Distributional Tax Analysis in Theory and Practice: Harberger Meets Diamond-Mirrlees*

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Abstract

This paper proposes a new framework to study the distribution of taxes and the effects of tax reforms, connecting classical tax incidence analysis to optimal tax theory. To study the distribution of *current taxes*, labor taxes are assigned to the corresponding workers, capital taxes to the corresponding asset owners, and consumption taxes to consumers. The tax rates are the wedges between pre-tax prices (relevant for production) and after-tax prices (relevant for the work, saving, and consumption decisions of households). In contrast to the conventional approach that shifts taxes across production factors, our approach measures actual incomes, is internally consistent, and maximizes the comparability of tax progressivity and inequality over time and across countries. Applying this methodology to the United States, we find that the effective tax rate of the top 1% has declined from about 50% in the early 1950s to 32% in 2021. It is through the corporate tax that a high degree of tax progressivity was achieved in the middle of the 20^{th} century. To analyze the distributional effects of *tax reforms*, mechanical changes in tax liability by income groups and aggregate revenue effects due to household behavioral responses are sufficient statistics in neoclassical optimal tax models. The effects of taxes on pre-tax prices at the heart of classical tax incidence analysis are irrelevant. This neoclassical framework can be extended to incorporate non-standard behavioral responses uncovered by the recent empirical literature. We apply this framework by providing a distributional analysis of frequently discussed tax reforms, including replacing employer-provided health insurance contributions by a payroll tax.

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1 Introduction

Who pays taxes, and how tax reforms would affect the different socieconomic groups, are arguably some of the most important questions in modern democratic societies. Governments of high-income countries collect 30% to 50% of national income in taxes. These cash payments have a first-order effect on the disposable income of households. To inform lawmakers and voters, it is thus critical to have a sound and practical way to allocate taxes across income groups and to analyze who would gain or lose from proposed changes to the tax system.

Theoretically, this is the classical question of tax incidence (see Kotlikoff and Summers, 1987, and Fullerton and Metcalf, 2002, for surveys). Empirically, distributional tax analysis of the full tax system was first produced in the United States following the founding work of Colm and Tarasov (1941), Musgrave et al. (1951), and Pechman and Okner (1974). Building on this work, US government agencies and think tanks have developed sophisticated frameworks to analyze the distribution of federal taxes.[1] The results of these models are published in the form of distributional tax tables that have a large impact in the public debate. A large and growing body of academic work also mobilizes the tools of distributional tax analysis globally (with variation in methods used) to estimate inequality and study tax progressivity.[2]

This paper highlights shortcomings in the conventional practice of distributional tax analysis and proposes a new framework grounded in optimal tax theory that overcomes these limitations. Our starting point is that distributional tax analysis serves two purposes. First, it provides information on the current distribution of income and tax payments by income groups, which is crucial to quantify income inequality, pre-tax and post-tax, and the direct effects of taxes. From now on, we call this analysis *distributional current-tax analysis*. Second, it is used to simulate how a change to the tax system would affect the different socioeconomic groups. From now on, we call this *distributional tax-reform analysis*. In the conventional approach, the allocation of existing taxes and the simulation of tax reforms are done using the same models of tax incidence. But the two types of analyses, we argue, require distinct methodologies, each different from the one conventionally used. This paper presents these methodologies, applies them to the United

[1] See US Congressional Budget Office (2018), US Joint of Committee on Taxation (1993, 2019), US Treasury (2019), and Tax Policy Center (2022) for detailed descriptions and Barthold (1993) for a summary of the practical use of such statistics by the US congress. There is less work on how state and local taxes are distributed, even though state and local taxes represent about a third of total US tax revenue. Institute on Taxation and Economic Policy (2018, 2019) is the only current systematic study on the distribution of US state and local taxes.

[2] Recent estimates of tax progressivity include Aaberge et al. (2021) in Norway, Advani et al. (2023) in the United Kingdom, Atria and Otero (2021) and De Rosa et al. (2022) in Latin America, Bach et al. (2023) in France, Blanchet et al. (2022) in Europe, Bruil et al. (2022) in the Netherlands,, Guzardi et al. (2022) in Italy, and Saez and Zucman (2019) in the United States.

States, and provides a practical guide for their implementation globally.

Our first contribution is to propose a new method for distributional current-tax analysis. In our framework, taxes based on labor income are assigned to the corresponding workers, taxes based on capital or capital income to the owners of the corresponding assets, and taxes based on consumption to the corresponding consumers. This current-tax analysis is economically sound: it describes the price distortions created by the tax system, as one writes a model of optimal taxation. The tax rates in this approach are the wedges between pre-tax prices (relevant for production) and post-tax prices (relevant for the work, saving, and consumption decisions of households). This approach differs from simply following statutory incidence. For example, both employer and employee payroll taxes are a tax on labor, and hence are assigned to workers. In contrast to the conventional approach that shifts some taxes—most notably the corporate tax—across production factors, our approach measures actual incomes (not counterfactual incomes); it is internally consistent; it maximizes the comparability of inequality and tax progressivity over time and across countries with different legal systems; and it is much simpler to implement, because it does not depend on assumptions about behavioral responses to taxes.

Applying this framework to the United States, we find that the effective tax rate of the top 1% of the income distribution has declined from nearly 50% in the early 1950s to 32% in 2021. Thanks to a consistent treatment of business profit taxes, we illuminate the dramatic changes in the taxation of top-end business income over the last century. Rich business owners faced significant price distortions in terms of pre-tax vs. after-tax returns to capital in the 1950s: they paid half or more of their profits in corporate taxes, before facing the progressive individual income tax on distributed income. We show that it is through the corporate tax that the US tax system achieved its high degree of progressivity in the middle of the 20^{th} century—not through the individual income tax, which has absorbed a relatively constant fraction of the pre-tax income of top earners since 1930.

In contrast to conventional incidence, our proposed current-tax analysis captures only the equity aspect of existing taxes. Conceivably, the high tax rates on business income at mid-century might have been detrimental to workers. Perhaps middle-class wages would have been even higher with lower corporate taxes. Our current-tax analysis does not provide information on counterfactual levels of income if the tax system was different, and hence is silent about the efficiency costs of taxation. But it provides a crucial input required to quantify these efficiency costs and to assess the desirability of tax reforms, namely the distortions created by the existing tax system. It is also consistent with the classic dichotomy between equity vs. efficiency effects that arise in all optimal tax models.

Our second contribution is to use optimal tax theory to identify the sufficient statistics needed to conduct distributional tax-reform analysis in neoclassical models. In the optimal tax models of Mirrlees (1971) and Diamond and Mirrlees (1971), all that is needed to assess the desirability of a tax reform is: (i) mechanical changes in tax liability by income groups (which follow directly from current-tax analysis) weighted by social marginal welfare weights to reflect the distributional preferences of society, and (ii) the aggregate revenue effects of the reform due to household behavioral responses, keeping pre-tax prices fixed. Revenue effects do not have to be broken down by income groups: behavioral responses matter only for their aggregate effect on the government budget. The effect of taxes on pre-tax prices—effects that are the heart of classical tax incidence analysis since Harberger (1962, 1964)—turn out to be irrelevant normatively because they can be offset at no fiscal cost with an additional tax adjustment. To understand the intuition, consider a tax on capital. If the tax hurts wages, it also correspondingly increases the rate of return for capitalists. Because this extra capital income can be taxed away to make workers whole, the change in factor prices is irrelevant from an optimal tax perspective. In a nutshell, in our paper, Harberger at long last meets Diamond and Mirrlees—and it is the Diamond-Mirrlees insights that turn out to matter most for tax reform policy advice. Diamond and Mirrlees provide the big picture on which directions of tax reform are desirable. Harberger provides the narrower technical information on how to achieve such tax reforms.

In the real world, because of departures from the assumptions of neoclassical models, tax reforms can have non-standard effects. Our framework can be extended to incorporate these effects. In such cases, it becomes necessary for welfare analysis to include predicted changes in pre-tax and post-tax income by income group in tax-reform tables. The result can then be compared to the current-tax table side by side, providing all the information needed to assess the desirability of the reform considered. To guide the analysis of tax reform in practice, we summarize the main non-standard effects uncovered by a burgeoning new empirical tax literature. We implement our framework by providing a distributional analysis of frequently discussed tax reforms in the United States, including replacing employer-provided health insurance contributions by a payroll tax, when non-standard incidence effects are shown to be crucial.

The rest of this paper proceeds as follows. Sections 2 founds our concepts in standard models of taxation. Sections 3 presents distributional current-tax analysis in practice. We provide an application to the study of the evolution of tax progressivity in the United States in Section 4. We then move to the practice of tax reform analysis. Section 5 applies our distributional tax-reform framework to an increase in the corporate tax rate and in the individual income tax for the top 1%. Section 6 extends our framework to incorporate non-standard incidence effects,

with an application to health insurance funding. Section 7 concludes.

2 Distributional Tax Analysis in Neoclassical Models

This section founds our proposed distributional current-tax and tax-reform tables in models of optimal taxation. In the context of each model we show what is a model-consistent current-tax analysis, and we derive sufficient statistics for tax-reform analysis. We start with the standard model of labor taxation with one sector. We then turn to a two-sector model of labor and capital allowing for effects of taxes on prices.

2.1 Distributional Analysis in the Standard Labor Taxation Model

Consider the model of labor taxation that underpins the analysis of labor supply and the optimal income tax theory of Mirrlees (1971). Individuals differ in their exogenous wage rate w and supply labor l to maximize utility $u(c, l)$, where $c = wl - T(wl)$ is consumption and $T(wl)$ is the tax on earnings wl.

Distributional current-tax analysis. In this model, pre-tax income is wl, after-tax income is $wl - T(wl)$, and taxes paid are $T(wl)$. A consistent current-tax analysis assigns $T(wl)$ in taxes to an individual earning pre-tax income wl. Aggregating pre-tax income, after-tax income, and taxes paid by income groups provides relevant information (in a sense made precise below) about the equity of the current tax system.

A potential limit of such an analysis is that it is silent about any efficiency consideration. To incorporate efficiency costs, the starting point is that income taxation affects labor supply—hence pre-tax earnings—through income and substitution effects. Take the simple case of quasilinear and iso-elastic utility functions of the form $u(c, l) = c - l^{1+1/e}/(1 + 1/e)$. Labor supply is $l = [w(1 - T'(wl))]^e$, so that e is the elasticity of labor supply with respect to the net-of-tax wage rate $w \cdot (1 - T'(wl))$. This model has the advantage of ruling out income effects so that e is both the compensated and uncompensated elasticity, and $u(c, l)$ is also a money-metric measure of utility where \$1 extra of consumption translates into \$1 extra of utility. In a counterfactual world without taxes, labor supply would be $l_0 = w^e$ and earnings would be $wl_0 = w^{1+e}$. The income tax depresses pre-tax earnings by a factor $(1 - T'(wl))^e$.

To assess the effect of the tax on utility, consider the simple case of a linear tax at rate τ, so that $T(wl) = \tau wl$. It follows that $u(c, l) = wl(1 - \tau) - l^{1+1/e}/(1 + 1/e) = wl(1 - \tau)/(1 + e)$ as $l^{1/e} = w(1 - \tau)$. The linear tax decreases utility from $wl_0/(1+e)$ down to $wl(1-\tau)/(1+e)$. The

money-metric welfare cost of the linear income tax is $[wl_0 - wl(1-\tau)]/(1+e)$. The money-metric cost of taxation is not simply counterfactual pretax income wl_0 minus actual aftertax earnings $wl(1-\tau)$. This difference has to be divided by $1+e$ to account for the fact that labor supply—hence its disutility—also changes. The tax burden can be expressed as $wl_0 \cdot [1-(1-\tau)^{1+e}]/(1+e)$. The linear tax rate τ is transformed into a burden tax rate of $[1-(1-\tau)^{1+e}]/(1+e)$. Tax burdens do not add up to taxes collected since tax burdens include the deadweight burden of taxes.

Although such an analysis can yield insights, it also faces two main limitations. First, it is sensitive to the assumption made about the elasticity e. Earnings absent taxes wl_0 are an unobserved counterfactual, the computation of which relies on estimates of behavioral responses to taxes. With a positive e, counterfactual earnings and welfare costs depart from actual pre-tax earnings wl and actual taxes paid $T(wl)$. Counterfactual aggregate earnings can be substantially higher than actual aggregate earnings. Second, counterfactual earnings absent taxes wl_0, money-metric welfare costs $[wl_0 - wl(1-\tau)]/(1+e)$, and actual earnings after-tax $wl(1-\tau)$ do not add up in the usual way (pre-tax earnings − taxes = after-tax earnings), except when $e = 0$ (no behavioral response) or the tax rate τ is vanishingly small. These limitations are probably the reason why, to our knowledge, official distributional tax tables have never been presented using wl_0 and welfare costs.

Optimal tax analysis. One could think that this added complexity is the price to pay to talk about optimal policy rigorously. But this is not correct, because modern optimal tax analysis is based on the analysis of small tax reforms, where the no-tax counterfactual is irrelevant.[3] Optimal tax theory aims at determining whether a tax reform is desirable and ultimately what is the best tax system (i.e., the tax system that no further reform can improve upon). The welfare changes caused by a tax reform are aggregated across all individuals using social marginal welfare weights. The social marginal welfare weight for a given individual is the social value of one extra dollar of disposable income to this individual (relative to one extra dollar of public funds). If the aggregated weighted welfare gains of a tax reform are positive, the reform is desirable.

Consider a small reform $dT(.)$ of an initial tax schedule $T(.)$. Crucially, because labor supply maximizes individual utility, the money-metric welfare cost of the reform for an individual making wl pre-reform is given by $dT(wl)$, i.e., the change in tax liability that the individual

[3]The literature on the marginal costs of public funds has also developed tools to evaluate the efficiency costs of marginal tax reforms (as opposed to existing taxes). There is a close conceptual connection between this literature and the optimal tax literature. See Auerbach (1985) for an early survey and Hendren and Sprung-Keyser (2020) for a new exposition and application to many policies.

would incur absent any behavioral response.[4] The welfare cost of the reform is obtained by looking at the mechanical impact of the tax change, ignoring behavioral responses. Of course, the reform also affects labor supply and pre-tax earnings by $d(wl)$, which in turn change the tax liability of each individual by $T'(wl)d(wl)$. But because labor supply responses have no first-order effect on the welfare of the corresponding individuals, such behavioral responses only matter for their aggregate impact on tax revenue. The classical tax incidence question of the burden of taxes relative to a no-tax counterfactual is not relevant for tax reform analysis. Instead, for the equity part of such an analysis, the two relevant concepts are i) the distribution of taxes actually paid and ii) the distribution of tax changes ignoring behavioral responses.

Distributional tax-reform analysis. In the context of the standard labor-supply model we consider, the useful tax-reform table provides information on the distribution of tax liability changes across income groups ignoring any behavioral responses. It supplements this with an estimate of the aggregate impact of the reform on tax revenue due to all behavioral responses. The dollar value (or cost) of a reform is obtained by (i) weighting the tax liabilities changes of each group with social marginal welfare weights to reflect distributional preferences, (ii) summing across income groups, and (iii) netting out the aggregate revenue effect due to behavioral responses. A positive value means that the reform is desirable.

Two examples are worth taking. First, consider an increase in the top marginal individual income tax rate. If the social welfare weight for top-bracket taxpayers is very small (because their income is high), the weighted welfare cost of the reform for this group is negligible. The reform is desirable if the extra taxes mechanically raised from top-bracket taxpayers are larger than the tax loss due to all behavioral responses—that is, if the tax reform raises revenue. Second, consider a tax reform that cuts (or increases) taxes proportionally to actual taxes paid (for instance, the income tax is cut by 10% across the board from $T(wl)$ to $0.9\times T(wl)$). Then the distributional current-tax analysis described above (a table of $T(wl)$ by income group) directly informs the equity aspect of the trade-off involved in this tax change. The efficiency aspect of that trade-off is a pure budgetary matter that does not require a distributional analysis. This highlights the usefulness of distributional current-tax analysis. We provide a concrete illustration in the case of an increase in the US federal income tax for top 1% income earners in Section 5.1 below.

[4]This is a direct consequence of the envelope theorem. The change in labor supply generated by the reform has only second order effects on welfare because labor supply maximizes utility.

Extension: tax evasion and avoidance. This model easily extends to incorporate tax evasion or avoidance. Suppose that labor supply l and hence earnings wl are inelastic but reported income z is elastic to taxes due to avoidance or evasion responses. In this case, pretax income is wl and aftertax income is $wl - T(z)$, as wl is a better measure of economic income than reported income z which is affected by tax avoidance. Our findings carry over in this setting. The direct impact of the tax change absent behavioral responses is what matters for distributional analysis, while the behavioral responses matter only for their aggregate impact on tax revenue. Empirically, wl may not be observable.[5] If wl is observable, the distributional tax table should be reported along this dimension and reported income z matters only through its impact on taxes.[6] If wl is not observable, one would ideally want to impute wl based on reported incomes and what is known about tax evasion/avoidance and its distribution. This highlights the need to develop good empirical measures of the distribution of tax evasion (see Guyton et al., 2021, for a recent attempt in the United States).

2.2 Distributional Analysis in a Two-Sector Capital and Labor Model

A core aspect of tax incidence, as taught in introductory classes in economics, is the effect of taxes on pretax prices. These price effects can shift taxes from one factor of production to another (or one side of a market to another), an aspect that could not be studied in the one-sector labor supply model discussed above. We now consider a simple neoclassical model of both labor and capital taxation. The model is chosen for its simplicity but also for its economic substance and can be extended along various dimensions.[7] Our reference optimal tax model is now the multi-good/multi-factor model of taxation of Diamond and Mirrlees (1971).

Setup of the model. On the production side, the model is competitive with an aggregate production function $Y = F(K, L)$ with constant returns to scale, where K is capital and L is labor. We denote by w the economy-wide pre-tax wage rate and by r the pre-tax rate of return on capital. Profits maximization leads to the standard conditions: $w = F_L$ and $r = F_K$.

[5] True earnings may be observable if reported earnings correspond to true earnings and evasion/avoidance takes place through deductions, for example. But true earnings may not be observable, for example, in the case of the self-employed.

[6] This is why distributional tables presented in income before deductions such as Adjusted Gross Income in the United States are more useful than distributional tables presented in taxable income that nets out deductions. The United States has a commendable tradition of presenting distributional tables in income before deductions.

[7] Feldstein (1974) is the classic reference for this model. Kotlikoff and Summers (1987) consider the same model in their tax incidence handbook chapter. Both focus primarily on the inelastic capital case while we find it more pedagogical to focus on the inelastic labor case. Our main addition in the context of this model is to show how the analysis of tax incidence—the focus of Feldstein (1974) and Kotlikoff and Summers (1987)—relates to optimal tax analysis.

Because of constant returns to scale, there are no pure profits and $F(K,L) = rK + wL$ in equilibrium, so that output Y can be divided into capital income rK and labor income wL. We denote by σ the elasticity of substitution between capital and labor in the production function and by $\alpha = rK/Y$ the share of capital income in the economy.[8]

On the supply side, we assume that labor (L) is fixed, labor income is taxed at rate τ_L, and capital depends on the net-of-tax return $\bar{r} = r \cdot (1 - \tau_K)$ where τ_K is the tax rate on capital income. We can express everything in terms of capital per unit of labor $k = K/L$. As L is fixed, the supply of k depends solely on $\bar{r}$: $k(\bar{r})$. We can define $f(k) = F(1, K/L) = F(K,L)/L$ as output per unit of labor. We have $F_K = f'(k)$ and $F_L = f(k) - kf'(k)$.

This model can be micro-founded with a simple two-class economy with workers and capitalists. Capitalists have a (reduced-form) utility function of the form $u^K(c,k)$ increasing in consumption $c = \bar{r}k$ and declining in k, reflecting the opportunity cost of supplying capital to domestic production. If the net-of-tax return increases, capitalists are willing to supply more capital, either by saving more or by bringing capital from another sector—e.g, capital owned abroad—into the domestic production sector.[9]

Equilibrium of the model. The following three equations determine the equilibrium (w, r, k):

$$r = f'(k), \quad w = f(k) - kf'(k), \quad k = k(r \cdot (1 - \tau_K)). \tag{1}$$

This simple model has the advantage of being representable in a standard capital demand and supply diagram (Figure 1). Even though this is a general equilibrium model, the diagram is the same as the standard textbook one-market model of tax incidence. The demand for capital is $r = f'(k)$ and is downward sloping (as $f''(k) < 0$). The supply for capital is $k = k(r \cdot (1 - \tau_K))$ and is upward sloping (and flat when $e_K = \infty$). The surplus accruing to workers is $w = f(k) - kf'(k) = \int_0^k f'(\kappa)d\kappa - rk$ and can be read off as the area below the demand curve and above the horizontal line at r. The surplus accruing to capitalists is the area above the

[8] With Cobb-Douglas production functions of the form $F(K,L) = A \cdot K^\alpha L^{1-\alpha}$ then $\alpha = rK/Y$ is constant and $\sigma = 1$. With a CES production function $F(K,L) = [\mu K^{(\sigma-1)/\sigma} + (1-\mu)L^{(\sigma-1)/\sigma}]^{\sigma/(\sigma-1)}$ the elasticity of substitution σ is constant.

[9] This utility form can arise from two models. First, suppose capitalists have a fixed capital k_0 and decide how much to invest domestically k and how much to invest abroad $k_0 - k$. Suppose capital abroad earns a rate of return r_0 but that capitalists value investing k at home by $a(k)$ with $a(.) \geq 0$ increasing and concave reflecting home bias. In this case, money metric utility takes the form $u^K(c,k) = c + a(k)$ with $c = \bar{r}k + r_0(k_0 - k)$, leading to a first order condition $a'(k) = r_0 - \bar{r}$ which defines an upward sloping supply of domestic capital $k(\bar{r})$. With no home bias, the supply is infinitely elastic as $\bar{r} = r_0$. Second, as in Saez and Stantcheva (2018), intertemporal maximizers have instantaneous utility $c + a(k)$ for consumption and wealth, discount rate δ, and start with wealth k_0. In this case, intertemporal utility takes the simple form $c + a(k) + \delta(k_0 - k)$ with $c = \bar{r}k$ which leads to $a'(k) = \delta - \bar{r}$ (the wealth of the individual jumps immediately from k_0 to k at time zero). Without utility for

supply curve and below the horizontal line at $\bar{r} = r \cdot (1 - \tau_K)$. Capital taxes are the rectangle $(r - \bar{r})k$. The triangle pointing toward the no-tax equilibrium $f'(k^*) = r^*, k(r^*) = k^*$ is the usual deadweight burden. It is equal to the loss in surplus of workers and capitalists created by the tax τ_K over and above its revenue yield $(r - \bar{r})k$.

Distributional current-tax analysis. How should we describe such an economy in a current-tax distributional table? wL is labor income and rK is capital income, as would be measured in national accounts statistics. While it is true that τ_K affects w negatively, w is the actual pre-tax wage rate in the economy. Similarly, τ_K affects r positively, but the actual pre-tax rate of return is r and not the lower r^*. The logical description of current pre-tax income, post-tax incomes, and tax paid is thus the following. On the labor side, pre-tax labor income is wL, post-tax labor income is $\bar{w} = w(1 - \tau_L)L$, and workers pay $\tau_L wL$ in taxes. On the capital side, pre-tax capital income is rK, post-tax capital income is $\bar{r}K = r(1 - \tau_K)K$, and capitalists pay $\tau_K rK$ in taxes.

Contrast this with the distributional tax analysis carried out by US government agencies, building on Pechman and Okner (1974). This analysis ignores the deadweight burden and considers that capital taxes $\tau_K rK = (r - \bar{r})K$ are shared by capitalists who pay $(r^* - \bar{r})K$, and by workers who pay $(r - r^*)K$. The pre-tax income of workers is $wL + (r - r^*)K$ and the pre-tax income of capitalists is $rK + (r^* - \bar{r})K = (r^* - \tau_K r)K$. These concepts are neither the actual incomes going to workers and capitalists before tax, nor the incomes that would go to workers and capitalists absent taxes (since the change in K and deadweight burden are ignored). This might be a defensible assumption for small taxes, where deadweight burden is second order. In practice, however, taxes are large. If the supply of capital is perfectly elastic, then the capital tax is borne fully by labor. In conventional distributional analysis, it is equivalent to a tax on inelastic labor, even though the two taxes have drastically different efficiency implications.

Tax incidence analysis. Let us now move to the analysis of tax reforms. We consider a small increase in the capital tax rate $d\tau_K$ and trace out its effects dk, dr, dw. Differentiating the 3 equations in (1), we have two equations on the production side:

$$\frac{dk}{k} = \sigma \cdot \left[\frac{dw}{w} - \frac{dr}{r} \right], \quad dw + k \cdot dr = 0.$$

The first equation is the definition of the elasticity of substitution between labor and capital, σ. The second equation is obtained by differentiating $f(k) = rk + w$ and using $f'(k) = r$. This

wealth, the supply is also infinitely elastic as $\bar{r} = \delta$.

equation is key: it states that the effects of the reform on factor prices sum to zero. What labor loses due to reduced wages is exactly what capital gains through a higher return.

On the supply side, we have:

$$\frac{dk}{k} = e_K \cdot \frac{d\bar{r}}{\bar{r}} = e_K \cdot \left(\frac{dr}{r} - \frac{d\tau_K}{1-\tau_K} \right).$$

Combining and rearranging, we obtain:

$$\frac{dr}{r} = \frac{(1-\alpha)e_K}{(1-\alpha)e_K + \sigma} \cdot \frac{d\tau_K}{1-\tau_K}, \quad \frac{dk}{k} = -e_K \cdot \frac{\sigma}{(1-\alpha)e_K + \sigma} \cdot \frac{d\tau_K}{1-\tau_K}, \quad dw = -kdr.$$

These equations display the usual lessons from tax incidence. First, if $\sigma = \infty$, then a capital tax increase has no effect on factor prices r and w. It only affects capital through a pure supply-side response: $dk/k = -e_K d\tau_K/(1-\tau_K)$. Second, if $\sigma < \infty$, then capital supply responses affect factor prices, spreading partly the incidence of the tax onto wages. The shift to wages is small whenever e_K is small relative to σ.

This is illustrated in Figure 2. The increase in τ_K shifts the equilibrium. The reduction in $\bar{r}$ along the supply curve is attenuated by an increase in dr along the demand curve. The response dk is attenuated relative to the case where r is fixed. Capital tax revenue is $\tau_K rk = (r-\bar{r})k$. Its change can be decomposed into three terms depicted on the graph:

$$d[(r-\bar{r})k] = -kd\bar{r} + kdr + (r-\bar{r})dk. \tag{2}$$

The first term $-kd\bar{r} > 0$ is the direct effect due to a lower net-of-tax rate of return $\bar{r}$. The second term $kdr > 0$ is due to a higher pre-tax rate of return r. Importantly, this term is exactly equal to $-dw$, i.e., what is lost by workers due the reduction in the wage rate w. The third term is the tax revenue lost due to the supply-side response of capital (itself triggered by $d\bar{r}$). This tax revenue loss is equal to the increase in the deadweight burden triangle of the tax.

Optimal tax analysis. Suppose the social marginal welfare weight on capitalists is zero. Maybe capitalists are much more well-off than workers (and hence have much lower marginal utility), or maybe all residents are workers and the country attracts capital from abroad only. In this case, society sets τ_K to maximize workers' income $w + (r-\bar{r})k$ where w is the wage and $(r-\bar{r})k$ is the tax collected from capitalists. As $w + rk = f(k)$, social welfare is $w + (r-\bar{r})k = f(k(\bar{r})) - \bar{r}k(\bar{r})$. The government effectively chooses $\bar{r}$ along the supply side curve $k(\bar{r})$ to maximize surplus—the area above the line $\bar{r}$ and below the demand curve for capital (blue area in Figure 1). The first-order condition for the optimum τ_K is such that:

$$0 = (f'(k) - \bar{r})dk - kd\bar{r} = -kd\bar{r}\left[1 - \frac{r-\bar{r}}{\bar{r}}\frac{\bar{r}}{k}\frac{dk}{d\bar{r}}\right] = -kd\bar{r}\left[1 - \frac{\tau_K}{1-\tau_K}e_K\right]. \tag{3}$$

This leads to the usual inverse-elasticity rule optimal tax rate $\tau_K^* = 1/(1+e_K)$.

The key insight is that the optimal tax rate only depends on the supply elasticity e_K, not on whether the tax on capital is shifted to workers. In other words, the supply elasticity is a sufficient statistics for the optimal tax rate (and the elasticity of substitution σ is irrelevant). The intuition for this result can be seen on Figure 2. Workers' welfare is the wage area w plus the tax rectangle. When τ_K increases, the reduction in wages dw is fully offset by the increase in tax revenue kdr. As a result, the tradeoff is only about the mechanical increase in tax revenue $kd\bar{r}$ vs. the revenue loss due to the supply side response $(r-\bar{r})dk$.[10] Intuitively, setting τ_K is equivalent to setting $\bar{r}$ so that the implicit changes in r triggered by τ_K can be neutralized.[11] This result is a special case of a more general result first derived by Diamond and Mirrlees (1971).[12] Optimal tax formulas can be expressed solely in terms of supply elasticities (for production factors) or demand elasticities (for consumption goods), and social marginal welfare weights. Conditional on these, elasticities of substitution (e.g., between capital and labor) are irrelevant.

This result has a key implication: the effects of taxes on pre-tax prices—effects that are at the heart of classical tax incidence analysis—are not normatively relevant. What matters for optimal tax policy is the behavioral responses of individuals as consumers, savers, and workers. In the context of capital taxation, changes in wages do not matter. How can this result be squared with the common intuition that if the tax on capital hurts wages, it makes the tax less desirable to workers? The reasoning is the following. If the tax on capital hurts wages, it also means that it increases the rate of return for capitalists, and therefore tax revenue from capitalists that can benefit workers. In net, this is a wash.

Why has the normative irrelevance of price effects been ignored by the literature on tax incidence? The aim of tax incidence was strictly positive and narrow: explain all the consequences of a given tax reform that a government is contemplating. The aim of optimal tax is normative and wider: figure out what tax reforms can improve social welfare. Policy makers always have some social objective. Hence, in our view, it is useful to provide the bigger picture view of which

[10] The derivation has been made (independently) by Piketty (2000) and Mankiw (2001) in the special case where $e_K = \infty$ (horizontal supply curve in our diagrams) as a way to demonstrate the uselessness of capital taxes in the standard model in which the infinite capital supply elasticity arises from infinite horizon optimizing and $\bar{r}$ is pinned down by the exogenous discount rate δ. This derivation based on long-run outcomes is distinct from the classical Chamley-Judd zero capital tax result (see Saez and Stantcheva, 2018; and Straub and Werning, 2020).

[11] This result carries over more generally even if government puts a weight on capitalists (say $g_K < 1$ per \$ of capitalist surplus lost). The reform depicted on Figure 2 reduces the surplus of capitalists by $kd\bar{r} < 0$ so that the optimum first-order condition simply becomes $(r-\bar{r})dk = (1-g_K)kd\bar{r}$ (instead of $(r-\bar{r})dk = kd\bar{r}$) leading to the classic optimal tax formula $\tau_K^* = (1-g_K)/(1-g_K+e_K)$.

[12] Piketty and Saez (2013) and Saez and Stantcheva (2018) show how it applies to inheritance taxation and capital income taxation respectively.

tax tools can achieve the social objective. A corporate tax increase may hurt workers' wages in a narrow incidence analysis but if the extra corporate tax increase is used to cut taxes on wages, then it can help workers on net as in our basic model and fulfill the social objective. We will see in Section 5 that connecting these two bodies of work is fruitful to inform the selection of models used to conduct tax-reform analysis.

Distributional tax-reform analysis. Because the effects of taxes on prices do not matter normatively, in the context of the model we consider it is both sounder and simpler to ignore them when carrying out distributional tax-reform analysis. Consider a capital tax increase. On the equity side of the trade-off, the relevant impact is the direct effect of the tax on capital owners, ignoring both supply-side responses and any effects on pre-tax wages and rates of return. For example in the case of a corporate tax increase, all that matters is the mechanical changes in corporate tax payments by income group, which can be computed using the current-tax table (reporting how much corporate tax each group of the population pays today). The welfare costs of these direct effects can be aggregated across income groups using social marginal welfare weights. On the efficiency side of the trade-off, the sufficient statistic is the total change in tax revenue due to supply-side responses, ignoring again any price effects. The revenue change does not need to be distributed by groups. We provide a concrete illustration in the case of an increase in the US corporate income tax rate in Section 5.1 below.

A capital tax increase also affects factor prices and the distribution of pre-tax income. It reduces workers' wages and increases capitalists' pre-tax income, typically leading to an increase in overall income inequality. It also changes the amount of taxes paid by each group. But these effects are normatively irrelevant, because all the pre-tax price effects can be neutralized by a corresponding adjustment of all the other taxes which is budget neutral. Of course, this result arises in the context of the specific neo-classical model of Diamond and Mirrlees (1971). It is important to note, however, that conventional distributional tax analysis considers the very same type of models. It emphasizes the effect of taxes on pre-tax prices, even though the logic of the models implies that these effects can be ignored for optimal tax analysis. In the real world, taxes can have effects that are more complex than what is captured by neoclassical models, in which case price effects may not be irrelevant. We extend the analysis along those lines in Section 6.

Generalization: Consumption taxes. The analysis of tax reforms can be generalized to incorporate multiple goods and good-specific consumption taxes, as in Diamond and Mirrlees

(1971). A consumption tax increase on a good can also generate price effects (on the taxed good, on other goods, and on production factors). As detailed in Appendix A.1 and illustrated in Appendix Figure A1, as long as there are no pure profits (or that the government can fully tax away pure profits), Diamond and Mirrlees (1971) show that such price effects are normatively irrelevant. This follows the same logic as described above for capital taxes. Any change in producers' profits created by the tax change can be neutralized by adjusting the tax on profits. What matters is (i) the direct distributional impact of the tax ignoring price effects and behavioral responses (basically whether the rich or the poor consume the good), (ii) the aggregate fiscal impact due to supply-side responses to the tax change, keeping pre-tax prices fixed. A distributional tax reform analysis of a consumption tax change should thus follow the same template as above.[13]

What if other taxes are not adjusted? The irrelevance of pre-tax price effects hinges on the key assumption that other taxes can be adjusted to neutralize them at zero budgetary cost. But what if other taxes are not adjusted? If other taxes are set at optimal levels–namely they satisfy the optimal tax formula of Diamond and Mirrlees (1971) so that a small change in any such tax rate has zero welfare impact, then pre-tax price effects still have zero welfare impact because they are equivalent to small tax rate changes. However, if other taxes are not set at optimal levels, then pretax price incidence effects have first order welfare impacts and such effects can overturn the conclusion. Let us take an illustrative example in the two factor model we considered above. We provide a complete formal description of such a model of labor and capital in appendix A.2.

Suppose the capital tax τ_K is only slightly below the optimal rate τ_K^* while the labor tax τ_L is substantially above τ_L^*. In this case, increasing τ_K has only small positive welfare effects when ignoring pre-tax price effects. The pre-tax price effects amount to shifting part of the τ_K increase into a reduced wage which is equivalent to an increase in τ_L. Because τ_L is already far too high, this has a large first order negative welfare effect which will swamp the small positive effect of increasing τ_K. Put simply, with pretax price effects, increasing τ_K is like increasing both τ_K and τ_L and the downside of increasing τ_L swamps the modest benefit of increasing τ_K. This is obviously valuable information that classical tax incidence analysis provides but it should not rule out increasing τ_K. Rather, it calls for lowering τ_L as a priority, as τ_L is far above its optimal level. Therefore, in our view, the most useful information to provide policy makers

[13]That is: (i) assign the tax to consumers in a distributional table, ignoring behavioral responses and price effects, to inform the equity side of the trade-off; (ii) estimate the extra aggregate budgetary effects due to behavioral responses keeping pre-tax prices constant, to inform the efficiency side of the trade-off.

is the effect of changing one specific tax rate with constant pre-tax prices. While such a tax change can be shifted to other tax bases through pre-tax price effects, such shifts are relevant only if the other tax rates are suboptimal, leading to the sound policy prescription of also readjusting the other tax rates. We shall see below that conventional incidence can even fail to detect second-best Pareto dominated policies such as the corporate tax in the classic Harberger model. Our proposed approach consistent with optimal tax analysis will sharply detect and flag such inefficient policies. To sum it, the optimal tax approach provides the big picture and tell the policy maker which direction to go. Classic tax incidence is a narrower technical tool useful to map out how to move in such direction taking into account–and neutralizing–price effects.

3 Distributional Current-Tax Analysis in Practice

We now turn to the practice of distributional tax analysis, first for current taxes (this Section and the next), then for tax reforms (Sections 5 and 6). We begin in this section with an overview of the general principles of current-tax analysis, before comparing our methodology to the conventional approach, and illustrating our approach with concrete case studies. Appendix A.3 provides a tax-by-tax discussion of practical issues not immediately covered by these general principles.

3.1 General Principles and Objectives

Distributional current-tax analysis involves building measures of individual pre-tax incomes, taxes, and after-tax incomes that describe the current economy and can be aggregated by socio-economic groups. This analysis serves two main goals. First, as shown in Section 2, it informs the equity part of the trade-off involved in changing taxes. Second, it allows to quantify tax progressivity—how effective tax rates vary across the income distribution.

Distributional tax wedges. To implement this analysis, the starting point—as in the models studied above—is that taxes are wedges between pre-tax prices (relevant for production decisions) and post-tax prices (relevant for work, saving, and consumption decisions of households). Because the government charges taxes on labor, producers pay labor costs in excess of what workers receive as net compensation. Because of taxes on assets and capital income, owners receive less than the full capital income generated by their assets. Due to consumption taxes, buyers of goods and services pay more than what producers receive. The optimal tax problem is about computing the optimal wedges.

Current-tax analysis allocates these wedges to individuals as follows. Labor taxes (which include payroll taxes and and taxes on wage income—i.e., the full wedge between pre-tax labor costs and net-of-tax compensation) are assigned to the corresponding workers. Consumption taxes are allocated to the corresponding consumers. Capital taxes are allocated to the corresponding assets owners: taxes on corporate profits to the individual owners of corporations, taxes on the profits of unincorporated businesses (e.g., partnerships) to the owners of unincorporated businesses, residential property taxes to the owners of residential properties, business property taxes to the owners of business property, individual income taxes on dividends, interest, rents, capital gains, and royalties to the individuals who earn this income. Assets, their income flows, and the taxes on those assets or their income are all allocated to the ultimate owners of the assets. For instance, corporate taxes paid by companies owned by pension funds are allocated–like the corresponding profits–to the underlying individual owners. A number of remarks are in order.

Economic meaning of tax wedges. First, even though it does not involve the specification of behavioral responses, this approach is more than accounting, because it respects the incentives of economic actors and follows from the standard modeling of supply and demand functions. Labor taxes are allocated to workers as opposed to employers, because what matters for workers' labor supply decisions is after-tax compensation, while what matters to employers is pre-tax labor costs. Capital taxes are similarly allocated to the respective capital owners as opposed to capital users, because what matters for capital supply is the after-tax capital return, while capital demand depends on pre-tax returns. Consumption taxes are allocated to consumers as opposed to producers, because the demand for goods and services depends on post-tax prices, while production decisions depend on pre-tax prices.

The taxes we measure capture what is effectively paid by people. They incorporate all the features of the tax system and of its implementation above and beyond the statutory rate, including any tax avoidance, evasion, and exemptions or deductions in the tax code.

Side of the market irrelevance. Second, this approach differs from statutory incidence—who nominally pays the tax to the government. The analysis of tax incidence often starts from the fact that which side of the market has to legally remit the tax is not relevant, so that the question "who pays?" does not have an obvious answer. The canonical example is employer vs. employee payroll taxes. Distributional current-tax analysis also features this side-of-the-market irrelevance. Both employer and employee payroll taxes are assigned to the corresponding workers

(even though part of payroll taxes are nominally paid by employers and part by employees), because both contribute to the wedge between pre-tax labor costs and post-tax compensation. Retail sales taxes are similarly assigned to final consumers regardless of whether the tax is nominally paid by consumers or retailers.

Neutrality with respect to income classification for tax purposes. Third, in our framework a tax on a given income is allocated in the same way no matter how the income is reported for tax purposes. This mimics a key principle underlying national accounts data, namely that economic statistics shouldn't be affected by purely legal changes in income reporting. Applying this principle maximizes comparability of tax progressivity over time and across countries.

To illustrate this point, consider the case of a consultant. This worker can choose to earn labor income as a salaried worker (W2 income in the United States), as an unincorporated self-employed (reported on Schedule C income of the individual income tax return), as a self-employed individual using a pass-through company (S-corporation or partnership income, reported on Schedule E of the individual income tax return), or as a self-employed individual incorporated in a company subject to the corporate tax (C-corporation income). In our framework, taxes paid on this consulting income are, in all cases, allocated in the same way—to the consultant.

Consistency with macroeconomic series. Our framework also ensures consistency between distributional analysis and macroeconomic analysis. Macroeconomics is concerned with the distribution of aggregate income across labor and capital. For the computation of factor shares, all pre-tax corporate profit—including 100% of the corporate tax—is considered capital income. In our approach, individual and (properly weighted) group-level capital shares add up to the macro capital share. Our approach is similarly consistent with the literature that estimates effective tax rates on factor incomes and consumption, following the influential work of Mendoza, Razin and Tesar (1994). In these macro series, the effective tax rate on capital, for example, is the ratio of all capital taxes (corporate tax, property taxes, dividend taxes, etc.) divided by all capital income (corporate profits, housing rents, etc.).[14] Our framework in essence extends this work to incorporate the distributional dimension. By design, our group-level capital tax rates add up to the macro capital tax rate.[15]

[14]See, e.g., Eurostat (2021) for cross-country series in high-income countries, and Bachas et al. (2023) for a global panel.

[15]Our approach also resembles the social accounting approach sometimes applied to distributional analysis (see, e.g., Wolff and Zacharias 2007). But we come to it using economic reasoning rather than abstracting from

Link with distributional national accounts. Last, current-tax analysis is a necessary input for the production of distributional national accounts—inequality statistics that allocate all pre-tax and post-tax national income across socio-economic groups (see, e.g., Blanchet et al., 2022).[16] But it can also be applied independently of the distributional national accounts framework. For instance, one may be interested in allocating only federal taxes (as opposed to all taxes at all levels of government as in distributional national accounts). One may also wish to consider specific definitions of income (that differ from the pre-tax national income or post-tax national income concepts central in distributional national accounts). In all these cases, the principles described here carry over.

3.2 Comparison With the Conventional Approach

Although our approach may seem obvious, it is in fact markedly different from the conventional practice of distributional tax analysis, as implemented by US government agencies and think tanks building on Colm and Tarasov (1941), Musgrave et al. (1951), and Pechman and Okner (1974) foundational contributions. This practice builds in tax incidence effects based on assumptions about behavioral responses to taxes, shifting some taxes across production factors.

Concretely, both we and the conventional approach assign labor and individual income taxes to the corresponding income earners, and consumption taxes to consumers. The key difference is that we assign the corporate tax to shareholders instead of shifting it to different economic actors.[17] Specifically, CBO and JCT assign 75% of the corporate tax to capital owners nationally, proportionally to reported taxable capital income (dividends, interest, rents, and realized capital gains, but excluding capital income earned on pension accounts for CBO while JCT includes pensions in its assignment) and 25% to workers nationally, proportionally to reported labor income. The US treasury and the Tax Policy Center used to follow the same rule but since the 2010s have assigned about 60% of the corporate tax to shareholders, and the remaining 40% half to labor income and half to capital income nationally.[18] One may think

it. The social accounting approach also focuses separately on different sectors (household, corporate, etc.) and hence cannot distribute corporate taxes, for example.

[16] Appendix A.4 discusses the application of current-tax analysis in the context of distributional national accounts.

[17] In principle all taxes can be partly shifted depending on the relevant elasticities (e.g., labor taxes are partly shifted to capital as long as labor supply is not completely inelastic, capital taxes other than the corporate tax are partly shifted to labor as long as capital supply is not completely inelastic). The conventional approach generally only shifts the corporate tax because of a presumption that the corporate tax is the one tax for which such incidence effects are most empirically relevant. As we discuss in Section 6, recent empirical research suggests this assumption is outdated. Internal consistency would call for shifting additional taxes, exacerbating the logical tension inherent to the conventional approach described below.

[18] See US Congressional Budget Office (2012, 2018); US Treasury (2019); Tax Policy Center (2022); and Nunns

that if only the allocation of the corporate tax varies, the choice of a particular methodology may not matter much practically. But this choice has in fact large implications (quantified in Section 4.2) for the measurement of trends in overall US tax progressivity. Conceptually, our methodology has four main advantages.

Internal consistency. First, it is internally consistent. In the conventional practice, the assignment of current taxes is based on a thought experiment: "what would incomes be if all taxes were removed?" The corporate tax is partly allocated to workers because it is assumed to reduce wages relative to this no-tax counterfactual. The actual pre-tax income of workers is increased by the amount of shifted corporate tax. When analyzing the current economy, the conventional approach thus captures the distribution of some unobservable counterfactual income—not of actual pre-tax income. When analyzing tax reforms, a corporate tax cut is shown as a reduction in taxes for workers—not a potential increase in their pre-tax income.

The logical problem is the following. In the no-tax counterfactual world, pre-tax incomes might well be higher than in the existing world, for example if people worked or saved more. But because these counterfactual pre-tax incomes absent any tax are abstract and uncertain, the conventional approach generally assumes that taxes do not affect aggregate income (only how the actual amount of aggregate income is distributed across groups), while nonetheless shifting the corporate tax. Shifting taxes from capital to labor while keeping aggregate income constant is logically inconsistent, however, because shifting precisely originates from behavioral responses to taxes that affect aggregate income. Our current-tax methodology that measures actual (not counterfactual) incomes does not suffer from this issue.

Consistent trends in tax progressivity. Second, our methodology allows one to study trends in tax progressivity and in inequality consistently, in contrast to official practice which can lead to biased trends. Consider the CBO methodology that allocates 25% of the corporate tax to workers (vs. 75% to capital owners) and 100% of the individual income tax to the corresponding individuals. If a C-corporation (subject to the corporate tax) elects to be treated as an S-corporation (subject to the individual income tax of its owners), then in the CBO treatment the tax system becomes more progressive and pre-tax income inequality increases, even though nothing real has changed in the tax system or in the economy. The tax system becomes more progressive because taxes that used to be partly allocated to workers are now fully allocated to firm owners, who are higher up in the income distribution. Income inequality

(2012), for a detailed description of the methodologies.

increases because income that was previously partly assigned to workers is now fully assigned to firm owners. As shown in Section 4.2, this bias turns out to be significant in the United States, given the rise of pass-through businesses over the last decades.[19].

Individual-level analysis. Third, our framework allows us to estimate meaningful tax rates at the individual level, in particular at the very top of the distribution. In the conventional approach, the corporate tax is spread across all workers and capital owners nationally, proportionally to their wage income and reported taxable capital income. There is no link between what a company pays in tax, and how much corporate tax is allocated to its owners. By contrast, our methodology assigns firm owners their share of corporate profits and corporate tax payments (de facto treating all corporations as pass-through businesses). This delivers high tax rates for the owners of corporations that pay high tax rates, and low rates for the owners of tax-avoiding corporations, as illustrated below.

Simplicity. Last, our current-tax methodology is much simpler than the conventional approach, as it does not require to make assumptions about behavioral responses to taxes or to specify counterfactuals. In the conventional approach, calibrating the shifting of the corporate tax requires complex assumptions (e.g., on the labor vs. capital component of various income forms, or the normal vs. supernormal rate of return on capital). The empirical basis for these assumptions is evolving, leading to discrepancies in methods across agencies and over time.

3.3 Illustration of the Current-Tax Method: Case Studies

We illustrate our current-tax methodology with case studies in the year 2018. These case studies only use publicly available information, and are summarized in Table 1.

Jeff Bezos. Start with Jeff Bezos, the richest person in the United States in 2018 according to *Forbes*. To compute his tax rate, we need to estimate his pre-tax income from all sources and the taxes he paid (directly and indirectly) worldwide.

Bezos derives most of his income from his stake in Amazon. As reported in its annual 10-K report to the Securities and Exchange Commission (SEC), the company made $11.3 billion in pre-tax income globally in 2018.[20] Since Bezos owned 16.3% of Amazon, he earned 16.3%

[19]The US Treasury (2019), the US Joint Committee on Taxation (2019), and the Tax Policy Center (2022) also treat differently taxes on C- vs. S-corporate profits. In contrast to all these approaches, our series are not affected by changes in businesses' organizational form or income re-classification.

[20]This number is net of interest and depreciation; it is conceptually close to corporate profits as included in

of Amazon's profit, i.e., around $1.84 billion. Even though Amazon did not pay dividends in 2018, its profits did constitute income for Amazon's shareholders like Bezos—income that was fully saved and reinvested in the firm. Bezos also earned income from other investments, such as his stake in the *Washington Post*. Public sources suggest he earned around $250 million in taxable income from these other investments.[21] We disregard other income sources such as imputed rents on real estate properties and income earned on pension assets and trusts, which are second-order for our purposes.

Bezos also realized capital gains by selling Amazon stocks, $33 million according to SEC form 4 public reports. Since he founded Amazon, and prior to 2018 Amazon made little profit, Bezos's cost basis was small in 2018. Virtually all of his realized capital gains reflected pure asset price appreciation, not the effect of past or current retained earnings (already included in income). Therefore we include the $33 million in realized capital gains in Bezos's income. Because his realized capital gains are small, including these gains in income makes negligible difference to Bezos's effective tax rate.

We compute Bezos's total income tax as his share of the income taxes paid by Amazon plus the income taxes he paid directly. Amazon paid $1.18 billion in cash income taxes in 2018 to federal, state, and foreign governments combined, an effective tax rate of 10.5%.[22] In our methodology, Bezos paid $193 million in corporate taxes, namely his share (16.3%) of Amazon's corporate income taxes (or, equivalently, 10.5% of his Amazon income of $1.84 billion). Moreover, Amazon paid business property taxes. The amounts are not publicly disclosed. We can estimate these taxes as roughly equal to 1% of Amazon's capital stock, the US-wide average business property tax rate. This adds around $100 million in taxes for Bezos. Last, according to ProPublica, Bezos paid $43 million in federal individual income taxes. As a resident of Washington State, Bezos did not pay state income taxes. Other taxes paid by him directly or through Amazon are negligible for our purposes.[23] His total tax payments thus amounted to

national income. There are differences between profit accounting in financial statements and in the national accounts; for our purposes in this paper, however, these differences are second-order.

[21] According to ProPublica (Eisinger et al., 2021), Bezos reported $284 million in total income on his individual income tax return. Of this, $1.7 million corresponds to Amazon compensation ($81,840 in wage and $1,600,000 in other compensation—security detail—according to public SEC forms). Since Amazon did not distribute dividends and since according to SEC form 4 public reports Bezos realized $33 million in capital gains by selling Amazon stocks (see below), around $250 million in income derived from non-Amazon holdings.

[22] Using provisions for income taxes instead of cash income taxes paid gives a similar effective tax rate, 10.6%. Both measures have merits and demerits. One issue with provisions for income taxes paid is that these provisions include tax contingencies—taxes that have not been paid but that companies estimate have a more than 50% chance to be eventually paid as a result of audits and other enforcement activities. Because some of these tax contingencies end up not being paid (e.g., due to a lapse in statute of limitation), provisions for income taxes can over-estimate actual tax payments.

[23] Residential property taxes paid by Bezos are likely to be negligible compared to his income. Sales taxes

$337 million, an effective tax rate of 15.2%.[24]

Two remarks about this result are worth mentioning. First, if we focus on federal taxes alone (as US government agencies do), Bezos's effective tax rate was only 1.9%. According to its 10-K, Amazon did not pay any federal corporate income taxes in 2018. Property taxes are all paid to state, local, and foreign governments. The only federal tax Bezos paid was the individual income tax. For many economic questions (e.g., the study of behavioral response to taxes) the relevant tax rates are those including all levels of governments. However in some contexts (e.g., policy discussions of federal tax reforms), effective federal tax rates can also be relevant. Second, our methodology to allocate the corporate tax implies a higher effective tax rate for Bezos than the conventional approach. In the conventional approach the amount of corporate tax allocated to Bezos has nothing to do with the amount paid by Amazon, since the corporate tax is shifted to workers and capital owners nationally. In the CBO methodology, Bezos pays about $41 million in corporate taxes, as opposed to $193 million with our methodology.[25]

Warren Buffett. Buffett's situation is to some extent similar to Bezos. The company he owns—Berkshire Hathaway—does not distribute dividends and he realizes little capital gains. Thus the bulk of his taxes correspond to his share of Berkshire Hathaway's corporate and property taxes. According to the conventional approach Buffet pays essentially zero tax, but in our methodology his effective tax rate (taking into account all taxes paid) was 18.4% in 2018.

Specifically, Buffett had $8.2 billion in income, corresponding to his share (30.2%) of Berkshire Hathaway's $27.0 billion in pre-tax profit.[26] According to ProPublica, and consistent with public SEC reports, Buffett had negligible reported individual income ($24.8 million, out of which he paid $5.36 million in federal taxes). According to its 10-K, Berkshire Hathaway's effective corporate global cash income tax rate was 16.1%—and 18.4% when adding our estimate

paid by Bezos are likely to be negligible too. For example, in the case where he consumed $10 million of taxable goods in Seattle, the associated sales tax would be $1.025 million (6.5% rate in Washington state plus 3.75% rate in Seattle), increasing his effective tax rate by only 0.05 percentage point.

[24]This effective rate is equal to $337 million divided by $2.2 billion in income: the $100 million in Amazon property taxes have to be added to the income denominator because they are not counted as income in corporate income statements.

[25]Specifically, in 2018 total U.S. corporate tax revenues (federal plus state) added up to $283 billion. Bezos earned 0.00002% of all reported taxable wages and 0.02% of all reported taxable capital income (dividends, taxable interest, net rents and royalties, and realized capital gains); hence he gets assigned $25\% \times 0.00002 + 75\% \times 0.02 = 0.0145\%$ of corporate tax payments (or $41 million) if one applies the CBO methodology.

[26]Berkshire Hathaway's pre-tax profits are computed as pre-tax income as officially reported in the 10-K ($4.0 billion), plus realized gains on investments ($22.5 billion), plus (imputed) business property taxes paid ($0.6 billion, computed like in the case of Amazon as 1% of net property and equipment). Unrealized gains on investments are removed because they are not taxable and not part of conventionally defined income. Consistently, we measure income tax paid as cash tax paid (as in the case of Amazon).

of business property taxes. Since Buffett had negligible individual taxable income, the taxes he paid at the individual level were negligible relative to his share of the taxes paid by Berkshire Hathaway. Buffett's effective tax rate was thus equal to Berkshire Hathaway's, 18.4%.

Buffett's case illustrates that the corporate tax—and to a lesser extent business property taxes—serve as a backstop for the ultra-wealthy. Without these taxes, Buffett's effective tax rate would be 0% out of $8.2 billion in income. Moreover, like for Bezos, our methodology assigns much more corporate tax to Buffett than the conventional approach. Since Buffett has negligible individual taxable income, in the CBO methodology Buffett is assigned virtually no corporate tax, even though Berkshire Hathaway, of which he owns 30%, paid more than $4 billion in cash corporate income taxes in 2018. A complete quantification of the taxes paid by the top 400 wealthiest Americans, systematically linking businesses to owners using administrative data, is left to future research (Balkir et al., 2023).

4 Evolution of US Tax Progressivity

This Section applies distributional current-tax analysis to the United States. We construct homogenous series of effective tax rates paid by top income groups including all taxes paid at all levels of government, from 1913 (creation of the federal income tax) to 2021 (the latest year available). By construction the series are not affected by changes in how business income is classified for tax purposes, maximizing the comparability of effective tax rates over time. This allows us to address key questions such as: How does the current level of tax progressivity compare to levels seen in the past? Did the United States ever impose high effective tax rates on the rich? And if so, what taxes mattered the most?

4.1 Changes in the Effective Tax Rates of Top Income Groups

Methodology and summary statistics. We conduct our analysis using the updated US distributional accounts of Piketty, Saez and Zucman (2018). This work distributes annual national income and household wealth by combining tax data, survey data, and national accounts aggregates. The Piketty, Saez and Zucman (2018) estimates are living series that are regularly updated to incorporate methodological improvements and revisions to the raw input data (such as updated national accounts statistics). All updates are described in online methodological notes.[27] Key methodological revisions are further detailed in Saez and Zucman (2020). The

[27]Available online at `http://gabriel-zucman.eu/usdina`, which also links to current micro-files, computer code, and tabulations of key findings. All vintage releases and corresponding code are also published at the same address.

micro-files (for the post-1962 period) and tabulated series (for the pre-1962 period) used in our analysis are taken from the February 2022 release of the PSZ series.

Our main statistic of interest is the effective tax rate, defined as total taxes paid at all levels of government divided by pre-tax income. Following the distributional national accounts literature, pre-tax income is defined as total income deriving from labor and capital, after the operation of the pension system and unemployment insurance system.[28] To construct income groups, our unit of observation is the adult individual (age 20 or more) with income equally split between married spouses, and we rank adults by their pre-tax income.

Table 2 reports the distribution of income and taxes by pre-tax income groups in 2021 using this methodology. The US tax system appears mildly progressive, with effective tax rates (all taxes included) ranging from about 26% in the bottom 50% to 34% for the top 0.1%. At the bottom of the distribution payroll taxes and consumption taxes play a key role. At the top, the individual income tax is the by far the largest tax.[29] When using the CBO methodology to allocate the corporate tax, effective tax rates at the top are slightly higher (by about 1 percentage point for the top 0.1%), as detailed in Section 4.2 below.

Effective tax rate of the top 1%. The top panel of Figure 3 reports the evolution of the effective tax rate of the 1% of adults with the highest pre-tax income back to 1913. A number of findings are worth noting. First, there has been a dramatic inverted-U-shaped evolution of this tax rate, which increased from about 15% in 1913 to a high of nearly 50% during World War II and in the early 1950s, before falling back to 32% in 2021. The tax rate of the top 1% is about the same in 2021 as immediately before the New Deal (32% in 1932). It rose strongly during World War II, remained at a high level of around 45% until the late 1960s, before falling in the 1970s and 1980s. Since the 1990s, it has been on a mild downward trend, with some business cycle volatility—due to relatively strong tax collection at the peak of the cycle—and a clear effect of tax reforms. It increased from about 30% to 34.5% between 2012 and 2013 (Obama tax reform). It fell from 35% in 2016 to about 32% in 2018 (Trump tax reform).

Second, the effective tax rate of the top 1% is only a little bit higher than the average tax

[28] That is, pre-tax national income is net of Social Security taxes, contributions to pension plans, and contributions to unemployment insurance, and symmetrically includes Social Security benefits, pension distributions, and unemployment insurance benefits. As in the example of Jeff Bezos above and for the same reason, we also include pure realized capital gains (defined as realized capital gains above 3% of national income, the historical average level of corporate retained earnings) in pre-tax income.

[29] Appendix Table A1 reports the same statistics but focusing on federal taxes only. The federal tax system is more progressive, with effective tax rates rising from 14.5% in the bottom 50% to close to 23% in the top 0.1%. This is due to the fact that more than 80% of consumption taxes—which are regressive, as low-income individuals consumer a higher fraction of their income—are levied by state and local governments.

rate today. The tax system, by contrast, was highly progressive in the 1940s, 1950s, and 1960s, when the top 1% rate exceeded the average tax rate by about 20 percentage points. While it is well known that the United States had a nominally highly progressive federal individual income tax (with top marginal tax rates exceeding 90% during and after World War II), it is also well known from publicly available tabulations of income tax returns that few individuals were in the tax brackets subject to these extremely high rates. The actual degree of progressivity of the US tax system in the after-war years is thus an open question. Our series show that—all taxes included—the tax system was progressive not only on paper but in actual facts too. It is also interesting to note that the rise of the fiscal state—the tripling of the macroeconomic tax rate from less than 10% of national income in the early 20^{th} century to 30% in the late 1960s—happened in tandem with an even larger increase in the tax rate of the top 1%, from less than 15% to up to 50%. The expansion of the US government might have been facilitated by the highly progressive nature of its tax system, although a rigorous test of this hypothesis falls beyond the scope of this research.[30]

The key role of the corporate tax. To better understand the change in tax progressivity, the bottom panel of Figure 3 shows the evolution of the effective tax rate of the top 0.1% with a decomposition by type of tax. The long-run evolution is even more striking than for the top 1%. The tax rate of the top 0.1% rose from barely 15% in the beginning of the 20^{th} century to nearly 60% in the middle of the 20^{th} century, before gradually falling back, to about 34% in 2021, the level observed in the 1920s.

When looking at the composition of taxes, a key finding emerges: it is through the corporate tax that the United States achieved a high level of tax progressivity in the middle of the 20^{th} century. More broadly, changes in corporate tax payments drive most of the changes in the effective tax rate of the top 0.1%. Corporate and business property taxes paid by the top 0.1% rose from about 10% of the pre-tax income of the top 0.1% in the early 1900s to a high of 35% in the 1950s, before falling back to about 7% after the Tax Cuts and Jobs Act of 2017.[31] By contrast, the individual income tax has absorbed a broadly constant fraction of the pre-

[30]The top 1% contributed about 30% of total US tax revenues in the middle of the 20^{th} century. For instance in 1950, the top 1% earned 16.5% of total national income, its effective tax rate was 45%, hence it paid 16.5% $\times$ 45% = 7.5% of national income in taxes, which is 30% of the total tax take of 25% of national income.

[31]In the 19^{th} century and early 20^{th} century, state and local governments relied on generalized property taxes—a comprehensive tax on all types of property (real, personal, and financial) that was de facto one of the first wealth taxes (Dray, Landais, Stantcheva, 2023). This explains why effective tax rate at the top are significantly higher than 0 (and higher than the average rate) even before the creation of the federal individual income tax in 1913 and the federal corporate tax in 1909. Generalized property taxes were then gradually phased out and de facto replaced by the income tax.

tax income of the top 0.1%—around 20%—since 1930, with no trend and some business cycle volatility. Estate taxes rose from 0 before the creation of the federal estate tax in 1916 to about 6% in the middle of the 20^{th} century, before falling back to about 1% of income in recent years. If not for the dramatic changes in corporate income taxation (and to some extent estate taxation), the effective tax rate of the top 0.1% would have exhibited little change since 1930.

Why does the corporate tax play such a large role? Figure 4 shows that there has been dramatic variation in corporate income tax revenues over the last century in the United States. In the middle of the 20^{th} century the corporate tax—which had a statutory rate above 50% and effective rates close to that level—generated about 5% of national income in revenue, and up to 7% during World War II and the early 1950s. By contrast in recent years it has only yielded about 2% of national income. Appendix Figure A2 contrasts this evolution to that of the individual income tax. In 1950 both generated almost as much. Since then, the individual income tax been growing (primarily due to a rise in state income taxes), while corporate income tax revenues have collapsed. When the corporate tax was a major source of tax revenue in mid-century, corporate ownership was highly concentrated—this was before the rise of pension funds somewhat equalized equity ownership—leading to high tax rates at the top.[32]

4.2 The Role of the Corporate Tax: Comparison of Methods

Does it really matter practically how one allocates the corporate tax? To address this question, we construct income and tax distributions series keeping the same principles as those underlying Figure 3, but allocating the corporate tax following the CBO methodology (25% of the corporate tax is allocated to all workers proportionally to labor income, and 75% to capital owners proportionally to reported taxable dividends, interest, rents, and a measure of normalized realized capital gains).

Share of the corporate tax paid by the top 1%. The top panel of Figure 5 contrasts the fraction of the corporate tax assigned to the top 1% in this approach and ours. A number of results are worth noting. First, our current-tax analysis allocates a higher fraction of the corporate tax to the top 1% in the middle of the 20^{th} century: 50–60% in the 1950s–1960s vs. 30%–40% in the CBO methodology. This is because the CBO methodology allocates 25% of the corporate tax to labor, in effect adding a notional wage tax to workers and reducing the

[32]While our current-tax analysis in this paper focuses on the top of the distribution, it can be implemented to study the effective tax rates for all groups of the population; see Saez and Zucman (2019) for such an analysis and an interpretative synthesis.

burden for firm owners symmetrically. The gap is even larger earlier in the 20^{th} century, at a time when equity ownership was extremely concentrated. Tabulations of income tax returns show that the top 1% earned up to 80%–90% of all dividend income through to the 1930s; accordingly our method allocates a very high share of the corporate tax to the top 1% back then. In the conventional approach that shifts part of the corporate tax to capital owners other than shareholders based on reported interest and rents—which were not as concentrated as dividends—less corporate tax goes to the top 1%.

Second, in our methodology, the top 1% pays a lower share of the corporate tax today than in the post-World War II decades. This is due to the rise of relatively broadly owned pension funds, negligible in the 1950s. The top 1% earns 30%–35% of the profits of companies subject to the corporate tax today—and hence is assigned 30%–35% of corporate tax payments—as opposed to more than 50% in the 1950s. The share of the corporate tax allocated to the top 1% is stable in our series since the 1980s, as the rise of pension funds since then has been offset by the rising concentration of directly-held corporate equities.

Third and by contrast, in the CBO methodology the fraction of the corporate tax assigned to the top 1% is on a rising trend since the 1980s. This is due to two issues. Pensions are ignored by CBO: for the 75% of the corporate tax assigned to capital owners, the assignment is proportional to taxable capital income, which excludes tax-exempt capital income earned on retirement accounts. As taxable capital income is increasingly concentrated (Saez and Zucman, 2016), so too is the corporate tax. Moreover, as 25% is allocated to labor, the corporate tax becomes more progressive with the rise of *wage* inequality.

Fourth, these biases are reinforced by the rise of S-corporations, depicted on Figure 4. Until the 1980s, almost all US corporations were subject to the corporate tax. Today, close to 40% of domestic corporate profits are made by S-corporations, free of corporate tax and subject solely to the individual income tax of their owners. These profits generate about 1% of national income in individual income tax revenues. In the CBO methodology, these taxes are fully assigned to the owners of the respective corporations, while taxes paid on C-corporations profits are shifted to workers and capital owners nationally. Taxes on S-corporation profits end up being assigned in a much more progressive manner (70%-80% to the top 1% in the 1980–2021 period with no trend) than taxes on C-corporation profits (25% to the top 1% in 1980, rising to 40% in 2021). As S-corporation profits have risen from 0% to 5% of national income over this period, this creates a large bias in the 1980–2021 evolution of tax progressivity in the CBO series.[33]

[33]Like CBO, the US Treasury, the Joint Committee on Taxation, and the Tax Policy Center all treat C-corporations and S-corporations inconsistently. The US Treasury and the Tax Policy Center assign all of the

Implication for the decline in tax progressivity. Because the conventional approach allocates the corporate tax more equally than our methodology in the middle of the 20^{th} century and corporate income tax revenues were very high then, it delivers significantly lower effective tax rates for the top 1% in those decades (bottom panel of Figure 5). But since corporate tax revenues are small today, the different allocation of the corporate tax has little impact on top effective tax rates today (cf. Table 2). As a result, while in our approach the effective tax rate of the top 1% falls by nearly 13 percentage points between 1950 and 2021, the decline is only 7 points when applying the CBO methodology. The bias in the conventional approach is larger as one moves up the income distribution, where business profits account for a greater share of income.

Comparison with PSZ. The original Piketty, Saez and Zucman (2018) series, which followed the conventional approach to distributional tax analysis, also suffer from this bias. In these series, corporate taxes were allocated to all owners of non-residential capital (including pensions and non-corporate businesses) and not only to shareholders, building in the tax incidence effects of the standard Harberger (1962) model. This led to the issues detailed above: internal inconsistency of shifting taxes while keeping aggregate income constant; non-neutrality with respect to changes in business organizational forms and income classification across tax forms. Appendix Figure A3 shows that the bias in the original PSZ series is similar to the one in the CBO methodology, and even more pronounced in the middle of the 20^{th} century.[34]

5 Distributional Tax-Reform Analysis in Practice

Distributional tax-reform analysis involves estimating how a tax reform would affect pre-tax income, post-tax income, taxes paid, and money-metric welfare for each income group. As shown in Section 2, in neoclassical models a comprehensive distributional tax reform table only needs to report (i) the mechanical change in tax liability by income groups assuming no behavioral responses and no price effects, and (ii) the aggregate revenue effect due to supply

individual income tax to the corresponding individuals, but about 60% of the corporate tax to shareholders and the remaining 40% half to labor income and half to capital income nationally. The Joint Committee on Taxation assigns the corporate tax like CBO and 95% of individual taxes on passthrough business profits to the corresponding owners vs. 5% to labor income nationally.

[34]The top 1% effective rate in the original PSZ series is significantly too low in mid-twentieth century (bottom panel of Figure A3) because a large share of the corporate tax is assigned to the owners of non-corporate business assets (e.g., farmers, small retailers, etc.) and other non-residential assets, which prior to the 1980s were more equally distributed than corporate stock—more and more so as one goes back in time (top panel of Figure A3). Updated PSZ series and Saez and Zucman (2019) use the methodology described in this paper.

side responses ignoring price effects. Along with social marginal welfare weights for each group of the population, these are sufficient statistics to evaluate the value or cost of the reform. As we discussed in detail, pre-tax price effects can be ignored because they can be neutralized by adjusting other taxes at zero budget cost. Without such neutralization, pre-tax price effects are welfare relevant if other taxes are not set optimally. This is why having the full suite of distributional tax reform for each type of tax is actually useful.

In this section we apply this methodology to two frequently discussed policies: a change in the federal corporate income tax rate, and an increase in federal individual income taxes for the top 1%. We contrast our approach with the conventional approach influenced by models where the relevant elasticities are sometimes infinite by assumption.

5.1 Application to Corporate and Individual Income Tax Reforms

Corporate tax increase. Consider first an increase in the US federal corporate income tax rate by 10%, from 21% to 23.1%. In neoclassical models, what matters for the equity side of the tradeoff involved in this tax change is the mechanical change in corporate tax payments (which follow directly from the current-tax table showing how much corporate tax is paid by the different income groups, cf. Table 2) and social marginal welfare weights. We assume a simple pattern of social welfare weights declining geometrically as one moves up the income distribution: the weight on the top 0.1% is half the weight on the next 0.9%, which is half the weight on the next 9%, etc. For the efficiency part of the tradeoff, what matters is the elasticity of corporate profits with respect to the net-of-corporate-tax rate keeping pre-tax factor prices constant. This elasticity governs the loss of tax revenue due to supply responses of corporate capital (such as movements of capital abroad or to the non-corporate business sector). The key point is that there is no need to assess how pre-tax incomes are going to change in response to the tax increase (e.g., if wages are going to increase), greatly simplifying the analysis relative to conventional practice. It is straightforward to assess how changing the elasticity and welfare weights parameters affects the results.

A specificity of the corporate tax is that a significant fraction of it is paid by non-resident owners of US corporations. Vice-versa, US individuals pay corporate taxes to foreign governments via their ownership of foreign stock. We estimate that 39% of the US federal corporate tax was paid by non-residents in 2021 (consistent with Rosenthal and Burke, 2020); the amount of corporate tax paid by US residents to foreign governments is similarly large (see Zucman, 2023, for complete details). In recent years, *net* cross-border corporate income tax payments are

small and can be neglected in distributional current-tax analysis.[35] But because the gross flows are large, taking into account foreign ownership of US corporations matters for distributional tax-reform analysis.[36] We assume a zero marginal social welfare weight on non US-residents, but other choices are possible.[37]

The top panel of Table 3 reports the results. The left panel shows the distribution of current (as of 2021) incomes and corporate tax payments by income groups. The right panel shows the effect of the reform considered. Federal corporate tax revenues would mechanically increase by 10%, a gain of $27.9 billion. Corporate profits would shrink, leading to a loss of $3.7 billion in aggregate tax revenue. The net tax revenue raised by the reform is $27.9 − $3.7 = $24.1 billion. The reform would entail social welfare costs for all domestic income groups, adding up to $6.9 billion in total. The net value of the reform—i.e., after subtracting social welfare costs—is $17.2 billion, making the reform desirable.

Three remarks are in order. First, in contrast to the conventional approach, we do not shift any of the corporate tax increase onto labor. If such a shift took place, our method implicitly assumes that it is undone by readjusting labor and corporate taxes at budget neutral cost. As we discussed in Section 2.2, this is theoretically possible in the neoclassical model underlying such incidence effects. It is also important to note that neoclassical pre-tax price effects assumed in the conventional model are hard to identify compellingly empirically. Therefore such price effects are much more assumption than established fact (see Section 6 below). Second, there is uncertainty about the corporate profits elasticity. With our social welfare weights, the reform is desirable for a value of the elasticity up to 3 (and it raises net revenues for an elasticity up to 4). Third, the fact that about 40% of the US corporate tax is paid by foreigners (with zero welfare weight in our analysis) makes the corporate tax reform desirable even if the government has no redistributive tastes within US residents. With equal social marginal social welfare weights across all income groups and an elasticity of 0.5, the net value of the reform is $7.2 billion.

Individual tax increase. The bottom panel of Table 3 considers a 10% increase in the US federal individual income tax for taxpayers in the top 1% of the pre-tax income distribution,

[35] I.e., the total amount of corporate tax revenue collected by US governments is similar to the total amount of corporate tax paid by US households to US and foreign governments, so that allocating one aggregate or the other makes little difference to effective tax rates by income groups.

[36] The US Joint Committee on Taxation (2013) assumes that 10.8 percent of the 75% of corporate income taxes not shifted to labor are borne by foreigners, i.e., about 8% of total federal corporate income taxes, much lower than the 39% in our analysis. The JCT allowance for non-resident ownership is insufficient because it only factors in portfolio investments into US stock (ignoring direct investment) and it is based on data from the 2005–2012 period (while foreign investments in US equities have been on a rising trend since then).

[37] For instance one could consider putting a weight on non-US residents equal to the average marginal social

another commonly discussed tax reform. We use the same social welfare weights and assume an elasticity of reported individual income with respect to the net-of-tax rate of 0.25, consistent with the large body of work estimating behavioral responses to individual income tax changes (see Saez, Slemrod and Giertz, 2012, Scheuer and Slemrod, 2020, for reviews). Under these assumptions the net revenue gain is \$75 billion, or 86% of the \$87 billion revenue gain absent any behavioral response. The net value of the reform is \$64 billion as the reform targets the top 1% only and hence has a low welfare cost of \$11 billion. The reform remains desirable for top incomes elasticities of up to 1.75.[38]

5.2 Model Selection: Pitfalls of Infinite-Elasticity Models

The conventional analysis relies heavily on tax incidence models, in particular the Harberger (1962) model of corporate tax incidence which has had an enormous influence in practice.[39] Confronting these models to the optimal tax literature shows that these models can be ill-suited to distributional tax-reform analysis, however.

Modeling corporate tax changes. Consider first the Harberger (1962) model, where capital can be used either in the corporate sector or in the non-corporate sector (such as unincorporated businesses and housing) with perfect substitution. Individuals care only about the net-of-tax return of the capital they own, not whether it is invested in the corporate vs. non-corporate sector. Thus, the net-of-tax rates of return must be equalized across the two sectors. The corporate tax creates a production inefficiency, because too little capital is used in the corporate sector relative to the non-corporate sector. Formally, in the Harberger model, production is $Y_1 = F^1(K_1, L_1)$ in sector 1 and $Y_2 = F^2(K_2, L_2)$ in sector 2 with $K_1 + K_2 = K$ total capital and $L_1 + L_2 = L$ total labor. Given fixed labor and capital endowments L and K, production efficiency maximizes $F^1(K_1, L_1) + \lambda F^2(K - K_1, L - L_1)$ for some $\lambda \geq 0$, so that $F^1_K = \lambda F^2_K$ and $F^1_L = \lambda F^2_L$ and hence $F^1_K / F^1_L = F^2_K / F^1_L$. A tax on the return to capital in sector 1 only (with equal taxes on labor in both sectors) violates this condition.

The corporate tax, as modeled in Harberger (1962), violates the production efficiency theorem of Diamond and Mirrlees (1971). The theorem states that taxes that create production

welfare weight of US residents, assuming that foreign shareholders have the same class structure as in the United States, and that the US government has cosmopolitan redistributive objectives.

[38] This analysis is consistent with the optimal income theory of Mirrlees (1971) and in particular the optimal top tax rate formula $\tau = (1-g)/(1-g+a \cdot e)$ developed in Diamond (1998) and Saez (2001) with the elasticity e, $a \simeq 1.5$ the Pareto parameter on the tail of the income distribution, and g the social marginal welfare weight assigned to top earners.

[39] See Auerbach (2006) for a review on the incidence of the corporate income tax.

inefficiencies are second-best Pareto inefficient: they can be replaced by other feasible taxes on final consumption goods or factors of production in a Pareto-improving way. In the Harberger model, replacing the corporate tax with a lower tax on *all* uses of capital can be Pareto-improving, because it would allow for more production in both the non-corporate and corporate sectors. This result immediately follows from the assumption of perfect mobility across sectors.

This point does not seem to have been noted in the literature, perhaps because of the gap between applied tax analysis and theoretical optimal tax analysis. To see this point within the context of our distributional tax-reform approach, consider a small increase of the corporate tax rate. The distributional part of the analysis assigns the extra tax to the owners of corporations, ignoring behavioral responses and price effects. The efficiency part of the analysis considers the supply-side response ignoring price effects. In the Harberger (1962) model, because the supply-side response has by assumption an infinite elasticity, the loss in tax revenue due to it swamps any distributional gain. As long as capital in the corporate sector is taxed more than capital outside the corporate sector, it is always desirable to lower the corporate tax rate. Conventional tax incidence, starting with the pioneering work of Harberger (1962) fails to note this important point because pre-tax price-effects muddy this clean conclusion that comes out of the Diamond and Mirrlees (1971) analysis. In our view, this is a decisive advantage of optimal tax pioneered by Diamond and Mirrlees (1971) over conventional tax incidence following Harberger (1962).[40]

Because an infinite elasticity for corporate capital supply is not realistic empirically, the basic Harberger (1962) model is not well suited to welfare analysis of the corporate tax. It is, however, easy to amend the model to make the elasticity finite as we did in Section 2.2. For example, if individuals value directly the type of capital they own over and above the net-of-tax return it delivers, then net-of-tax returns will not be equalized across sectors. There will be a finite supply elasticity of corporate capital with respect to the net-of-tax rate of return, leading to non-degenerate optimal tax analysis.

Modeling capital tax changes. The same issue applies to the analysis of the incidence of capital taxes more generally. Section 2.2 showed that in neoclassical models, supply elasticities are sufficient statistics for the efficiency part of the trade-off involved with a capital tax reform. In two standard models of capital taxation, the elasticity of capital supply e_K is infinite. First, in the infinite horizon consumption model of Barro-Becker, in steady-state the net-of-tax return $\bar{r}$ has to be equal to the discount rate δ. Any deviation of $\bar{r}$ from δ leads to an explosive

[40] Conventional distributional analysis carried out by US agencies and inspired by the Harberger (1962) model further muddies the waters because it is not conceptually fully consistent with the Harberger model, in particular because of its assumption that taxes cannot change aggregate output and its composition.

or implosive long-run capital stock. Second, in the open-economy model where capital moves freely and costlessly internationally but capital is taxed where it is used (as is the case with standard territorial corporate taxes), $\bar{r}$ has to be equal everywhere to the worldwide net-of-tax return, creating again an infinite elasticity from a single (small) country perspective. As shown in Section 2.2, these models can also be amended to generate more realistic finite elasticities.

5.3 A Litmus Test: Tax Exempt Municipal Bonds

Sometimes very large elasticities exist. This is the case for municipal bonds (munis) whose interest payments are currently exempt from federal individual income tax. It is enlightening to consider a reform of the taxation of munis, a litmus test for our approach.

In our current-tax analysis, the owners of munis pay no federal tax on the corresponding interest income and are assigned relatively low tax rates. Due to their tax-exempt status, however, munis have lower pre-tax returns than taxable bonds, as there is an active market of professional bond traders that arbitrage the net-of-tax returns between munis and taxable bonds. This is a key difference with the corporate tax, as it is much harder to arbitrage corporate stock with other capital assets (e.g., given the price volatility of stocks). Our current-tax methodology captures that the pre-tax incomes of the owners of munis are depressed, although it does not single out taxes as the culprit.[41]

Consider now introducing a (small) tax on munis interest. Current owners of munis would pay the extra tax mechanically. However, the behavioral response would likely be large. People would shift away from munis into taxable bonds (as our method keeps pre-tax returns constant), effectively a very large elasticity. This behavioral response would create a large revenue gain for the government, as taxable bonds generate more tax revenue than munis. With a very large elasticity, this revenue gain swamps any distributive consideration. In a standard model, our method indicates that it is unambiguously good to increase the tax rate on munis as long as munis are tax-favored, up to the point where the tax rates are aligned.[42] Indeed, in the Diamond and Mirrlees (1971) model, exempting munis but not other bonds creates a production inefficiency. Too much capital flows to the local government sector at the expense of the other sectors. Any tax optimum should align the tax treatment of munis and other bonds.

Justifying the munis tax exemption requires a departure from the standard model. The

[41] The conventional approach, by contrast, should logically assign muni investors a higher counterfactual pre-tax income (based on applying a normal rate of return to their holdings), and then fictitious taxes they do not pay, following the same logic as the one used for the corporate tax and workers. To the best of our knowledge, however, US agencies and think-tanks follow our methodology and do not gross up muni interest income by fictitious taxes.

[42] Once the tax rates are aligned, portfolio rebalancing responses no longer generate revenue effects as tax

simplest is to assume that investors derive utility from owning specific assets (such as munis), in which case different tax rates on different assets can be optimal. More radically, if top wealth generates excess power in the form of concentrated business ownership, the munis tax exemption could be a desirable tool to induce top wealth holders to divest from their businesses and invest in local government projects.

6 Incorporating Non-Standard Behavioral Effects

In the neoclassical models considered so far, distributional tax-reform analysis is straightforward to conduct. These models also have the advantage of accommodating tax avoidance responses which are often first order (Slemrod, 1995), as shown by Feldstein (1999) and detailed in Section 2.1 above. Their main limitation is that they do not allow for some important non-standard behavioral responses to taxes uncovered by the modern literature. In this Section we take stock of this body of work. We show that non-standard incidence can be incorporated into our tax-reform framework, and provide an application to a reform that would replace employer-provided health insurance premiums by a payroll tax.

6.1 Non-Standard Incidence: Lessons from the Recent Literature

We define as non-standard incidence any incidence effect that cannot be reconciled with the neoclassical model used above. Table 4 provides a summary of the key non-standard behavioral responses to taxes uncovered by the recent literature, tax by tax.[43]

Corporate taxes. A number of papers find non-standard effects of the corporate tax that operate through bargaining over the distribution of value-added within businesses. Fuest, Peichl, and Siegloch (2018) show that municipality-level corporate tax cuts in Germany affect wages, with workers receiving about 40% of the tax windfall. Kennedy et al. (2022) show that the large 2018 cut in the US corporate tax rate also generated earnings gains for workers but concentrated among top 10% and especially top 1% earners with no gain for the bottom 90%. Highly paid workers capture 32% of the corporate tax cut (Table 11 in Kennedy et al., 2022), comparable to the German estimate but concentrated solely among highly paid workers. This suggests that bargaining power within the firm affects how a corporate tax windfall is distributed, with strong unions in Germany perhaps able to spread windfalls more equitably among workers. In Table 4,

rates are the same.

[43]The individual income tax does not exhibit major non-standard incidence effects, except for the fact that individuals do not have perfect understanding of the tax system (see e.g. Rees-Jones and Taubinsky (2020)).

we use Kennedy et al.'s estimates and assign 2/3 of a corporate tax change to profits and 1/3 to workers. Crucially, these within-firm effects have nothing to do with the macroeconomic effect of taxes on factor prices in classical incidence models, and hence are relevant for assessing the direct welfare effects of a reform.[44]

Consumption taxes. The standard model predicts that increases vs. decreases in taxes should have symmetric effects. This result is strikingly proven false by Benzarti et al. (2020) in the case of the value-added tax (VAT), the major form of consumption tax worldwide, using a comprehensive analysis of VAT reforms in Europe from 1996 to 2015. While producers can pass almost all of a VAT increase onto consumers consistent with conventional assumptions, VAT cuts are only half passed onto consumers and hence benefit businesses–and their workers and suppliers. These asymmetric price effects persist several years after VAT changes take place. The most likely explanation is that businesses can justify a price increase if there is a tax increase, but can silently pocket a tax decrease with inattentive consumers.[45] This asymmetric evidence is based on many VAT changes in Europe and hence solidly established. For distributional tax reform analysis, this implies that a VAT tax increase can be assigned to the corresponding consumers as in conventional analysis, but a VAT tax decrease should be shared half between consumers and half for businesses and their workers.

There is more uncertainty on how the tax windfall going to businesses should be split between profits and workers. The estimates from Benzarti and Carloni (2019) for a single specific VAT cut for restaurants in France finds that of the incidence on businesses, 75% goes to profits and 25% to workers but it is hard to know whether such numbers generalize to other sectors or countries as they likely depend on workers' bargaining institutions and power.[46] Hence, in our summary Table 4, we split a VAT cut 50% to consumers, 37.5% to profits, and 12.5% to workers with the latter two figures being highly uncertain. Because some of the VAT reforms considered by Benzarti et al. (2020) are very sector specific (e.g., hairdressers or restaurants), we conjecture in Table 4 that similar effects would hold for excise taxes as such taxes are like the VAT typically built in the price posted to consumers.

[44]We did not incorporate these effects in our corporate tax reform analysis of Section 5.1, because the wage effect in the United States is highly concentrated at the top of the distribution, so that accounting for it has only minor effects relative to assuming that the full incidence is on profits (see Kennedy et al. 2022, for a detailed analysis).

[45]See Kosonen (2015) and Harju et al. (2018) for a more detailed discussion in the context of the hairdressing and restaurant industries in Finland showing that non-standard incidence is concentrated among smaller businesses.

[46]Benzarti and Carloni (2019) find that firm owners pocketed around 55.7 percent of the VAT cut and employees received 18.6 of the VAT cut, making for a 3/4 vs. 1/4 split between profits and workers in this case.

The persistent asymmetric result by Benzarti et al. (2020) also shows that there is no single equilibrium, since a cut followed by an offsetting increase in VAT rate on a specific good seem to lead to permanently higher prices for the good (Figure 2 in Benzarti et al. 2020 provides a striking case study for hairdressers vs. beauty salons in Finland). This radical departure from equilibrium analysis means that the no-tax counterfactual of classical tax incidence analysis might not even be well defined.

US sales taxes are not visible on posted prices and charged at the checkout. Empirical work shows that they are passed to consumers symmetrically (for cuts or increases) and generally fully (see e.g. Poterba 1996 and Besley and Rosen 1999 for empirical studies). Chetty, Looney and Kroft (2009) show that consumers also under-react to changes in sales taxes relative to changes in excise taxes that are included in posted prices, a relevant finding to inform distributional tax-reform tables that we point out in Table 4.

Payroll taxes. A celebrated result in classical incidence analysis is that employer and employee payroll taxes are equivalent. In the real world, this result fails to materialize. A number of studies compellingly show that *employee* payroll taxes changes affect the wage earnings of the corresponding workers one-to-one but that employers fail to pass changes in *employer* payroll taxes to the corresponding workers, likely because of wage rigidities.[47] As a result, an increase in employer payroll taxes likely reduces wages across the board and probably profits inside the business.[48] This effect, however, is not a neoclassical price effect.[49] It produces relevant welfare effects on the corresponding parties that should be tracked in the distributional tax-reform table. It is possible that these non-standard effects persist in the long-run and are asymmetric for increases and decreases. The studies by Saez, Schoefer, and Seim (2019) for Sweden and

[47]Saez et al. (2012) show that, in Greece, uncapping employer payroll tax increases the labor cost of the corresponding workers but uncapping the employee payroll tax does not. Bozio et al. (2022) find the same result in France when there is no close link between employer payroll taxes and benefits. Saez, Schoefer, and Seim (2019) find that employer payroll tax cuts for the young in Sweden do not increase their net-wages and businesses redistribute the tax cut windfall partly across all workers. Rubolino (2022) finds a female specific payroll tax cut does not increase their net-wages but boosts female employment and firm performance. Guillot (2019) shows that a special temporary employer payroll tax on very high wage earners in France was mostly borne by employers but then asymmetrically increased net wages upon expiration of the tax.

[48]Conceivably, it could also increase prices of output of the business benefitting consumers. There is no direct empirical evidence on this to date but the literature on minimum wage increases shows compellingly that part of this extra labor cost is passed on consumers (e.g. Harasztosi and Lindner 2019 find that 75% of the minimum wage).

[49]Bozio et al. (2022) provide a meta-analysis of 21 estimates in the literature showing that employer payroll tax changes are not passed to corresponding workers except when there a tight and salient tax-benefit linkage. While most of these studies tried to interpret their finds within the neo-classical supply vs. demand elasticities framework, Bozio et al. (2022) show that non-standard effects: saliency of the link between taxes and benefits and inequity aversion within firms are a more parsimonious way to account for the disparate empirical findings.

Benzarti and Harju (2021) for Finland show that payroll tax incidence happens at the firm level rather than the individual level as in standard theory. Saez, Schoefer, and Seim (2019) show that firms which have many workers eligible for a specific payroll tax cut on young workers increase the wages of all their workers, not just the eligible workers, and that profits also go up. This suggests that, within the firm, workers and profits share the tax cut or tax increase in proportion to their share in value-added but there remains considerable uncertainty on how such findings generalize. It is likely that sharing depends on institution and bargaining power of workers within the firm as suggested by Kim, Kim, and Koh (2022).[50] Therefore, in Table 4, we tentatively assume that an employer payroll tax change would be borne collectively within the firm by workers for 2/3 and by profits for 1/3.[51] There is also evidence of strong employment effects of employer payroll tax changes particularly if tax changes are targeted to a specific group (Saez, Schoefer, and Seim 2019 for youth in Sweden, Ku, Schoenberg, and Schreiner 2020 for local changes in Norway, Benzarti and Harju 2021 for small businesses in Finland, Cottet 2022 for low wage workers in France, Rubolino 2022 for female hires in Italy, Citino and Fenizia 2022 for apprentices in Italy). But with rigid wages, such employment effects fail to generate wage responses as predicted by standard incidence.

6.2 Application: Medicare for All Funding

The United States is the only advanced economy without universal health insurance. Nearly half of the population has to pay for their health insurance privately, primarily through employers. Employer-provided health insurance is part of the labor income of the corresponding workers. It has become a mandated benefit after the Affordable Care Act enacted in 2010 (except for small employers and part-time employees). Economically, compelling employers to provide insurance is similar to funding health insurance for workers with a payroll tax—but a very specific type of payroll tax: one equal to the cost of health insurance for the corresponding worker, as opposed to proportional to earnings as for usual payroll taxes. Saez and Zucman (2019), Case and Deaton (2020), and Finkelstein et al. (2023) analyze this regressive funding system—similar to a head tax per worker—and discuss how to create a more progressive form of financing.[52]

[50] They show that in Singapore, an employer payroll tax cut on workers aged 60 and above increases wages and they provide a meta-analysis of the literature suggesting that countries with more competitive labor markets show less evidence of non-standard incidence effects.

[51] Earlier macro-level studies have pointed out that the stability the labor share in national income in spite of large increases in employer payroll taxes in the 20th century suggests that profits are not affected by employer payroll taxes in the long-run (see e.g., Brittain 1971).

[52] The current system is not exactly akin to a head tax as insurance cost varies by family size (if the policy also insures the family members of the worker) and by type of insurance provided. Moreover, although providing health insurance is mandatory for most employers, the premiums are not paid to the government but to private

To illustrate the importance of non-standard tax incidence, consider replacing the current head-tax mandate by a payroll tax proportional to earnings for all workers currently covered by their employers. In 2021, about 85 million workers have employer-sponsored health insurance, covering about 155 million non-elderly individuals (see KFF, 2021). These workers have total pre-tax wage income of $9.0 trillion, their health insurance costs nearly $1.1 trillion, so the new payroll tax would need to be levied at a rate of about $\tau = 12\%$.[53] We assume that health insurance would remain the same worker by worker (to focus solely on the funding aspect—ignoring the complex issues of heterogeneity in benefits).

Conventional incidence with flexible wages. In the conventional analysis and in our neoclassical analysis, both the current head tax and the proportional payroll tax are taxes on labor, borne by the corresponding workers. This is also the assumption used in the recent comprehensive analysis of Finkelstein et al. (2023) who consider a shift to proportional payroll tax funding. This reform would leave labor costs (cash wage earnings plus the cost of health insurance and other fringe benefits) unchanged for each worker. After the reform, health insurance premiums currently paid by employers convert into extra gross cash earnings dollar for dollar and worker by worker. All gross earnings are then reduced proportionally by a factor $1 - \tau$ due to the new payroll tax. Any worker with health care insurance costs above τ times her earnings benefits from the reform (and conversely). This is a progressive reform that would have significant positive effects on the disposable income of the working and middle class, at the expense of highly paid workers. Pre-tax incomes would not change, but post-tax incomes would become more equal, as the proportional payroll tax replaces the head tax for covered workers. As shown by Table 5, column 6, this reform would increase after-tax earnings of the bottom 50% by about 2.5% (and reduce after-tax income at the top by 1% to 2%), making it seemingly simple to put US health care funding on a fairer and more sustainable path.[54] Non-standard tax incidence, however, is crucial to understand how and whether this would work in practice. Three scenarios illustrate this point.

companies, and thus are best described as non-tax compulsory payments. We refer to them as a head tax to highlight the similarities with standard taxes. These payments are not included in our analysis of the progressivity of the current US tax system presented in Section 4 and Section 5.1 above.

[53]We assume that the payroll tax would be charged before any other tax and not be part of the tax base for existing payroll and income taxes, mimicking the current tax-exempt status of employer-provided health insurance.

[54]The results in Table 5 report the effects of the reform on the full population including non-workers and on total pre-tax income (including non-wage income). Restricting the analysis to the covered population (less than half of the total population of the United States) and wage income only would show significantly larger effects.

Employee payroll tax with rigid wages. Suppose first that the new payroll tax is charged to employees. Workers would see their net earnings reduced by the new payroll tax (as workers bear this new tax one for one, cf. Table 4). The elimination of the head tax is akin to an employer payroll tax cut. As explained in Table 4, because of wage rigidities, this payroll tax cut would not be passed one-to-one to the corresponding workers but instead passed roughly 2/3 to workers across the board within each firm (proportionately to their wages) and 1/3 to profits, according to existing studies. Under these assumptions, the reform becomes *regressive* as illustrated in Table 5. Both pre-tax and post-tax incomes become more unequal.

Employer payroll tax with rigid wages. Suppose now that the new payroll tax is charged to employers. The head tax–the current insurance premiums paid by employers–becomes an employer payroll tax. Because the amounts are the same, there is no tax savings or costs for employers. Wage rigidities imply that net earnings do not change but pre-tax labor income becomes more unequal: labor costs for each worker change by the difference between the new payroll tax and the former head tax.[55] The reform again fails to make the progressive gains of the conventional analysis. But it is more progressive than the previous scenario as none of the savings made by employers goes to profits.[56]

With non-standard incidence effects of this kind, labor costs for workers change so that there could be employment effects due to labor demand responses of employers (cf. Table 4). In our setting, as labor costs for low-paid workers fall, they could become more attractive to employers, boosting employment at the low end. In a competitive standard labor market model, such demand effects lead to wage responses generating the conventional incidence results. But with rigid wages, such responses may be sluggish and incomplete, as shown by empirical evidence. There remains considerable uncertainty, and hence need for more research on how quickly such wage adjustments would take place.[57]

[55]This is the most plausible incidence in light of the studies analyzed above. Because there is a linkage between the head tax and health care benefits, the analysis of Bozio et al. (2022) suggests that the incidence passed on to workers individually (Gruber 1994 and Baicker and Chandra 2006 present US based analysis of health premiums changes consistent with this). Therefore, it is possible that wages would not be completely rigid and that the incidence of removing the head tax would eventually shift back to workers as in the standard incidence model.

[56]In the employee payroll tax scenario, if workers have a lot of power and can recoup 100% of the saving (instead of just 2/3), then it is likely that workers would insist on a proportional-to-earnings compensation to offset the payroll tax. In this case, the incidence is the same in the employee vs. employer payroll tax funding cases, but this equivalence depends crucially on strong worker bargaining power (instead of being the standard consequence of competitive markets).

[57]The classic study by Gruber (1994) on mandated maternity benefits in some US states found that wages of child bearing women adjusted within a few years.

Directed tax incidence with rigid wages. Last, how can incidence be steered toward the equilibrium of the conventional analysis in the real world with wage rigidities? As proposed by Saez and Zucman (2019), existing employer-provided benefits could be converted one-for-one into a permanent wage increase worker-by-worker by law. This would leave labor costs for employers unchanged worker by worker. A new payroll tax on employees should then be created at rate τ as in the first scenario. This tax would fall on the corresponding employees. It would recreate the exact conventional incidence. The key difference with conventional incidence is that the equilibrium would be reached by legislation rather than through competitive market forces.

7 Conclusion

Who pays taxes, and how tax reforms would affect the different socio-economic groups, are some of the most important public-interest questions in democratic societies. The official practice currently used to inform the public about these questions, which has evolved somewhat inorganically from foundational scholarship developed in the middle of the 20^{th} century, has shortcomings. We attempt to address these issues by founding distributional tax analysis on modern optimal tax theory.

Two main lessons emerge from this work. First, it is possible to do conceptually consistent and practically relevant current-tax analysis that does not merely follow statutory incidence but rather follows economic reasoning and yet does not require to specify behavioral responses. This analysis assigns taxes to individuals simply—labor taxes to the corresponding workers, capital taxes to the corresponding owners, consumption taxes to consumers—as one writes a model of optimal taxation. The tax rates are the wedges between pre-tax prices (relevant for production) and after-tax prices (relevant for work, savings, and consumption decisions of households). This method maximizes the comparability of tax progressivity over time and across countries, regardless of differences in the legal tax structure and the form of business organization. Classical tax incidence analysis is not required to study the distribution of current taxes.

Second and more deeply, classical incidence analysis also turns out to be largely irrelevant for the distributional analysis of tax reforms. This is because the effect of taxes on pretax prices at the heart of classical tax incidence are normatively irrelevant in optimal tax models. Moreover, the recent applied literature on behavioral responses to taxes uncovers effects that are far from those captured by classical incidence. Instead, the existence of a hierarchy of responses (with tax avoidance coming first), asymmetries (tax cuts having different effects than tax increases), intra-firm bargaining effects, and wage rigidities appear to be key. Additional work needs to be

carried out to understand the nature of these non-standard effects. If they generalize to other contexts, additional theories need to be developed, for example to account for the asymmetry of VAT tax changes and to clarify how to measure the resulting welfare effects.

In the meantime, government agencies should stop shifting taxes for the analysis of the current tax system. Practically in the US, this concerns solely the corporate income tax which should simply be assigned to shareholders. To study the economic effects of small tax reforms, the analysis should focus on the relevant supply elasticities and the non-standard effects uncovered by the modern empirical literature. This approach, dramatically simpler than the current practice and yet more consistent, would improve the quality of the official information available to lawmakers and the public about the progressivity of the tax system, historical changes in that progressivity, and the potential effect of proposed tax reforms—core topics of democratic interest.

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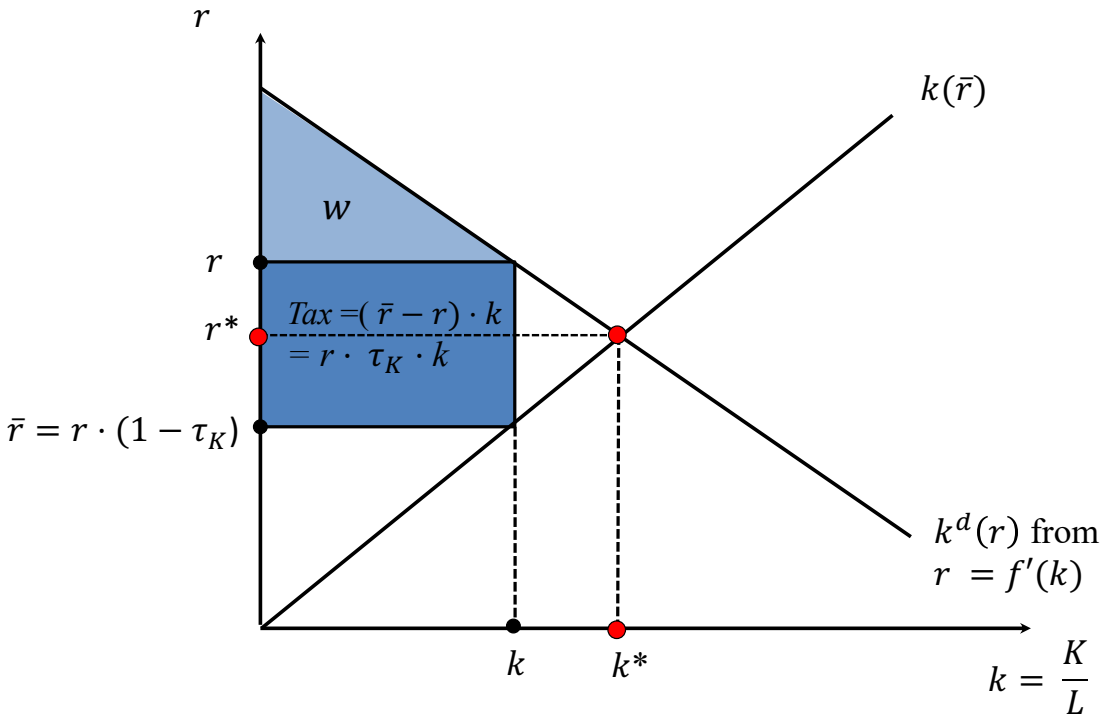
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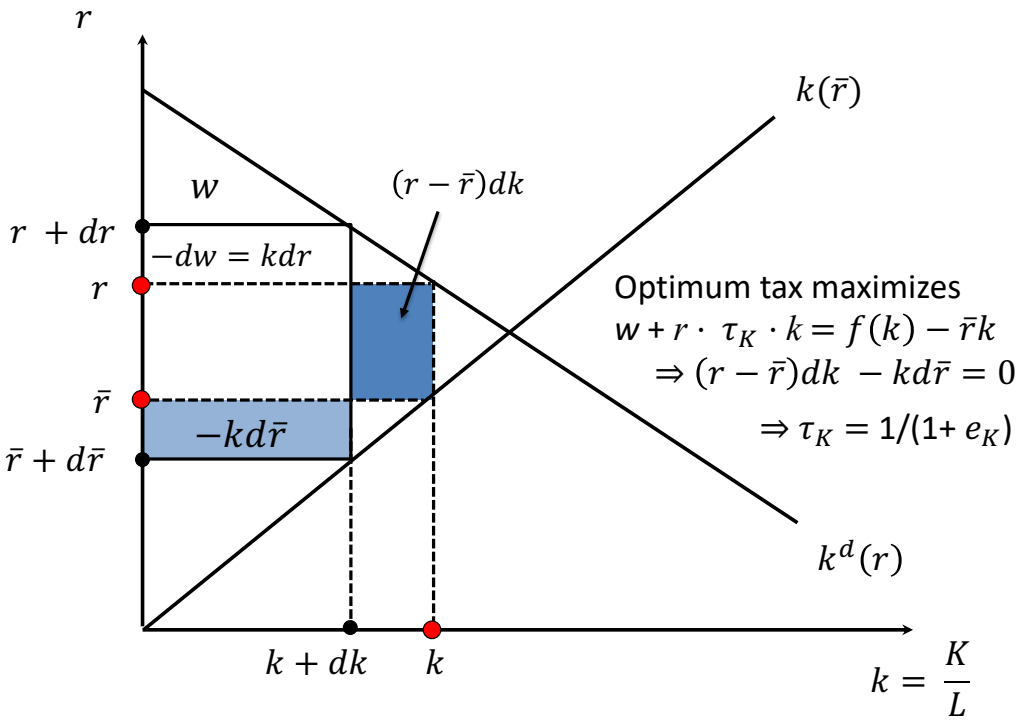
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Figure 1: General Equilibrium with Capital Tax



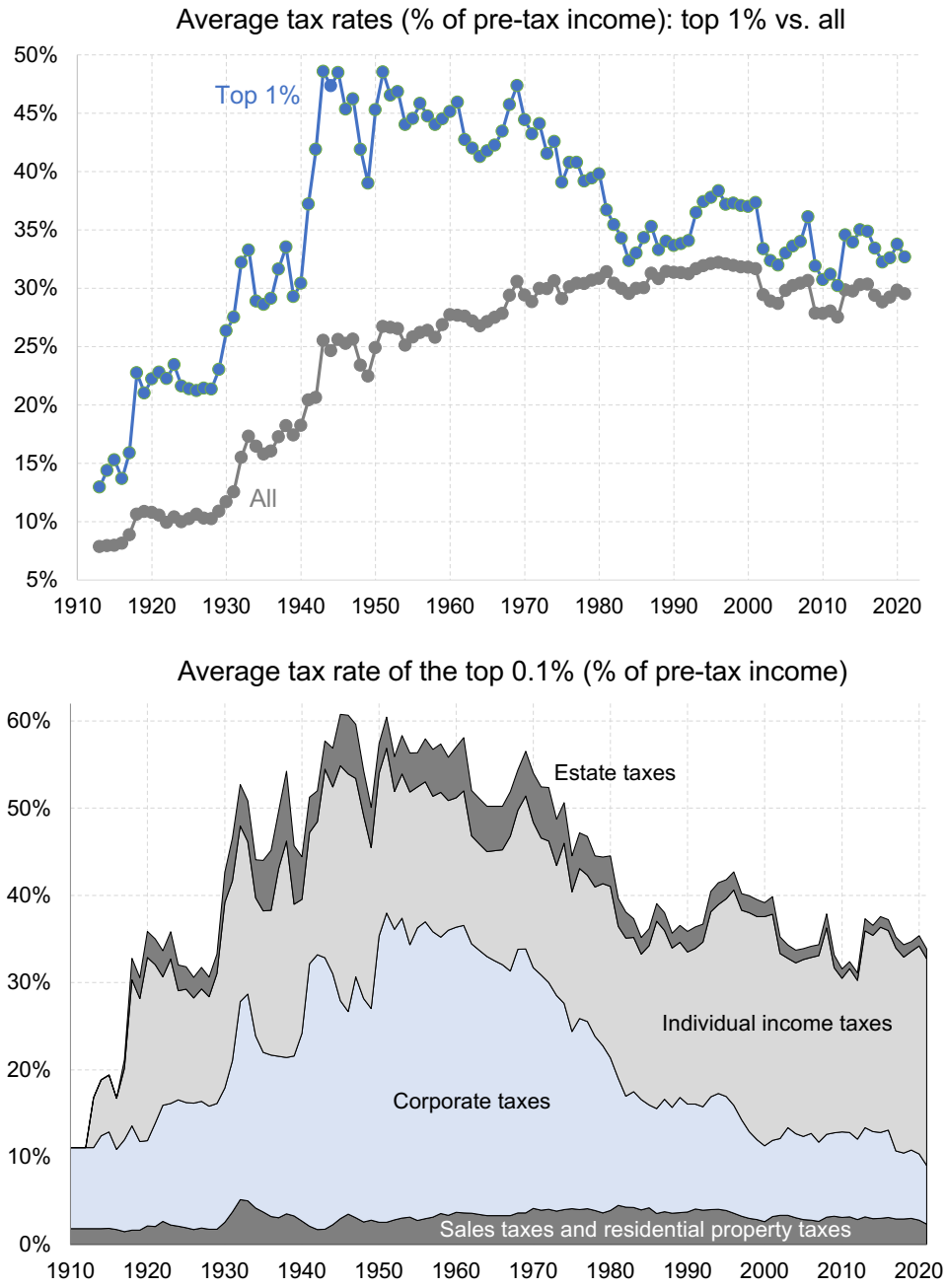
Notes: The figure depicts the effect of a tax on capital income at rate τ_K on the interest rate r, the capital to labor ratio $k = K/L$, and the wage w in a general equilibrium neoclassical model with fixed labor L, CRS production $F(K, L) = L \cdot F(K/L, 1) = L \cdot f(k)$. The equilibrium is characterized by 3 equations: (1) $r = f'(k)$ (rate of return of capital equals its marginal return which generates the demand for capital $k^d(r)$), (2) $k = k(\bar{r})$ (capital supply depends on its net of tax return $\bar{r} = r(1 - \tau_K)$), (3) $w = f(k) - kf'(k) = \int_0^k f'(\kappa)d\kappa - rk$ (the wage w can be read as the area below the demand curve and above the r horizontal line). Without taxes, the equilibrium is (r^*, k^*). With a tax rate τ_K, the equilibrium shifts to (r, k). The tax collects the rectangle, $(r - \bar{r})k = \tau_K rk$, it increases r, and reduces $\bar{r}$ and w. The tax reduces the wage and the surplus of capitalists by an excess burden triangle $\simeq (1/2) \cdot r\tau_K \cdot (k^* - k)$ over and above taxes collected. In this economy, pre-tax labor income is wL, pre-tax capital income is rK, and post-tax capital income is $r(1 - \tau_K)K$.

Figure 2: Capital Tax Reform and Optimum



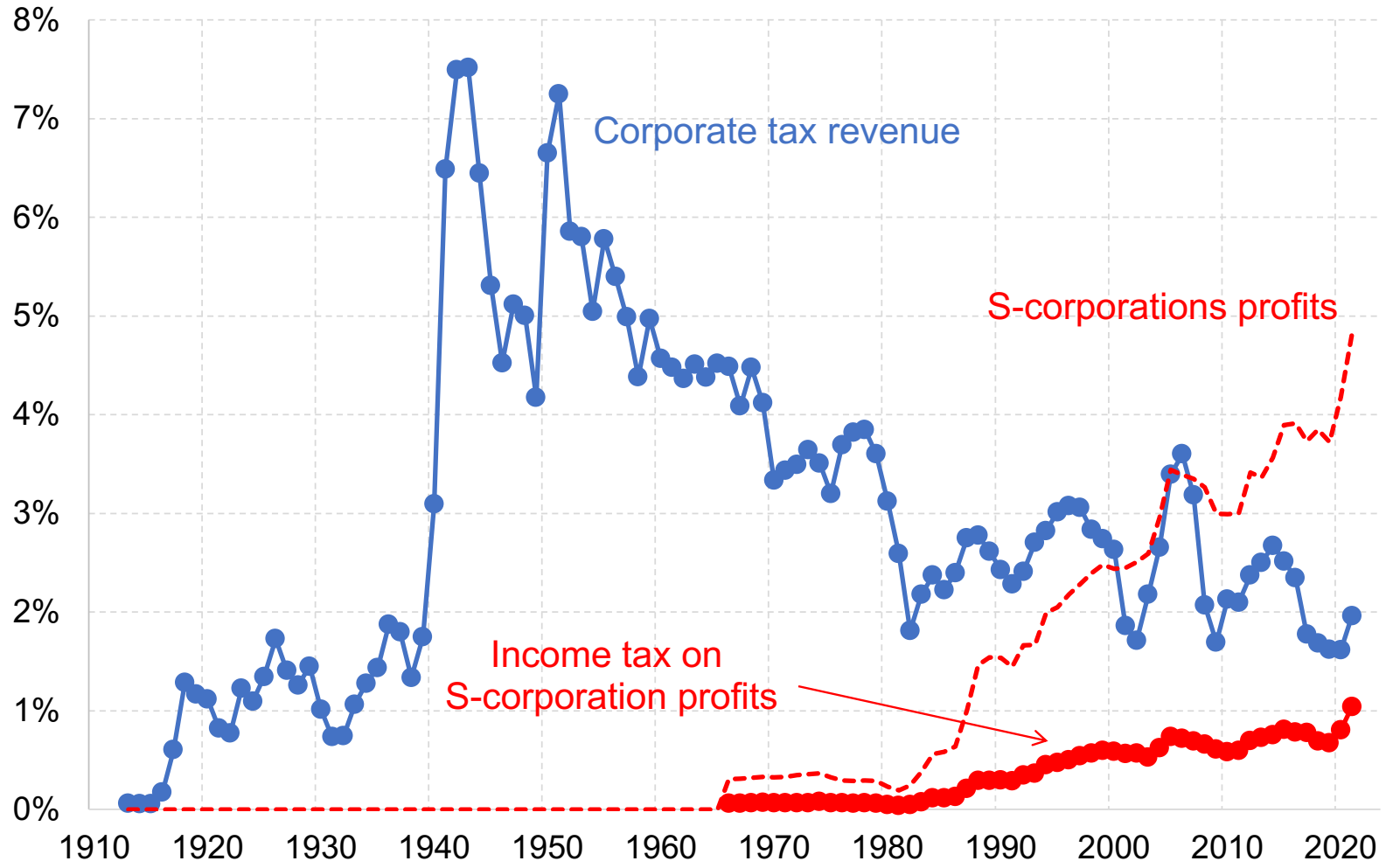
Notes: The figure depicts the effect of a change $d\tau_K$ in the capital income tax rate τ_K in the simple neoclassical model depicted on Figure 1. The tax change reduces capital k by $dk < 0$, increases the pre-tax rate of return r by dr, reduces the net-of-tax rate $\bar{r}$ by $d\bar{r} < 0$. If the government wants to maximize the welfare of workers, it sets τ_K to maximize $w + \tau_K rk$ (wages plus tax revenue extracted from capitalists). As $w = f(k) - kf'(k)$, we have $w + \tau_K rk = f(k) - \bar{r}k$, the area below the demand curve $r = f'(k)$ and above the horizontal line $\bar{r}$ (the blue areas in Figure 1). The first order condition for the optimum is $(f'(k) - \bar{r})dk - kd\bar{r} = 0$ (the 2 blue rectangles on the Figure cancel out at the optimum). As $f'(k) = r$, this can be rewritten as $(r - \bar{r})dk/d\bar{r} = k$ or $(r - \bar{r})/\bar{r} = 1/e_K$ which is the classical inverse elasticity rule $\tau_K^* = 1/(1 + e_K)$ where $e_K = (\bar{r}/k)dk/d\bar{r}$ is the pure supply side elasticity. Therefore the classical pre-tax price incidence dr, dw is irrelevant for optimal tax analysis, a result that generalizes to any social welfare function as shown in Diamond and Mirrlees (1971).

Figure 3: Changes in Tax Progressivity in the United States



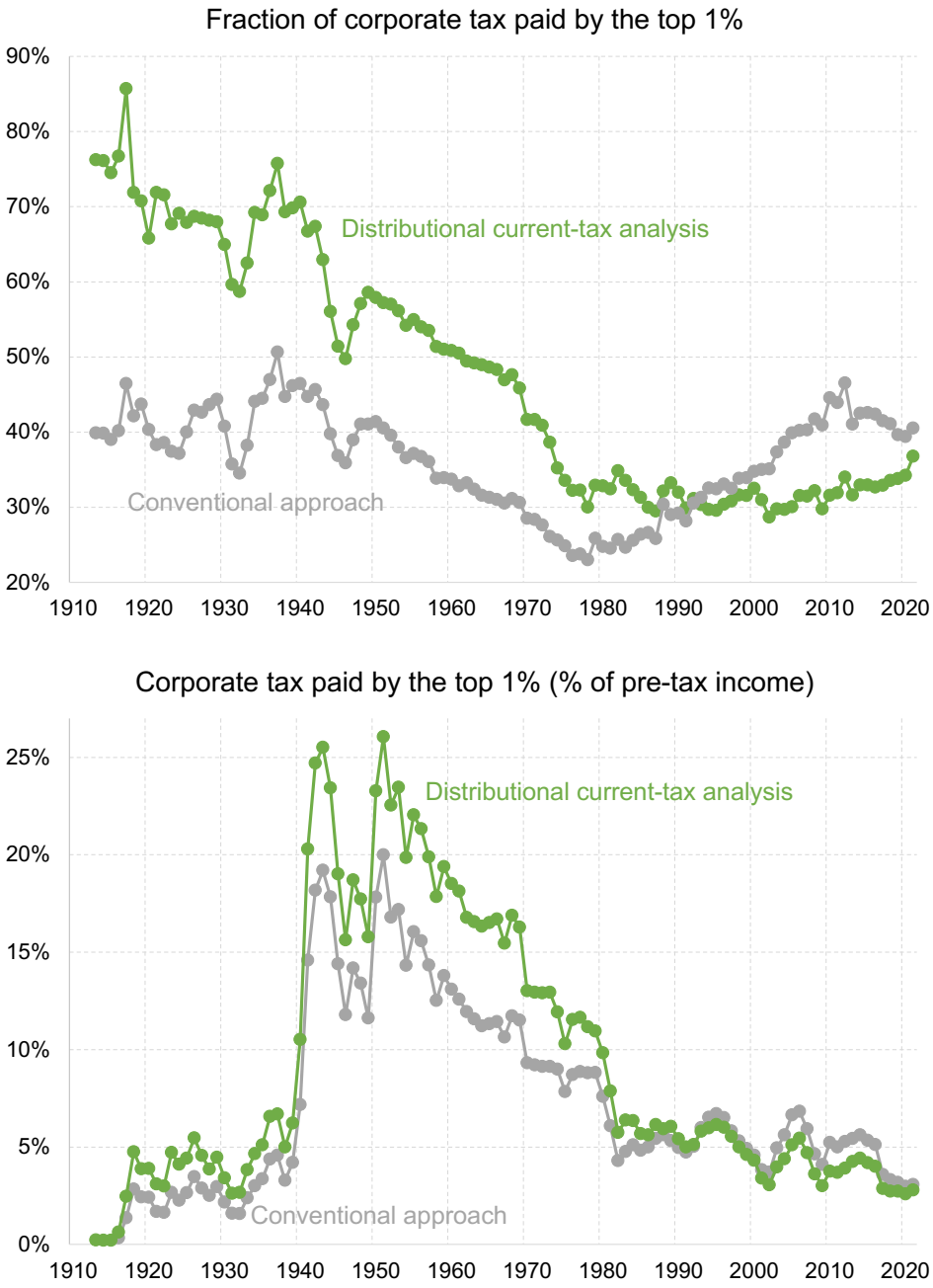
Notes: The top panel reports average effective tax rates for the US population as a whole and for the top 1% of the pre-tax income distribution. To construct income groups, the unit of observation is the adult individual (aged 20 or above), and adults are ranked by their pre-tax national income, with income equally split between married spouses. All taxes at all levels of government are included in the numerator, and all pre-tax national income is included at the denominator. Pure realized capital gains (defined as realized gains in excess of 3% of national income) are included in pre-tax income. The bottom panel shows the effective tax rate of the top 0.1% of the pre-tax income distribution similarly defined, with a decomposition by type of tax. "Corporate taxes" include both federal and state corporate taxes and business property taxes. "Individual income taxes" include both federal and state individual income taxes and payroll taxes.

Figure 4: Corporate Tax Revenue (% of National Income)



Notes: The figure plots the evolution of (federal plus state) US corporate income tax revenue and of S-corporation profits, both as a fraction of US national income. S-corporation profits are taken from the prototype BEA estimates of S-corporation profits in US national income (Krakower et al., 2021, updated), which cover the years 2012–2018, and are estimated by us using similar methods before 2012 and after 2018. Taxes on S-corporation profits are estimated by applying the effective average income tax rate on ordinary income (i.e., income excluding capital gains) to reported S-corporation profits, separately for the top 1% and the bottom 99% of the fiscal income distribution.

Figure 5: Allocating the Corporate Tax



Notes: The top panel contrasts the share of the US corporate income tax (federal and state) paid by the top 1% adults with the highest pre-tax national income in our methodology and the CBO methodology. The CBO methodology assigns 75% of the corporate tax to capital owners nationally (proportionally to reported dividends, interest, rents, and a normalized measure of capital gains) and 25% to workers nationally. Our current-tax methodology assigns 100% of the corporate tax to the corresponding shareholders individually. The bottom panel plots the amount of corporate tax paid by the top 1% (as a fraction of top 1% pre-tax income) in the two methodologies. The allocation of the corporate tax does not make a significant difference in the early 20^{th} century and since the 1980s (when the corporate tax overall is small), but makes a significant difference in the middle of the 20^{th} century (when the corporate tax was high). Both the CBO methodology and our approach distribute only the amount of US corporate tax collected by US governments (i.e., make the implicit assumption that US residents pay in foreign corporate tax as much as what foreigners pay in US corporate taxes).

Table 1: Illustration of Current-Tax analysis: Case Studies (2018)

Millions of US$	Jeff Bezos	Warren Buffett
US federal taxes	**43**	**930**
Individual income tax	43	5
Corporate tax	0	925
Payroll taxes	0	0
Consumption taxes	0	0
US state and local income taxes	**140**	**241**
Individual income tax	0	1
Corporate taxes	70	53
Business property taxes	69	187
Consumption taxes	~0	~0
Residential preoperty taxes	~0	~0
Foreign taxes	**154**	**337**
Corporate taxes	123	337
Business property taxes	31	0
Total taxes	**337**	**1,508**
Pre-tax income	2,221	8,176
Effective tax rate	**15.2%**	**18.4%**
Federal	1.9%	11.4%
State and local	6.3%	2.9%
Foreign	6.9%	4.1%

Notes: See text for complete sources and details. Corporate taxes paid are equal to global cash tax payments reported by Amazon and Berkshire Hathaway in their SEC 10-K reports, apportioned by the ownership stake of Bezos and Buffett respectively. No geographical breakdown of cash taxes paid is available. We use the published breakdown of provisions for current taxes (Amazon) and provisions for current plus deferred taxes (Berkshire Hathaway) to allocate these cash payments to federal vs. state and local vs. foreign governments. Property taxes are computed as 1% of net property and equipment, and allocated to US state and local governments vs. foreign governments based on the geographical location of assets reported in the 10-K item 2. Individual income taxes are taken from Eisinger et al. (2021) for federal taxes and based on public information about state of residency for state and local taxe. State and local consumption and residential property taxes are assumed to be negligible relative to income. Income is equal to the apportioned share of Amazon and Berkshire Hathaway's pre-tax profits (excluding unrealized gains on investments, and adding imputed business property taxes) plus any individual income (e.g., realized capital gains, wages, income from other investments) identified in Eisinger et al. (2021).

Table 2: Current Tax Distribution in the United States, 2021

	Pretax income		After-tax income		Taxes (all levels)		Tax rate composition					
Income groups	Average	Share	Average	Share	Share	Tax rate	Individual income taxes	Payroll taxes	Consump-tion taxes	Property taxes (incl. estate tax)	Corporate tax	Memo: Corporate tax, conventional approach
P0-50	$20,889	12.3%	$15,526	13.0%	10.7%	25.7%	2.2%	10.7%	10.5%	1.7%	0.6%	1.1%
P50-90	$80,618	38.1%	$57,498	38.6%	36.9%	28.7%	8.6%	10.3%	5.6%	2.7%	1.4%	1.1%
P90-99	$243,587	25.9%	$170,579	25.8%	26.2%	30.0%	14.7%	6.3%	3.5%	3.5%	2.1%	1.8%
P99-99.9	$1,085,455	11.5%	$741,550	11.2%	12.3%	31.7%	20.8%	2.4%	2.2%	3.8%	2.5%	2.8%
top 0.1%	$10,288,542	12.2%	$6,804,921	11.4%	13.9%	33.9%	22.8%	0.8%	1.8%	5.1%	3.2%	4.1%
All	**$84,672**	**100%**	**$59,593**	**100%**	**100%**	**29.6%**	**12.5%**	**7.3%**	**4.8%**	**3.2%**	**1.8%**	**1.8%**

Notes: Groups are based on pre-tax national income plus pure realized capital gains (defined as realized gains in excess of 3% of national income). Unit is individual adult (aged 20+) with equal split of income among couples. Pre-tax income is income before all taxes but after the operation of pension systems (public and private). Taxes include taxes at all levels of government (federal, state, and local). Refundable tax credits are not included as negative tax (as they are treated as transfers, like other cash transfers, in the national accounts). Labor taxes are assigned to the corresponding workers, capital taxes to the corresponding asset owners, consumption taxes to the corresponding final consumers. In the conventional approach currently used by CBO, the corporate tax is assigned 75% to capital income reported on individual tax returns and 25% to labor income (with no adjustment for corporate profits earned through pension funds). The current tax distribution for federal taxes only (excluding state, local, and foreign taxes) is presented in appendix Table A1.

Table 3: Distributional Tax-Reform Analysis: Applications

A. Reform of the US federal corporate income tax

	Current income and taxes				Tax reform analysis			
	Pretax income	All corporate taxes	Federal corporate tax		Consider a 10% increase in the federal corporate income tax rate, from 21% to 23.1%			
Income groups	Share	Share	Share	Taxes. ($ billion)	Mechanical tax increase ($ billion)	Tax loss supply side ($ billion)	Social welfare weights	Social welfare cost ($ billion) = -(5) x (7)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
P0-50	12%	4%	3%	$7	$0.7	-$0.1	1.38	-$1.0
P50-90	38%	29%	18%	$50	$5.0	-$0.7	0.69	-$3.4
P90-99	26%	30%	18%	$50	$5.0	-$0.7	0.35	-$1.7
P99-99.9	12%	16%	9%	$26	$2.6	-$0.4	0.17	-$0.5
top 0.1%	12%	21%	13%	$36	$3.6	-$0.5	0.09	-$0.3
Non-US residents	0%	0%	39%	$109	$10.9	-$1.5	0	$0.0
All	**100%**	**100%**	**100%**	**$279**	**$27.9**	**-$3.7**	**1.00**	**-$6.9**
					Net revenue:		**$24.1**	**billion**
					Net value of reform:		**$17.2**	**billion**

B. Reform of the US federal individual income tax

	Current income and taxes (2021)					Tax reform analysis			
	Pretax income	Fiscal income	Federal individual income tax			Consider a 10% increase in the Federal individual income tax for the top 1% only			
Income groups	Share of total pretax income	as % of pretax income	Share of total individual income tax	Tax rate = Taxes / Pretax income	Taxes ($ billion)	Mechanical tax increase ($ billion)	Tax loss supply side ($ billion)	Social welfare weights	Social welfare cost ($ billion) = -(5) x (8)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
P0-50	12%	53%	2%	1.7%	$46	$0.0	$0.0	1.38	$0.0
P50-90	38%	67%	26%	6.8%	$552	$0.0	$0.0	0.69	$0.0
P90-99	26%	68%	30%	11.6%	$639	$0.0	$0.0	0.35	$0.0
P99-99.9	12%	72%	19%	16.5%	$404	$40.4	-$5.7	0.17	-$7.0
top 0.1%	12%	74%	22%	18.1%	$467	$46.7	-$6.3	0.09	-$4.0
All	**100%**	**67%**	**100%**	**9.9%**	**$2,108**	**$87.1**	**-$12.0**	**1.00**	**-$11.0**
						Net revenue:		**$75.1**	**billion**
						Net value of reform:		**$64.1**	**billion**

Notes: Groups are based on pre-tax national income including pure realized capital gains. Unit is individual adult (aged 20+) with equal split of income among couples. The top panel considers 10% increase in the federal corporate income tax while the bottom panel considers a 10% increase in the federal individual income tax for the top 1%. In the top panel, column (2) includes all corporate taxes (US, state, and foreign) paid by US residents on their corporate ownership (in US and abroad). Column (3) includes only the federal corporate tax, close to 40% of which is paid by non-resident owners of US corporations. For the reform analysis, the tax loss due to supply side responses is computed assuming an elasticity of corporate profits of 0.5 in the top panel and a top 1% reported income elasticity of 0.25 in the bottom panel. We use a marginal tax rate of 30% for top 1% individuals in the current federal individual income tax (as top 1% fiscal incomes include ordinary income and tax preferred business income, dividends, and capital gains). In both cases, we assume a simple pattern of social marginal welfare weights declining geometrically as one moves up the income distribution: the weight on the top 0.1% is half the weight on the next 0.9%, which is half the weight on the next 9%, etc. The bottom of each table shows the aggregate net revenue gain (mechanical tax increase minus tax loss due to behavioral responses) and the net value of the reform (net revenue minus the social welfare cost which is the mechanical tax increase weighted by the social welfare weights). A positive net value implies that the reform is desirable. As discussed in the main text, we ignore pretax price effects because such effects are normatively irrelevant (i.e., can be neutralized at zero fiscal cost by adjusting labor and capital taxes).

Table 4: Lessons from the Modern Literature on Non-Standard Tax Incidence

Tax	Who bears the burden of a tax change	Notes and key references	Nature/hierarchy of main behavioral Responses	Size of behavioral Responses
	(1)	(2)	(3)	(4)
Individual income Tax	Individuals 100%	Consistent with conventional incidence	Avoidance/evasion Real responses	Varies with context, can be large Likely small. Inattentiveness (Rees-Jones, Taubinsky 2020)
Corporate income tax	Profits 2/3* Workers 1/3* Consumers 0%*	Fuest, Peichl, and Siegloch (2018) for Germany and Kennedy et al. (2022) for the US. Likely depends on bargaining power. Asymmetric effects?	Avoidance/evasion Real responses	Varies with context, can be large Likely medium, varies with design
Consumption taxes				
Value-added-tax or excise tax **increase**	Consumers 100%	Benzarti et al. (2020) on VAT in Europe	Evasion Consumer demand	Varies with context, can be large Larger response for tax on specific goods
Value-added-tax or excise tax **decrease**	Consumers 50% Profits 37.5%* Workers 12.5%*	Benzarti et al. (2020) on VAT in Europe Benzarti and Carloni (2019). Likely depends on bargaining power	Consumer demand	Response muted by 50% price passthrough
Sales taxes (not posted on prices)	Consumers 100%	Consistent with conventional incidence. Poterba (1996) and Besley and Rosen (1999) for local sales tax in the US	Evasion Consumer demand response	Can be large for small retailers Muted by inattentiveness (Chetty et al. 2009)
Payroll taxes				
Employee side payroll tax	Workers 100%	Consistent with conventional incidence	Labor supply response	Likely small (higher for less attached subgroups)
Employer side payroll tax	Corresponding workers 0%	Saez et al. (2012) for Greece, Bozio et al. (2022) for France, Saez et al. (2019) for Sweden	Employer labor demand responses	Can be large for targeted tax changes
	Workers **collectively** 2/3* Profits 1/3* Consumers 0%*	Saez et al. (2019) for Sweden, Benzarti and Harju (2021) for Finland. Likely depends on bargaining power. Asymmetric effects?		

Notes: Column 1 reports who bears the burden of a tax change with some explanatory notes and key references in column 2. A * denotes large uncertainty in the estimate, and therefore where further research would be most valuable. The table ignores any neoclassical pre-tax price effects as they are normatively irrelevant and hard to compelling estimate empirically. Therefore, incidence is always within a production unit (such as a firm) on how surplus is shared among stakeholders in the unit (owners profits, workers earnings, and consumers' prices). Column 3 lists the most important behavioral responses with some notes on magnitudes in col. 4. "Small" means elasticity of the tax base with respect to the net-of-tax rate in range (0,.25), "medium" in range (.25,.5), "large" is .5 or more. See text for more detailed justifications and more nuanced explanations.

Table 5: Replacing Employer-Provided Health Insurance Contributions By a Payroll Tax

	Current system			Reform replacing current employer health care contributions by flat 11.8% payroll tax								
				Conventional incidence and directed incidence			Employee payroll tax with rigid wages			Employer payroll tax with rigid wages		
Income groups	Average pre-tax income	Current head tax ($ per adult)	Current head tax (% pre-tax income)	New payroll tax (% pre-tax income)	% change in pre-tax income	Change in after-tax income (% pre-tax income)	New payroll tax (% pre-tax income)	% change in pre-tax income	Change in after-tax income (% pre-tax income)	New payroll tax (% pre-tax income)	% change in pre-tax income	Change in after-tax income (% pre-tax income)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
P0-50	$20,889	$1,440	6.9%	4.5%	0.0%	2.4%	4.5%	-3.3%	-0.9%	4.5%	-2.4%	0.0%
P50-90	$80,618	$6,505	8.1%	7.0%	0.0%	1.1%	7.0%	-2.1%	-1.0%	7.0%	-1.1%	0.0%
P90-99	$243,587	$7,826	3.2%	5.2%	0.0%	-1.9%	5.2%	2.1%	0.2%	5.2%	1.9%	0.0%
P99-99.9	$1,085,455	$6,212	0.6%	2.7%	0.0%	-2.1%	2.7%	3.5%	1.4%	2.7%	2.1%	0.0%
top 0.1%	$10,288,542	$5,841	0.1%	1.3%	0.0%	-1.3%	1.3%	3.8%	2.5%	1.3%	1.3%	0.0%
All	**$84,672**	**$4,259**	**5.0%**	**5.0%**	**0.0%**	**0.0%**	**5.0%**	**0.0%**	**0.0%**	**5.0%**	**0.0%**	**0.0%**

Notes: This table simulates the distributional effects of replacing the premiums paid by employers for health insurance provided to their workers by a flat payroll tax in 2021. The total amount of employer-provided health insurance premiums is taken from the National Health Expenditures accounts, Table 5.6, sum of contributions to employer-sponsored private health insurance paid by private business, households, federal government, and state and local governments. The total amount is $1,068 billion in 2021, which is equal to 5.0% of total national income (including pure realized capital gains) and 11.8% of the total pre-tax wage income of currently-covered employees. This total is allocated to income groups following the distribution of health insurance contributions reported in W2 forms (with a correction at the bottom of the distribution to take into account that only employers with more than 250 workers have to report). In column 3, the result is divided by pre-tax national income (as reported in Table 2 and in col. 1 here) to compute the current "head tax" rate. Columns 4 to 12 consider the effects of replacing this head tax by a flat payroll tax of 11.8% on the gross wage earnings of currently-covered employees. In cols. 4 to 6 we assume that health insurance premiums currently paid by employers convert into extra gross cash earnings dollar for dollar and worker by worker, so that pre-tax income does not change, and after-tax incomes rise at the bottom of the distribution and fall at the top (as a head tax is replaced by a flat tax). In cols. 7 to 9 we assume that the payroll tax is charged to employees, wages are rigid, 2/3 of what was previously paid by employers to insurers goes to covered workers and 1/3 goes to profits. In this case the reform is regressive: both pre-tax and after-tax income become more unequally distributed that in the current status-quo. In cols. 10 to 12 we assume that the tax is charged to employers and wages are rigid, so that pre-tax income increases by the difference between the payroll tax and the head tax (col. 10 minus col. 3), and there is no change in after-tax income.

A Online Appendix

A.1 Consumption Tax Incidence: Price Effects are Irrelevant

In this appendix, we explain why price effects at the heart of standard incidence analysis (effect of a tax on goods) are normatively irrelevant.

Let us consider the basic supply and demand tax incidence diagram for one good from introductory economics, as illustrated on appendix Figure A1(a). Formally, the producer profit is $\Pi = pQ - c(Q)$ where p is the pre-tax price of the good, Q the quantity produced, and $c(Q)$ the increasing and convex cost of producing a quantity Q. Profit maximization implies that $p = c'(Q)$ which defines the supply curve $S(p)$. The consumer utility is $V = v(Q) - \bar{p}Q$ where Q is the quantity of the good consumed, $v(Q)$ the increasing and concave utility of consuming Q, and $\bar{p} = p + t$ the after-tax price of the good (with t the tax per unit of good). Utility maximization implies $v'(Q) = \bar{p}$ which defines the demand curve $D(\bar{p})$. The key point is that, in the Diamond and Mirrlees model, pure profits are assumed to be fully taxed away.[58] Therefore, taxes collected are $T = tQ + \Pi = \bar{p}Q - c(Q)$.

The classic Ramsey tax problem sets tax rates to collect a certain tax revenue while minimizing utility loss. Therefore, the key tradeoff is consumer surplus vs. taxes collected at the margin. As illustrated on appendix Figure A1(b), increasing the tax t mechanically increases tax revenue (and correspondingly reduces consumer surplus) but it also reduces taxes through the behavioral response (and correspondingly increases deadweight burden). Because pure profits are in the tax base, the increase in tax from the consumption good due to $dp < 0$ is fully offset by the loss of profit $d\Pi$ and hence this margin is irrelevant.[59]

Mathematically, the Lagrangian takes the form

$$V + \lambda T = v(D(\bar{p})) - \bar{p}D(\bar{p}) + \lambda[\bar{p}D(\bar{p}) - c(D(\bar{p}))].$$

Hence, (and using the envelope conditions $v'(Q) = \bar{p}$, $c'(Q) = p$), the first order condition in $\bar{p}$ takes the form: $-D(\bar{p}) + \lambda D(\bar{p}) + \lambda D'(\bar{p})[\bar{p} - p] = 0$ which can be rewritten as the classic inverse elasticity formula:

$$\frac{t}{p+t} = \frac{1}{\varepsilon_D} \cdot \frac{\lambda - 1}{\lambda}, \tag{4}$$

with $\varepsilon_D = -\bar{p}D'(\bar{p})/D(\bar{p}) > 0$ the elasticity of demand for the good from the consumer and $\lambda > 1$ reflecting the fact that the marginal dollar of tax creates a welfare loss in excess of one dollar on the consumer. The elasticity of supply coming out of the production side does not appear in equation (4).

[58] Pure profits arise in this simple one good model but would not exist in a model with several production factors and constant returns to scale (as in the labor and capital model discussed above).

[59] This is of course the same logic as in the two-factor model where the lost wages dw were made up by more capital income kdr.

With only one taxed good, the Ramsey problem is not meaningful but it is straightforward to consider multiple goods. With separability $V = \sum_i v_i(Q_i) - \bar{p}_i Q_i$, the demand function for each good Q_i depends only on its own price $\bar{p}_i$, and the same analysis carries through and equation (4) applies to each good with the same λ, which is the basic Ramsey inverse elasticity rule.[60]

A.2 Tax Incidence vs. Optimal Tax in the Two-Sector Model

In this section, we formally contrast the tax incidence approach with the optimal tax approach in a slightly extended version of the two-sector model labor and capital model of Section 2.2 to allow for elastic labor supply and the presence of inactive benefit recipients.

A population of size 1 is divided between p_L workers, p_K capitalists, and $p_0 = 1 - p_L - p_K$ inactive benefit recipients. The government raises revenue with taxes on domestic labor income and capital income at flat rates τ_L and τ_K and uses it to fund a lumpsum transfer R to all. Workers have all identical individual utilities of the form $u^L(c, l) = c - l^{1+1/e_L}/(1+1/e_L)$ (where c is consumption and l is labor supply) which they maximize under the budget constraint $c = \bar{w} \cdot l + R$ where $\bar{w} = w(1 - \tau_L)$ is the net-of-tax wage rate. The first order condition $l^{1/e_L} = \bar{w}$ generates an isoelastic labor supply $l = \bar{w}^{e_L}$ which aggregates into macro-level labor supply $L = p_L \cdot l = L(\bar{w})$ with elasticity e_L. Recall that capitalists choose to invest a part k of their total capital k_0 at home with rate of return $\bar{r} = r(1 - \tau_K)$ and the remaining part $k_0 - k$ abroad with a rate of return r_0. They have a money metric utility with home-bias $u^K(c, k) = c + a(k)$ with $c = \bar{r}k + R + r_0(k_0 - k)$, leading to a first order condition $a'(k) = r_0 - \bar{r}$ which defines an upward sloping supply of aggregate domestic capital $K = p_K k = K(\bar{r})$ with elasticity e_K. The inactive have utility $u^0(c) = c$ and simply consume the lumpsum grant with $c = R$.

The following four equations determine the equilibrium (w, r, K, L) of the model as a function of the tax rates τ_L, τ_K, the production function $F(.,.)$ and the supply functions $L(.), K(.)$:

$$r = F_K(K, L), \quad w = F_L(K, L), \quad L = L(w \cdot (1 - \tau_L)), \quad K = K(r \cdot (1 - \tau_K)). \tag{5}$$

Optimal tax. Let us start with the optimal tax approach. The government chooses τ_L, τ_K, R to maximize social welfare

$$SW = p_L g_L u^L + p_K g_K u^K + p_0 g_0 u^0,$$

[60] Ramsey (1927) did not assume that pure profits could be taxed so that Ramsey's formulas do depend on supply elasticities as well. However, Diamond and Mirrlees (1971) noted that constant returns to scale, which rules out pure profits, is a better assumption in general equilibrium. Hence, the standard assumption in modern optimal tax theory has been to assume that there are no pure profits or that they can be taxed away fully. Stiglitz and Dasgupta (1971) is the classic reference exploring this point.

with g_L, g_K, g_0 the exogenous social marginal welfare weights on each group which we assume average to one (without loss of generality) so that

$$SW = R + p_L g_L \cdot [\bar{w} l - l^{1+1/e_L}/(1+1/e_L)] + p_K g_K \cdot [\bar{r} k + r_0(k_0 - k) + a(k)].$$

The government budget constraint is:

$$R = \tau_L w L + \tau_K r K = (w - \bar{w})L + (r - \bar{r})K = F(K, L) - \bar{w} L - \bar{r} K$$

which can be plugged in the social welfare function. Hence, equivalently, the government choose $\bar{w}$ and $\bar{r}$ to maximize:

$$SW = F(K(\bar{r}), L(\bar{w})) - \bar{w} L(\bar{w}) - \bar{r} K(\bar{r}) + p_L g_L [\bar{w} l - l^{1+1/e_L}/(1+1/e_L)] + p_K g_K [\bar{r} k + r_0(k_0 - k) + a(k)].$$

Importantly, pretax prices w and r have disappeared from the objective function. The government can use taxes τ_L and τ_K to determine the after-tax prices $\bar{w}$ and $\bar{r}$ ignoring the effects on pre-tax prices, one of the key results from Diamond and Mirrlees (1971). Using the envelope conditions that l and k choices maximize individual utilities, and using that $F_K = r$ and $F_L = w$, we obtain the following first order condition for government optimization:

$$0 = \frac{dSW}{d\bar{r}} = (r - \bar{r})\frac{dK}{d\bar{r}} - K + p_K g_K k = \frac{r - \bar{r}}{\bar{r}} e_K K - K + g_K K.$$

$$0 = \frac{dSW}{d\bar{w}} = (w - \bar{w})\frac{dL}{d\bar{w}} - L + p_L g_L l = \frac{w - \bar{w}}{\bar{w}} e_L L - L + g_L L.$$

These two equations lead to the standard optimal tax formulas:

$$\frac{\tau_K^*}{1 - \tau_K^*} = \frac{r - \bar{r}}{\bar{r}} = \frac{1 - g_K}{e_K} \quad \text{i.e.} \quad \tau_K^* = \frac{1 - g_K}{1 - g_K + e_K},$$

$$\frac{\tau_L^*}{1 - \tau_L^*} = \frac{w - \bar{w}}{\bar{w}} = \frac{1 - g_L}{e_L} \quad \text{i.e.} \quad \tau_L^* = \frac{1 - g_L}{1 - g_L + e_L}.$$

Optimal tax rates depend solely on the supply side behavioral responses of labor and capital e_L and e_K along with the social welfare weights that the government assigns to each group g_L and g_K. Tax incidence on pretax prices is irrelevant because it affects the splitting of production into pretax labor and capital income: $F(K, L) = wL + rK$ but what matters for the government budget is total resource $F(K, L)$ and what matters for individuals are aftertax prices.

Tax incidence. Let us now consider the tax incidence approach starting from a given tax system (τ_L, τ_K). We consider a small increase in the capital tax rate $d\tau_K > 0$ and trace out its effects dK, dL, dr, dw. Differentiating the 4 equations in (5), we have two equations on the production side:

$$\frac{dK}{K} - \frac{dL}{L} = \sigma \cdot \left[\frac{dw}{w} - \frac{dr}{r}\right], \quad L \cdot dw + K \cdot dr = 0.$$

The first equation is the definition of the elasticity of substitution between labor and capital, σ. The second equation is obtained by differentiating $F(K,L) = rK + wL$ and using $F_K = r$ and $F_L = w$.

On the supply side, we have two equations:

$$\frac{dK}{K} = e_K \cdot \frac{d\bar{r}}{\bar{r}} = e_K \cdot \left(\frac{dr}{r} - \frac{d\tau_K}{1-\tau_K} \right), \quad \frac{dL}{L} = e_L \cdot \frac{d\bar{w}}{\bar{w}} = e_L \cdot \frac{dw}{w}.$$

Combining and rearranging, on the capital side we obtain:

$$\frac{dr}{r} = \frac{(1-\alpha)e_K}{(1-\alpha)e_K + \alpha e_L + \sigma} \cdot \frac{d\tau_K}{1-\tau_K}, \quad \frac{d\bar{r}}{\bar{r}} = -\frac{\alpha e_L + \sigma}{(1-\alpha)e_K + \alpha e_L + \sigma} \cdot \frac{d\tau_K}{1-\tau_K},$$

and on the labor side:

$$\frac{d\bar{w}}{\bar{w}} = \frac{dw}{w} = \frac{-\alpha e_K}{(1-\alpha)e_K + \alpha e_L + \sigma} \cdot \frac{d\tau_K}{1-\tau_K}.$$

Therefore, pretax price incidence shifts the initial capital tax increase partly onto labor: the after-tax return on capital falls by less than the new tax but the after-tax wage also falls. Hence, in the optimal tax approach discussed just above where the government optimizes $\bar{r}$ and $\bar{w}$, $d\tau_K > 0$ amounts to reducing $d\bar{r}$ by less than $-rd\tau_K$ but at the same time reducing $\bar{w}$ by $d\bar{w}$. Therefore, it mixes a (smaller) tax increase on capital with a tax increase on labor. The welfare effects of the reform $d\tau_K$ amount to analyzing the welfare effects of $d\bar{r}$ and $d\bar{w}$ and ignoring the irrelevant price effects as discussed above.

If the labor tax is optimal and equal to τ_L^*, then $d\bar{w}$ has zero first order welfare effects, and hence the welfare effects of $d\tau_K > 0$ are the same as the welfare effects of $d\bar{r} < 0$. If $\tau_K < \tau_K^*$, increasing the tax rate is desirable whether or not price effects are taken into accounts.

If the labor tax is suboptimal $\tau_L < \tau_L^*$ then $d\bar{w} < 0$ has a positive first order welfare effect. Therefore, if $\tau_K < \tau_K^*$, then $d\tau_K > 0$ is desirable both because it increases the tax on capital and also because it implicitly increases the tax on labor.

However, if the labor tax is too large $\tau_L > \tau_L^*$ then $d\bar{w} < 0$ has a negative first order welfare effect. Therefore, if $\tau_K < \tau_K^*$, then $d\tau_K > 0$ will be desirable if and only if the positive impact of $d\bar{r} < 0$ is larger than the negative impact of $d\bar{w} < 0$. Which effect dominates depends on which tax rate is furthest away from its optimum. If τ_K is only slightly below τ_K^* and τ_L is substantially above τ_L^*, then the $d\bar{w}$ welfare effect will dominate making the reform $d\tau_K > 0$ undesirable.

While it is certainly important for a policy maker to learn from classic tax incidence that a reform $d\tau_K > 0$ may be undesirable even if $\tau_K < \tau_K^*$, it is also important for economic advice to explain that the reason $d\tau_K > 0$ is not desirable is because τ_L is too low and that combining an even greater capital tax increase with a reduction of τ_L can achieve the goal of policy maker. This is why we view classic tax incidence as useful but overly narrow and why we think that

optimal tax analysis offers a vital broader picture view for the analysis of tax reform. Put simply, the optimal tax approach tells the policy maker which direction to go; the tax incidence analysis can provide the technical pathway on how to get there.

A.3 Practical Considerations For Current-Tax Analysis

This appendix provides a tax-by-tax discussion of the practical implementation of distributional current-tax analysis for cases that are not immediately covered by the general principles outlined in Section 3.

Taxes on intermediate goods. Some consumption taxes (such as tariffs, taxes on alcohol and fossil fuels, and business turnover taxes) are levied on intermediate rather than final goods. Intermediate goods taxes are small, less than 3% of total tax revenue in the United States. Most countries have replaced turnover taxes by the value-added tax which only taxes final consumption.[61] Because taxes on intermediate goods distort production prices, there is no direct model guidance on how to assign these taxes for distributional current-tax analysis.

The best way to proceed is to treat these taxes as consumption taxes on the final goods eventually produced using the taxed intermediate goods. For example, a tax on wholesale beer will be assigned to final beer consumers (as part of the post-tax beer price), a tax on jet fuel to the consumers of airplane travel. A more complex case involves turnover taxes on natural resource extraction that many extracting countries impose. If the marginal cost of extraction is equal to the selling price (no pure profits), the tax is akin to an intermediate goods tax. However, if the marginal cost of extraction is lower than the selling price (e.g., oil extraction in Saudi Arabia, where marginal costs are much lower than the global oil price determined by the marginal producer), royalties are akin to a tax on the pure profits of extracting companies. Practically, one needs to assess whether the royalty is assessed on a resource for which production is closer to the no pure profit vs. pure profit benchmark. In the case of US oil and gas extraction, marginal costs are significant and we treat royalties levied by US governments (0.2% of government revenue) like taxes on other intermediate goods.[62]

Taxes on depreciable capital assets. Assets used in production are subject to property taxes. If the asset does not depreciate (e.g., land) the tax is fully assigned to the ultimate owner of the asset. If the asset depreciates (e.g., a building) then the depreciating part of the asset is like an intermediate good: it is consumed during the production process. The corresponding tax is allocated like other taxes on intermediate goods, i.e., to consumers of the corresponding

[61] Intermediate goods taxes create production inefficiencies and the Diamond and Mirrlees (1971) model shows that they should not be used.

[62] In 2021 taxes on the extraction of natural resources such as oil and natural gas, called severance taxes, generated $13.5 billion in revenue (NIPA Table 3.5), out of $6.3 trillion in government tax revenue.

final goods. For example, if Amazon uses up 1/40 of its warehouses each year (straight-line depreciation over 40 years), then 1/40 of the annual property tax paid on these warehouses are included in the consumption taxes on Amazon products sold to final consumers. In practice, because the bulk of taxes on capital assets are property taxes on buildings and land, which have long or infinite lives, business property taxes can be fully assigned to business owners.[63]

Carbon taxes. Carbon taxes may become important during the transition to clean energy. Because both consumption and investment decisions are responsible for carbon emissions, a general carbon tax covering all forms of emissions should be allocated to both consumers and owners, in proportion to carbon emitted. In the case of emissions due to investment (e.g., a warehouse built with cement), the intermediate-goods logic described above continues to apply. Since assets are partly consumed during the production process, part of the tax should be allocated to the consumers of the final goods produced with the depreciating assets. Overall, our framework assigns carbon taxes to consumers in proportion to consumption of final goods and fixed capital, and to business owners in proportion to net investment (i.e., gross investment minus consumption of fixed capital).

Because business ownership is more concentrated than consumption, with this methodology carbon taxes are more progressive than when the assignment is only based on the consumption of final goods (ignoring investment), the conventional approach (see Carloni and Dinan, 2021, for a survey). But carbon taxes are less progressive than in the methodology of Chancel (2022) and Chancel and Rehm (2023), where carbon emissions are allocated to consumers for consumption goods and business owners for *gross* investment (instead of *net* investment as we propose). In the United States, net domestic investment is only about 25% of gross domestic investment. Our method is thus approximately 1/4 of the way between the conventional method and the Chancel method.

Inheritance, gift, and estate taxes. Taxes assessed on the transfer of wealth can hurt the welfare of two parties: the donor and the donee.[64] They could be assigned to either. We follow the conventional approach that assigns taxes to donors. This can be rationalized by the fact that the potential negative impact on donors is the one that usually raises most concerns (transfer

[63] In the case of residential property taxes, for owner-occupiers the owners and the consumers are the same individuals, so there is no assignment issue. For rented housing, the part of the property tax corresponding to the annual depreciation of the structure should conceptually be allocated to the consumers of housing services (the renters). This part, however, is very small (1.25% of the property tax assuming (i) straight-line depreciation of the structure over 40 years and (ii) that land, which does not depreciate, represents half of the taxable value of the house) and can be neglected in practice.

[64] Piketty and Saez (2013) propose an optimal inheritance tax model where both welfare effects play a role. In a dynastic model of Barro-Becker, donor and donee are part of the same dynasty, but in the real world individuals matter separately from dynasties (and indeed to the best of our knowledge, no distributional tax table has ever been presented for dynasties).

taxes harm the property rights and incentives of donors to accumulate wealth), while the cost for donees is secondary (as they benefit from a transfer through no effort of their own).[65]

Transaction taxes. Some countries impose taxes on specific transactions such as real estate transactions, or financial transactions. The simplest treatment is to allocate such taxes to the buyer side of the transaction (and make it flow to the ultimate individual owner if an intermediary such as a business is buying the asset). This naturally extends our treatment of consumption taxes where consumption taxes charged on second-hand goods are also assigned to the buyer.[66] If turnover is fast (as is often the case with financial transactions), allocating to buyers vs. sellers does not make much of a difference.

Progressive consumption taxes. A progressive consumption tax that exempts net savings from taxation and adds net dissaving to the tax base (i.e., that extends the traditional pension treatment to all forms of savings) is allocated to individuals based on their consumption. As savings are concentrated at the top of the income distribution (Saez and Zucman, 2016) with negative savings at the bottom and positive and large savings rate at the top, moving to a progressive consumption tax would be regressive when distributional impacts are assessed relative to income percentile.[67]

Flat taxes. Flat taxes have been proposed in the US tax debate by Bradford 1986 (the X-tax) and Hall and Rabushka 1985 (the flat tax). This "flat tax" is a tax on wage income combined with a cash flow tax on business profits with no deduction for interest income payments and full expensing of investment instead of depreciation of capital assets over their lifetime as in regular corporate taxes.[68] Using our methodology, the flat tax would be assigned on the corresponding wage earners and the corresponding business owners.

While the "flat tax" is economically equivalent to a flat consumption tax such as a VAT from a dynamic perspective (and ignoring the exemption for low earners built in the flat tax), the distributional impact is quite different when measured on an annual basis. A worker who saves most of his income consumes little and hence pays no consumption tax, but would pay the "flat tax" on wage earnings. As highly paid workers save more than low paid workers, the

[65] Arguments in favor of assigning taxes on donees can also be provided. For example, if bequests are accidental, then donors do not care about transfer taxes and only donees are affected.

[66] The convention in national accounts is that if a second-hand good is resold through a business, it is seen as a business activity with the used good being an input and the resold used good being like a new good with the difference in prices reflecting value added: the cost of buying and reselling the used good for the business, and the value of reallocating the good to a consumer with higher value on the consumer side.

[67] Proponents of consumption taxation might argue that individuals should be ranked by consumption rather than income when assessing progressivity. To our knowledge, such distributional tables have not been produced, in large part because there is no good micro-data in the United States measuring both income and consumption especially at the top of the distribution.

[68] TCJA provides full expensing for five years 2018-2022 with a phased-in return to depreciation over 2023-2027.

flat tax will be more progressive than the VAT on an annual basis.[69] The "flat tax" exempts investment while the consumption tax exempts savings. Investment is made by business owners who maybe different from savers but both business owners and savers are concentrated toward the top of the distribution. Therefore, on net, the flat tax is likely to be more progressive than the VAT, measured on an annual basis. Naturally, from a dynamic perspective, the two taxes generate the same budget sets and hence are formally equivalent (See Auerbach 2019 for a recent exposition). However, if households face borrowing constraints or do not plan according to the classic intertemporal utility model, this equivalence is lost.

Taxes on mixed business income. Business income is a mix of labor income (the labor effort of the owner) and capital income (the return on the business assets). Neither national accounts nor income tax data can separate cleanly the two components. How then should we assign the corporate income tax on a closely held business or the individual income tax on pass-through businesses? With our methodology, such taxes are assigned directly to the owners themselves who supply both the labor and the capital so we do not need to separate labor and capital to assign taxes either. CBO assigns 25% of the corporate tax to workers but it assigns 100% of the tax paid by a passthrough business to its owners (because it allocates individual income taxes to each taxpayer individually). Hence, a pure change in organizational form with no change in economic activity, such as a change from a sole proprietorship to a C-corporation, increases the tax rate on workers nationally, which is not satisfactory conceptually.

Foreign taxes. One limitation of both the conventional approach and ours is that cross-border corporate income tax payments are ignored. Only corporate taxes collected by the US government are allocated to individuals. This is because government agencies are interested in distributing US federal tax revenues, while the distributional national accounts literature is interested in distributing national income—and foreign corporate taxes are not part of national income. In reality US individuals pay corporate taxes to foreign governments, and some of the corporate taxes collected by the United States are paid by foreigners. In recent years the two flows broadly offset each other and our series thus capture the effective rate paid by US individuals globally. However this was not the case historically. It would be valuable to develop distributional current-tax series adding back net cross-border corporate income tax payments, a task we leave to future research (Zucman, 2023).

How to rank individuals? Traditional distributional tables ranks individuals (or families) by annual pre-tax income. This is justified if annual pre-tax income is indeed the best measure of economic status. Other rankings are conceivable such as changing the time frame (such a month,

[69]Similarly, for private pension arrangements in the US, a Roth IRA is equivalent to a traditional IRA from a lifetime perspective. But on an annual perspective, if savers who get the tax exemption through the traditional

multi-years, or even a lifetime) or changing the variable to after-tax income, consumption, or wealth. There is no definitive or right answer to this question. Different measures might work best for different purposes. At the high end, wealth plays a role over and above income to measure economic status. A CEO earning $50 million/year with no accumulated wealth is not in the same economic class than a wealthy owner making $50 million/year out of fortune of $1 billion. This would call for factoring wealth over and above the capital income it generates in some way. Consumption becomes an almost irrelevant variable at the very top as even lavish personal consumption is going to be small relative to wealth for billionaires or deca-billionaires. At the low-end, transfers play a large role so that after-tax and transfer disposable income is likely to be a more meaningful measure of economic well-being than pre-tax income.[70] Even at the low end, consumption may not be a better measure of economic well-being than disposable income (available for consumption and savings) as the ability to save is clearly a marker of economic security and hence well-being. If our view, economists have spent too little time thinking through these important and non-trivial issues.

A.4 Applying Current-Tax Analysis to Distributional National Accounts

This Appendix provides guidelines for the application of distributional current-tax analysis in the context of distributional national accounts, economic statistics that allocate all national income, taxes, and transfers to individuals. Section 3 and Appendix A.3 provide general principles and tax-by-tax discussions. Here we focus on the subtle issue of how to deal with indirect taxes for the measurement of inequality and for the estimation of effective tax rates by income groups. We discuss both issues in turn.

Pre-tax and post-tax incomes. National income includes indirect taxes. To estimate the distribution of national income, the most sensible approach is to first estimate the distribution of national income excluding consumption taxes (i.e., factor-price national income), and then gross up income levels proportionally (i.e., with no impact on the distribution of income). What follows details the reasoning.

At the micro-level, pre-tax income y and post-tax income c are related as follows:

$$c + t_c = y - t_y + g, \tag{6}$$

where y is pre-tax income (from labor and capital), t_y taxes paid on labor and capital generating pre-tax income y, g are transfers from the government, c is consumption—exclusive of consump-

IRA have higher incomes than retirees who get the exemption through the Roth IRA, the traditional IRA is less progressive than the Roth IRA. Viard and Carroll (2012) note that the flat tax is like a Roth IRA while the VAT is like a traditional IRA.

[70] Pre-tax and after-tax income rank might differ substantially if transfers are targeted to specific groups.

tion taxes paid—plus saving and t_c are taxes paid on consumption. The relevant concepts for inequality analysis are y (pre-tax income) and c (post-tax income). Total income $c + t_c$ is less interesting because it is an intermediate concept that includes taxes on consumption.

Importantly, equation (6) can be defined using broad or narrow definitions of income, consumption, and government transfers. At the broadest level: y includes all pre-tax income from labor and capital (labor income cash or in-kind and capital income distributed or retained within a business); g—and hence c—includes all forms of public spending (including collective consumption expenditures such as defense, education, etc.).[71]

Taking the broadest definition of income, equation (6) can be aggregated across individuals. Using capital letters for the macro level, we have:

$$\text{National Income NI} = C + T_c = Y - T_y + G. \tag{7}$$

c and y aggregate to $NI_f = C = Y$ *factor-price national income* (national income minus taxes on consumption) while $c + t_c$ aggregates to national income NI. $t_c + t_y$ aggregates to total taxes in national income $T_c + T_y$. As G includes all forms of government spending net of the government deficit, G also aggregates to total taxes in national income. As a result, $Y + T_c$ is also national income.[72]

As both y and c, the most relevant concepts for inequality, aggregate to factor national income, it is the most natural aggregate concept for distributional analysis. Factor national income measures income at pre-tax prices (i.e., prices before consumption taxes) while national income measures income at post-tax prices (prices inclusive of consumption taxes).[73]

Let us denote by $\tau_c = T_c/NI = T_c/(C + T_c) = T_c/(Y + T_c)$ the aggregate consumption tax rate so that $NI = (1 + \tau_c)NI_f = (1 + \tau_c)C = (1 + \tau_c)Y$. In general, $\tau_c \simeq 10 - 15\%$ in advanced economies. It is possible to blow up c and y uniformly by a factor $1 + \tau_c$ so as to aggregate to national income, which is more widely used in national accounting than factor national income, without affecting inequality indexes. The drawback is that this makes the incomes less concrete relative to the incomes received by people.[74]

[71] As collective consumption expenditures provided by the government are hard to assign across individuals, it can also sometimes be useful to net them out on both sides of equation (6). Denoting them by cg, we have $g = g' + cg$ where g' are transfers from the government that can be individualized and valued individual by individual (such as cash and quasi-cash transfers) and $c = c' + cg$ where c' is disposable income of the individual so that $c' + t_c = y - t_y + g'$ which is a narrower definition of post-tax income.

[72] Indeed, national income is built as the sum of labor and capital income (which equals factor national income) plus all indirect taxes on products (i.e., what we assign as consumption taxes). Minor caveat: in national accounts, property taxes are counted in taxes on products while we think it is better to count them as part of capital income of owners (except for the depreciation piece, cf. Appendix A.3 above).

[73] In a closed economy, factor national income can buy national production at pre-tax prices (but not at post-tax prices). National income can buy national production at post-tax prices. This explains the unintuitive fact that consumption taxes have to be added to factor income to get to national income even though individuals use their factor income to purchase goods and pay consumption taxes.

[74] Furthermore, it is not possible to move from $(1 + \tau_c) \cdot y$ (pre-tax) to $(1 + \tau_c) \cdot c$ (post-tax) by subtracting actual taxes paid and actual transfers received.

Tax rates and transfers. We now turn to the issue of how consumption taxes should be treated for the estimation of effective tax rates. In brief: consumption taxes should be allocated to consumers (as explained in the paper), but the portion of consumption taxes paid out of transfer income are best treated as reducing transfer income rather than as taxes.

To see this, note that in equation (6), t_y and t_c are the taxes paid by the individual on her income y and when consuming (or saving) disposable income $y - t_y + g$. Therefore, it makes sense to assign t_c separately to $y - t_y$ and g in proportion of the taxable consumption generated by each component.[75] Hence we split t_c into t_{cy} the consumption tax assigned to $y - t_y$ and t_{cg} the consumption tax assigned to g and re-write (6) as:

$$c = y - t_y - t_{cy} + g - t_{cg}. \tag{8}$$

The net transfer received is $g_n = g - t_{cg}$ and the total tax paid on pre-tax income is $t = t_y + t_{cy}$. This tax concept is the most natural one to estimate effective tax rates by income groups.[76] It avoids the issue of assigning very large tax rates to individuals at the bottom of the pre-tax income distribution with very low income y relative to transfers g and who pay consumption taxes on their consumption out of transfer income.[77] It makes sense to measure transfers as $g_n = g - t_{cg}$, i.e., net of consumption taxes paid.

Taxes paid by nonprofits. Some nonprofit organizations pay capital taxes: corporate taxes on the profits of the companies they invest in, property taxes on the assets the own. To the extent that nonprofits provide collective wealth and services, they should be left out of distributional analysis. To match national income, both their primary capital income and the corresponding taxes should be allocated in a distributionally-neutral manner, i.e., proportionally to after-tax disposable income.

[75] If $y - t_y$ and g are both cash, then they contribute to t_c in proportion. If g is a pure in-kind transfer such as health insurance that faces no consumption tax, then t_c would be assigned fully to $y - t_y$.

[76] For linear taxes $t_y = \tau \cdot y$ and $t_c = \tau_c \cdot c$, we have $(1+\tau_c)c = y \cdot (1-\tau) + g$ so that $c = y \cdot (1-\tau)/(1+\tau_c) + g/(1+\tau_c)$. Hence $y - t_y - t_c = y \cdot (1-\tau)/(1+\tau_c)$ and $g_n = g/(1+\tau_c)$. Hence τ and τ_c add up to the standard $(\tau+\tau_c)/(1+\tau_c)$.

[77] We can still have high tax rates for individuals with no income and no transfers who consume through dissaving, but this issue is typically alleviated when aggregating by income groups.

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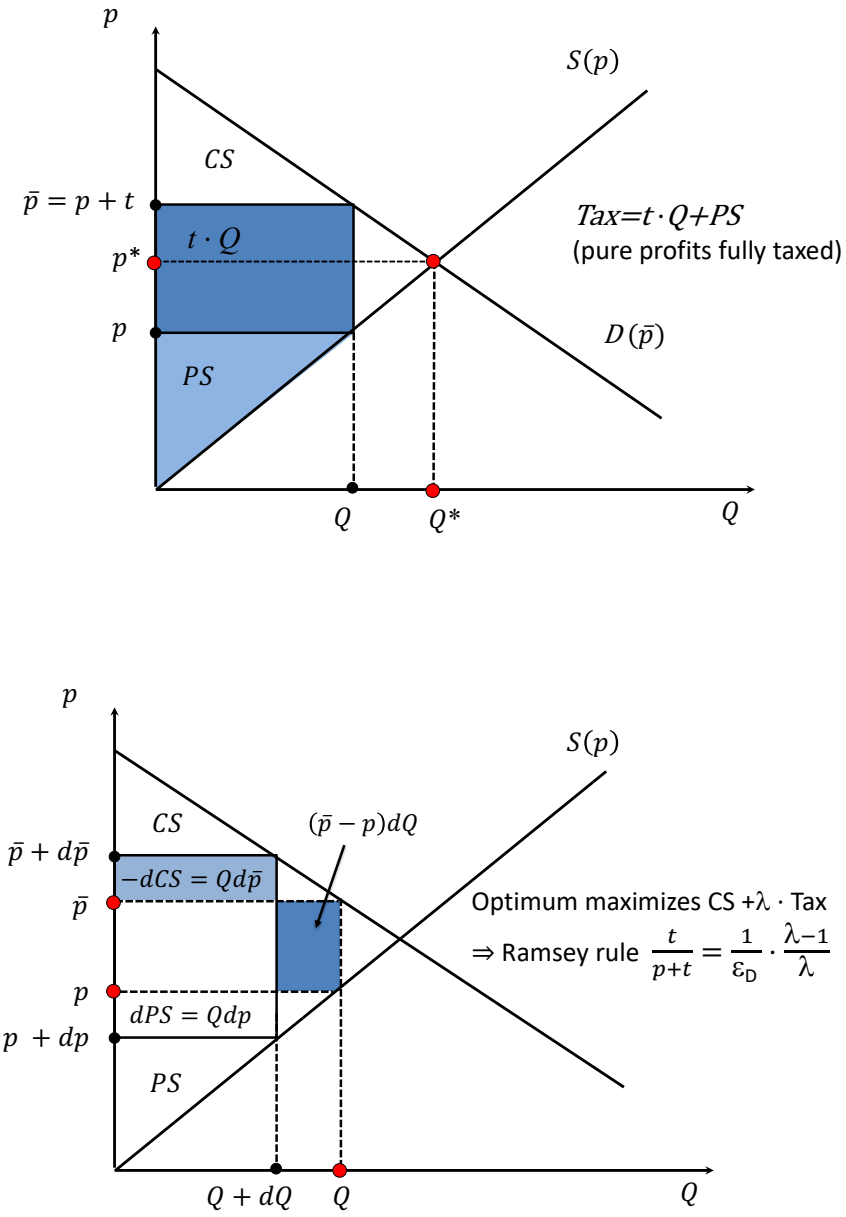
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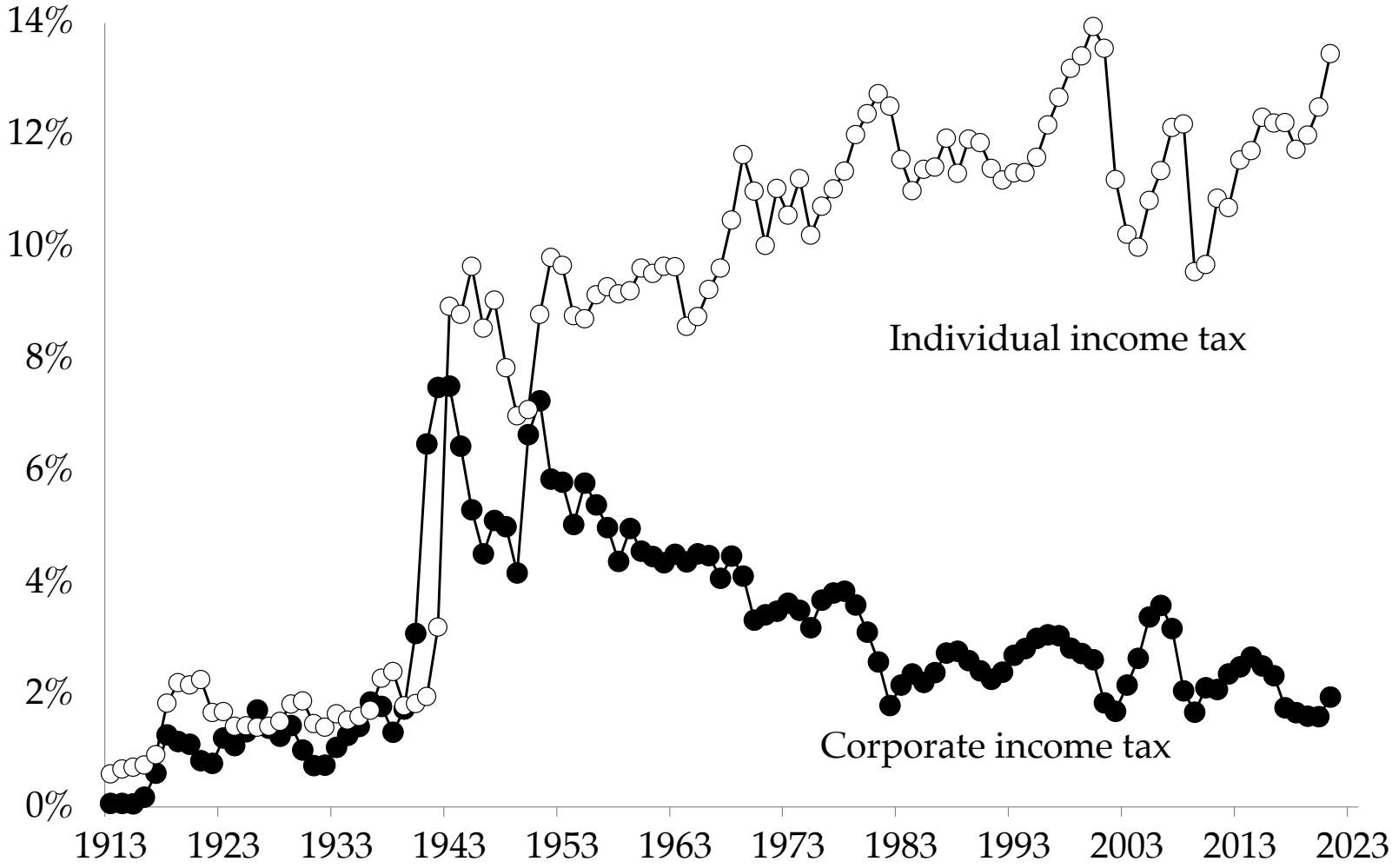
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Figure A1: Consumption Tax: Incidence and Ramsey Optimum



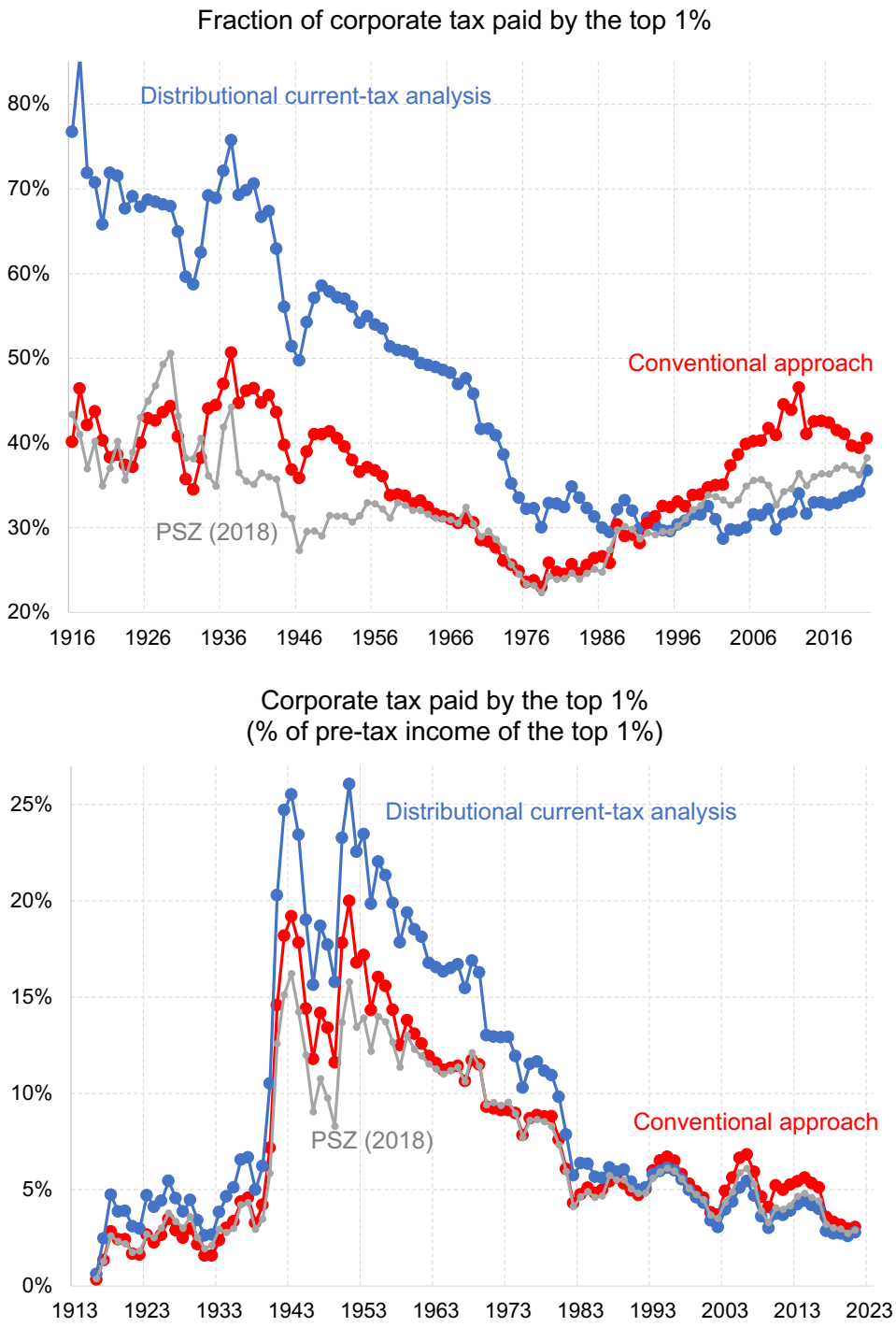
Notes: The top panel depicts the classic consumption tax incidence in a one good model. If we assume as in Diamond and Mirrlees (1971) that pure profits (=producer surplus in the diagram) can be fully taxed away, the tax is represented by the blue areas: $t \cdot Q + PS$. The bottom panel depicts the derivation of the optimum tax that maximizes consumer surplus plus taxes (weighted by factor $\lambda > 1$): $CS + \lambda T = v(Q) - \bar{p}Q + \lambda[\bar{p}Q - c(Q)]$. A small tax increase $d\bar{p}$ reduces CS by $Qd\bar{p}$ and increases taxes collected by $Qd\bar{p} + (\bar{p} - p)dQ$. Because pure profits are in the tax base, the increase in tax from the consumption good Qdp is fully offset by the loss of producer surplus dPS and hence the price effect dp is irrelevant. The first order condition $(\lambda - 1)Qd\bar{p} + \lambda dQ[\bar{p} - p] = 0$ leads to the classic inverse elasticity Ramsey rule $t/(p + t) = (1/\varepsilon_D) \cdot (\lambda - 1)/\lambda$. The supply side elasticity ε_S and the price effect dp are irrelevant.

Figure A2: Individual vs. Corporate Income Tax Revenue (% of National Income)



Notes: This graph shows the evolution of US corporate income tax revenues and individual income tax revenues, expressed as a fraction of US national income. Federal, state and local taxes are included.

Figure A3: Allocating the Corporate Tax: Conventional Approach vs. Piketty-Saez-Zucman (2018) vs. Our Methodology



Notes: The top panel contrasts the share of the US corporate income tax (federal and state) paid by the top 1% units with the highest pre-tax national income in our current-tax methodology and the conventional practice of distributional tax analysis, as implemented by the Congressional Budget Office (CBO) and the original series of Piketty, Saez and Zucman (2018), denoted by PSZ. The bottom panel plots the amount of corporate taxes paid by the top 1% (as a fraction of the pre-tax income of the top 1%) implied by each of these methodologies.

Table A1: Current Federal Tax Distribution in the United States, 2021

	Pretax income		After-tax income		Taxes (federal only)		Tax rate composition (federal taxes only)					
Income groups	Average	Share	Average	Share	Share	Tax Rate	Individual income taxes	Payroll taxes	Consumption taxes	Property taxes (incl. estate tax)	Corporate tax	Corporate tax, conventional approach
P0-50	$20,889	12.3%	$17,862	13.1%	9.2%	14.5%	1.7%	10.5%	1.8%	0.0%	0.4%	0.8%
P50-90	$80,618	38.1%	$65,303	38.3%	37.3%	19.0%	6.8%	10.2%	1.0%	0.0%	1.0%	0.8%
P90-99	$243,587	25.9%	$195,098	25.7%	26.6%	19.9%	11.6%	6.2%	0.6%	0.0%	1.5%	1.3%
P99-99.9	$1,085,455	11.5%	$855,334	11.3%	12.6%	21.2%	16.5%	2.3%	0.4%	0.2%	1.8%	2.0%
top 0.1%	$10,288,542	12.2%	$7,956,531	11.7%	14.2%	22.7%	18.1%	0.8%	0.3%	1.1%	2.3%	2.9%
All	**$84,672**	**100%**	**$68,266**	**100%**	**100%**	**19.4%**	**9.9%**	**7.1%**	**0.8%**	**0.2%**	**1.3%**	**1.3%**

Notes: Groups based on pre-tax income including pure realized capital gains (defined as realized gains in excess of 3% of national income). Unit is individual adult (aged 20+) with equal split among couples. Pre-tax income is income before all taxes but after the operation of pension systems (public and private). Taxes include federal taxes only. Refundable tax credits are not included as negative tax (as they are treated as transfers, like other cash transfers, in the national accounts). Labor taxes assigned to corresponding workers, capital taxes to corresponding asset owners, consumption taxes to final consumers. In the conventional approach (currently used by CBO), the corporate tax is assigned 75% to capital income on individual tax returns and 25% to labor income (with no adjustment for corporate profits earned through pension funds).