The Looming Fiscal Reckoning: Tax Distortions, Top Earners, and Revenues

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Abstract

How should the U.S. confront the growing revenue needs driven by higher spending requirements? We investigate the mix of potential tax increases that can generate a given revenue need at the minimum welfare cost and evaluate its macroeconomic impact. We do so in the context of a life-cycle growth model that captures key aspects of the earnings and wealth distributions and the non-linear shape of taxes and transfers in place. We evaluate changes in income taxes, the introduction of an economy-wide linear consumption tax, and a wealth tax for top wealth holders that match different revenue targets. Our findings show that a proportional consumption tax combined with transfers and a reduction in income tax progressivity consistently emerges as the best alternative to minimize welfare costs associated with a given increase in revenue. A 30% long-run increase in Federal tax revenue requires a consumption tax rate of 27.8%, a transfer of about 12% of mean household income to all households, and a reduction of top marginal income tax rates of more than 5 percentage points. Output declines by 7.9% in the long run. While transfers are substantial, smaller transfers can accomplish most of the reduction in welfare costs. We find no role for wealth taxes in either increasing revenues or minimizing welfare costs.

JEL Classifications: E6, H2.

Key Words: Taxation, Progressivity, Tax Revenue.

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1 Introduction

A fiscal winter is coming. According to the Congressional Budget Office, the United States needs to raise 3.8 to 4.8% of the GDP of additional revenue annually in the coming years.[1] Such a large need for resources partly results from the huge expenditure increases associated with the COVID-19 pandemic, which are comparable to increases during the two World Wars of the 20th century, as Hall and Sargent (2022) note. These pandemic-related expenditures came at a time with a large debt from past fiscal deficits, unfunded health care and pension liabilities due to an aging population, and a push for additional transfers and infrastructure investments. Yet, an increase in defense expenditures is likely on the horizon. In this paper, we ask: how should the U.S. confront this increasing revenue needs in the medium and long term? Assuming that no reductions in spending are available, what should be the mix of tax instruments to generate additional revenue at the minimum welfare loss?

Increasing tax revenue at such a scale presents multiple challenges and trade-offs. The magnitude of the tax hikes needed will have an aggregate impact under distortionary taxes, lowering labor supply and saving and forcing the government to extract revenue from a smaller pie. More importantly, it is unlikely that simply increasing taxes on income or wealth at the very top will be enough. Using taxes with a broader base, such as consumption taxes, on the other hand, might require transfers to mitigate welfare costs.

Our approach in this paper is to search for a mix of existing and new taxes that minimizes the welfare cost for those alive at the start of a hypothetical transition triggered by a tax regime change that aims to increase tax collections. We abstract from demographic changes and demographic-induced budget imbalances and focus with high resolution on the trade-offs induced by alternative taxes within an equilibrium model with household heterogeneity. In doing so, we provide a quantitative road map to evaluate tax hikes that can meet growing revenue needs.

[1] See *The Budget and Economic Outlook: 2021–2031*, Table 1–5. Congressional Budget Office, 2021.

Model We develop a parsimonious model economy with a minimally realistic description of the tax and transfer system in the United States. The model is a standard life-cycle economy with individual heterogeneity and endogenous labor supply. Heterogeneity is driven by differences in individual labor productivity at the start of the life cycle and idiosyncratic shocks received as individuals age. Individuals are also heterogeneous in their discount factors correlated with permanent differences in labor endowments. Individuals have access to a single, risk-free asset.

Individuals face different taxes. They pay flat-rate taxes on capital and total income and face a non-linear income tax schedule with increasing marginal and average tax rates. The first two taxes capture the corporate income tax and the state and local income taxes, respectively. The non-linear tax schedule captures the salient features of the Federal Income Tax in the U.S. and is represented by a parametric tax function, where a single parameter controls the level of tax progressivity. In addition, there is a consumption tax that approximates state-level consumption taxes. Working-age households can receive transfers that are declining in income, capturing the means-tested structure of transfers in the U.S. Individuals also have access to a social security transfer upon retirement that is financed via proportional taxes on labor income.

We parameterize the model economy to be consistent with a host of aggregate and cross-sectional observations under the current tax and transfer system. Given our parameterization, the model economy is in line with the observed household earnings and wealth distributions, including the shares of earnings and wealth at the top. Furthermore, the model economy is broadly consistent with the substantial heterogeneity observed in the distribution of tax liabilities by household income. In particular, the benchmark economy reproduces the taxes paid by the top 1% of income earners.

Findings We first provide a road map for the impact of alternative taxes on revenue when they are increased one at a time. Then, we search for the optimal mix of tax instruments that deliver alternative levels of revenue increases with the minimum welfare loss.

We start by investigating the consequences of changing Federal income taxes permanently to generate a given revenue increase in the long run—a 30% increase in Federal tax revenue, or about 2.4% of output in the benchmark economy.[2] In the benchmark economy, a household with a mean income faces an average tax rate of 5.1%, while those with twice and five times the mean income pay 8.5% and 12.9%, respectively. We first consider changes that raise the level of taxes for everyone but leave the progressivity intact. To generate a 30% revenue increase, taxes on households with mean income have to increase from 5.1% to 8.3%. Since we keep the progressivity intact, the tax increase for a household with twice (or five times) the mean income is also about 3% points. Considering transitions between steady states, the increase in taxes results in a significant 4.3% welfare loss in consumption terms.

Next, we increase the level of progressivity by adjusting the parameter governing the curvature of the income tax function. As we make taxes more progressive, output shrinks significantly. Indeed, simply increasing progressivity cannot deliver a 30% increase in revenue. After a certain point, higher progressivity generates lower tax revenue, and even at the top of the Laffer curve, the additional revenue falls below the 30% target. As a result, on top of increasing progressivity, the level of income taxes also has to increase to generate the required revenue. Taking into account transitions between steady states, the best combination of higher progressivity and a higher tax level causes a welfare loss of 2.7%. Overall, we find non-trivial declines in hours worked, labor supply, and long-run output. Long-run output losses range from 2.4% when only the level of the tax function changes to about 12% at the maximum permissible level of progressivity.

We subsequently explore a hypothetical linear consumption tax characterized by a tax rate and a lump-sum transfer to target again a 30% revenue increase in the long run. We envision this as a new federal consumption tax on top of the existing state-level consumption taxes in the benchmark economy. When the transfer is zero, we have a simple proportional consumption tax; when there is a lump-sum transfer, the consumption tax is progressive. Due to standard income effects, as the lump-sum transfer increases, hours, labor supply, and output decline. As a result, as the transfer increases, higher consumption taxes are needed to

[2] A revenue need of 2.4% of output is lower than the 3.8 to 4.8% estimates by the Congressional Budget Office. We take a conservative stand on revenue needs; our target is close to the CBO numbers without taking into account the deficit of the Social Security system.

generate the revenue target. However, unlike the case of a change in income tax progressivity, the associated changes in aggregates are more moderate since consumption taxes, even when accompanied by a transfer, tend to be less distorting than a non-linear income tax. Furthermore, transfers significantly reduce the welfare costs associated with higher taxes. We find that a consumption tax of 13.4% with a transfer of about $5,000 per household (in 2020 dollars) leads to a decline in output of about 4.2% in the long run. Considering transitions between steady states, the welfare loss is about 2.8% in consumption terms.

What happens when we search for a mix of tax instruments that delivers a given increase in revenue at the lowest possible welfare loss? Our results find that the optimal mix consists of a progressive consumption tax (a high consumption tax rate together with relatively large transfers) and a non-trivial reduction in tax progressivity. Thus, the alternative that minimizes the welfare cost leads to a reduction in distortions on labor choices and asset formation for top incomes via a decrease in progressivity. Increasing Federal revenues by 30% requires a transfer per household of about $12,000 in 2020 dollars, a consumption tax of 27.8%, and a reduction of marginal tax rates at the top. In the optimal mix, a household with twice and five times the mean income faces 7.2% and 10% average Federal income taxes, respectively. Their tax rates were 8.5% and 12.9% in the benchmark—output declines by 7.9% in the long run. The resulting welfare cost is about 2.0% in consumption terms. In subsequent robustness checks, we find that relatively small transfers can mitigate the bulk of welfare losses associated with tax hikes.

Our findings do not reveal significant long-run increases in revenues from a wealth tax when applied to top wealth holders. In isolation, the introduction of a wealth tax implies that tax collections sharply rise and then decline. For example, a 2% wealth tax on the top 1% increases the tax revenue by 8% in the period right after its implementation. But the tax revenue declines rapidly, becoming even lower than what the government could collect in the benchmark without any wealth tax. A gradual decline in output accompanies the decline in revenues. When we impose a wealth tax alongside our search for the optimal tax mix, we find worse welfare outcomes than under our baseline findings, even when the government can smooth out tax revenues using debt. We conclude that from the standpoint of the questions we pose in this paper, a wealth tax is clearly not a good idea.

Background Our paper relates to three different strands of the literature. The first one is the recent and ongoing literature on tax progressivity and revenue maximization in macroeconomic models. Examples of this line of work include Badel, Huggett and Luo (2020), Bakış, Kaymak and Poschke (2015), Conesa, Kitao and Krueger (2009), Erosa and Koreshkova (2007), Guner, López-Segovia and Ramos (2020), Heathcote, Storesletten and Violante (2017), Holter, Krueger and Stepanchuk (2019), Kinderman and Krueger (2022) and our work in Guner, Lopez-Daneri and Ventura (2016). Our emphasis here is different: we go beyond single tax instruments and focus on the mix of taxes that minimize welfare losses for distinct revenue targets.

The second group we connect to relates to the recent papers on the interplay of taxes and transfers in dynamic equilibrium models. Examples of this work include Boar and Midrigan (2022), Conesa, Li and Li (2021), Dyrda and Pedroni (2022), Ferriere, Grubener, Navarro and Vardishvili (2021), Guner, Kaygusuz and Ventura (2022b), Lopez-Daneri (2016) and Luduvice (2021). Our analysis shares with these papers the interplay between the degree of progressivity in taxation and transfers. In particular, as we do in the current study, Boar and Midrigan (2022) and Conesa, Li and Li (2021) emphasize how proportional taxes combined with lump-sum transfers can be optimal. Nonetheless, our focus here is different. We consider this interplay while focusing on multiple forms of taxation to raise revenue to minimize welfare losses.

Finally, our paper is connected with a few articles that analyze the macroeconomic implications of higher spending and debt financing and the consequences that emerge from the need for higher revenues in the coming years. Examples include Auerbach and Gorodnichenko (2017), Barro (2020), Gomme (2022), Nelson and Phillips (2021), among several others. Among these papers, Nelson and Phillips (2021) is close to our analysis in the current paper. These authors focus on the macroeconomic and intergenerational effects of financing additional spending in a life-cycle growth model with ex-ante heterogeneity. Unlike our work, they do not attempt to reproduce earnings or wealth distributions and do not consider consumption, wealth taxes, and transfers as tax instruments. More importantly, they do not characterize the optimal mix to raise a given level of additional revenue.

Our paper is organized as follows. Section 2 presents a brief big-picture view of the revenue needs of the United States and OECD countries. Section 3 presents the model we use in our analysis. We discuss the parameterization of the model and its mapping to data in section 4. Section 5 contains findings related to using single tax instruments to generate additional revenue in the long run, whereas section 6 contains our main results regarding the optimal mix of tax instruments. In section 7, we put our findings in perspective. Section 8 presents concluding remarks.

2 The Looming Revenue Requirements

The COVID pandemic implied a massive increase in discretionary and mandatory spending worldwide. A $10.8 trillion, about 10% of the 2020 World GDP, was spent during the pandemic, plus $6.1 trillion, about 6% of the 2020 World GDP, in liquidity measures—International Monetary Fund (IMF).[3] The United States was by far the largest spender, with 25.5% of its 2020 GDP spent during the pandemic and an additional 2.4% in liquidity measures. To put these numbers into perspective, the total value of the New Deal was 40.1% of the 1929 U.S. GDP, but it lasted six years, while the 2009 Recovery and Investment Act after the Great Recession was 6.1% of the 2006 U.S. GDP—see Dupor (2021). As a result, deficits and debts soared worldwide, and the United States was no exception. In 2020, the United States had the worst deficit-to-GDP and debt-to-GDP ratios since WWII, with 14.5% and 134.2%, respectively.[4]

Unfortunately, for many high-income countries, this massive but transitory spending came

[3]Liquidity measures refer to equity injections, loans, assets and debt purchases, and new contingent liabilities the governments assumed during the pandemic (guarantees and quasi-fiscal operations). See International Monetary Fund (IMF) for more details.

[4]Right after WWII, the debt-to-GDP ratio in 1946 was about 106%, and the deficit-to-GDP ratio was about 30% in 1943.

at a time when there are already significant and persistent projected increases in fiscal expenditures due to an aging population and the associated rise in health care costs and entitlement programs. As the OECD projected (Guillemette and Turner, 2021), the G7 economies need an average increase in the fiscal pressure of 8% of their potential GDP in the next forty years to keep the debt-to-GDP ratio at the 2021 level. Still, there is no consensus on lowering government outlays as there is a renewed demand for more redistributive policies and public investments in clean energy and infrastructure. Even so, the share of discretionary spending on total expenditure is small. Most of it is defense spending, which seems more challenging to reduce given the current geopolitical climate.

Consequently, in the case of the U.S., the Congressional Budget Office projects that there will be a 10% points gap between outlays and revenues by 2050 (see Figure 1), and the debt-to-GDP ratio will be around 180%. Looking at the CBO's projections, by 2050, interest rate payments, health care, and pension expenditures will represent 73% of all outlays—CBO (2021d). The health care and pension expenditures will be 51% of all outlays in 2050, while interest rate payments are expected to soar to 23% (they are just 7% of all outlays today). Furthermore, the projected depletion of the entitlement programs' trust funds is close. According to the Social Security Board of Trustees (2022), the Old-Age and Survivors Insurance (OASI) Trust Fund will run out of its reserve by 2034, and the combined OASI and Disability Insurance (DI) Trust Fund will do so in 2035.[5] By 2028, the Hospital Insurance Trust Fund (Medicare Part A) will be exhausted. Overall, the room for spending reduction on these fronts is limited unless drastic measures are taken.

Even if we ignore the U.S. fiscal projections, the current legislative agenda is expensive in fiscal resources and demands a dramatic increase in revenues. In Figure 2, we select some of the most recent initiatives being discussed and show their cost in terms of the 2020 GDP. For instance, as passed in the House, the Build Back Better Bill would have required 0.2% of GDP yearly, while its permanent version amounts to 14% of GDP. The Infrastructure, Investment, and Jobs Act is estimated to cost 1.2% of GDP. A program that will make colleges more affordable (CBO, 2019) and a Student Loan Forgiveness proposal (CBO, 2020) are expected

[5]See The Boards of Trustees, Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds (2022).

to cost about 2.6% of GDP. Altogether, the U.S. government needs significant additional resources, and given that the era of low-interest rates is over and the high debt levels make it harder to incur additional debt, higher taxes in the future appear unavoidable.[6]

3 Model

We present below our model economy. It is an otherwise standard life-cycle growth model with individual heterogeneity, augmented with a realistic but minimal description of current tax and transfers in place. Individuals are heterogenous in terms of their initial labor productivity, as well as uninsurable labor productivity shocks experienced over the life cycle. Individuals are also heterogenous in their discount factors. We present a stationary version of our model, leaving a formal definition of equilibrium in the Appendix.

Demographics In each period, a continuum of agents is born. Agents live a maximum of N periods and face a probability s_j of surviving up to age j conditional upon being alive at age $j-1$. Population grows at a constant rate n. The demographic structure is stationary, such that age-j agents always constitute a fraction μ_j of the population at any point in time. The weights μ_j are normalized to sum to 1 and are given by the recursion $\mu_{j+1} = (s_{j+1}/(1+n))\mu_j$.

Preferences All agents have preferences over streams of consumption and hours worked and maximize:

$$E\left[\sum_{j=1}^{N}\beta^j(\prod_{i=1}^{j}s_i)u\left(c_j,l_j\right)\right], \tag{1}$$

[6]A similar situation is expected in other high-income countries. For the 2021–2060 period, the OECD predicts that Japan, France, and Italy will need to generate additional revenue of around 12.4, 12.0, and 9.5% of GDP, respectively. See Guillemette and Turner (2021).

where c_j and l_j denote consumption and labor supplied at age j. The period utility function u is given by

$$u(c, l) = \log(c) - \varphi \frac{l^{1+\frac{1}{\eta}}}{1+\frac{1}{\eta}}. \tag{2}$$

The parameter η in this formulation governs the intertemporal labor supply elasticity. The parameter φ controls the intensity of preferences for labor versus consumption.

Technology A constant returns to scale production technology that transforms capital K and labor L into output Y. This technology is represented by a Cobb-Douglas production function, with capital share α. The technology improves over time because of labor augmenting technological change, X, which grows at a constant rate, g. Therefore,

$$Y = F(K, LX) = K^{\alpha}(LX)^{1-\alpha}. \tag{3}$$

The capital stock depreciates at the constant rate δ.

Heterogeneity At birth, individuals differ in permanent differences in labor endowments and discount factors. In addition, as they age, they experience persistent shocks to their labor endowments.

Let θ stand for (the log of) a permanent shock to labor endowments and z for (the log of) a persistent shock. Hence, the labor endowment of an individual as a function of shocks and age is given by $e(\Omega, j)$, where $\Omega = \{\theta, z\}$, with $\Omega \in \mathbf{\Omega}$ and $\mathbf{\Omega} \subset \Re^2_+$. Age-1 individuals receive permanent shocks according to the probability distribution $Q_\theta(\theta)$. Conditional on a value of the permanent shock, individuals also draw a discount factor from a distribution $Q_\beta(\beta|\theta)$. Hence, permanent shocks and discount factors are potentially correlated. We refer to these shocks as permanent as they remain constant during the working life cycle.[7]

[7] We introduce discount factor heterogeneity to account for key aspects of wealth inequality not generated by other sources—see section 4. As such, our paper is connected to models that emphasize discount factor

The persistent shock z follows a Markov process, with age-invariant transition function Q_z, so that $\text{Prob}(z_{j+1} = z'|z_j = z) = Q_z(z', z)$. Productivity shocks are independently distributed across agents, and the law of large numbers holds. We describe the parametric structure of shocks in detail in section 4.

Individual Constraints The market return per hour of labor supplied by an age-j individual is given by $we(\Omega, j)$, where w is the wage rate common to all agents.

All individuals are born with no assets and face mandatory retirement at age $j = j_R + 1$, so they work only up to age j_R (inclusive). An age-j individual experiencing shocks Ω chooses consumption c_j, labor hours l_j, and next-period asset holdings a_{j+1}. Then, given period-j income level $I_j \equiv we(\Omega, j)l_j + ra_j$, the budget constraint for such an agent is given by

$$c_j + a_{j+1} \leq a_j(1 + r) + (1 - \tau_p)we(\Omega, j)l_j + TR(I_j) + B_j - T(I_j), \tag{4}$$

with

$$c_j \geq 0, \quad a_j \geq 0, \quad a_{N+1} = 0,$$

where a_j stands for the asset holdings at age j, T_j are taxes paid, τ_p is the (flat) social-security tax, and B_j is a social security transfer. Asset holdings pay a risk-free return r. In addition, if an agent survives up to the terminal period ($j = N$), the next-period asset holdings are zero. $TR(.)$ are transfers available to working-age individuals. The social security benefit B_j is zero up to the retirement age j_R and equals a fixed benefit level for an agent after retirement.

Taxes, Transfers, and Government Consumption The government consumes the amount G in every period, financed through taxation and by fully taxing an individual's

heterogeneity as a source of wealth inequality, such as Krusell and Smith (1998), Hendricks (2007), and Hubmer, Krusell and Smith Jr (2021).

accidental bequests. In addition to payroll taxes, taxes paid by individuals have three components: a flat-rate income tax, a flat-rate capital income tax, and a non-linear income tax scheme. Income for tax purposes (I) consists of labor plus capital income. Hence, taxes paid at age j are

$$T(I_j) = T_f(I_j) + \tau_I I + \tau_k r a_j + \tau_c \left[we(\Omega, j) l_j + r a_j - (a_{j+1} - a_j) + B_j + \phi TR(I_j) \right], \quad (5)$$

where T_f is a strictly increasing and convex function. τ_I and τ_k are the flat taxes on income and capital income, respectively. We later use the function T_f to approximate effective Federal Income taxation in the United States. We will use the rates τ_I and τ_k to approximate income taxation at the state level and corporate income taxes and τ_p to capture payroll (social security) taxes in the United States.

The rate τ_c captures a consumption tax at the state level when the tax base is income, including transfers, net of savings $(a_{j+1} - a_j)$. Note that we allow for a potential deduction $\phi \in [0, 1]$ of transfers TR in the tax base; i.e., when $\phi = 1$, transfers are not deductible and fully taxable via the (state) consumption tax. A ϕ less than one implies that a part of the transfers is not subject to consumption taxes.[8] Transfers are available to working-age individuals and are a function of income I as well. Transfers decline with income up to a threshold level and then become zero. We parameterize this function in section 4.

3.1 Decision Problem

We now state the decision problem of an individual in the recursive language by first transforming the variables to remove the effects of secular growth and indicating these transformed variables with the symbol $(\hat{.})$.

[8] For example, recipients of the Supplemental Nutrition Assistance Program (SNAP), the nation's most extensive food assistance program, do not pay state or local sales taxes on the foods and beverages they purchase with SNAP benefits.

We denote the individuals' state by the triple $x = (\hat{a}, \Omega, \beta)$, $x \in \mathbf{X}$, where $\hat{a}$ are current (transformed) asset holdings, Ω are the idiosyncratic productivity shocks, and β stands for the discount factors. The set $\mathbf{X}$ is defined as $\mathbf{X} \equiv [0, \bar{a}] \times \mathbf{\Omega} \times \mathcal{B}$, where $\bar{a}$ stands for upper bounds on (normalized) asset holdings and $\beta \in \mathcal{B}$, a finite set. We denote taxes (other than payroll taxes) at state (x, j) by $T(I(x, j))$ and total transfers by $TR(I(x, j))$, where $I(x, j)$ is the income of an individual of age j with state x. Then, optimal decision rules are functions for consumption $\hat{c}(x, j)$, labor $l(x, j)$, and next period asset holdings $\hat{a}(x, j)$ that solve the following dynamic programming problem:

$$V(x, j) = \max_{(\hat{l}, \hat{a}')} u(\hat{c}, l) + \beta s_{j+1} E[V(\hat{a}', \Omega', \beta, j+1)|x], \tag{6}$$

subject to

$$\hat{c} + \hat{a}'(1+g) \leq \hat{a}(1+\hat{r}) + (1-\tau_p)\hat{w}e(\Omega, j)l + \hat{B}_j + TR(I(x, j)) - T(I(x, j)),$$

$$\hat{c} \geq 0, \quad \hat{a}' \geq 0, \quad \hat{a}' = 0 \;\text{ if } j = N, \;\text{ and} \tag{7}$$

$$V(x, N+1) \equiv 0.$$

Comments It is worth noting that taxation affects after-tax rates of return in different ways. This follows as an agent's income subject to taxation includes capital (asset) income; capital income is taxed through the non-linear income tax as well as through the flat-rate tax on income τ_I and capital income τ_k. In addition, transfers and the consumption tax also affect after-tax rates of return. Altogether, our specification implies that for an individual with income I, the (gross) after-tax rate of return on savings equals to

$$(1+r)\,[1-\tau_c] - r[T_f'(I) + \tau_I + \tau_k - TR'(I)(1-\tau_c\phi)].$$

The marginal tax rate on labor income for an individual with income I is given by

$$T_f'(I) + \tau_I + \tau_c - TR'(I)(1 - \tau_c \phi) + \tau_p.$$

It is important to note a couple of points here. First, the term $(1 - \tau_c)$ appears on both sides of the equation in the first-order intertemporal condition for asset choice. Thus, in the absence of other taxes, consumption taxes do not distort asset choices in the margin, as is well known. Second, note that transfers affect the decisions to work and save when they are operative. Since $TR'(I) < 0$, an additional unit of labor or asset income reduces transfers and, thus, affects choices on the margin.

3.2 Equilibrium

In our model, individuals are heterogeneous with respect to their idiosyncratic labor productivity shocks, discount factors, asset holdings, and age. To specify the notion of equilibrium, we define a probability measure ψ_j on subsets of the individual state space that describes heterogeneity within a particular cohort. Hence, for any set $S \subset \mathbf{X}$, $\psi_j(S)$ is the mass of agents of age j for with state $x \in S$. We specify this probability measure in the Appendix, where we formally define a stationary equilibrium.

In any equilibrium, factor prices equal their marginal products. Hence, $\hat{w} = F_2(\hat{K}, \hat{L})$ and $\hat{r} = F_1(\hat{K}, \hat{L}) - \delta$. Moreover, markets clear, which in our context implies

$$\sum_j \mu_j \int_X (c(x,j) + a(x,j)(1+g)) d\psi_j + \hat{G} = F(\hat{K}, \hat{L}) + (1-\delta)\hat{K} \tag{8}$$

$$\sum_j \mu_j \int_X a(x,j) d\psi_j = (1+n)\hat{K}, \text{ and } \sum_j \mu_j \int_X l(x,j) e(\Omega, j) d\psi_j = \hat{L}. \tag{9}$$

Budget Balance The government budget and the social security system are balanced in any equilibrium. This implies that government consumption plus transfers equal tax collections from all sources and that social security transfers are consistent with payroll tax collections. Therefore,

$$\sum_j \mu_j \int_X TR(I(x,j))d\psi_j + \hat{G} = \sum_j \mu_j \int_X T(I(x,j))d\psi_j + \hat{AB} \tag{10}$$

$$\tau_p \hat{w}\hat{L} = \sum_{j=R+1}^{N} \mu_j \hat{B}_j. \tag{11}$$

Note that equation (10) includes the aggregate amount of accidental bequests, $\hat{AB}$, which reflects our assumption that the government fully taxes accidental bequests.

4 Parameter Values

We now proceed to assign parameter values to our benchmark economy's endowment, preference, and technology parameters. To this end, we use aggregate as well as cross-sectional and demographic data from multiple sources. A model period is a year.

Demographics We assume that individuals start their life at age 25, retire at age 65 and live up to the maximum possible age of 100. This implies that $j_R = 40$ (age 64) and $N = 75$. We set demographic parameters to reflect the recent U.S. demographics. The population growth rate is 0.7% per year ($n = 0.007$), corresponding to the growth rate for the period 2010–2019.[9] We set the survival probabilities according to the U.S. Life Tables for 2018.[10]

Heterogeneity and Endowments To parameterize labor endowments, we assume that the log-hourly wage of an individual is given by the sum of a fixed effect or permanent

[9] Average growth in Resident Population (April 2010–April 2019). Source: Table 1 from "Monthly Population Estimates for the United States: April 1, 2010 to December 1, 2020 (NA-EST2019-01)" by the U.S. Census Bureau, Population Division. Release date: December 2019.

[10] United States Life Tables, 2018. National Vital Statistics Reports (2020), Volume 69, Number 12.

shock (θ), a persistent component (z), and a common, age-dependent productivity profile, $\bar{e}_j$. Specifically, we set

$$\log(e(\Omega, j) = \bar{e}_j + \theta + z_j, \tag{12}$$

with

$$z_j = \rho z_{j-1} + \epsilon_j, \quad z_0 = 0, \tag{13}$$

where $\epsilon_j \sim N(0, \sigma_\epsilon^2)$. For the permanent shock (θ), we assume that a fraction π of the population is endowed with θ^* at the start of their lives, whereas the remaining $(1 - \pi)$ fraction draws θ from $N(0, \sigma_\theta^2)$. The basic idea is that a small fraction of individuals within each cohort has a value of the permanent component of individual productivity that is quite higher than the values drawn from $N(0, \sigma_\theta^2)$. We occasionally refer to these individuals as superstars. Given a value for permanent shocks, we assign a *single* discount factor for each level of θ. This strategy allows us to reproduce a set of targets jointly for the distributions of earnings and wealth in a parsimonious way.

We calibrate the parameters characterizing heterogeneity in two steps. First, we use available estimates and observations on individual wages (hourly earnings) to set the parameters governing the age-productivity profile and the persistence and magnitude of idiosyncratic shocks over the life cycle. We then determine the parameters governing permanent differences—permanent shocks to endowments and discount factors—so that in the stationary equilibrium of the model economy, the overall degree of earnings and wealth inequality for *households* is in line with the data. For these purposes, we calculate statistics of earnings and wealth inequality for households in a consistent manner. We use data from the 2013 Survey of Consumer Finances (SCF) to calculate wealth inequality. The sample includes all households with non-negative income and non-negative wealth. For earnings inequality, we further restrict the SCF sample to households with a head between 25 and 64 years old.

We estimate the age-dependent deterministic component $\bar{e}_j$ by regressing mean-log wages of households on a polynomial of age together with time effects. We use data from the Current

Population Survey (CPS) for 1980–2005 and restrict the sample to males aged between 25 and 64. We drop observations with individual wages less than half of the federal minimum wage. Moreover, as in Heathcote, Perri and Violante (2010), we impose that individuals must work at least 260 hours per year. We also correct for top-coding following Lemieux (2006).[11] To select the values for the parameters governing persistent shocks, we follow Kaplan (2012) and set the autocorrelation coefficient (ρ) and the variance of the persistent innovation (σ_ϵ^2) to the estimates therein—$\rho = 0.958$ and $\sigma_\epsilon^2 = 0.017$.

For the permanent differences in labor endowments and discount factors, we proceed as follows. We set $\pi = 0.01$; i.e., we assume that 1% of each cohort are superstars. Then, we set the variance of permanent shocks for the remaining $1 - \pi$ fraction (σ_θ^2) and the value of the permanent superstar shock (θ^*) to reproduce two targets: i) the Gini coefficient for household earnings, and ii) the share of the top 1% households in total households' earnings. Based on the 2013 Survey of Consumer Finances (SCF), these targets are 0.55 and 12.9%, respectively. This procedure yields $\sigma_\theta^2 = 0.45$ and $\theta^* = 2.7$, which implies that superstar individuals are 15 times more productive than the median individual in each cohort (i.e., $15 \sim \exp(2.7)$).

We approximate $N(0, \sigma_\theta^2)$ with five grid points, so there are six permanent types together with the superstar (θ^*). We select six corresponding discount factors to reproduce the overall capital-output ratio (3.0), the wealth Gini coefficient (0.81), and the shares of wealth held by the bottom 60% and the top 20%, 5%, and 1%. Again, based on the 2103 SCF sample, these shares amount to 5.9%, 83%, 59%, and 32%, respectively.

Taxes Following Benabou (2002), Heathcote, Storesletten and Violante (2014), and others, we use a convenient tax function to represent Federal Income taxes in the data. Specifically, we set the function T_f to

[11] To calculate household-level wages for single households and married ones with one earner, we use hourly wages (total yearly labor earnings divided by total annual hours). For a married household where both members work, the hourly wage is given by total household earnings divided by total hours (husband plus wife).

$$T_f(I) = It(\tilde{I}), \tag{14}$$

where

$$t(\tilde{I}) = 1 - (1 - \gamma_0)\tilde{I}^{-\gamma_1}, \tag{15}$$

is an average tax function, and $\tilde{I}$ is income relative to mean income. The parameter γ_0 defines the 'level' of the tax rate, whereas the parameter γ_1 governs the curvature or progressivity of the system.

To set values for the curvature parameter γ_1, we use the estimates of *effective tax rates* for this tax function in Guner, Kaygusuz and Ventura (2014). The underlying data is a representative sample of tax returns from the Internal Revenue Service for 2000 (Statistics of Income Public Use Tax File). We use the estimates for *all households* when refunds for the Earned Income Tax Credit are included, resulting in $\gamma_1 = 0.053$. We set the level parameter γ_0 so that our economy reproduces in stationary equilibrium, the observed tax collections out of the Federal Income Tax for 2000–2015, which averaged 7.6% of GDP. This determines $\gamma_0 = 0.051$. Altogether, these estimates imply that a household around mean income faces an average tax rate of 5.1% and a marginal tax rate of 10.1%. For high-income individuals, average and marginal rates are non-trivially higher. At five times the mean household income, the average and marginal rates for a married household amount to 12.9% and 17.5%, respectively. Figure 3 shows average tax rates as a function of household income for our parameter estimates and higher and lower levels of progressivity, where a change in γ_1 rotates the tax function around the mean household income.

We use the tax rate τ_I to approximate state and local income taxes. Guner, Kaygusuz and Ventura (2014) find that average tax rates on state and local income taxes are essentially flat as a function of household income, ranging from about 4% at the central income quintile to about 5.3% at the top one percent of household income. From these considerations, we set $\tau_I = 0.05$.

We set τ_k to proxy the U.S. corporate income tax. We estimate this tax rate as the one that reproduces the observed level of tax collections out of corporate income taxes in stationary equilibrium (about 1.6% of GDP for the 2000–2015 period).[12] The resulting value is $\tau_k = 0.074$. We set the consumption tax rate so that our economy reproduces the share of consumption tax collections in terms of GDP at the state level—about 2.9% of GDP. Under the assumption of full deductibility of transfers ($\phi = 1$), the resulting rate is 4.8%.[13] Finally, we calculate $\tau_p = 0.162$ as the (endogenous) value that generates an earnings replacement ratio of about 55%.[14]

Transfers The final component of the fiscal policy in our environment is the Federal transfers to working-age households. Guner, Rauh and Ventura (2022a) use the Survey of Income and Program Participation data to estimate an effective transfer schedule that relates transfers received by different household types to their income, excluding medical transfers (Medicaid). Transfers include the Temporary Assistance to Needy Families (TANF), the Supplemental Nutrition Assistance Program (SNAP), the Supplemental Nutrition Program for Women, Infants, and Children (WIC), Supplemental Security Insurance (SSI), and Housing Subsidies. Guner, Rauh and Ventura (2022a) estimate a transfer function of the following form:

$$TR(\tilde{I}) = \omega_0, \text{ if } \tilde{I} = 0; \text{ and } TR(\tilde{I}) = \exp(\omega_1)\exp(\omega_2\tilde{I})\tilde{I}^{\omega_3}, \quad \text{if } \tilde{I} > 0,$$

[12] This is the average corporate income tax in 2000–2015 (Source: Series-FCTAX, Federal Reserve Economic Data (FRED), which we divide by output in the period computed with the methodology of Cooley and Prescott (1995).

[13] To calculate government revenue from consumption taxes, we use the Annual Survey of State and Local Government Finances, State and Local Government Finances Datasets, and Tables by the U.S. Census Bureau; link. The numbers refer to the average value for the 2000-2015 period. The revenue covers Sales Taxes and Gross Receipts from Local and State Governments (General sales and Selective sales—Motor fuel, Alcoholic beverage, Tobacco products, Public utilities, Other selective sales).

[14] We use the median replacement rate of long-career workers born in the 1960s, taking into account all earnings from age 22 through age 61. Source: Social Security Replacement Rates and Other Benefit Measures: An In-Depth Analysis. CBO, April 2019.

where $\tilde{I}$ is household income relative to the mean as before. This formulation implies that transfers are positive if household income is zero and accommodate for a smooth decline as household income increases. We illustrate the resulting function in Figure 4. The estimates imply that a household with zero income collects 12.1% of mean household income, and transfers decline rapidly with income, with households at around median income collecting about 0.5–0.3% of mean income.

Preferences and Technology We set the intertemporal labor supply elasticity (η) to 1. Our choice is in line with macro estimates of the labor supply elasticity, which tend to be larger than micro estimates at the intensive margin—see Keane and Rogerson (2012) for a review. We set the value of the parameter φ to reproduce in stationary equilibrium a value of mean hours of 1/3.

We calibrate the capital share and the depreciation rate using a notion of capital that includes fixed private capital, land, inventories, and consumer durables. For the period 2010–2019 period, we calculate a growth rate in labor efficiency (real GDP per capita) of about 1.6% per year ($g = 0.016$).[15] We then estimate a capital share of 0.38 and an annual depreciation rate of 0.04 under a targeted capital-output ratio of 3.0.

Summary Table 1 summarizes our parameter choices. Recall that the parameters ($\{\beta_z\}_1^6$, φ, θ^* and σ_θ^2) are set to reproduce endogenously several observations in stationary equilibrium: the capital-output ratio, the wealth Gini coefficient, the wealth shares of the bottom 60%, the wealth shares of the top 20%, top 5% and 1%, aggregate hours worked, earnings Gini and the share of labor income accounted for by the top 1% of households.

[15] This is the geometric mean for the real gross domestic product per capita (chained 2012 dollars; annual; seasonally adjusted by annual rates). Source: Series-A939RX0Q048SBEA, Federal Reserve Economic Data (FRED).

4.1 The Benchmark Economy

We now discuss the quantitative properties of the benchmark economy that are important for the questions of this paper. We focus on the consistency of the benchmark economy with facts on cross-sectional inequality in earnings and wealth. We also show that the model is in line with the distribution of taxes paid at different percentiles of the distribution of income.

Earnings and Wealth Heterogeneity Table 2 shows that the model reproduces the distribution of household earnings very well. It captures the overall inequality in household earnings as measured by the Gini coefficient and the share of earnings accounted for by the top 1%. The model is also in line with the (untargeted) shares of different quintiles, ranging from empirical values of just 0.2% in the bottom quintile to nearly 83.4% in the fifth quintile. Finally, the shares of labor earnings accounted by top percentiles, beyond the targeted share of the top 1% earners, are also consistent with the data. As the table summarizes, the income share of the top 5% earners in the data is about 58.7%, while the model implies 59.3%.

Table 2 also shows that the model is in close agreement with the observed wealth distribution from the SCF data. This includes the wealth share of the top 1%, which is a problematic target for models with no heterogeneity in discount factors. Altogether, these findings imply that the model's Lorenz curves for both labor earnings and wealth holdings are in close conformity with the data.

We note that our parameterization does *not* require large discount factors for top earners to account for the observed wealth concentration. The mean value for the discount factor is about 0.973, and discount factors are negatively correlated with permanent types, as Table 1 shows. The correlation is relatively low (-0.17) since the discount factors must obey a U-shape relationship with the permanent types to account for observed wealth disparities. The discount factor for superstar individuals is 0.994. This is similar to the values at the bottom of the distribution of permanent types (1.013 for the lowest permanent productivity and 0.993 for the second lowest). On the other hand, it is higher than discount factors for agents around the middle of the distribution of the permanent types.

The Distribution of Taxes Paid Figure 5 shows the distribution of income-tax payments at the Federal level for different percentiles of the income distribution for both model and data. As the figure shows, the distribution of tax payments is highly concentrated, more than the distributions of labor income and wealth. The first three income quintiles do not account for much of the tax liabilities, whereas the top income quintile accounts for nearly 80% of tax payments. This is the natural consequence of a concentrated distribution of household income and a progressive income tax scheme. While the model does not explicitly target how tax payment shares increase with income, the model tracks the data across the entire distribution reasonably well. In particular, the model matches quite nicely the share of tax payments accounted for by the top 1%. Overall, this is reassuring in light of our subsequent analysis of tax changes.

5 Increasing Revenues

We now use our model environment to assess the impact of increases in different taxes, one at a time, that can generate a *given* percentage increase in tax collection in the long run. For expositional purposes, in this section, we focus on a 30% increase in Federal tax revenues relative to the benchmark economy, which is 2.4% of output in the initial steady state. We later explore how a mix of tax instruments can achieve a given targeted increase in revenue and, within that context, also consider higher and lower targeted increases.

Our approach is to implement at date $t = t_0$ a non-anticipated change in taxes that lead to a targeted revenue increase in the long run. We compute the transitions between steady states, report changes over time in different variables, and provide welfare measures for those alive at $t = t_0$. We concentrate on three separate cases. First, we evaluate the increase in revenues via changes in the federal income tax schedule. We then introduce an additional, new linear federal consumption tax. We also consider versions of the consumption tax when households receive a lump-sum transfer. We finally examine the implications of a wealth tax. In our calculation of Federal revenue increases, we do not take into account revenues from payroll taxes. We only impute revenues from the existing taxes (Federal income tax and the capital income tax τ_k) and any new tax instrument we introduce.

5.1 Federal Income Taxes

We first present results when changes in federal income taxes achieve a 30% increase in federal tax revenues. First, we keep the progressivity of the tax function intact and increase federal income taxes for all households, i.e., we set γ_1 to its benchmark value, 0.053, and adjust the "level" of the tax function via changes in the parameter γ_0. For a 30% increase in tax collection, γ_0 increases from 0.051 to 0.08, which implies that the whole tax function shifts by around 3% points.

We then experiment with higher levels of progressivity ($\gamma_1 = 0.07$ and $\gamma_1 = 0.09$). We also show results for the value for γ_1 that generates the maximum revenue in the long run when only γ_1 is adjusted, and γ_0 is kept at its benchmark value. Without any changes in γ_0, the top of the Laffer curve is obtained at $\gamma_1 = 0.114$. Since the extra revenue collected, even at this level of progressivity, is less than the 30% target, we also increase the level of the tax function via changes in the parameter γ_0. With higher progressivity, the change in γ_0 to obtain a 30% increase in tax collection is lower. For $\gamma_1 = 0.114$, for example, to get a 30% increase in Federal tax collection, γ_0 increases from its benchmark value of 0.051 to 0.078.

The results of these experiments are shown in Table 3. To assess our findings, note that increases in the curvature of the tax function, while increasing tax rates at the top and reducing them at the bottom, imply higher marginal rates for everyone (see Figure 3). As a result, individuals face higher marginal tax rates on labor and asset income, reducing labor supply and asset accumulation. The result is higher revenue (up to a point) but lower labor supply and output levels in the long run.

A prominent finding emerging from our exercises is that quite different effects on output and labor supply are consistent with the same level of revenue increases. Table 3 and Figure 6 clearly show this. When revenues are increased via a proportional shift in the tax schedule, and the progressivity is kept at its benchmark level, output drops by only 2.4%. With higher progressivity, the decline in output is 5.5% for $\gamma_1 = 0.07$ and 8.7% for $\gamma_1 = 0.09$, respectively. At the highest level of curvature consistent with a targeted increase of 30%, $\gamma_1 = 0.114$, the decline in output is about 12%. These differences are substantial and reflect the non-trivial distortionary effects associated with higher levels of progressivity.[16]

Welfare Table 3 also shows welfare losses associated with changes in the income tax schedule for those alive at $t = t_0$ and the number of agents in favor of the tax changes. The welfare losses are measured by a common, compensating increase in consumption for all individuals alive at $t = t_0$. The results show that as progressivity increases, the welfare losses become smaller. They range from 4.3% when $\gamma_1 = 0.053$ to 2.7% at the highest sustainable level of progressivity. There are two opposing effects behind these results. On the one hand, the declines in output and other aggregates become more prominent as the progressivity increases. On the other hand, a higher level of curvature provides insurance against idiosyncratic risk. Overall, the trade-offs associated with different progressivity levels are crucial to understanding the optimal mix of tax instruments, which we will analyze in the next section.

State-level Revenues Table 3 also shows the changes in revenues at the *state* level that follow the tax changes. As Table 3 and Figure 6 illustrate, different progressivity levels have sharp implications for other sources of tax revenue (i.e., state and local). Alongside the drop in the aggregates, as shown in Figure 6, state revenues also decline. State revenues fall by 4.5% when the additional revenue is raised by a proportional tax, while they do by 12.3% at the maximum level of progressivity. These significant effects highlight additional trade-offs associated with *how* revenue increases are generated in an economy with different jurisdictions. Altogether, total tax revenue (i.e., federal plus state) increases non-trivially less than the Federal tax revenue.

[16] To have a sense of the implied changes in marginal rates at top incomes, the marginal tax rate at five times mean household income increases by about 6, 10, and 14.5 percentage points when the curvature increases to $\gamma_1 = 0.07$, $\gamma_1 = 0.09$, and $\gamma_1 = 0.114$, respectively.

5.2 Introducing a Consumption Tax

We now introduce a federal consumption tax as a new instrument to increase Federal tax revenues by 30%. Specifically, we evaluate the merits of a linear consumption tax, i.e., a tax rate τ_c^F, alongside a lump-sum transfer in all dates and states. We assume that the new transfer households receive is subject to state-level consumption taxes. We consider three cases: the case without a transfer and the cases where transfers equal 3% and 5% of the benchmark household income.

The results are presented in Table 4 and Figure 7. A consumption tax does not distort asset choices and only distorts labor supply. Given prices, it may lead to changes in labor supply depending on the relative strengths of income and substitution effects. When households receive a transfer, a transfer increase is associated with a fall in labor supply due to income effects. The substitution effect associated with the consumption tax becomes stronger. Moreover, larger transfers require higher tax rates, leading to more substantial substitution effects away from market work. Altogether, the net result is further reductions in labor supply as transfers and tax rates increase.

Table 4 shows that as lump-sum transfers increase, a higher consumption tax rate is necessary to generate a 30% rise in revenues. Larger transfers are also associated with more significant declines in hours, labor supply, and output in the long run. Figure 7 presents the time path for output for different levels of transfers. These effects are in line with our previous findings, whereby increases in the progressivity of the income resulted in larger declines in long-run output for a given increase in revenues.

Two important differences with respect to the results for income taxes are worth pointing out. First, output differences tend to be larger for changes in income tax progressivity in the long run. This will play a central role in the mix of taxes that minimize welfare costs. Second, when transfers increase, hours drop on average more than labor supply, while the opposite is the case when progressivity rises. This follows as the lump-sum transfer is disproportionately more important for less productive (poorer) agents than more productive ones. As a result, there is a decline in hours, which is more pronounced for agents with low productivity. Therefore, changes in average hours are larger than changes in labor supply (hours weighted by efficiency units). Since what matters for prices and output is labor supply—not raw hours—the adverse effects on output as the transfer increases are less pronounced than under changes in progressivity.

Welfare Table 4 presents the effects on welfare. As transfers and consumption tax rates increase, the welfare cost associated with increasing revenues declines, and the support for the tax changes decline. This is in line with the previous findings regarding changes in income taxes. These findings also show that the reduction in the welfare cost is relatively quick, as small transfers lead to non-trivial changes in welfare. This suggests that consumption taxes in conjunction with transfers may be a critical part of an optimal arrangement of tax increases. We will elaborate on this later on.

5.3 Wealth Taxes?

Can wealth taxes generate enough revenue in the long run? We address this question by introducing a proportional wealth tax that applies to all levels of wealth above a threshold. We focus on a threshold that defines the top 1% of wealth holders in the benchmark economy and three rates: 1%, 2%, and 3%. All other taxes are left unchanged.

Our findings for Federal tax revenue and output are summarized in Figure 8. As the figure illustrates, the unexpected enactment of a wealth tax raises revenues immediately in a non-trivial fashion. Revenues jump by about 12%, as all wealth in the top 1% is taxed. This substantially discourages wealth formation and reduces asset accumulation at the top. The net result is a reduction in revenues that kicks in very quickly.

The wealth tax also has implications for labor supply and output. Figure 8 shows the gradual reduction in output that ensues after introducing the tax on top wealth. Output declines in the long run by about 1.2%, 2%, and 2.6%. Overall, this reduction in output over time leads to a decrease in other sources of revenue, resulting in a net *decline* in Federal tax revenues in the long run. Hence, a wealth tax is unlikely to generate enough revenue in the long run, even when it could be part of an optimal mix of tax instruments. We explore these issues later in section 7.2.

6 Increasing Revenues: Mixing Tax Instruments

We now look for a mix of tax instruments that can generate a given revenue target at the minimum welfare loss. Based on our previous results, we focus on three tax instruments to deliver a long-run increase in Federal revenues of 15%, 30%, and 45%, respectively. We consider changes in (i) the curvature of the income tax function, (ii) the introduction of a linear consumption tax at the Federal level, and (iii) the associated transfers, as explained in the previous section. We assume no changes in the 'level' of the income tax function (γ_0). A wealth tax is also not considered part of an optimal mix, nor changes in capital income tax rates (τ_k), although we later relax this assumption. Our procedure is to select the (constant over time) tax rate on consumption, the level of lump-sum transfer, and a curvature of the tax function to maximize the welfare of those alive at $t = t_0$ (minimize welfare loss), subject to the generation of the target revenues in the long run.

Our findings are summarized in Table 5, where we present the benchmark values in the first column for expositional purposes. Values for transfers are expressed in terms of the mean household income of the benchmark economy (initial steady state).

First, the optimal mix includes a consumption tax alongside a lump-sum transfer. The required tax rates are substantial, ranging from 27.4% to 30.2%, depending on the needs for revenue. These high rates are concomitant with high transfers, of about 13% of the mean income of the benchmark economy under a targeted 15% increase in revenues, declining to about 11–12% in the other two cases.

Second, the progressivity of the income tax declines, with a reduction in curvature from $\gamma_1 = 0.053$ to values around $\tau = 0.03$. This implies non-trivial reductions of marginal rates for top incomes. At five times mean income, this implies a drop in the income tax marginal rate of more than five percentage points. With higher revenue requirements, the reduction in curvature and transfers are necessary to mitigate output losses in the long run. Table 5 shows that output declines by 8.7%, 7.9%, and 6.9% for revenue increases of 15%, 30%, and 45%, respectively. In sum, in an optimal mix of tax instruments, more significant revenue needs are associated with smaller declines in output in the long run.

Third, state revenues fall only mildly in all cases, even when the output loss is up to 8% in the long run. This occurs as the new transfer is taxed at the local level via the state consumption tax. Moreover, the reductions in progressivity and the introduction of a consumption tax minimize losses on the tax base at the state level. Finally, the results in Table 5 suggest that a small 15% increase in Federal tax revenue—about 1.2% of initial GDP—can be achieved without welfare losses for all. This would imply lowering the progressivity of income taxes and introducing a progressive consumption tax that consists of a high rate (27.5%) and a transfer for all households of about 13% of the mean household income (about $13,000 in 2022 dollars).

These findings imply that the search for additional revenue requires additional spending, i.e., the creation of new transfers, to minimize welfare costs for all alive at $t = t_0$. The transfer embedded in the linear consumption tax is significant, of around $12,000 per household. The intuition for these findings is connected to our previous results, which suggest that linear consumption taxes lead to smaller changes in long-run macroeconomic aggregates as opposed to changes in the progressivity of income taxes. A consumption tax plus a transfer is preferred since a consumption tax distorts individual choices on the margin less, while lump-sum transfers minimize welfare losses. In addition, the optimal mix involves a *reduction* in income tax progressivity. Such a reduction reduces distortions on labor and asset formation decisions for more productive agents, minimizes output losses, and contributes to achieving the revenue target. Altogether, these forces suggest that as revenue needs increase, the reduction in progressivity becomes stronger.

Inequality Table 5 shows that with the optimal mix of tax instruments, earnings inequality measured by the Gini coefficient increases non-trivially—from 0.55 to 0.60–0.62. The wealth Gini also increases from 0.81 to 0.85. A higher inequality is expected, given the nature of tax instruments that emerges in this exercise. Large transfers in conjunction with a consumption tax disproportionately reduce the labor supply of labor-poor agents. At the same time, reductions in progressivity mitigate the decline or even increase the labor supply at the top of the distribution of earnings. The net result is an increase in earnings inequality, and this process is mirrored in terms of asset accumulation, increasing wealth inequality.

Our findings imply interesting and drastic changes in terms of taxes (net of transfers) at different levels of income. For these purposes, we show in Figure 9 the average net tax rates (at the Federal level) paid at percentiles of the overall income distribution, both in the benchmark economy as well as in the optimal mix with a 30% revenue increase target in steady state. The figure shows a clear counterclockwise rotation of the net tax schedule, with substantially higher taxes at the top and more negative at the bottom. Households in the top 5% pay about ten percentage points more of their income in taxes than in the benchmark economy. Nonetheless, the net tax profile of average rates under the optimal mix case is essentially *flat* at high-income levels, despite the additional transfers accruing to all households.[17]

Welfare As revenue needs increase, the welfare cost of raising additional revenue rises sharply, and support among those alive at $t = t_0$ declines. Our results show and highlight the quantitative importance of considering multiple tax instruments. Consider the case of a 30% increase in Federal revenues we analyzed in the previous section. When only the income tax function could be used, the welfare cost ranges from 4.3%, under the benchmark curvature level, to 2.7%, under the maximum feasible increase in curvature. In contrast, the welfare cost in Table 5 amounts to 2.0%. Similarly, a linear consumption tax with either no transfer or lower levels of transfers, as documented in Table 4, delivers non-trivially higher welfare costs. In section 7, we evaluate the quantitative importance of different components of the tax mix.

[17]To present the findings in Figure 9, we use the personal and corporate income taxes paid net of transfers received. We exclude social security taxes and benefits. For the optimal mix case, we add the new consumption tax plus the associated transfer.

7 Findings in Perspective

This section discusses our findings, focusing on the importance of the different tax instruments in the optimal mix. We first study the inclusion of alternative tax instruments in the optimal mix. We then analyze the consideration of a wealth tax as in section 5.3 but allowing the government to smooth out revenues via debt. We also explore the importance of transfers and the reduction of tax progressivity in the optimal mix. Finally, we discuss means-tested versus lump-sum transfers as part of the optimal mix. In all cases, we aim for an increase of 30% in revenues relative to the benchmark economy, as we explain below.

7.1 A Broader Set of Tax Instruments

Our baseline findings for the optimal mix of taxes are restricted to three instruments—a consumption tax, a transfer, and the choice of how progressive the income tax is. We now expand the set of available taxes. First, we allow the capital-income tax rate (τ_k) to be part of the mix. Then we also consider the level of the Federal income tax schedule (captured by γ_0) to change.

The results are summarized in Table 6. In both cases, a consumption tax and a non-trivial transfer remain part of the optimal mix that delivers the smallest welfare losses. Likewise, the level of curvature of the income tax again declines relative to the benchmark economy. With additional instruments, welfare costs are lower than in the baseline but in the same order of magnitude—with similar levels of support among those alive at t_0.

It is important to note that optimal mix leads to a choice of a zero level of τ_k. A lower tax rate on capital income reduces distortions in capital formation, resulting in smaller output losses and, thus, larger tax collections via other taxes. The output loss is smaller than in the baseline case (6.6% vs. 7.9%), and the welfare loss is the smallest (1.8% vs. 2.0%) in all the optimal mix cases we consider.[18]

[18]We note that we restricted our search to non-negative values of τ_k, so subsidies on capital income via τ_k are not possible. Intuitively, our finding is in line with the theoretical results of Erosa and Gervais (2002),

In the second case, we allow, instead, for the level of the tax function in the mix. We know from our previous results that small increases in the level of income taxes can generate substantial revenue gains. The optimal mix leads to a small increase in taxes at the mean income of less than two percentage points and a lower consumption tax than in the baseline case. In the long run, output losses are larger than in the baseline case (-8.7%), but the welfare loss is about the same (-1.9%).

7.2 Wealth Taxes and Government Debt

We analyzed the implications of taxes on wealth for revenues and aggregates in section 5.3, but so far, we have abstracted from wealth taxes as part of the optimal mix of tax instruments. We know from the discussion therein that a tax on wealth on top holders depresses output and may not even increase revenue in the long run. Yet, an unanticipated wealth tax can collect substantial revenues in the short run. Suppose the government can smooth out revenues over time via debt. Will a wealth tax be part of the optimal mix?

To address this question, we again consider a wealth tax at rates of 1% and 2% applied to the top 1% wealth holders in the benchmark. For each tax rate on wealth, we select a consumption tax rate, a transfer, and the level of progressivity of the income tax. We assume that the government has access to a fixed rate r^* to issue debt or hold assets. We assume for simplicity that all debt is held by foreigners (or that assets are invested abroad) so that it does not affect domestic capital formation. We then search for a flow of resources via taxation in each period in perpetuity equivalent to a 30% extra Federal revenues in the benchmark economy, which is consistent with an intertemporal budget constraint for the government. Notice that intuitively, this allows for an increase in revenues that is higher than 30% to accrue in any given period, which can then be invested and deliver interest income for the government, leading to lower levels of taxation.

which prescribe a zero capital-income tax rate in the long run for life-cycle economies with preferences of the type we consider when labor income taxes can vary over the life cycle. In our case, labor income taxes vary over the life cycle due to the progressive income tax even if shocks are absent, and capital income taxation is nonzero, as the notion of taxable income includes capital income.

When calibrating r^*, we are forced to confront the issue of the real rate of return on the debt that can be lower than the economy-wide growth rate. We use a rate of return of 2.35%, which corresponds to the average rate in the period 1990–2000 for U.S. treasuries with a one-year maturity. Removing the effects of secular growth in the government budget constraint, we end up with a relevant rate of 0.14%.[19]

Our results are summarized in Table 7 and are again in line with our previous results. We find that a consumption tax alongside a substantial transfer is part of the optimal mix and that the progressivity of income taxes is lower than in the benchmark economy. Indeed, given the depressing effects of taxes on output and revenues, the decline in curvature is sharper than in our baseline results. The presence of a wealth tax leads to *higher* welfare costs relative to the baseline case, even when smoothing is available for the government. These findings align with our previous results (section 7.1), where we found that taxes on capital income are not part of an optimal mix.

7.3 The Importance of Transfers and Income Tax Progressivity

Our findings highlight the emergence of a proportional consumption tax in the optimal mix of tax instruments, with substantial transfers and a reduction in progressivity. The fact that consumption taxes are part of the mix is not surprising. But why is there a sharp decline in progressivity and large transfers at the same time? What is the quantitative importance of lump-sum transfers vis-a-vis the reduction of progressivity in the optimal mix? Which of these two channels is more important?

We proceed by conducting two experiments, where we focus again on the case of the increase in revenues of 30%. We first analyze a case where the progressivity of the income tax is left unchanged, whereby the optimal mix finds the tax rate and the lump-sum transfer as components of the linear consumption tax. In the second case, we assume that transfers are *not* feasible and search for the consumption tax rate and the progressivity of the income tax

[19] Perhaps not too surprisingly, this is a 'low' rate. Using other time periods leads to lower or even negative rates.

function that minimizes the welfare loss.

Our findings are summarized in Table 8 and show that the transfers are the key element in the optimal mix. When only a consumption tax and a transfer are allowed, the welfare cost amounts to 2.1%. This is quite close to the baseline welfare loss (2.0%), where we optimized over the level of progressivity. The fraction of those in favor of tax changes is also comparable, 33.0% in the baseline and 31.3% now. Relative to the optimal mix, the transfer is now smaller (10% vs. 12% of the mean household income), and so is the consumption tax. Not surprisingly, as progressivity is kept unchanged from the benchmark economy, the reduction in output, in the long run, is larger than in the general case (8.9% vs. 7.9%).

When transfers are *not* part of the optimal mix, welfare costs become much larger than in the baseline case (-3.6% vs. -2.0%). In this case, the consumption tax is, not surprisingly, lower, but the tax function's curvature is much higher at about $\gamma_1 = 0.11$, implying a substantial rise of marginal tax rates across the board. At five times the mean income, the marginal tax rate increases by about 11.8 percentage points. The taxes, in this case, redistribute via a higher curvature, i.e., lower (higher) tax rates below (above) mean income levels, as Figure 3 illustrates. Given the sharp rise in marginal rates across the board, significant distortionary effects on labor supply and asset accumulation kick in, leading to a large reduction in output, in the long run, relative to the baseline case (8.4% vs. 7.9%).

Overall, these findings suggest that transfers are essential in the optimal mix. In their absence, welfare costs of raising revenue become non-trivially larger. These results also imply that the direction of the changes in tax progressivity hinges on the presence of transfers. Tax progressivity declines when transfers are available, but it strongly increases otherwise.

How Large should Transfers be? In the optimal mix, lump-sum transfers are quite substantial. A natural question is whether such a high level is necessary to achieve significant reductions in the welfare costs associated with revenue increases. Figure 10 answers this question, concentrating again on the revenue-increase case of 30%. In this exercise, we set the lump-sum transfer at various levels and optimize over the consumption tax rate and the curvature level, γ_1. The levels considered include the value that minimizes the welfare costs—12% of the benchmark's household income.

The figure shows that without any transfers, the welfare cost is substantial, around -3.5%. As transfers increase, welfare losses decline quickly, but the welfare profile soon becomes flat. Welfare costs for a wide range of transfer income become nearly the same as the lowest one. Note that a transfer of about 6% attains about two-thirds of the welfare-cost reduction (relative to the no-transfers case). There are essentially no gains relative to a transfer of about 8%. We conclude from these findings that while transfers are critical in the optimal mix, non-trivially smaller transfers are nearly optimal.

7.4 Using Means-Tested Transfers

To what extent does it matter that transfers accrue to everyone in the optimal mix? To address this question, instead of transfers paid to everyone, we look for the potential expansion of means-tested transfers as part of an optimal mix. We consider 'upward' shifts in the transfer *function*, Figure 4, by a proportional factor, together with changes in a consumption tax and the progressivity as before. Since the transfer function approaches zero at around mean household income, increases in transfers are now concentrated at low-income realizations.

For the case of a revenue increase of 30%, we find that using targeted transfers leads to a significantly *higher* welfare cost and a different configuration of tax instruments. In this case, we find that the optimal mix involves an upward shift in the transfer function of about 14%, a Federal consumption tax of about 4%, and a curvature of the income tax of $\gamma_1 = 0.114$. That is a smaller increase in transfers and a significantly higher income tax progressivity than what we found when transfers were lump sum. The resulting welfare cost is 3.3%, non-trivially higher than the 2.0% we found in the baseline.

To understand these findings, it is key to note that since transfers approach zero rapidly as income increases, not many individuals alive at $t = t_0$ benefit from a potential expansion in means-tested transfers. Hence, large proportional increases do not benefit those around the middle of the income distribution. Moreover, as the curvature of the income tax increases, taxes paid at around mean income decline and can become negative for low-income values. This results in the use of the income tax for redistributive purposes and a small consumption tax—in relation to the baseline case—to raise revenue. Since the increase in curvature is substantial, output declines in the long run by about 10%.

8 Conclusions

We searched for a mix of tax instruments that achieves the growing tax revenue needs in the United States at the minimum welfare cost. We did so in the context of a life-cycle economy consistent with key features of earnings and wealth distribution and when non-linear taxes and transfers are in place. In our baseline results, consumption taxes, transfers, and the progressivity of the federal income tax schedule are the only tax instruments that can change to achieve a given increase in federal tax revenue. Several key findings emerge.

First, a consumption tax consistently turns out to be a central part of the optimal mix. Consumption taxes are accompanied by a substantial transfer that helps mitigate the burden of tax increases. This finding holds when we expand the set of tax instruments and allow the level of federal income tax schedule to change and when wealth and capital income taxes are potentially part of the mix. Consumption taxes appear unavoidable and become the 'silver bullet' to generate additional revenue.

The fact that consumption taxes are good instruments to collect revenue at a low cost is not surprising. However, we also show that a consumption tax has to be introduced together with potentially significant transfers to all households in order to minimize welfare costs.

Second, a reduction in the tax progressivity of the income tax is always part of the optimal mix. The higher the tax revenue needs, the higher the needed reduction in progressivity. Intuitively, lower progressivity is associated with a larger output and, thus, higher potential tax collections, while redistribution is achieved via transfers.

Third, we also find no role for wealth taxes as part of an optimal mix. Wealth taxes reduce output via their distortionary effects on capital formation, do not generate much revenue, and lead to *lower* revenues beyond low tax rates (around 1%). Even when we impose wealth taxes and allow the government to issue debt for tax smoothing, the resulting welfare costs are higher than in our baseline results.

Finally, two other findings are worth mentioning. First, while substantial transfers are part of the optimal mix, we find that relatively small transfers can accomplish the bulk of the reduction of welfare costs from tax hikes. Put differently, beyond a certain level of transfers, welfare costs as a function of transfers are quite 'flat' over a long range. When we optimize over consumption taxes, transfers, and the progressivity of the federal income tax schedule, the transfers are about 12% of the household income of the benchmark economy. Once transfers are about half of this level, they achieve about two-thirds of the reduction in welfare costs compared to the no-transfer case. Second, we also find that when the flat capital income tax is included in the mix, its level is *zero*. Clearly, this finding has implications for ongoing discussions of tax hikes on capital income, e.g., via increases in the corporate income tax.

We conclude by mentioning two issues related to the questions we address in this paper that we have abstracted from in our analysis. First, it might be important to investigate the implications of non-separable preferences for consumption and leisure for our findings. This is a central point in the optimal taxation in life-cycle economies; see Erosa and Gervais (2002) and others. We conjecture that our main findings will hold but that the consequences on macroeconomic aggregates of needed tax hikes could be more substantial than the ones we found here. Second, we have not considered issues related to the gradual implementation of tax hikes or the gradual implementation of consumption taxes as in Raei (2020). Similarly, we have abstracted from the consequences of preannounced tax hikes. We leave these and other issues for future work.

Appendix: Equilibrium Definition

We now proceed to define a stationary equilibrium. Recall that an individual's state is denoted by $x = (\widehat{a}, \Omega, \beta)$, $x \in \mathbf{X}$, where $\widehat{a}$ are current (transformed) asset holdings, Ω are the idiosyncratic productivity shock (θ, z), and β stands for the discount factors. For aggregation purposes, a probability measure ψ_j, for all $j = 1, \ldots.., N$, defined on subsets of the individual state space, will describe the heterogeneity in assets, productivity shocks, and discount factors within a particular cohort. Let $(\mathbf{X}, B(\mathbf{X}), \psi_j)$ be a probability space where $B(\mathbf{X})$ is the Borel σ-algebra on $\mathbf{X}$. The probability measure ψ_j must be consistent with individual decision rules that determine the asset position of individual agents at a given age, given the asset history, the history of labor productivity shocks, and the individual discount factor. Therefore, it is generated by the law of motion of the productivity shocks Ω and the asset decision rule $a(x, j)$. The distribution of individual states across age 1 agents is determined by the initial exogenous distribution of labor productivity shocks Q_θ, discount factor heterogeneity $Q_\beta(\beta|\theta)$, and persistent and temporary innovations since agents are born with zero assets.

For agents $j > 1$ periods old, the probability measure is given by the recursion:

$$\psi_{j+1}(B) = \int_X P(x, j, B) d\psi_j, \tag{16}$$

where

$$P(x, j, B) = \begin{cases} Q_z(z', z) & \text{if } (a(x, j), z', \theta, \beta) \in B \\ 0 & \text{otherwise} \end{cases}.$$

It is possible now to state the definition of steady-state equilibrium:

Definition: A steady-state equilibrium is a collection of decision rules $c(x, j)$, $a(x, j)$, $l(x, j)$, factor prices $\hat{w}$ and $\hat{r}$, taxes paid $T(I(x, j),)$, transfers received $TR(I(x, j))$, per-capita accidental bequests $\hat{AB}$, social security transfers $\widehat{B}_j$, aggregate capital $\hat{K}$, aggregate labor $\hat{L}$, government consumption $\hat{G}$, a payroll tax τ_p, a tax regime $\{T_f(.), \tau_I, \tau_k, \tau_c\}$ and distributions $(\psi_1, \psi_2, ..., \psi_N)$ such that

1. $c(x,j)$, $a(x,j)$ and $l(x,j)$ are optimal decision rules.
2. Factor Prices are determined competitively: $\hat{w} = F_2(\hat{K}, \hat{L})$ and $\hat{r} = F_1(\hat{K}, \hat{L}) - \delta$
3. Markets Clear:

$$\sum_j \mu_j \int_X (c(x,j) + a(x,j)(1+g))d\psi_j + \hat{G} = F(\hat{K}, \hat{L}) + (1-\delta)\hat{K}, \tag{17}$$

   and

$$\sum_j \mu_j \int_X a(x,j)d\psi_j = (1+n)\hat{K}, \text{ and } \sum_j \mu_j \int_X l(x,j)e(\Omega,j)d\psi_j = \hat{L}. \tag{18}$$

4. Distributions are Consistent with Individual Behavior:

$$\psi_{j+1}(B) = \int_X P(x,j,B)d\psi_j$$

   for $j = 1, ..., N-1$ and for all $B \in B(X)$.

5. Government Budget Constraint is satisfied:

$$\sum_j \mu_j \int_X TR(I(x,j))d\psi_j + \hat{G} = \sum_j \mu_j \int_X T(I(x,j))d\psi_j + \hat{AB}, \tag{19}$$

6. Social Security Benefits equal Taxes:

   and

$$\tau_p \hat{w}\hat{L} = \sum_{j=R+1}^{N} \mu_j \hat{B}_j. \tag{20}$$

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Table 1: Parameter Values

Parameter	Value	Comments
Population Growth Rate (n)	0.007	U.S. Data
Labor Efficiency Growth Rate (g)	0.016	U.S. Data
Mean Discount Factor (β)	0.973	See text
Correlation (b/w β and θ)	-0.17	See text
Intertemporal Elasticity (η)	1.0	Literature
Disutility of Market Work (φ)	6.55	Calibrated—matches hours worked
Capital Share (α)	0.38	Calibrated
Depreciation Rate (δ_k)	0.04	Calibrated
Autocorrelation Permanent Shocks (ρ)	0.958	Kaplan (2012)
Variance Permanent Shocks (σ_θ^2)	0.45	Calibrated—matches Earnings Gini
Variance Persistent Shocks (σ_ϵ^2)	0.017	Kaplan (2012)
Share of Superstars (π)	0.01	
Value of Superstars Productivity (θ^*)	2.9	Calibrated—matches labor income share of top 1%
Payroll Tax Rate (τ_p)	0.162	Calibrated
Capital Income Tax Rate (τ_k)	0.065	Calibrated
Income Tax Rate (τ_I)	0.050	Guner et al. (2014)
Consumption Tax Rate (τ_c)	0.048	Calibrated
Tax Function Level (γ_0)	0.051	Calibrated
Tax Function Curvature (γ_1)	0.053	Guner et al. (2014)
Transfers at zero income (ω_0)	0.1207	Guner et al. (2022a)
Curvature of Transfer Function (ω_1)	-2.122	Guner et al. (2022a)
Curvature of Transfer Function (ω_2)	-4.954	Guner et al. (2022a)
Curvature of Transfer Function (ω_3)	0.044	Guner et al. (2022a)

Note: Entries show parameter values and briefly explain how they are selected. See text for details.

Table 2: Labor Income and Wealth Shares (%)—Model and Data

Percentiles	Data Labor Income	Model Labor Income	Data Wealth	Model Wealth
Quantile				
1st (bottom 20%)	1.3	2.6	0.2	0.0
2nd (20–40%)	7.3	7.0	1.4	0.2
3rd (40–60%)	13.2	12.1	4.3	4.3
4th (60–80%)	21.9	20.5	10.7	12.0
5th (80–100%)	56.3	57.9	83.4	82.8
Top				
10%	39.7	41.6	70.9	70.1
5%	28.5	29.7	58.7	59.3
1%	12.9	12.9	32.0	31.8
Gini Coefficient	0.55	0.55	0.81	0.81

Note: Entries show the distribution of labor income in the data and the implied distribution from our model. Both wealth and labor income data are from the 2013 Survey of Consumer Finances. See text for details.

Table 3: Income Taxes—30% Tax Revenue Increase

	$\gamma_1 = 0.053$	$\gamma_1 = 0.07$	$\gamma_1 = 0.09$	$\gamma_1 = 0.114$
Output	97.6	94.5	91.3	88.0
Hours	98.6	97.7	96.2	94.4
Labor Supply	99.5	97.7	95.9	90.7
Tax Function Level (γ_0)	0.083	0.080	0.078	0.078
Revenues				
Federal Income Tax	130.0	130.0	130.0	130.0
State and Local Taxes	96.5	93.7	90.7	87.7
All Taxes	114.7	113.6	112.3	110.7
Welfare				
Welfare (%)	-4.3	-3.9	-3.6	-2.7
% in Favor	0.0	0.5	8.8	13.0

Note: The table presents the steady-state effects on a host of variables associated with different levels of income tax curvature, ranging from the benchmark case of curvature ($\gamma_1 = 0.053$) to the level that maximizes revenues from progressivity changes only ($\gamma_1 = 0.114$). In all cases, the 'level' of the tax function is adjusted to achieve the target of a 30% increase in Federal revenues. See text for details.

Table 4: Linear Consumption Tax—30% Tax Revenue Increase

	No transfer	Transfer 3%	Transfer 5%
Output	99.9	97.5	95.8
Hours	99.9	94.8	91.3
Labor Supply	99.9	97.3	95.4
Consumption Tax Rate (%)	4.5	9.6	13.4
Revenues			
Federal	130.0	130.0	130.0
State and Local	99.9	99.3	98.8
All Taxes	116.6	115.7	115.6
Welfare			
Welfare (%)	-4.7	-3.4	-2.8
% in Favor	0.0	9.2	18.4

Note: The table presents the steady-state effects on a host of variables related to different levels of transfers associated with the introduction of a linear consumption tax. The transfer values are in terms of mean household income in the benchmark economy. The value of the consumption tax rate is chosen to achieve the target of a 30% increase in Federal revenues (net of the transfer). See text for details.

Table 5: Optimal Mix of Tax Changes

	Benchmark	15% Revenue Increase	30% Revenue Increase (baseline)	45% Revenue Increase
Output	100.0	91.3	92.1	93.1
Hours	100.0	77.1	78.4	77.9
Labor Supply	100.0	88.6	89.5	89.7
Consumption Tax Rate (%)	-	27.5	27.8	30.3
Transfer (%)	-	13.0	12.0	12.0
Tax Function Curvature (γ_1)	0.053	0.034	0.033	0.025
Tax Function Level (γ_0)	0.051	0.051	0.051	0.051
Revenues				
Federal	100.0	115.0	130.0	145.0
State and Local	100.0	98.9	99.1	100.0
All Taxes	100.0	107.6	115.7	124.3
Inequality and Welfare				
Gini Earnings	0.55	0.60	0.59	0.60
Gini Wealth	0.81	0.86	0.86	0.87
Welfare (%)	-	0.7	-2.0	-4.6
% in Favor	-	42.3	33.0	25.3

Note: The table presents results on the effects on different variables for alternative targets of Federal revenue increase relative to the benchmark economy in the long run. The instruments considered are the curvature of the income tax function, the level of the consumption tax rate, and the associated transfer (in terms of the mean income of the benchmark economy). In all cases, the reported mix minimizes the welfare loss for all alive at the initial date, taking into account transitional dynamics. See text for details.

Table 6: Additional Tax Instruments

	Benchmark	Optimal Mix (baseline)	Optimal Mix (include τ_k)	Optimal Mix (include γ_0)
Output	100.0	92.1	93.4	91.3
Hours	100.0	78.4	76.9	77.7
Labor	100.0	89.5	88.9	89.4
Consumption Tax Rate (%)	-	27.8	31.1	26.0
Transfer (%)	-	12.0	13.0	12.0
Tax Function Curvature (γ_1)	0.053	0.03	0.035	0.03
Tax Function Level (γ_0)	0.051	0.051	0.051	0.07
Capital Income Tax (τ_k)	6.5	6.5	0.0	6.5
Welfare (%)	-	-2.0	-1.7	-1.9
% in Favor	-	33.0	34.4	32.3

Note: The table presents the results for different variables associated with a 30% increase in Federal revenue relative to the benchmark economy in the long run. The third column is the baseline case, which we use for comparison. The fourth column shows the mix of tax instruments when the capital income tax is included. The final column shows the tax instruments mix when the tax function level is included. In all cases, taking into account transitional dynamics, the reported combination minimizes the welfare loss for all alive at the initial date. See text for details.

Table 7: Wealth Taxes and Debt

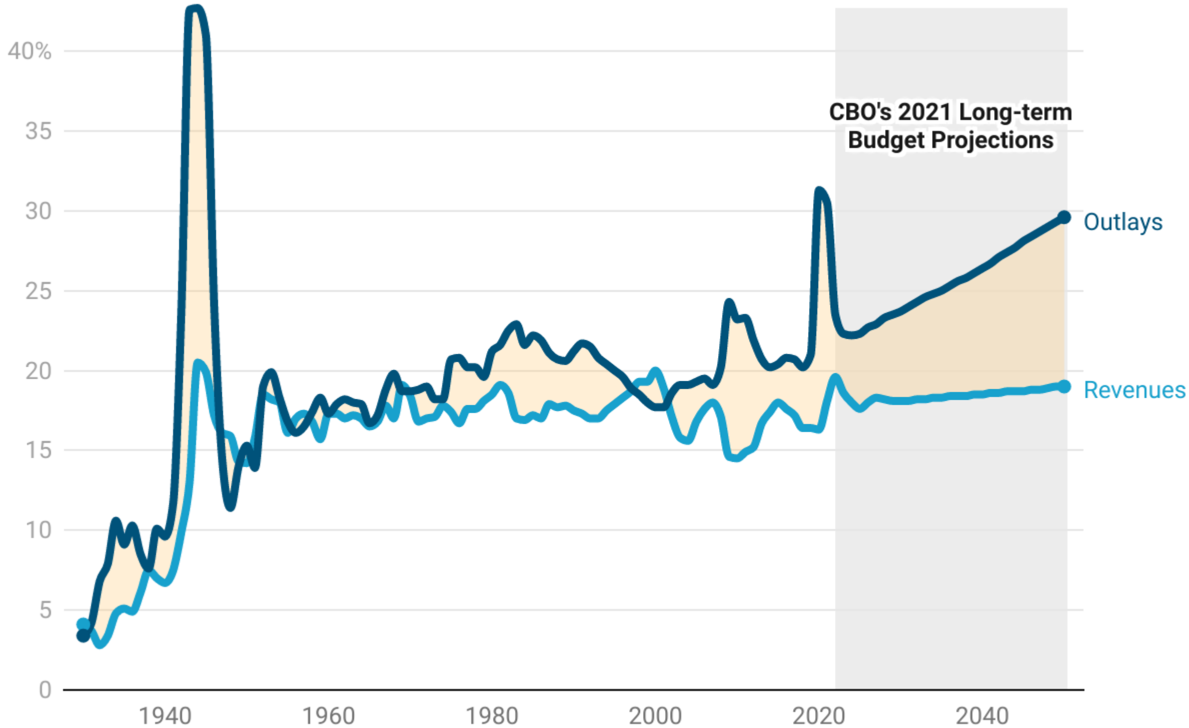
	Benchmark	Optimal Mix (baseline)	Optimal Mix (1% wealth tax)	Optimal Mix (2% wealth tax)
Output	100.0	92.1	92.5	91.5
Hours	100.0	77.9	77.8	78.2
Labor	100.0	89.7	89.6	89.5
Consumption Tax Rate (%)	-	27.8	27.8	28.5
Transfer (%)	-	12.0	12.4	12.2
Tax Function Curvature (γ_1)	0.053	0.033	0.020	0.020
Tax Function Level (γ_0)	0.051	0.051	0.051	0.051
Welfare (%)	-	-2.0	-2.2	-2.7
% in Favor	-	33.0	31.6	29.7

Note: The table presents the results for different variables associated with a 30% increase in Federal revenue relative to the benchmark economy that satisfies the government's intertemporal budget constraint. The third column is the baseline case, which we use for comparison. The fourth column shows the mix of tax instruments when a wealth tax on the top 1% is included, and government debt is available. The final column shows the mix of tax instruments when a wealth tax on the top 2% is included, and government debt is available. In all cases, taking into account transitional dynamics, the reported combination minimizes the welfare loss for all alive at the initial date. See text for details.

Table 8: Constrained Mix of Tax Changes

	Benchmark	Optimal Mix (baseline)	Optimal Mix (benchmark γ_1)	Optimal Mix (no transfer)
Output	100.0	92.1	91.1	90.6
Hours	100.0	78.4	81.7	95.7
Labor Supply	100.0	89.5	90.2	93.7
Consumption Tax Rate (%)	-	27.8	23.4	3.6
Transfer (%)	-	12.0	10.0	-
Tax Function Curvature (γ_1)	0.053	0.03	0.053	0.11
Tax Function Level (γ_0)	0.051	0.051	0.051	0.051
Welfare (%)	-	-2.0	-2.1	-3.6
% in Favor	-	33.0	31.3	10.7

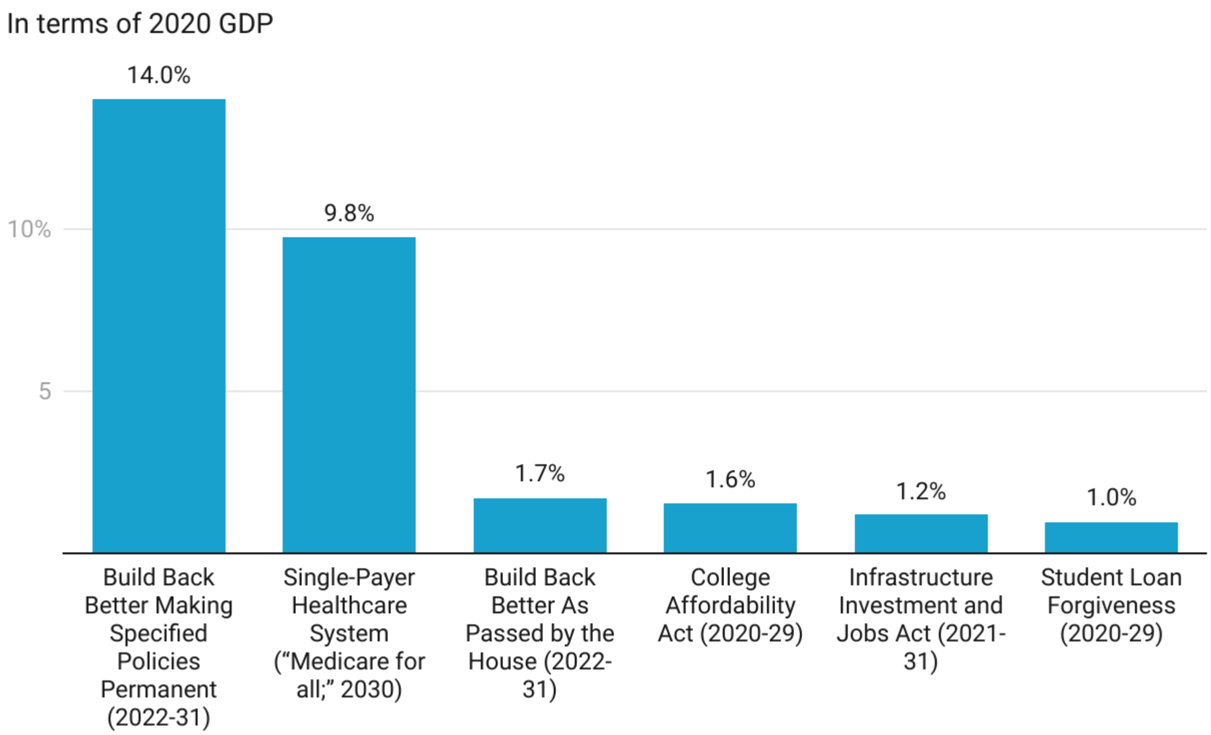
Note: The table presents the results for different variables associated with a 30% increase in Federal revenue relative to the benchmark economy. The third column is the baseline case, which we use for comparison. The fourth column shows the constrained mix of tax instruments when only the lump-sum transfer and the consumption tax rate are used. The final column shows the constrained combination of tax instruments when only the consumption tax rate and the curvature of the tax function are used. In all cases, considering transitional dynamics, the reported combination minimizes the welfare loss for all alive at the initial date. See text for details.



Source: White House Historical Tables and Congressional Budget Office (CBO)

Note: The figure shows the historical times series and 2021 CBO's long-term projections for the U.S. revenues and outlays. See CBO (2021d) for an explanation of the underlying assumptions behind these projections and their methodology.

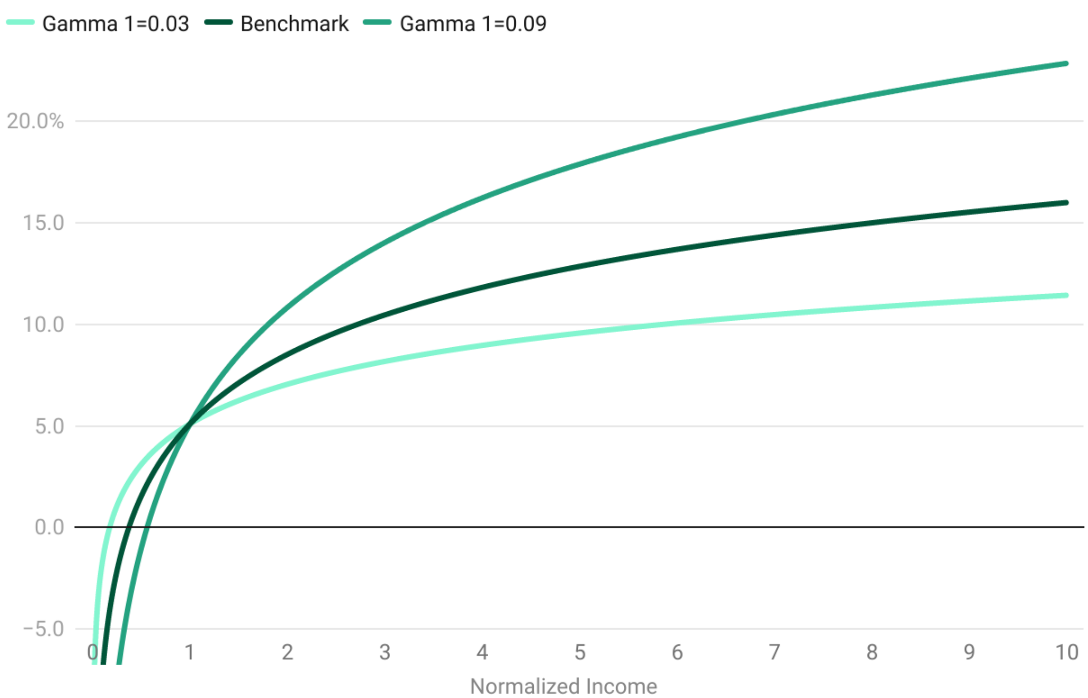
Figure 1: US Outlays and Revenues: 1930–2052.



Source: Congressional Budget Office (CBO)

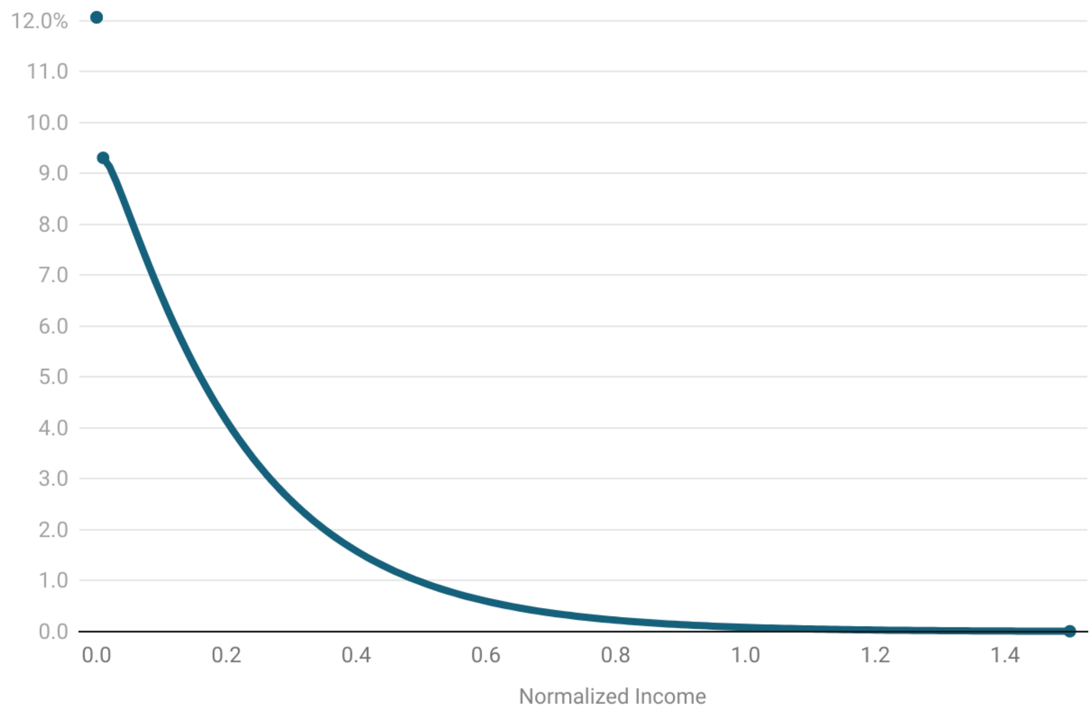
Note: The chart shows the CBO estimation of the net cumulative change in the deficit (difference in the change in spending and revenues due to the proposal) from some recent spending proposals. Except for the "Single-Payer Healthcare" proposal, the time frame is ten years. For the Build Back Better Act, we take two estimates: the cost of the proposal as the House of Representatives approved it (see CBO, 2021e) and the cost of the bill if some policies were permanent (see CBO, 2021f). In the case of "Medicare for all," we take the median cost of five proposals studied in CBO (2020b; option 1). We take the costs of the College Affordability Act and the Infrastructure, Investment, and Jobs Act from CBO (2019a) and CBO (2021g), respectively. We estimate the cost of the Student Loan Forgiveness by summing the debt forgiveness of undergraduate and graduate debt in Table 3.3 of CBO (2020c).

Figure 2: CBO Cost Estimation of Key Spending Proposals.



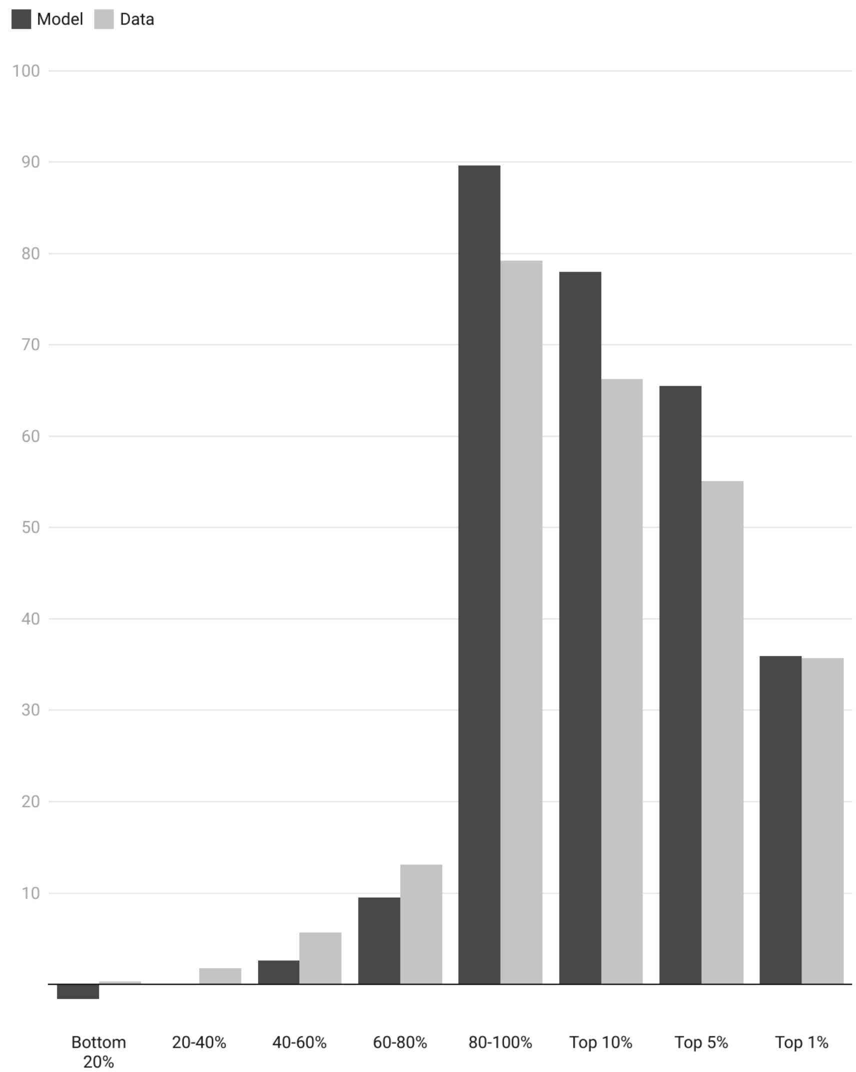
Note: The figure presents the average tax rates for the federal income tax used in our benchmark economy and cases with a lower and higher curvature, $\gamma_1 = 0.03$ and $\gamma_1 = 0.09$, respectively. See text for details

Figure 3: Average Tax Rates for the Federal Income Tax.



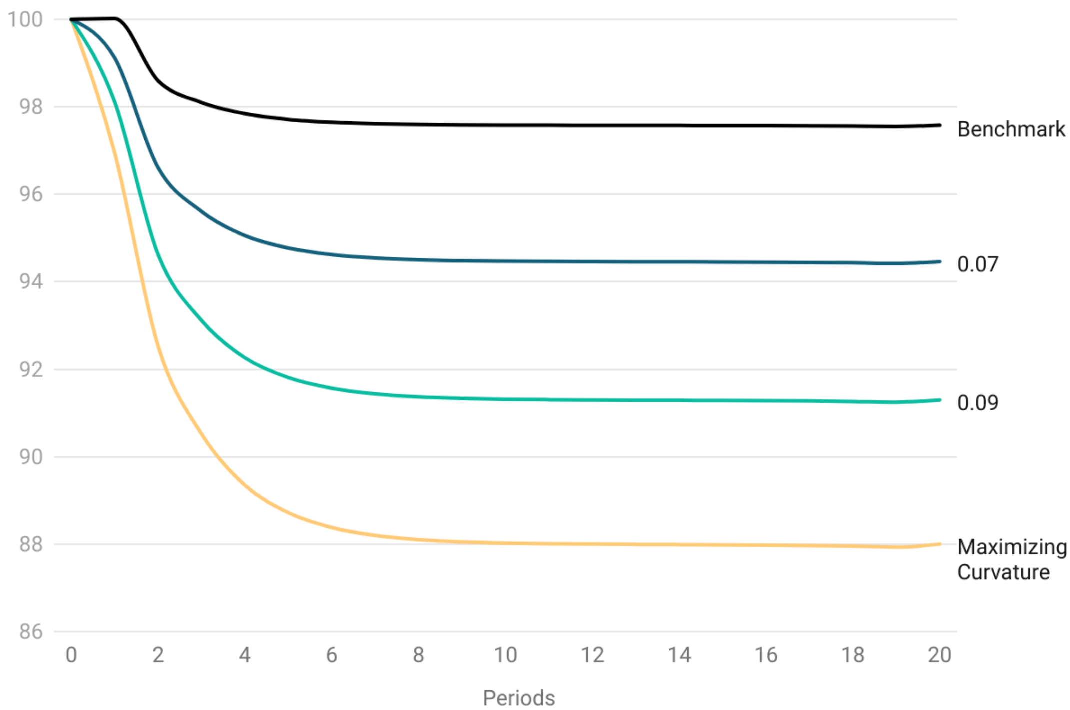
Note: The figure presents the relationship between means-tested transfers and income used in the benchmark economy. See text for details.

Figure 4: Means-Tested Transfers



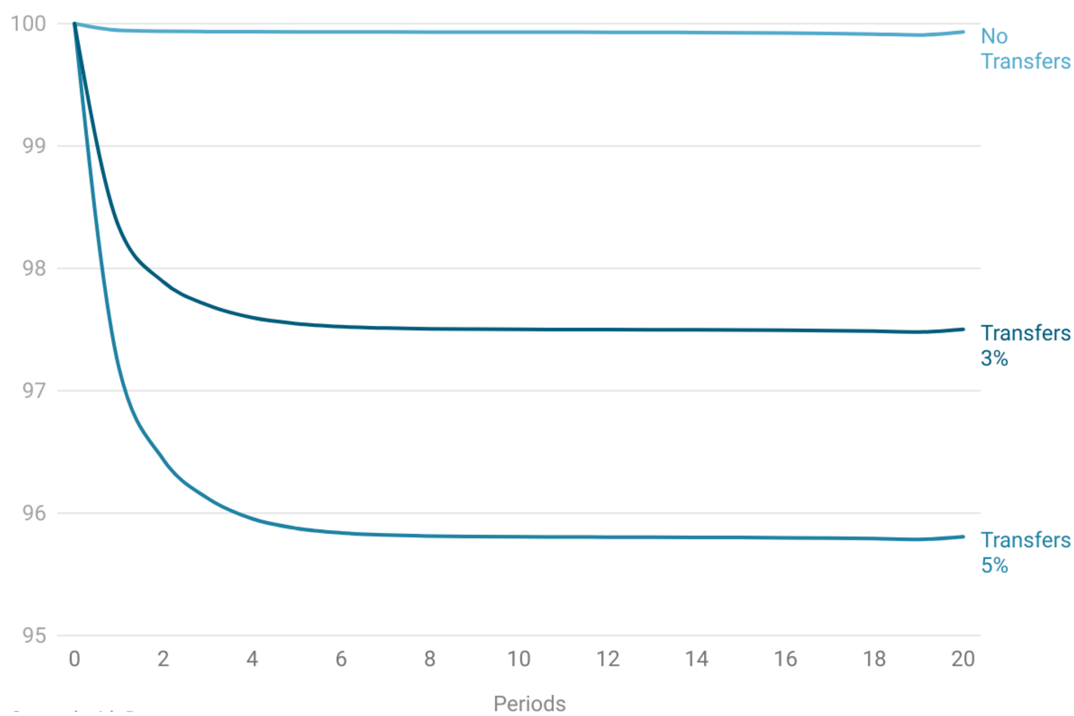
Note: The figure presents the distribution of income taxes paid by household income. Data is from the Internal Revenue Service.

Figure 5: Distribution of Income Taxes Paid—Model versus Data.



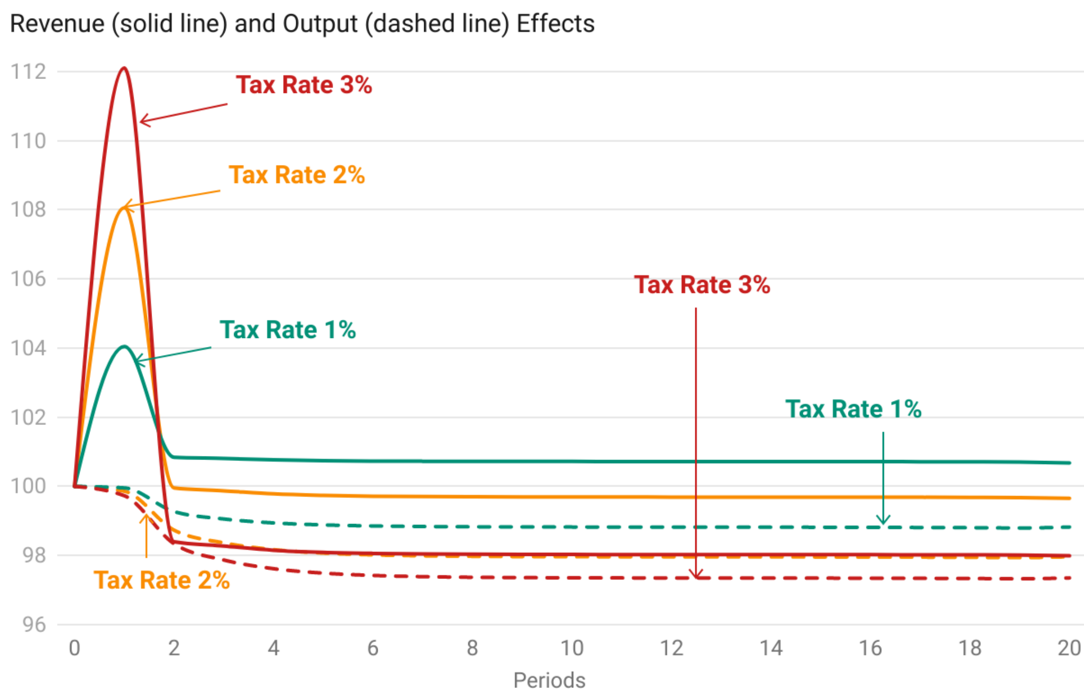
Note: The figures display the time path out model output under different levels of curvature of the income tax function, ranging from the benchmark value to the one that maximizes revenue from progressivity changes only. See text for details.

Figure 6: Changes in Output for Different Levels of Progressivity.



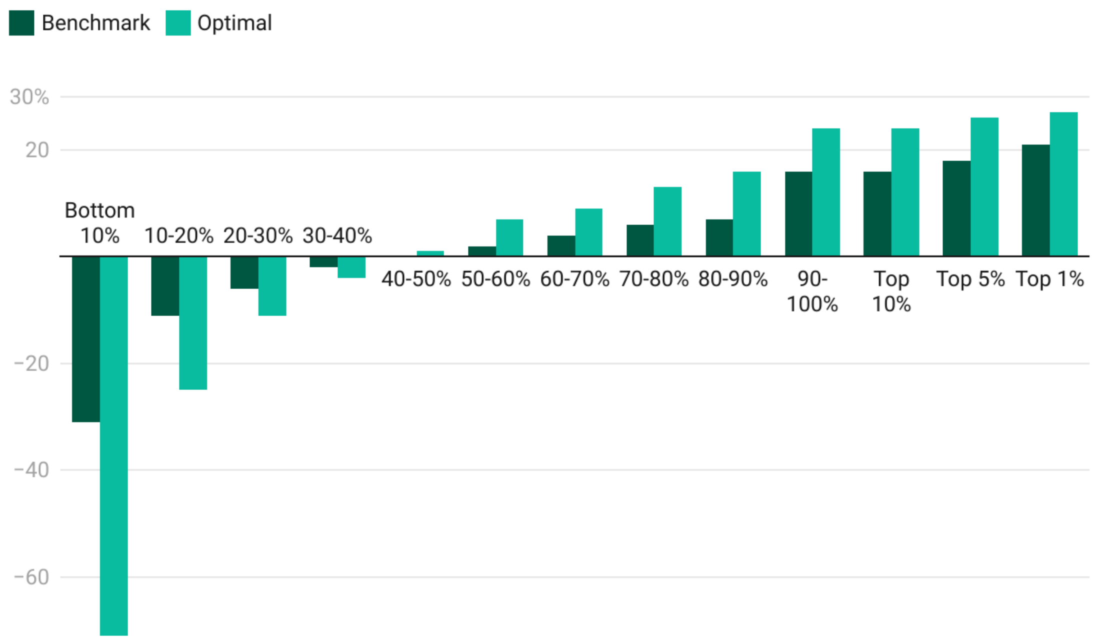
Note: The figure displays the time path of the model output under different transfer levels in the linear consumption tax. Values of the transfer are given in terms of the mean household income of the benchmark economy. See text for details.

Figure 7: Changes in Output for the Federal Consumption Tax.



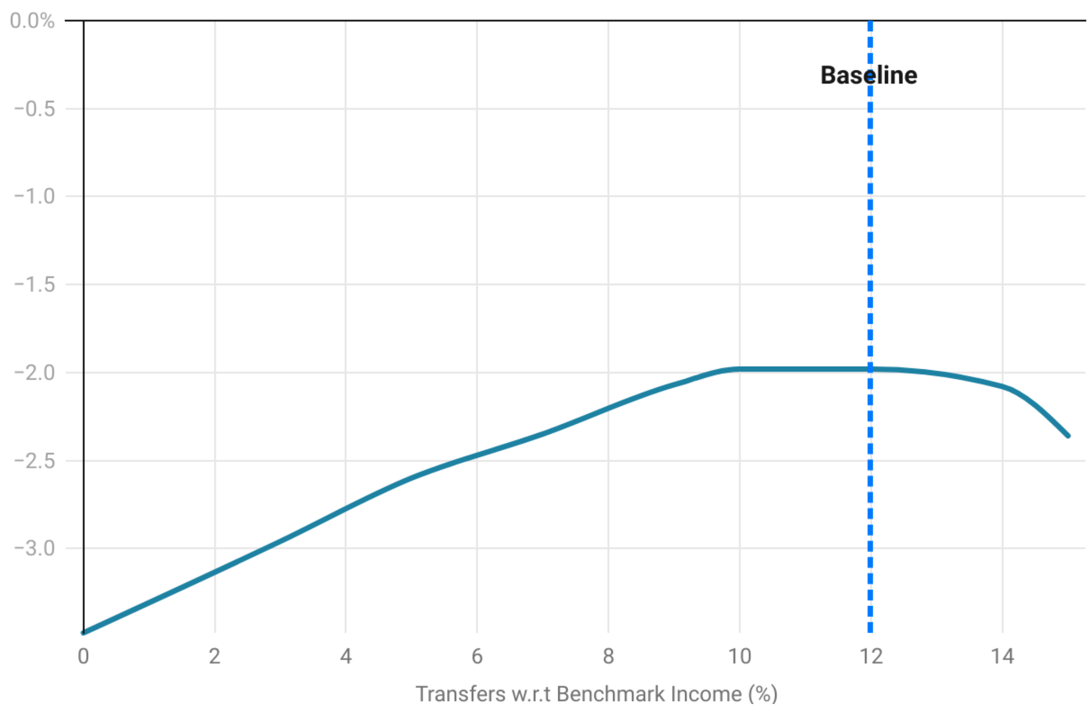
Note: The figure shows the time path for revenues from a wealth tax and the associated output effects. The wealth is imposed at different rates on the top 1% of wealth holders.

Figure 8: Wealth Taxes on Top 1%: Revenues and Output Effects over Time



Note: The figure shows federal taxes net of transfers as a fraction of income at different percentiles of the income distribution, both in the benchmark economy and in the optimal mix case (30% revenue increase). To compute the net tax rates, we use personal and corporate income taxes paid net of transfers received. We exclude social security taxes and benefits. For the optimal mix case, we add the new consumption tax plus the associated transfer.

Figure 9: Taxes Paid Net of Transfers: Benchmark vs. Optimal Mix Case (30%)



Note: The figure shows the welfare cost of revenue increases of 30% in a constrained optimal mix when the transfer level is set exogenously at different levels.

Figure 10: Transfers and Welfare Costs: Constrained Optimal Mix