	-2940	-5144	830	657	-6095	-3146	-2813	8964
Addendum								
80-89	-3270	-7731	100	246	-8907	-6059	-4258	14809
90-94	-5350	-11476	750	642	-16129	-8965	-5115	19828
95-98	-18490	-27657	4690	2673	-39352	-15364	-13256	37801
Top 1 Percent	-214690	-275257	117760	78284	-407708	-162646	-167325	525365

Notes: This table shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reform proposals of the US federal personal income tax by income quintile as well as a decomposition for the top quintile. The data is taken from the Tax Policy Center's ex ante analysis of each reform proposal. Details on the underlying data, methods and simulation model can be found here: `https://www.taxpolicycenter.org/resources/brief-description-tax-model`. For each proposal, there is a code ("Source") corresponding to the source document from the Tax Policy Center. The table also contains information on the year of the proposal, the year of the projection and the employed baseline (current law vs. current policy).
Source: Authors' calculations based on Tax Policy Center.

Table G.2: Counterfactual change in tax liability of 2012 Presidential Campaign Tax Proposals

	Romney A	**Romney B**	**Romney C**	**Romney D**	**Santorum A**	**Santorum B**	**Perry A**	**Perry B**	**Gingrich**	**Gingrich**	**Cain**
Year of projection	2015	2015	2015	2015	2015	2015	2015	2015	2015	2015	2013
Party Affiliation	Republican	Republican	Republican	Republican	Republican	Republican	Republican	Republican	Republican	Republican	Republican
Source	T12-0039	T12-0041	T12-0002	T12-0004	T12-0012	T12-0014	T11-0377	T11-0379	T11-0403	T11-0405	T11-0373
Baseline	Current Law	Current Policy	Current Law	Current Policy	Current Law	Current Policy	Current Law	Current Policy	Current Law	Current Policy	Current Law
Lowest Quintile	-77	149	-69	157	-265	-39	-66	160	-185	6	1659
Second Quintile	-859	-97	-681	82	-1144	-383	-311	452	-593	-295	3189
Middle Quintile	-2054	-810	-1383	-138	-2744	-1502	-1258	-13	-1464	-1118	3238
Fourth Quintile	-4919	-2139	-3315	-532	-6879	-4102	-3607	-822	-2593	-2916	2071
Top Quintile	-26845	-16134	-17653	-6899	-39750	-29070	-34004	-23226	-13947	-28572	-23522
All	-5342	-2847	-3566	-1064	-7799	-5309	-5889	-3383	-2813	-4936	-1271
Addendum											
80-89	-9076	-4177	-6048	-1143	-13718	-8824	-7627	-2719	-4258	-5723	-1871
90-94	-14639	-7759	-9491	-2599	-22663	-15793	-13951	-7051	-5115	-10551	-7104
95-98	-34243	-22368	-19393	-7477	-49314	-37471	-40183	-28243	-13256	-28789	-26737
Top 1 Percent	-231971	-149997	-164719	-82188	-341447	-259865	-366739	-283903	-167325	-340179	-307473

Notes: This table shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reform proposals of the US federal personal income tax by income quintile as well as a decomposition for the top quintile. The data is taken from the Tax Policy Center's ex ante analysis of each reform proposal. Details on the underlying data, methods and simulation model can be found here: `https://www.taxpolicycenter.org/resources/brief-description-tax-model`. For each proposal, there is a code ("Source") corresponding to the source document from the Tax Policy Center. The table also contains information on the year of the proposal, the year of the projection and the employed baseline (current law vs. current policy).
Source: Authors' calculations based on Tax Policy Center.

Table G.3: Counterfactual change in tax liability of 2004 and 2008 Presidential Campaign Tax Proposals

	Obama A	Obama B	Obama C	McCain A	McCain B	McCain C	Kerry A	Kerry B
Year of projection	2009	2009	2009	2009	2009	2009	2005	2005
Party Affiliation	Democratic	Democratic	Democratic	Republican	Republican	Republican	Democratic	Democratic
Source	T08-0172	T08-0170	T08-0114	T08-0184	T08-0182	T08-0108	T04-0018	T04-0020
Baseline	Current Law	Current Law	Current Law	Current Law	Current Law	Current Law	Current Law	Current Law[1]
Lowest Quintile	-567	-567	-567	-65	-21	-19	-81	-80
Second Quintile	-892	-892	-892	-259	-118	-113	-115	-66
Middle Quintile	-1118	-1041	-1042	-608	-325	-319	-210	-57
Fourth Quintile	-1264	-1257	-1290	-1487	-994	-1009	-361	-49
Top Quintile	5697	4115	4092	-12144	-6498	-6264	41	1213
All	67	-151	-160	-2250	-1230	-1195	-146	194
Addendum								
80-89	-2132	-2130	-2204	-3736	-2584	-2614		
90-94	-2764	-2763	-2789	-6322	-4437	-4380		
95-98	799	-20	12	-15877	-8159	-7871		
Top 1 Percent	143688	115713	115974	-109214	-48862	-45361	23309	24319

Notes: This table shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reform proposals of the US federal personal income tax by income quintile as well as a decomposition for the top quintile. The data is taken from the Tax Policy Center's ex ante analysis of each reform proposal. Details on the underlying data, methods and simulation model can be found here: `https://www.taxpolicycenter.org/resources/brief-description-tax-model`. For each proposal, there is a code ("Source") corresponding to the source document from the Tax Policy Center. The table also contains information on the year of the proposal, the year of the projection and the employed baseline (current law vs. current policy).
Source: Authors' calculations based on Tax Policy Center.

Table G.4: Counterfactual change in tax liability of Tax Reform Proposals (not initiated by the Administration) Part 1

	Working Families Tax Relief Act	**House GOP Tax Plan**	**Gov. Pawlenty Proposal A**	**Gov. Pawlenty Proposal B**	**Bowles-Simpson Plan A**	**Bowles-Simpson Plan B**	**Bowles-Simpson Plan C**	**Bowles-Simpson Plan D**	**Bowles-Simpson Plan E**	**Bowles-Simpson Plan F**
Year of projection	2019	2017	2013	2013	2015	2015	2015	2015	2015	2015
Year of proposal	2019	2016	2011	2011	2010	2010	2010	2010	2010	2010
Originator	Senate Democrats	House of Representatives GOP	Gov. Pawlenty	Gov. Pawlenty	Bowles-Simpson Deficit Commission	Bowles-Simpson Deficit Commission	Bowles-Simpson Deficit Commission	Bowles-Simpson Deficit Commission	Bowles-Simpson Deficit Commission	Bowles-Simpson Deficit Commission
Source	T19-0053	T16-0197	T11-0169	T11-0171	T10-0247	T10-0248	T10-0251	T10-0252	T10-0253	T10-0254
Baseline	Current Law	Current Law	Current Law	Current Policy	Current Law	Current Policy	Current Law	Current Policy	Current Law	Current Policy
Lowest Quintile	-720	-50	-218	-23	319	402	152	234	-135	-53
Second Quintile	-640	-120	-919	-205	757	1370	293	906	-181	432
Middle Quintile	-350	-260	-2057	-955	738	1890	-113	1039	-776	376
Fourth Quintile	-190	-410	-4825	-2572	121	2845	-1177	1548	-2112	612
Top Quintile	-190	-11760	-33149	-23557	-1755	8848	-3075	7527	-1976	8626
All	-460	-1810	-6267	-4078	165	2583	-569	1850	-878	1540
Addendum										
80-89	-220	-310	-10051	-5672	-602	4020	-2084	2538	-2824	1798
90-94	-190	-370	-15495	-9654	-1690	5161	-3013	3838	-3846	3005
95-98	-160	-7690	-36403	-25796	-3348	8210	-4390	7168	-5321	6238
Top 1 Percent	0	-212660	-337439	-261433	-7322	77409	-8118	76613	28704	113434

Notes: This table shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reform proposals of the US federal personal income tax by income quintile as well as a decomposition for the top quintile. The data is taken from the Tax Policy Center's ex ante analysis of each reform proposal. Details on the underlying data, methods and simulation model can be found here: `https://www.taxpolicycenter.org/resources/brief-description-tax-model`. For each proposal, there is a code ("Source") corresponding to the source document from the Tax Policy Center. The table also contains information on the year of the proposal, the year of the projection and the employed baseline (current law vs. current policy).
Source: Authors' calculations based on Tax Policy Center.

Table G.5: Counterfactual change in tax liability of Tax Reform Proposals (not initiated by the Administration) Part 2

	Wyden-Gregg Act)	**Wyden-Gregg Act)**	**Roadmap for America's Future Act A**	**Roadmap for America's Future Act B**	**Roadmap for America's Future Act C**	**Roadmap for America's Future Act D**	**Republican Stimulus Proposal A**	**Republican Stimulus Proposal B**	**Sen. Thompson's Tax Plan**	**Democratic Stimulus Proposal**
Year of projection	2014	2014	2014	2014	2014	2014	2009	2009	2009	2003
Year of proposal	2010	2010	2010	2010	2010	2010	2009	2009	2007	2003
Originator	Sen. Wyder and Sen. Gregg	Sen. Wyder and Sen. Gregg	Rep. Ryan	Rep. Ryan	Rep. Ryan	Rep. Ryan	House of Representatives GOP	House of Representatives GOP	Sen. Thompson	House of Representatives Democrats
Source	T10-0122	T10-0119	T10-0087	T10-0091	T10-0089	T10-0093	T09-0046	T09-0048	T07-0334	T03-0005
Baseline	Current Law	Current Policy	Current Law	Current Policy	Current Law	Current Policy	Current Law	Current Law	Current Law	Current Law
Lowest Quintile	-142	-64	393	472	-180	-164	-45	-45	-25	-234
Second Quintile	-957	-369	541	1137	62	339	-452	-455	-284	-292
Middle Quintile	-1603	-581	152	1227	-17	794	-1173	-1295	-774	-337
Fourth Quintile	-2594	-250	-165	2242	-454	1694	-1345	-2432	-2199	-413
Top Quintile	-7638	2227	-23756	-13885	-24478	-15250	-2806	-4627	-9138	-509
All	-2140	71	-3298	-1063	-3742	-1786	-988	-1465	-2485	-357
Addendum										
80-89	-4068	196	-1701	2609	-2079	1929	-1242	-3568	-4262	-501
90-94	-4391	1622	-3022	3195	-3618	1972	-1734	-3793	-8140	-516
95-98	-7579	2594	-20931	-10296	-21977	-12553	-3601	-4278	-12626	-520
Top 1 Percent	-58990	23861	-353891	-274171	-357376	-279521	-20412	-20559	-48933	-518

Notes: This table shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reform proposals of the US federal personal income tax by income quintile as well as a decomposition for the top quintile. The data is taken from the Tax Policy Center's ex ante analysis of each reform proposal. Details on the underlying data, methods and simulation model can be found here: `https://www.taxpolicycenter.org/resources/brief-description-tax-model`. For each proposal, there is a code ("Source") corresponding to the source document from the Tax Policy Center. The table also contains information on the year of the proposal, the year of the projection and the employed baseline (current law vs. current policy).
Source: Authors' calculations based on Tax Policy Center.

Table G.6: Counterfactual change in tax liability of Tax Reform Proposals (initiated by the Administration) Part 1

	Unified Framework	**Proposal for Budget FY2010 A**	**Proposal for Budget FY2010 B**	**Proposal for Budget FY2011 A**	**Proposal for Budget FY2011 B**	**Proposal for Budget FY2012 A**	**Proposal for Budget FY2012 B**
Year of projection	2018	2012	2011	2012	2012	2013	2013
Year of proposal	2017	2009	2009	2010	2010	2011	2011
Source	T17-0225	T09-0132	T09-0501	T10-0037	T10-0039	T11-0027	T11-0029
Baseline	Current Law	Current Law	Current Law	Current Law	Current Policy	Current Law	Current Policy
Lowest Quintile	-60	-572	-496	-284	-216	-272	-216
Second Quintile	-290	-1197	-1059	-844	-264	-805	-264
Middle Quintile	-660	-1625	-1484	-1261	-244	-1166	-244
Fourth Quintile	-1110	-2747	-2553	-2396	-229	-2297	-229
Top Quintile	-8470	-5028	-6483	-5465	3698	-4882	3698
All	-1570	-1965	-2051	-1729	347	-1599	347
Addendum							
80-89	-1140	-4672	-4690	-4439	-273	-4184	-273
90-94	-1500	-5790	-5900	-5820	-222	-5654	-222
95-98	-7620	-6223	-8579	-7994	1857	-6881	1857
Top 1 Percent	-129030	-138	-18755	-3966	68906	-205	68906

Notes: This table shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reform proposals of the US federal personal income tax by income quintile as well as a decomposition for the top quintile. The data is taken from the Tax Policy Center's ex ante analysis of each reform proposal. Details on the underlying data, methods and simulation model can be found here: `https://www.taxpolicycenter.org/resources/brief-description-tax-model`. For each proposal, there is a code ("Source") corresponding to the source document from the Tax Policy Center. The table also contains information on the year of the proposal, the year of the projection and the employed baseline (current law vs. current policy).

Source: Authors' calculations based on Tax Policy Center.

Table G.7: Counterfactual change in tax liability of Tax Reform Proposals (initiated by the Administration) Part 2

	Proposal for Budget FY2013 A	**Proposal for Budget FY2013 B**	**Proposal for Budget FY2014 A**	**Proposal for Budget FY2015 B**	**Implement a Simplified Tax System**	**Integrated Payroll Tax Plan**
Year of projection	2014	2014	2015	2016	2010	2008
Year of proposal	2012	2012	2013	2014	2010	2007
Source	T12-0043	T12-0045	T13-0134	T14-0057	T10-0077	T07-0209
Baseline	Current Law	Current Policy	Current Law	Current Policy	Current Law	Current Law
Lowest Quintile	-196	-2	2	-126	-13	-181
Second Quintile	-731	-22	1	-23	-53	-264
Middle Quintile	-1133	-40	-13	-18	-62	-337
Fourth Quintile	-2255	-22	-15	-17	19	-420
Top Quintile	-3762	5683	2537	2519	4502	3345
All	-1355	807	368	312	644	431
Addendum						
80-89	-4279	68	29	14	132	7108
90-94	-5659	120	65	93	127	13410
95-98	-5743	4495	2652	2677	2707	43126
Top 1 Percent	18519	93707	39739	38264	76558	65689

Notes: This table shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reform proposals of the US federal personal income tax by income quintile as well as a decomposition for the top quintile. The data is taken from the Tax Policy Center's ex ante analysis of each reform proposal. Details on the underlying data, methods and simulation model can be found here: `https://www.taxpolicycenter.org/resources/brief-description-tax-model`. For each proposal, there is a code ("Source") corresponding to the source document from the Tax Policy Center. The table also contains information on the year of the proposal, the year of the projection and the employed baseline (current law vs. current policy).
Source: Authors' calculations based on Tax Policy Center.

Table G.8: Counterfactual change in tax liability of Further Amended Tax Reforms

	Middle Class Tax Relief and Job Creation Act	**Temporary Payroll Tax Cut Continuation Act**	**Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act A**	**Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act B**	**American Recovery and Reinvestment Act**	**Economic Stimulus Act**	**Tax Increase Prevention Act**	**Tax Increase Prevention and Reconciliation Act**	**Working Families Tax Relief Act**
Year of projection	2012	2012	2011	2011	2009	2008	2007	2006	2005
Year of proposal	2012	2011	2010	2010	2009	2008	2007	2005	2004
Source	T12-0034	T12-0006	T10-0273	T10-0275	T09-0113	T08-0062	T07-0343	T06-0086	T04-0154
Baseline	Current Law(1) ()	Current Law(1)	Current Law	Current Policy	Current Law	Current Law	Current Law	Current Law	Current Law
Lowest Quintile	-89	-15	-351	-307	-473	-420	0	0	-2
Second Quintile	-309	-52	-1047	-524	-642	-653	0	-7	-55
Middle Quintile	-597	-103	-1713	-772	-765	-824	-4	-20	-162
Fourth Quintile	-1105	-191	-3186	-1296	-1263	-969	-88	-117	-331
Top Quintile	-2021	-341	-10887	-2556	-3113	-715	-1415	-2119	-1317
All	-682	-116	-2823	-950	-1092	-715	-301	-453	-374
Addendum									
80-89	-1780	-302	-5906	-2068	-2470	-975	-704		
90-94	-2226	-376	-7759	-2544	-3732	-688	-1514		
95-98	-2278	-380	-11983	-2903	-4642	-268	-3253		
Top 1 Percent	-2407	-396	-70836	-6095	-514	-38	-684	-14094	-2390

Notes: This table shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for reform proposals of the US federal personal income tax by income quintile as well as a decomposition for the top quintile. The data is taken from the Tax Policy Center's ex ante analysis of each reform proposal. Details on the underlying data, methods and simulation model can be found here: `https://www.taxpolicycenter.org/resources/brief-description-tax-model`. For each proposal, there is a code ("Source") corresponding to the source document from the Tax Policy Center. The table also contains information on the year of the proposal, the year of the projection and the employed baseline (current law vs. current policy).
Source: Authors' calculations based on Tax Policy Center.

H. Details on US Tax Reforms

In this section, we briefly outline the major changes in the US personal income tax system from 1964 until 2017. Table H.1 provides an overview of the 11 reforms that we identified and analyze. We concentrate on large legislative changes which drive the tax policy effect. Reforms of interest are the Revenue Act of 1964 (RA64), the Tax Reform Act of 1969 (TRA69), the Revenue Act of 1978 (RA78), the Economic Recovery Tax Act of 1981 (ERTA81), the Tax Reform Act of 1986 (TRA86), the Omnibus Budget Reconciliation Act of 1990 and 1993 (OBRA90 and OBRA93), the Economic Growth and Tax Relief Reconciliation Act of 2001 (EGTRRA01), the Jobs and Growth Tax Relief Reconciliation Act of 2003 (JGTRRA03), the American Taxpayer Relief Act of 2012 (ATRA12) and the Tax Cuts and Jobs Act of 2017 (TCJA17).

Tax reform	pre	post	key features of the reform
RA64	1962	1966	Tax cut (top rate from 91% to 70%)
TRA69	1968	1970	Introduction of Alternative Minimum Tax and new tax schedule for single taxpayers
RA78	1978	1979	Widening of tax brackets (and reducing their number)
ERTA81	1980	1984	Tax cut (top rate from 70% to 50%)
TRA86	1985	1988	Broadening of tax base and reductions in MTRs (top rate from 50% to 28%)
OBRA90	1990	1991	Increase of top tax rate from 28% to 31%
OBRA93	1992	1993	Expansion of EITC and increase of top tax rate from 31% to 39.6%
EGTRRA01	2000	2002	Reductions in marginal tax rates
JGTRRA03	2002	2003	Reductions in marginal tax rates
ATRA12	2012	2013	Increase of tax rates for high income earners
TCJA17	2016	2018	Tax cuts (top rate from 39.6% to 37%)

Table H.1: Overview of US reforms

Notes: Table H.1 lists the major reforms of the federal income tax in the US after WWII: the Revenue Act of 1964 (RA64), the Tax Reform Act of 1969 (TRA69), the Revenue Act of 1978 (RA78), the Economic Recovery Tax Act of 1981 (ERTA81), the Tax Reform Act of 1986 (TRA86), the Omnibus Budget Reconciliation Act of 1990 and 1993 (OBRA90 and OBRA93), the Economic Growth and Tax Relief Reconciliation Act of 2001 (EGTRRA01), the Jobs and Growth Tax Relief Reconciliation Act of 2003 (JGTRRA03), the American Taxpayer Relief Act of 2012 (ATRA12) and the Tax Cuts and Jobs Act of 2017 (TCJA17). The pre reform year is always the last year before any change was implemented while the post reform year is the one after all changes are phased in (except for RA64 due to only bi-annual data availability of SOI PUF before 1966).

The key features of these reforms as well as distributional ex ante analyses of these reforms are summarized in the following.

RA64: RA64 was proposed by President Kennedy, thus often referred to as

"Kennedy tax cuts", but came into effect only after his assassination in 1964. Individual tax rates were reduced considerably, with the marginal rate at the top dropping from 91% to 70%. The tax revenue effect was negative (Tempalski (2006)). To the best of our knowledge, there is no retrievable distributional analysis for this reform and we provide such an analysis in Figure 2 .

TRA69: The main goal of TRA69 was to tax high-income earners who had previously avoided paying taxes due to various exemptions and deductions by creating the Alternative Minimum Tax (AMT). There were also some tax rate and bracket changes (mostly for single taxpayers) and some changes to standard deductions and personal exemptions. The tax revenue effect was negative (Tempalski (2006)). To the best of our knowledge, there is no retrievable distributional analysis for this reform and we provide such an analysis in Figure 2 .

RA78: RA78 reduced individual income taxes by widening tax brackets, reducing the number of tax rates, increasing the personal exemption, increasing the standard deduction and reducing the effective tax rate on realized capital gains. The tax revenue effect was negative (Tempalski (2006)). To the best of our knowledge, there is no retrievable distributional analysis for this reform and we provide such an analysis in Figure 2 .

ERTA81: ERTA81 introduced the indexation of individual income tax parameters which became effective in 1985. Tax cuts were phased in over the years 1982–1984, with a reduction of top marginal tax rates from 70% to 50% in 1982 and of other tax rates by 23% in three annual steps. Further, the income threshold for the top rate substantially increased from $85,600 in 1982 to $109,400 (1983) and $162,400 (1984) for married couples filing jointly. Similarly, thresholds were increased for couples filing separately and for singles. The Joint Committee on Taxation (1981) conducted an ex ante analysis of the anticipated distributional effects. Estimates for the year 1982 show that all income classes are expected to pay less taxes (see Table H.3).

TRA86: Key aspects of TRA86 were the broadening of the tax base and reductions in marginal tax rates.[5] TRA86 further lowered the top marginal rate to 38.5% in 1987 and to 28% in 1988, reduced the number of tax brackets from 15 in 1986 to two in 1988, but also substantially expanded the EITC with financial benefits for low–income households. The Joint Committee on Taxation (1986) conducted an ex ante analysis of the anticipated distributional effects. The prediction was that all taxpayers would gain (see Table H.3).

OBRA90 & OBRA93: OBRA90 contained increases in income taxes as well as expansions of the EITC and other low–income credits. Furthermore, payroll taxes were increased by lifting the taxable maximum for Medicare which was finally abolished in 1994. OBRA93 then led to the largest single expansion of the EITC (cf. Eissa and Hoynes (2011), and further increases in income tax rates were implemented, e.g. the top rate rose from 31% to 39.6% in 1993. The

[5] As part of the tax burden was effectively shifted from the individual to the corporate sector which is not part of our analysis, TRA86 constitutes a tax cut in the context of this paper.

EITC became much more generous in 1994 with higher maximum credits and an expansion to single workers with no children. The EITC was further expanded in the following years. Joint Committee on Taxation (1990) and Congressional Budget Office (1991) conducted ex ante analyses of the anticipated distributional effects of OBRA90, while Congressional Budget Office (1993) analyzed OBRA93. Both reforms were overall tax increases for most taxpayers except for those at the bottom of the distribution (see Tables H.2 and H.3).

EGTRRA01 & JGTRRA03: EGTRRA01 and JGTRRA03 were characterized by reductions in marginal tax rates, both for low– and high–income families, expansions of the child tax credits, and reductions in taxes on dividends. In 2003, JGTRRA accelerated those provisions of EGTRRA which were not set to become effective until 2006. Ex ante analyses of the anticipated distributional effects of both EGTRRA01 Tax Policy Center (2002); Joint Committee on Taxation (2001) and JGTRRA03 Tax Policy Center (2003b,c) show that both reforms were tax cuts and that the absolute dollar change in income tax payments increases with each household income quintile (see Tables H.2 and H.3).

ATRA12: ATRA12 made the changes introduced with EGTRRA01 and JGTRRA03 permanent with the exception of high-income taxpayers. For individuals with earnings in excess of $400,000 ($450,000 for jointly filing married couples), the lowered rates expired as scheduled and the previous marginal rate of 39.6% was brought back. Additionally, these individuals saw an increase in the taxation of long-term capital gains and dividends, with the rate raising from 15 to 20%. Tax Policy Center (2012k,l) conducted ex ante analyses of the anticipated distributional effects of ATRA12 assuming either current law as baseline (i.e., temporary tax changes are considered to expire once finished) or current policy as baseline (i.e., temporary tax changes are assumed to remain in place after they expire) (see Tables H.2 and H.3). When using the current law baseline, the reform is a tax cut for all taxpayers while it is an increase for the top of the distribution when using current policy as the baseline. We refer to Saez (2016) for a detailed analysis ex post of ATRA12.

TCJA17: TCJA17 made several significant changes to individual tax rates as well as to the calculation of taxable income. Tax rates were reduced for all income brackets but the lowest by one to four percentage points. The top rate was brought down from 39.6% to 37%. Furthermore, both the standard deduction and the child tax credit were roughly doubled. Joint Committee on Taxation (2017); Tax Policy Center (2018b,a) conducted ex ante analyses of the anticipated distributional effects (see Tables H.2 and H.3).

Table H.2: Distributional effects of major US Tax Reforms from 1981 to 2017, by Income Percentiles

	TCJA17	**ATRA12**	**ATRA12**	**JGTRRA03**	**EGTRRA01**	**OBRA93**	**OBRA90**	**TRA86**	**ERTA81**
Year of projection	2018	2013	2013	2003	2002	1994	1991	(n.a.)	(n.a.)
Source	Tax Policy Center (2018b)	Tax Policy Center (2012b)	Tax Policy Center (2012d)	Tax Policy Center (2003b)	Tax Policy Center (2002b)	CBO (1993)	CBO (1991)		
Baseline		Current Law	Current Policy						
Lowest Quintile	-190	-265	0	-1	-26	-166	-109		
Second Quintile	-550	-795	1	-72	-283	-35	73		
Middle Quintile	-1,050	-1184	0	-245	-469	64	290		
Fourth Quintile	-1,810	-2170	-2	-475	-601	110	414		
Top Quintile	-7,170	-6845	2,483	-2,666	-1,287	1,884	1389		
All	-2,180	-1847	364	-692	-534	382	411		
Addendum									
80-89	-2,950	-4275	-1	-1,253	-871	239			
90-94	-4,100	-5494	-1	-2,110	-1,081	388			
95-98	-12,130	-10359	-71	-3,173	-1,418	1,177			
Top 1 Percent	-51,310	-25672	50,508	-17,540	-5,950	29,417			
Top 0.1 Percent	-247,020	-71885	322,528						

Notes: This table shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for implemented reforms of the US federal personal income tax by income quintile as well as a decomposition for the top quintile. The table also contains information on the year of the proposal, the year of the projection, the source and the employed baseline (current law vs. current policy).

Source: Authors' calculations based on the "Source".

Table H.3: Distributional effects of major US Tax Reforms from 1981 to 2017, by Income Class

	TCJA17	**ATRA12**	**ATRA12**	**JGTRRA03**	**EGTRRA01**	**OBRA93**	**OBRA90**	**TRA86**	**ERTA81**
Year of projection	2018	2013	2013	2003	2002	1994	1991	1986	1982
Source	Tax Policy Center (2018a)	Tax Policy Center (2012a)	Tax Policy Center (2012c)	Tax Policy Center (2003a)	Tax Policy Center (2002a)	CBO (1993)	JCT (1990)	JCT (1986)	JCT (1981)
Baseline		Current Law	Current Policy						
Less than 10	-10	-131	0	-2	-27	-68	-6	-39	-92
10-20	-50	-351	0	-97	-270	-86	-83	-200	-284
20-30	-180	-709	2	-225	-448	-41	103	-220	-498
30-40	-360	-891	0	-324	-495	50	183	-273	-782
40-50	-570	-1047	0	-445	-549	105	205	-486	-1135
50-75	-870	-1428	-1	-688	-687	192	234	-150	-1934
75-100	-1310	-2253	-2	-1597	-924	312	453	-176	-3275
100-200	-2260	-4436	-1	-2497	-1159	649	940	-612	-13282
200-500	-6560	-10203	-70	-4997	-2020				-58250
500-1,000	-21240	-17585	6689	-15452	-4769				
More than 1,000	-69660	-38947	122560	-3	-18604	23521	9323	-3362	-135249
All	-1610	-1847	364	-692	-534	382			

Notes: This table shows the average value of the counterfactual change in tax liability $T_1\left(\hat{y}_0^i\right) - T_0\left(y_0^i\right)$ for implemented reforms of the US federal personal income tax by income classes. The table also contains information on the year of the proposal, the year of the projection, the source and the employed baseline (current law vs. current policy).
Source: Authors' calculations based on the "Source".

I. Extensions

In this section we show that the median voter theorem for small monotonic reforms (Theorem 1) applies to models with more than one source of heterogeneity among individuals. Again, we show that a small tax reform is preferred by a majority of taxpayers if and only if it is preferred by the taxpayer with median income. Throughout, we stick to the assumption that individuals differ in their productive abilities ω. We introduce a second consumption good and the possibility of heterogeneity in preferences over consumption goods in Section I.I.1. We use this framework to discuss whether the introduction of distortionary taxes on savings is politically feasible. In Section I.I.2 we consider fixed costs of labor market participation as an additional source of heterogeneity.[6] In Section I.I.3 we assume that individuals differ in their valuation of increased public spending.[7] Finally, in Section I.I.4, individuals differ by how much of their income is due to luck as in Alesina and Angeletos (2005).

I.1. Political support for taxes on savings

We now suppose that there are two consumption goods. We refer to them as food and savings, respectively. An individual's budget constraint now reads as

$$c_f + c_s + T_{0s}(c_s) + \tau_s h_s(c_s) \leq c_0 + y - T_0(y) - \tau h(y) \; . \tag{I.1}$$

The variables on the right-hand side of the budget constraint have been defined before. On the left-hand side, c_f denotes food consumption and c_s savings. In the status quo savings are taxed according to a possibly non-linear savings-tax function T_{0s}. A reform replaces both the status quo income tax schedule T_0 by $T_1 = T_0 + \tau h$ and the status quo savings tax schedule T_{0s} by $T_{1s} = T_{0s} + \tau_s h_s$. We maintain the assumption that the functions h and h_s are non-decreasing and focus on revenue neutral reforms so that either $\tau > 0$ and $\tau_s < 0$ or $\tau < 0$ and $\tau_s > 0$.

Preferences of individuals are given by a utility function $u(v(c_f, c_s, \beta), y, \omega)$, where v is a subutility function that assigns consumption utility to any consumption bundle (c_f, c_s). The marginal rate of substitution between food and savings depends on a parameter β. We do not assume a priori that β is the same for all individuals. Under this assumption, however, the utility function u has the properties under which an efficient tax system does not involve distortionary commodity taxes, see Atkinson and Stiglitz (1976), or Laroque (2005) for a more elementary proof. Distortionary taxes on savings are then undesirable from a welfare-perspective.

Individuals choose c_f, c_s and y to maximize utility subject to the budget constraint above. We denote the utility maximizing choices by $c_f^*(\tau_s, \tau, \beta, \omega)$,

[6] See Saez (2002), Choné and Laroque (2011), and Jacquet et al. (2013).
[7] See Boadway and Keen (1993), Hellwig (2004), Bierbrauer (2014), or Weinzierl (2018).

$c_s^*(\tau_s, \tau, \beta, \omega)$ and $y^*(\tau_s, \tau, \beta, \omega)$ and the corresponding level of indirect utility by $V(\tau_s, \tau, \beta, \omega)$. The slope of an indifference curve in a τ-τ_s diagram determines the individuals' willingness to accept higher savings taxes in return for lower taxes on current earnings. The following Lemma provides a characterization of this marginal rate of substitution in a neighborhood of the status quo. Let

$$s(\tau, \tau^s, \beta, \omega) = -\frac{V_\tau(\tau_s, \tau, \beta, \omega)}{V_{\tau_s}(\tau_s, \tau, \beta, \omega)}$$

be the slope of an individual's indifference curve in a τ-τ_s diagram. The slope in the status quo is denoted by $s^0(\omega, \beta)$. We denote the individual's food consumption, savings and earnings in the status quo by $\tilde{c}_f^0(\omega, \beta)$, $\tilde{c}_s^0(\omega, \beta)$ and $\tilde{y}^0(\omega, \beta)$, respectively.

Lemma I.1 *In the status quo the slope of a type (ω, β)-individual's indifference curve in a τ-τ_s diagram is given by*

$$s^0(\omega, \beta) = -\frac{h(\tilde{y}^0(\omega, \beta))}{h_s(\tilde{c}_s^0(\omega, \beta))} \ .$$

The Lemma provides a generalization of Roy's identity that is useful for an analysis of non-linear tax systems. As is well known, with linear tax systems, the marginal effect of, say, an increased savings tax on indirect utility is equal to $-\lambda^* c_s^*(\cdot)$, where λ^* is the multiplier on the individual's budget constraint, also referred to as the marginal utility of income. Analogously, the increase of a linear income tax affects indirect utility via $-\lambda^* y^*(\cdot)$ so that the slope of an indifference curve in a τ_s-τ-diagram would be equal to the earnings-savings-ratio $-\frac{y^*(\cdot)}{c_s^*(\cdot)}$. Allowing for non-linear tax systems and non-linear perturbations implies that the simple earnings-savings-ratio is replaced by $-\frac{h(y^*(\cdot))}{h_s(c_s^*(\cdot))}$.

Consider a reform that involves an increase in the savings tax rate $d\tau_s > 0$ and a reduction of taxes on income $d\tau < 0$. We say that a type (ω, β)-individual strictly prefers a small reform with increased savings taxes over the status quo if

$$V_{\tau_s}(0, 0, \beta, \omega)\ d\tau_s + V_\tau(0, 0, \beta, \omega)\ d\tau > 0 \ ,$$

or, equivalently, if

$$\frac{d\tau_s}{d\tau} > s^0(\omega, \beta) = -\frac{h(\tilde{y}^0(\omega, \beta))}{h_s(\tilde{c}_s^0(\omega, \beta))} \ . \tag{I.2}$$

Since h_s is an increasing function, this condition is, ceteris paribus, easier to satisfy if the individual has little savings in the status quo.[8]

[8]The ratio $\frac{d\tau_s}{d\tau}$ on the left-hand side of inequality (I.2) is determined as follow: Let $R^s(\tau_s, \tau)$ be the change of revenue from savings taxes and $R(\tau_s, \tau)$ the change of revenue from income taxation due to

Different types will typically differ in their generalized earnings-savings-ratio $s^0(\omega, \beta)$ and we can order types according to this one-dimensional index. Let $(\omega, \beta)^{0M}$ be the type with the median value of $s^0(\omega, \beta)$. The following proposition extends Theorem 1. It asserts that a small reform is politically feasible if and only if it is supported by the median type $(\omega, \beta)^{0M}$.

Proposition I.1 *For a given status quo tax policy and a given pair of non-decreasing functions h and h_s, the following statements are equivalent:*

1) *Type $(\omega, \beta)^{0M}$ prefers a small reform with increased savings taxes over the status quo.*
2) *There is a majority of individuals who prefer a small reform with increased savings taxes over the status quo.*

As Theorem 1, Proposition I.1 exploits the observation that individuals can be ordered according to a one-dimensional statistic that pins down whether or not they benefit from a tax reform. This makes it possible to prove a median-voter theorem for reforms that remain in a neighborhood of the status quo. There is also an important difference to Theorem 1. With only one-dimensional heterogeneity, there is a monotonic relation between types and earnings so that the identity of the type with median income does not depend on the status quo. Whatever the tax system, the person with the median income is the person with the median type ω^M. Here, by contrast, we allow for heterogeneity both in productive abilities and in preferences over consumption goods. The type with the median value of the generalized earnings-savings-ratio $s^0(\omega, \beta)$ will then typically depend on the status quo tax system. This does not pose a problem if we focus on small reforms. In this case, preferences over reforms follow from the generalized earnings-savings-ratios in the status quo, and a small reform is preferred by a majority of individuals if and only if it is preferred by the individual with the median ratio.

I.2. Fixed costs of labor market participation

With fixed costs of labor market participation individuals derive utility $u(c - \theta\, \mathbf{1}_{y>0}, y, \omega)$ from a (c, y)-pair. Fixed costs θ absorb some of the individual's after-tax income if the individual becomes active on the labor market, e.g. because of additional child care expenses. As before, there is an initial status quo tax

the reform. Revenue-neutrality requires that

$$R^s_{\tau_s}(\tau_s, \tau) d\, \tau_s + R^s_{\tau}(\tau_s, \tau)\; d\tau + R_{\tau_s}(\tau_s, \tau)\; d\tau_s + R_{\tau}(\tau_s, \tau)\; d\tau = 0\;,$$

or, equivalently, that

$$\frac{d\tau_s}{d\tau} = -\frac{R_\tau(\tau_s, \tau) + R^s{}_\tau(\tau_s, \tau)}{R^s_{\tau_s}(\tau_s, \tau) + R_{\tau_s}(\tau_s, \tau)}\;,$$

which has to be evaluated for $(\tau_s, \tau) = (0, 0)$. We assume that this expression is well-defined and takes a finite negative value.

schedule under which earnings are transformed into after-tax income according to the schedule C_0 with $C_0(y) = c_0 + y - T_0(y)$. After a reform, the schedule is

$$C_1(y) = c_0 + R + y - T_0(y) - \tau\, h(y)\ ,$$

where h is a non-decreasing function of y. We denote by $y^*(R, \tau, \omega, \theta)$ the solution to

$$\max_y\ u(C_1(y) - \theta\ \mathbf{1}_{y>0}, y, \omega),$$

and the reform-induced change in indirect utility by $V(R, \tau, \omega, \theta)$. We proceed analogously for other variables: what has been a function of ω in previous sections is now a function of ω and θ.

For a given function h, the marginal gain that is realized by an individual with type (ω, θ) if the tax rate τ is increased, is given by the following analogue to equation (2),

$$V_\tau(\omega, \theta \mid \tau, h) = \tilde{u}^1_c(\omega, \theta)\left(R_\tau(\tau, h) - h(\tilde{y}^1(\omega, \theta))\right)\ , \tag{I.3}$$

where $\tilde{u}^1_c(\omega, \theta)$ is the marginal utility of consumption realized by a type (ω, θ)-individual after the reform, and $\tilde{y}^1(\omega, \theta)$ are the individual's post-reform earnings. At $\tau = 0$, we can also write

$$V_\tau(\omega, \theta \mid 0, h) = \tilde{u}^0_c(\omega, \theta)\left(R_\tau(0, h) - h(\tilde{y}^0(\omega, \theta))\right)\ , \tag{I.4}$$

where $\tilde{u}^0_c(\omega, \theta)$ and $\tilde{y}^0(\omega, \theta)$ are, respectively, marginal utility of consumption and earnings in the status quo.

For a given status quo tax policy and a given function h we say that type (ω, θ) strictly prefers a small tax reform over the status quo if $V_\tau(\omega, \theta \mid 0, h) > 0$. The status quo median voter strictly prefers a small reform if $V_\tau\left((\omega, \theta)^{0M} \mid 0, h\right) > 0$, where $\tilde{y}^{0M}$ is the median of the distribution of earnings in the status quo and $(\omega, \theta)^{0M}$ is the corresponding type; i.e. $\tilde{y}^0\left((\omega, \theta)^{0M}\right) = \tilde{y}^{0M}$.

Proposition I.2 *For a given status quo tax policy and a monotonic function h, the following statements are equivalent:*

1) *Type $(\omega, \theta)^{0M}$ prefers a small reform over the status quo.*
2) *There is a majority of individuals who prefer a small reform over the status quo.*

Proposition I.2 exploits that the slope of a type (ω, θ) individual's indifference curve through a point (τ, R),

$$s(\tau, R, \omega, \theta) = h(y^*(R, \tau, \omega, \theta))\ .$$

is a function of the individual's income. As in the basic Mirrleesian setup, the interpretation is that individuals with a higher income are more difficult to convince that a reform that involves tax increases ($\tau > 0$) is worthwhile. A difference to the Mirrleesian setup is, however, that there is no monotonic relation between types and earnings. In the presence of income effects, and for a given level of ω, y^* will increase in θ as long as θ is below a threshold $\hat{\theta}(\omega)$ and be equal to 0 for θ above the threshold. Moreover, the threshold is affected by tax policy. This implies that there is no longer a fixed type whose income is equal to the median income whatever the tax schedule. As in Proposition I.1, this does not pose a problem if we focus on small reforms, i.e. on small deviations from $(\tau, R) = (0, 0)$. In this case, preferences over reforms follow from the relation between types and earnings in the status quo, and a small reform is preferred by a majority of individuals if and only if it is preferred by the individual with the median level of income in the status quo.

I.3. Public-goods preferences

Suppose that the change in revenue R is used to increase or decrease spending on publicly provided goods. The post-reform consumption schedule is then given by

$$C_1(y) = c_0 + y - T_0(y) - \tau\ h(y)\ ,$$

We assume that individuals differ with respect to their public-goods preferences. Now the parameter θ is a measure of an individual's willingness to give up private goods consumption in exchange for more public goods. More specifically, we assume that individual utility is

$$u(\theta(R^0 + R) + C_1(y), y, \omega)\ ,$$

where R^0 is spending on publicly provided goods in the status quo. Again, we denote by $y^*(R, \tau, \omega, \theta)$ the solution to

$$\max_y\ u(\theta(R^0 + R) + C_1(y), y, \omega)$$

and the reform-induced change in indirect utility by $V(R, \tau, \omega, \theta)$. By the envelope theorem, the slope of a type (ω, θ) individual's indifference curve through point (τ, R) is now given by

$$s(\tau, R, \omega, \theta) = \frac{h(y^*(R, \tau, \omega, \theta))}{\theta}\ .$$

This marginal rate of substitution gives the increase in public-goods provision that an individual requires as a compensation for an increase of marginal tax rates. Ceteris paribus, individuals with a lower income and individuals with a higher public-goods preference require less of a compensation, i.e. they have a higher willingness to pay higher taxes for increased public-goods provision. If we focus on small reforms we observe, again, that if a type (ω, θ)-individual benefits from a small tax-increase, then the same is true for any type (ω', θ') with

$$\frac{h(\tilde{y}^0(\omega,\theta))}{\theta} \geq \frac{h(\tilde{y}^0(\omega',\theta'))}{\theta'} \ .$$

By the arguments in the proof of Proposition I.2, a small reform with $\tau > 0$ is preferred by a majority of individuals if and only if

$$\left(\frac{h(\tilde{y}^0(\omega,\theta))}{\theta}\right)^{0M} < R_\tau(0,h) \ ,$$

where $\left(\frac{h(\tilde{y}^0(\omega,\theta))}{\theta}\right)^{0M}$ is the median willingness to pay higher taxes for increased public spending in the status quo.

I.4. Fairness and politically feasible reforms

The validity of our approach does not dependent on the assumption that voting behavior is driven by narrow self-interest. To illustrate this insight, we analyze politically feasible reforms in the context of a model in which social preferences determine political support for redistributive taxation. Specifically, we adopt the framework of Alesina and Angeletos (2005). Alesina and Angeletos assume that individual incomes can be due to luck or effort and that preferences over tax policies include a motive to tax income that is due to luck more heavily than income that is due to effort. Alesina and Angeletos focus, however, on linear tax systems.

There are two periods. When young individuals choose a level of human capital k. When old individuals choose productive effort or labor supply l. Pre-tax income is determined by

$$y = \pi(l,k) + \eta \ ,$$

where π is a production function that is increasing in both arguments and η is a random source of income, also referred to as luck. An individual's life-time utility is written as $u(c,l,k,\omega)$. Utility is increasing in the first argument. It is decreasing in the second and third argument to capture the effort costs of labor supply and human capital investments, respectively. Effort costs are decreasing in ω. More formally, lower types have steeper indifference curves both in a (c,l)-space and in a (c,k)-space. We consider reforms that lead to a consumption schedule

$$C_1(y) = c_0 + R + y - T_0(y) - \tau \ h(y) \ .$$

We assume that individuals first observe how lucky they are and then choose how hard they work, i.e. given a realization of η and given the predetermined level of k, individuals choose l so as to maximize

$$u(C_1(\pi(l,k)+\eta), l, k, \omega) \ .$$

We denote the solution to this problem by $l^*(R,\tau,\omega,\eta,k)$. The reform-induced change in indirect utility is denoted by $V(R,\tau,\omega,\eta,k)$. As of $t=1$, there is multi-dimensional heterogeneity among individuals: they differ in their type ω, in their realization of luck η and possibly also in their human capital k.

In Alesina and Angeletos (2005) preferences over reforms have a selfish and fairness component. The indirect utility function V shapes the individuals' selfish preferences over reforms. The analysis of these selfish preferences can proceed along similar lines as the extension that considered fixed costs of labor market participation. Selfish preferences over small reforms follow from the relation between types and earnings in the status quo, and a small reform makes a majority better off if and only if it is beneficial for the individual with the median level of income in the status quo. More formally, let $\tilde{y}^0(\omega,\eta,k) := y^*(0,0,\omega,\eta,k)$ be a shorthand for the earnings of a type (ω,η,k)-individual in the status quo and recall that the sign of

$$s(0,0,\omega,\eta,k) = h(\tilde{y}^0(\omega,\eta,k))$$

determines whether an individual benefits from a small tax reform. Specifically, suppose that h is a non-decreasing function and denote by y_0^M the median level of income in the status quo and by $(\omega,\eta,k)^{0M}$ the corresponding type. A majority of individuals is – according to their selfish preferences – made better off if and only if the median voter benefits from the reform,

$$s^0\left((\omega,\eta,k)^{0M}\right) = h\left(\tilde{y}^{0M}\right) < R_\tau(0,h)\ .$$

In their formalization of social preferences, Alesina and Angeletos (2005) view $\pi(l,k)$ as a reference income. It is the part of income that is due to effort as opposed to luck. A tax reform affects the share of $y=\pi(l,k)+\eta$ that individuals can keep for themselves. After the reform, the difference between disposable income and the reference income is given by[9]

$$C_1(y) - \pi(l,k) = \eta - T_0(\pi(l,k)+\eta) - \tau h(\pi(l,k)+\eta)\ .$$

A social preferences for fair taxes is then equated with a desire to minimize the variance of $\eta - T_0(\pi(l,k)+\eta) - \tau h(\pi(l,k)+\eta)$ taking into account that k and l are endogenous variables.[10] Denote this variance henceforth by $\Sigma(R,\tau)$. Any one individual is assumed to evaluate a tax reform according to

$$V(R,\tau,\omega,\eta,k) - \rho\ \Sigma(R,\tau)\ ,$$

[9]The analysis in Alesina and Angeletos (2005) looks at a special case of this. They focus on a status quo equal to the laissez-faire schedule so that $T_0(y)=0$, for all y, and a reform that introduces a linear tax schedule, i.e. $h(y)=y$, for all y. Under these assumptions, we have $\eta - T_0(\pi(l,k)+\eta) - \tau h(\pi(l,k)+\eta) = (1-\tau)\eta + \tau\pi(l,k)$.

[10]Human capital investment is a function of effort costs ω and the expectations (R^e,τ^e) of the young on the tax reforms that will be adopted when they are old.

where ρ is the weight on fairness considerations which is assumed to be the same for all individuals. Therefore, heterogeneity in preferences over reforms is entirely due to heterogeneity in selfish preferences. Consequently, the finding that a small reform is preferred by a majority of taxpayers if and only if it is preferred by the voter with median income in the status quo is not affected by the inclusion of a demand for fair taxes.

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