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Distribution Analysis as Welfare Analysis

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Distribution Analysis as Welfare Analysis*

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Abstract

This paper formalizes fixed-quantities distribution analysis as the primary ingredient in the welfare analysis of tax changes. The fixed-quantities change in tax, meaning the change in household resources resulting from the tax change ignoring any voluntary change in quantities but reflecting any impact on prices, provides an approximation to the utility impact of a proposed tax change in a specific year. Changes in output, which reflect a change in quantities, should be ignored. However, quantity changes do help determine a proposal's effect on the government budget. Together, a revenue estimate and a distribution analysis provide the information necessary for quantitative welfare analysis of proposed tax changes.

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1 Introduction

The congressional Joint Committee on Taxation, the U.S. Treasury, and private organizations produce three main types of quantitative analysis to inform policymakers' consideration of tax proposals: conventional revenue estimates, distribution analyses, and macroeconomic analyses. A conventional revenue estimate is the estimated impact of a proposal on projected annual deficits over the next decade, conditional on an assumption that the proposal does not cause aggregate income to change. A distribution analysis estimates the change in tax resulting from a proposal for different income groups in specific years. A macroeconomic analysis provides an estimate of the impact of a proposal on aggregate output and the consequent impact of that change in output on deficits.[1]

Distribution analysis is central to the public debate about tax legislation, but the question such analyses are intended to answer is often ambiguous. This ambiguity is reflected in differences in how the analysis is conducted by different organizations and confusion about the interpretation of the analyses, including the relationships between conventional revenue estimates, distribution analyses, and macroeconomic analyses.

This paper formalizes distribution analysis in two ways. First, it identifies the purpose of distribution analysis as estimating the impact of tax changes on household utility in a specific year, also referred to as the impact on tax burdens. Second, it proposes a method for distribution analysis based on an application of the envelope theorem, which I term fixed-quantities distribution analysis, and it demonstrates that this approach to distribution analysis provides precise prescriptions regarding the conduct and interpretation of the analysis.

Under the fixed-quantities approach, the object of central interest is the fixed-quantities change in tax, meaning the change in household resources resulting from a tax change ignoring any voluntary change in quantities but reflecting any impact on prices. Quantity changes, such as changes in labor supply or investment, are excluded because—when the envelope theorem applies—changes in quantities have no first-order effect on the well-being of the household making that change. Price changes, such as changes in wage rates or rates of return, are included because they are implicit transfers between different households. Indeed, it is these price changes that can cause the economic incidence of a tax (who bears the burden in terms of reduced utility) to differ from the statutory incidence of a tax (who has the legal obligation to pay the tax). Importantly, the label fixed-quantities distribution analysis is something of a misnomer as it will be appropriate to vary quantities in certain circumstances that arise in applications. Nonetheless, the name provides a useful reminder of the envelope theorem logic that underlies the approach.

A distribution analysis that shows the utility impact of tax legislation in terms of the change in tax for

[1] See Appendix A for examples of these analyses from the Joint Committee on Taxation and the Tax Policy Center for the Tax Cuts and Jobs Act.

different income groups in specific years offers two major advantages relative to other means of evaluating the welfare impact of tax legislation.[2] First, any approach to aggregating the impact of public policies on different households necessarily involves assumptions about the relative value of one dollar in the hands of different people. A distribution analysis limits the extent of the aggregation required. Second, any long-run or present-value welfare analysis that attempts to summarize the impact of tax legislation over the indefinite future must either make assumptions about future policies or directly assess the long-term consequences of potentially unsustainable changes in deficits and debt. By instead evaluating impacts for specific years in the short and medium-term, distribution analysis provides the ingredients of a present-value welfare analysis without assuming future policy changes. That said, a distribution analysis incorporating assumed future policy changes that offset any impact of proposed tax changes on the deficit is necessary to illustrate the true tradeoffs in tax policy: the tradeoffs between taxes and spending or between one set of taxes and another set of taxes. Such an analysis is unavoidably hypothetical, however, as legislators enacting a proposal that increases or decreases the deficit do not specify future offsets when they do.[3]

The primary contribution of this paper is to provide a rigorous conceptual foundation for conducting distribution analysis of tax changes for the policy process. In doing so, it makes three additional subsidiary contributions. First, it clarifies the relationship between distribution analysis and revenue estimates and, by doing so, clarifies how to do quantitative welfare analysis (and thus also cost-benefit analysis) of tax legislation and regulation.[4] Distribution analysis provides estimates of the impact of a proposed tax change on households' utility, but it ignores the impact of a proposed tax change on the government budget. This impact is reflected in a revenue estimate. Together, a revenue estimate and a distribution analysis are sufficient to assess the welfare impact of proposed tax changes.[5] While changes in quantities resulting from tax legislation should be excluded from distribution analysis, they do matter in determining the fiscal impact of the legislation. Thus, for purposes of quantitative welfare analysis, revenue estimates should include the impact of changes in quantities. As a result, the aggregate change in tax reflected in a revenue estimate

[2]In their most common form, distribution analyses summarize the impact of proposed tax changes by income class. However, the choice of classifier is arbitrary. Distribution analyses can also be conducted by age, race, gender, family structure, or any other dimension of heterogeneity. Wiehe et al. (2018) present a distribution analysis of the Tax Cuts and Jobs Act by race. Tax Policy Center (2017) includes separate distribution analyses of the Tax Cuts and Jobs Act for each tax filing status. The conceptual framework set forth in this paper applies to the construction of distribution analyses using any classifier.

[3]The need to evaluate the impact of policies that increase or decrease the deficit without assuming additional future policies is core to the idea of scoring legislation, which is intended to inform Congressional consideration of the legislation. However, most formal economic modeling imposes a government budget constraint, which implicitly requires an assumption of offsetting policies. Changes in lump-sum taxes or transfers are often used for this purpose in academic contexts. Such an approach is not appropriate in a policy setting, however, and the absence of a compelling alternative is at the heart of this paper, as well as debates about the relative merits of conventional and dynamic scoring in general.

[4]For an application of this conceptual framework to the cost-benefit analysis of tax regulations, see Leiserson and Looney (2018).

[5]It is the individual or household-specific estimates of the fixed-quantities change in tax underlying the distribution analysis that are sufficient for welfare analysis. These estimates could be presented in any fashion and need not be summarized by income as in the common practice, as noted in footnote 2 above.

and the aggregate change in tax shown in a distribution analysis will not necessarily be the same.[6] It is the mismatch between these two aggregates that reflects the role of the excess burden of taxation in the economic analysis of tax changes. In addition to clarifying these relationships in a benchmark model using competitive assumptions, I present a series of extensions exploring various models with market failures that demonstrates the power and flexibility of the proposed approach for understanding the impact of tax changes.

Second, this analysis clarifies the relationship between the results of macroeconomic analysis and distribution analysis of tax changes. Macroeconomic analyses yield estimates of price and quantity changes that result from tax legislation. Fixed-quantities distribution analysis provides an estimate of the utility impact of proposed tax legislation relying on incidence assumptions that reflect implicit assumptions about price changes. Thus, the key connection between macroeconomic analysis and distribution analysis is the price changes of the former and the incidence assumptions of the latter. Implicit incidence assumptions for macroeconomic analyses can be computed using estimates of the impact of the legislation on prices, baseline quantities, and the fixed-quantities change in tax. Notably, the macroeconomic analysis itself does not provide information about welfare impacts beyond those already reflected in the revenue and distribution analysis.

Finally, this paper makes several recommendations for methodological changes in the conduct of distribution analysis. The approaches to distribution analysis taken by the Joint Committee on Taxation, the U.S. Treasury, and the Tax Policy Center are closely related to distribution analysis under the fixed-quantities approach, but the methods used by each organization differ in at least some respects. The fixed-quantities approach has four major implications for practice that differ from current practice for at least one organization. First, under the fixed-quantities approach, distribution analysis should be conducted for a specific year and follow the policy regime as it will be in place in that year. Second, the incidence assumptions used in distribution analysis should vary over time, consistent with the rate at which prices change following enactment of the legislation. Third, the total change in tax distributed under the fixed-quantities approach should ignore quantity changes but reflect the impact of relative price changes on tax bases and thus revenues.[7] In the case of payroll and excise tax changes, this means the income tax offset should be distributed.[8] Fourth,

[6]The distinction between an analysis that excludes quantity changes and one that includes quantity changes is not parallel to the distinction between conventional and dynamic revenue estimates, as conventional revenue estimates reflect some but not all quantity changes. For this reason, the aggregate tax change in a conventional revenue estimate will not necessarily match the aggregate tax change in a distribution analysis either.

[7]Under the fixed-quantities approach, the aggregate change in tax distributed should not reflect changes in quantities in most cases as they have no impact on welfare. However, it is appropriate to include changes in quantities that do have a direct effect on welfare, which can occur when the benchmark assumptions are violated. For example, distribution analyses typically reflect changes in tax that result when filers switch from claiming the standard deduction to itemizing their deductions. More broadly, stroke-of-the-pen changes that require nothing other than changes in how forms are completed, low-cost labeling responses (shifting one type of income or expense to another), and other similar responses should be included.

[8]The income tax offset to excise and payroll taxes is a technical adjustment made in estimating the revenue impact of excise and employer-side payroll tax changes (Joint Committee on Taxation 2011). As described in Sheiner (1994), the offset reflects the sensitivity of federal deficits to changes in prices.

distribution analysis under the fixed-quantities approach should reflect the role of deficits in determining the incidence of tax changes, including, for example, any impact of changes in deficits on interest rates.

Applied to the Tax Cuts and Jobs Act, this approach to welfare analysis would offer modestly different quantitative results and a much clearer understanding of the tradeoffs involved. Fixed-quantities distribution analyses of the legislation likely would have shown a somewhat larger and somewhat more regressive tax cut. Analysis from both the Joint Committee on Taxation and the Tax Policy Center distributed the conventional revenue estimate for the corporate tax changes rather than the fixed-quantities change in tax and thus likely understated the size of the tax cut (Joint Committee on Taxation 2017*a*; TPC Staff 2017). More radically, the welfare-based framework of this paper clarifies that this tax cut is the economic benefit of the legislation. Growth, a change in quantities, provides no additional benefit not already reflected in a revenue estimate and fixed-quantities distribution analysis. The common suggestion that growth delivers additional welfare gains is deceptive. Moreover, just as the tax cut is the economic benefit of the legislation, the fiscal cost is its economic cost. The Tax Cuts and Jobs Act was a large regressive tax cut with a large fiscal cost. Proponents of the legislation presumably judge that regressive tax cut to be a cost-effective policy delivering tax cuts to deserving recipients. Opponents presumably do not.

As this example makes clear, the common framing of tax analysis around the revenue, distribution, and economic effects of tax legislation risks misleading policymakers and the public. The revenue and burden impacts of tax legislation shown in a revenue estimate and distribution analysis are the economic effects of the legislation. Macroeconomic analysis underlies the two but is no different in kind than the behavioral assumptions used to construct a conventional revenue estimate or the incidence assumptions underlying a distribution analysis. Indeed, direct examination of the impacts of tax legislation on output or other macroeconomic quantities may encourage incorrect welfare analysis by double-counting welfare-relevant gains or ignoring welfare-relevant costs. Moreover, the informational content of distribution analysis is often underappreciated. Distribution analysis matters not only for what it shows about the relative benefits and costs of tax legislation for different groups but also for what it shows about the absolute level of benefits and costs for each group.[9]

The primary purpose of taxation is raising revenues. Put differently, the tax system is a means of transferring resources from households to the government. Economic analysis of tax changes that is to provide useful insight must therefore center the role of this transfer. Tax changes raise revenues by imposing burden or reduce burden at the expense of revenues. Modes of analysis that deemphasize transfers are

[9]In placing distribution analysis at the center of the evaluation of tax changes, the perspective advanced in this paper also creates a bridge to critical tax theory (Infanti and Crawford 2009). Direct inspection of the distribution of benefits conferred by the tax code on different groups, as in Brown (1997), is a form of distribution analysis. That said, the proposal set forth here remains firmly within a welfarist paradigm, which many critical tax theory analyses would find limiting.

ill-suited to evaluating changes in a policy regime that exists to conduct transfers. This limitation of other modes of analysis is clearest when tax legislation increases or decreases the deficit, as tax legislation often does. In these cases, analytic frameworks such as the equity-efficiency tradeoff or analytic quantities such as deadweight loss rely on assumptions about hypothetical lump-sum offsets or other auxiliary policies. As noted above, analyses relying on such assumptions are necessary to illustrate the true tradeoffs of tax policy and can be useful for that reason, but it is imperative that such analyses be clearly distinguished from analyses of the legislation itself. As they rely on auxiliary policies, conclusions reached in these frameworks cannot justify tax changes that increase or decrease the deficit. In contrast, analysis that centers the impact of tax changes on revenues and burden provides useful insight even when tax legislation increases or decreases the deficit. Moreover, when tax legislation does not affect the deficit, a distribution analysis still provides a clear and transparent assessment of the impacts of the legislation on families across the income distribution that is far more detailed than summary statements about equity and efficiency.

Aspects of the approach to distribution analysis set forth in this paper are implicit or explicit in previous work, largely conducted by economists at the U.S. Treasury and the congressional Joint Committee on Taxation.[10] Notably, however, past work is not always indicative of current practice at the same agencies as methodological innovations have occasionally been developed and then discarded. Joint Committee on Taxation (1993) demonstrates the advantages of excluding changes in tax liability attributable to changes in behavior when distributing tax changes. Though not the focus of the paper, Cronin (1999) argues that excise tax offsets should be reflected in distribution analysis. Cronin et al. (2012) and Joint Committee on Taxation (2013) present closely related methods for distributing taxes on business income that allocate a share of such taxes to labor income and a share to capital income consistent with relative price changes. Horowitz et al. (2017) document an approach to conducting distribution analysis of a carbon tax that incorporates two roles for price changes: (1) the excise tax offset and (2) relative price effects associated with differential consumption of carbon-intensive goods and services across the income distribution.[11]

In a prior attempt to reconcile macroeconomic and distribution analysis of tax changes, Elmendorf et al. (2008) conduct what they term a dynamic distributional analysis of the 2001 and 2003 tax cuts. The authors' dynamic distributional analysis is a welfare analysis completed under the assumption that lump-sum taxes are used to offset the fiscal cost of the legislation. However, this assumption necessarily makes the analysis one not of the 2001 and 2003 tax cuts as enacted, but a hypothetical balanced-budget version of those tax cuts. In contrast, this paper focuses on methods suitable for the evaluation of polices as proposed

[10] More concretely, this paper is an expansion of the argument in Furman (2016) and Leiserson (2017).

[11] Saez and Zucman (2019) distinguish between the analysis of the existing tax burden and the analysis of tax changes and, in a sharp departure from existing methodologies, argue that the latter—the subject of this paper—should estimate changes in incomes rather than welfare. However, such an approach cannot be used as the basis for cost-benefit analysis or welfare analysis and thus risks misleading policymakers and the public as to the advantages and disadvantages of proposed reforms.

by legislators without hypothetical offsets, an essential feature of analysis to be used in the policymaking process.

The framework set forth here is closely related to the marginal value of public funds (MVPF) analysis of Hendren (2016; 2019) and Hendren and Sprung-Keyser (2020). The MVPF for a policy is the ratio of the economic benefit of the policy, evaluated using the envelope theorem, to the economic cost, inclusive of behavioral responses that affect the government budget.[12] In the case of a tax cut, distribution analysis can be understood as the benefit of the policy—reported in a disaggregate manner—and the revenue estimate can be understood as the cost of the policy. In the case of a tax increase, the roles are reversed. Just as the MVPF allows for welfare analysis of generic public policy interventions, the combination of a distribution analysis and revenue estimate allows for a welfare analysis of tax changes. A notable difference between the analysis of Hendren (2019) and this analysis, however, is that this approach emphasizes the importance of reporting disaggregate results to avoid any reliance on implicit assumptions about alternative policies with similar distributional incidence or the merits of redistribution, an issue that is especially relevant in the context of complex tax legislation that has numerous provisions and affects different groups in different ways.

Finally, the perspective advanced in this paper contrasts with prior work that places little emphasis on deficits or political economy.[13] For purposes of informing the policymaking process, the ability to evaluate tax changes that increase or decrease the deficit and an appreciation of political economy are essential. Policies that increase or decrease the deficit affect the financial resources available to future policymakers without any indication of how future policies will change as a result. A reasoned assessment of how future policymakers will respond, whether through action or induced inaction, is thus a necessary ingredient in an economically grounded assessment of a proposed deficit-increasing or deficit-reducing policy. Questions of political economy cannot be avoided. As noted above, a distribution analysis of a proposed policy combined with auxiliary policies that deliver budget balance can play an important role in this assessment, but political judgment is necessary in determining which auxiliary policies to include. In contrast to prior work that sets these issues to the side and thus provides little guidance in evaluating fiscally unbalanced policies, the analytic perspective set forth in this paper facilitates the analysis of both fiscally unbalanced policies and fiscally balanced alternatives.

The remainder of this paper proceeds as follows. Section two derives the fixed-quantities change in tax as a measure of the utility impact of a tax change in a labor supply model with fixed wages and explains

[12] Implicitly, Hendren (2019) turns non-balanced budget policy changes into balanced-budget policy changes by comparing them to a tax change with the same distributional incidence. In doing so, Hendren sidesteps the question of how to deal with policies that increase or decrease the deficit.

[13] Examples include Hendren (2016; 2019), Kaplow (2008; 2020), Slemrod and Yitzhaki (2001), and the benchmark conclusions of optimal tax theory.

the role the government budget plays in the analysis. Section three derives the same result in more general competitive models. Section four considers a series of alternative models in which the benchmark result fails and illustrates the types of adjustments that would be required to estimate the utility impact of tax changes in these settings. Section five discusses the implications of the conceptual framework proposed in this paper for conducting distribution analysis. Section six concludes.

2 Welfare Analysis of Tax Changes in a Labor Supply Model with Fixed Wages

A simple labor supply model suffices to illustrate the basic points motivating the fixed-quantities change in tax as a utility measure. I first lay out the model and derive equations for the utility impact of a tax change. I then show the role of the government's budget constraint and the implications of imposing budget balance. Next, I consider a two-period version of the model to show how the result applies in the case of fiscally unbalanced policies. Finally, I relate the fixed-quantities change in tax to the traditional partial equilibrium analysis of tax incidence.

2.1 A labor supply model with fixed prices

The basic fixed-quantities result is a direct application of the envelope theorem. Assume that there are N workers with utility $u^i(c_i, l_i)$ who earn wage w_i. Labor earnings are subject to tax at rate τ. The workers' behavior is described by the maximization problem

$$\max_{c_i, l_i} \quad u^i(c_i, l_i) \quad s.t. \quad c_i \leq (1-\tau) w_i l_i. \tag{2.1}$$

Denote the indirect utility of worker i by $V^i(w_i, \tau)$. The workers' choices for consumption and labor must satisfy the relationship $u_c^i(1-\tau) w_i + u_l^i = 0$, and thus the impact of a change in the tax rate on utility for worker i is:

$$\frac{\partial V^i}{\partial \tau} = -u_c^i w_i l_i + \left[u_c^i (1-\tau) w_i + u_l^i\right] \frac{\partial l_i}{\partial \tau} = -u_c^i w_i l_i. \tag{2.2}$$

Normalizing the utility impact by the marginal utility of consumption yields

$$\frac{1}{u_c^i} \frac{\partial V^i}{\partial \tau} = -w_i l_i. \tag{2.3}$$

The revenues collected by the government from worker i are $\tau w_i l_i$. The impact of a change in the tax rate on the revenues collected from worker i is thus

$$\frac{\partial R_i}{\partial \tau} = w_i l_i + \tau w_i \frac{\partial l_i}{\partial \tau}. \tag{2.4}$$

The first term in this expression is the change in revenues resulting from the change in the tax rate at baseline quantities and prices, and the second term is the change in revenues resulting from a change in quantities at the baseline prices and tax rates. Define the fixed-quantities change in tax as

$$\left.\frac{\partial R_i}{\partial \tau}\right|_{q_0} = w_i l_i. \tag{2.5}$$

Then

$$\frac{1}{u_c^i}\frac{\partial V^i}{\partial \tau} = -\left.\frac{\partial R_i}{\partial \tau}\right|_{q_0}. \tag{2.6}$$

The impact of a change in the tax rate on utility is the fixed-quantities change in tax multiplied by the marginal utility of consumption. The essential ingredient in a welfare analysis is thus an estimate of the fixed-quantities change in tax in dollars.

This relationship between the fixed-quantities change in tax and the utility impact is an application of the envelope theorem. The value to the worker of a slight increase in consumption from working more (less) is exactly offset by the cost of working slightly more (less). As a result, the utility impact does not depend on the behavioral response to the policy change. In other words, changes in quantities are not directly relevant for the impact of the change in tax policy on well-being—it is the effect of the tax change on incomes through the worker's budget constraint that matters.[14]

Aggregation of utility impacts across people requires taking a stance on the relative merits of a dollar in the hands of two different families. Distribution analysis providing dollar changes in tax allows users to evaluate the impact on different families using the redistributive preferences of their choice. However, it may be reasonable to proxy for marginal utility using the inverse of after-tax income. Doing so yields the widely used percent change in after-tax income as a measure of the utility impact of a tax change.

[14]One alternative interpretation of distribution tables is that they reflect the change in disposable incomes resulting from a tax change excluding behavior. The key observation of this paper is that this change in disposable incomes is the relevant impact for utility by virtue of the envelope theorem. Nonetheless, the income-based interpretation remains valid under benchmark assumptions, and offers a clear intuition.

2.2 The government's fiscal balance

Changes in quantities are irrelevant for utility, but they do matter for government revenues. The impact of a change in the tax rate on total government revenues in this simple labor supply model is

$$\frac{\partial R}{\partial \tau} = \sum_i w_i l_i + \sum_i \tau w_i \frac{\partial l_i}{\partial \tau} = \left.\frac{\partial R}{\partial \tau}\right|_{q_0} + \sum_i \tau w_i \frac{\partial l_i}{\partial \tau}. \tag{2.7}$$

Changes in quantities can partially offset the fixed-quantities cost of a tax reduction, but there are no further benefits to the public. The reduction in the fiscal impact is the benefit of the additional economic activity. Similarly, changes in quantities can partially offset the fixed-quantities revenue gains of a tax increase, but there are no further costs to the public. The reduction in the revenue raised is the cost of reduced economic activity.[15] Moreover, the reduction in the fixed-quantities cost of a tax cut or the reduction in the fixed-quantities revenue raised by a tax increase is far less than the change in quantities. In this stylized setting, the change in output is $\sum_i w_i \frac{\partial l_i}{\partial \tau}$ but the fiscal impact is only $\sum_i \tau w_i \frac{\partial l_i}{\partial \tau}$. At a 33 percent marginal tax rate, for example, the increase in output would be three times the gain in government revenues.

Next, suppose—contrary to the analysis of the prior section—that all revenues from the labor tax are rebated lump-sum to the workers. Utility for worker i is then $u^i\left((1-\tau)\, w_i l_i + T, l_i\right)$ where T is the rebate, and the impact of a change in the tax rate on the utility of worker i is

$$\frac{1}{u_c^i}\frac{\partial V^i}{\partial \tau} = -\left.\frac{\partial R_i}{\partial \tau}\right|_{q_0} + \frac{1}{N}\left(\frac{\sum_i \left.\frac{\partial R_i}{\partial \tau}\right|_{q_0} + \sum_i \tau w_i \frac{\partial l_i}{\partial \tau}}{1 - \frac{1}{N}\sum_i \tau w_i \frac{\partial l_i}{\partial T}}\right) = -\left.\frac{\partial R_i}{\partial \tau}\right|_{q_0} - \left.\frac{\partial R_i}{\partial T}\right|_{q_0} \times \frac{\mathrm{d}T}{\mathrm{d}\tau}. \tag{2.8}$$

The impact of a change in the labor tax rate on worker i's utility depends on the fixed-quantities tax change for worker i, the fixed-quantities tax change for all workers, and the change in quantities that results from the tax changes. This result might seem to suggest that the fixed-quantities tax change is not the key analytic object, but, in fact, this more complex quantity is the fixed-quantities tax change for the combined policy of a change in the labor tax rate and a change in the lump-sum tax. The result that what matters for utility is the fixed-quantities tax change continues to hold. Policymakers' decision to combine the change in the labor tax rate with an automatic change in the lump-sum tax causes the impact of changes in behavior resulting from the change in the labor tax rate to pass directly to the workers. This result also highlights that it is policymakers' choices about taxes and spending that determine how the fiscal feedback of a change in quantities is distributed among the public.

[15] It is theoretically possible for the behavioral change to more than offset the revenue cost of a tax cut or revenue gain of tax increase. However, such an outcome is unlikely in practice and I do not focus on that case in this paper.

2.3 Unbalanced fiscal policies

In practice, the government need not balance the budget in any period. To illustrate the consequences of deficits resulting from fiscally unbalanced tax changes, consider a two-period model with a single worker. The worker solves the problem:

$$\max \quad u\left(c_1, l_1\right) + \beta u\left(c_2, l_2\right) \quad s.t. \quad \left(1-\tau_1\right) w_1 l_1 + \frac{1}{1+r}\left(1-\tau_2\right) w_2 l_2 + T_1 + \frac{1}{1+r} T_2 \geq c_1 + \frac{1}{1+r} c_2, \tag{2.9}$$

where c_i and l_i denote consumption and labor in period i, β is the discount rate, r is the interest rate, τ_i is the labor tax rate in period i, and T_i is the lump-sum rebate in period i. Consider a change in the first-period labor tax rate. Applying the envelope theorem directly yields

$$\frac{\partial V}{\partial \tau_1} = \lambda \frac{\partial g}{\partial \tau_1}, \tag{2.10}$$

where V is indirect utility, λ is the lagrange multiplier on the household budget constraint, and g is the household budget constraint. This result is the analog of the results in the previous sections. The impact of the change in tax rates on utility is the fixed-quantities tax change multiplied by the marginal utility of income.

However, if there is a long-term government budget constraint, a change in τ_1 requires a change in some other tax parameter. Suppose unbalanced fiscal policy can be modeled as a change in τ_1 offset by a change in one of the two tax instruments in the second period, either T_2 or τ_2. Take T_2 first. For simplicity, assume r is fixed, though this is not required for the result. Then

$$\frac{\partial V}{\partial \tau_1} = \lambda \frac{\partial g}{\partial \tau_1} + \lambda \frac{\partial g}{\partial T_2} \frac{\mathrm{d}T_2}{\mathrm{d}\tau_1}. \tag{2.11}$$

The government budget constraint is

$$\left(1+r\right) \tau_1 w_1 l_1 + \tau_2 w_2 l_2 - \left(1+r\right) T_1 - T_2 = 0, \tag{2.12}$$

and thus by the implicit function theorem

$$\frac{\mathrm{d}T_2}{\mathrm{d}\tau_1} = \frac{\left(1+r\right) w_1 l_1 + \left(1+r\right) \tau_1 w_1 \frac{\partial l_1}{\partial \tau_1} + \tau_2 w_2 \frac{\partial l_2}{\partial \tau_1}}{1 - \left(1+r\right) \tau_1 w_1 \frac{\partial l_1}{\partial T_2} - \tau_2 w_2 \frac{\partial l_2}{\partial T_2}}. \tag{2.13}$$

Computing the other derivatives directly yields

$$\frac{\partial g}{\partial \tau_1} = -w_1 l_1 \tag{2.14}$$

$$\frac{\partial g}{\partial T_2} = \frac{1}{1+r}, \tag{2.15}$$

and thus

$$\frac{1}{\lambda}\frac{\partial V}{\partial \tau_1} = -w_1 l_1 + \frac{w_1 l_1 + \tau_1 w_1 \frac{\partial l_1}{\partial \tau_1} + \frac{1}{1+r}\tau_2 w_2 \frac{\partial l_2}{\partial \tau_1}}{1 - (1+r)\,\tau_1 w_1 \frac{\partial l_1}{\partial T_2} - \tau_2 w_2 \frac{\partial l_2}{\partial T_2}}. \tag{2.16}$$

This result parallels the result of section 2.2 for the scenario in which all labor tax revenues are immediately rebated to the public. The utility impact of a balanced-budget tax swap depends on the impact of the swap on behavior through the impact of that behavior on the government budget. However, the expression in equation 2.16 is only valid if a reduction in the labor tax rate in the first period is offset with a change in the lump-sum tax in the second period. If policymakers change the labor tax rate in period one without specifying a change in the lump-sum tax rate in period two there is little reason to privilege this policy experiment over all other potential policy experiments.

Even without making assumptions about future policy changes, however, examining the period by period fixed-quantities tax change yields a useful and transparent quantity of substantial economic interest. Denote the tax payment in period one by t_1 and the tax payment in period two by t_2. The fixed-quantities change in tax on a period-by-period basis is

$$\left.\frac{\partial t_1}{\partial \tau_1}\right|_{q_0} = -w_1 l_1 \tag{2.17}$$

$$\left.\frac{\partial t_2}{\partial \tau_1}\right|_{q_0} = \frac{\mathrm{d}T_2}{\mathrm{d}\tau_1}. \tag{2.18}$$

The present-value change in utility can thus be written as

$$\frac{1}{\lambda}\frac{\partial V}{\partial \tau_1} = \left.\frac{\partial t_1}{\partial \tau_1}\right| + \frac{1}{1+r}\left.\frac{\partial t_2}{\partial \tau_1}\right|_{q_0}. \tag{2.19}$$

In other words, the present-value utility impact is the discounted sum of the fixed-quantities change in tax for each period. While the fixed-quantities change in tax in period one overstates the long-run gain from a tax cut and the long-run cost of a tax increase, it remains an informative quantity. Moreover, it is the only element of the lifetime impact that can be measured without assuming future policy changes. Thus, while the multi-period model generates an ambiguity in the timing of consumption and period utility flows, the

period-by-period tax change can be interpreted as the period-specific impact of tax legislation relevant for lifetime utility.

An important difference in interpretation between the fixed-quantities change in tax in the single period model of section 2.1 and this more complex formula in the two-period model is that the required normalization in the two-period model depends on the lifetime marginal utility of consumption. Under this interpretation, normalization by the current period after-tax income makes less sense than it does in the one period model.[16]

Next, assume that a change in τ_1 is offset by a change in τ_2 rather than a change in T_2. The change in utility is

$$\frac{1}{\lambda}\frac{\partial V}{\partial \tau_1} = \frac{\partial g}{\partial \tau_1} + \frac{\partial g}{\partial \tau_2}\frac{\mathrm{d}\tau_2}{\mathrm{d}\tau_1} = -w_1 l_1 + w_2 l_2 \left(\frac{w_1 l_1 + \tau_1 w_1 \frac{\partial l_1}{\partial \tau_1} + \frac{1}{1+r}\tau_2 w_2 \frac{\partial l_2}{\partial \tau_1}}{w_2 l_2 + (1+r)\,\tau_1 w_1 \frac{\partial l_1}{\partial \tau_2} + \tau_2 w_2 \frac{\partial l_2}{\partial \tau_2}} \right). \tag{2.20}$$

The difference between equation 2.16 and 2.20 highlights the role of future policies in determining the overall utility impact. In the lump-sum case, any reduction in the labor tax rate in the first period—provided labor supply was not completely inelastic—increased utility because it was replaced with a lump-sum tax. However, in this case, there is no guarantee that a reduction in the distortionary tax in the first period delivers a utility gain. Replacing one distortionary tax with another distortionary tax may increase or decrease lifetime utility.

Importantly, however, the period-by-period fixed-quantities change in tax retains the same compelling interpretation, notwithstanding the change in policies. For a change in the labor tax rate in the first period offset by a change in the labor tax rate in the second period, the period-by-period change in tax can be expressed as

$$\left.\frac{\partial t_1}{\partial \tau_1}\right|_{q_0} = -w_1 l_1 \tag{2.21}$$

$$\left.\frac{\partial t_2}{\partial \tau_1}\right|_{q_0} = -w_2 l_2 \frac{\mathrm{d}\tau_2}{\mathrm{d}\tau_1}, \tag{2.22}$$

and the present value utility effect can again be expressed as the discounted sum of these tax changes:

$$\frac{1}{\lambda}\frac{\partial V}{\partial \tau_1} = \left.\frac{\partial t_1}{\partial \tau_1}\right|_{q_0} + \frac{1}{1+r}\left.\frac{\partial t_2}{\partial \tau_1}\right|_{q_0}. \tag{2.23}$$

Thus, it remains the case that the fixed-quantities change in tax in the first period provides an ingredient relevant for estimating the impact on lifetime utility, and the other ingredients in the calculation depend on

[16] Notably, if there are binding constraints on an agent's ability to borrow or save, the weighting of the period-specific tax changes in the present value would change as well. This source of additional complexity emphasizes the value of separately reporting the impacts in each period rather than attempting to summarize impacts in present value.

future policies that have yet to be enacted.

The presentation above assumes that it is known in advance how the government budget constraint will be satisfied. In practice, of course, Congress can enact legislation that increases or decreases the deficit without any guarantee of how future policy will respond. It thus becomes an important subject of theoretical and empirical investigation what the short and medium-term practical impacts of changes in the deficit are. The simple model of this section assumes that wages are fixed and labor supply is freely chosen, so there are no economic effects of changes in deficits and debt. For the same reason, there is no reason to collect taxes independent of the assumed budget constraint. The more general model of the next section relaxes the fixed-prices assumption, and thus deficits can have economic effects through their impact on prices.

While the feedback from deficits to interest rates is the channel through which deficit impacts are typically reflected in scoring legislation, this is not the only way the economic effects of deficits can appear. For example, the literature on the fiscal theory of the price level considers the possibility that prices may adjust when the government violates the government budget constraint. There is a fundamental tension between the conceptual foundation for scoring—which assumes no future changes in federal policy—and the economic evaluation of policies that change the long-run deficit outlook. A full resolution of this issue is beyond the scope of this paper. Nonetheless, distribution analysis provides a tractable mode of analysis that provides critical information about the utility impacts of proposed tax legislation to policymakers even without resolving these issues.

2.4 The traditional partial equilibrium presentation

The traditional introduction to tax incidence relies on a graphical supply and demand analysis. This section presents such an analysis for the simple labor supply model above. In doing so, it highlights four points. First, the basic idea of the fixed-quantities change in tax is apparent in the supply and demand presentation. As the algebraic analysis and the graphical analysis simply offer two different perspectives on the same underlying economic model, this is to be expected. Second, the graphical analysis is not well-suited to evaluating tax legislation with different impacts on different people, a major limitation in using it to evaluate policy changes. Third, to the extent the graphical analysis encourages the use of intuition developed from market-level analysis of large tax changes in policy contexts, it may offer poor guidance in thinking about realistic policy changes in the policy context. Finally, the algebraic analysis provides a stronger foundation for thinking about the extensions beyond the case of perfect competition.

Consider the impact of a modest reduction in the labor income tax rate assuming the demand for labor is infinitely elastic (Figure 1). The drop in the labor tax rates from t_1 to t_2 increases the quantity of labor

supplied from Q_1 to Q_2, and the net wage increases from $(1-t_1)\,w$ to $(1-t_2)\,w$. The revenue raised by the tax falls by the reduction in the tax rate multiplied by the wage and the original quantity of labor (rectangle ABCD in blue), but increases by the new tax rate multiplied by the wage and the increase in the quantity of labor (rectangle DEFG in red). The worker's surplus increases by the reduction in the original tax rate multiplied by the original quantity (rectangle ABCD) plus the area below the new net wage and above the supply curve between the original quantity and the new quantity (triangle CDE).

This presentation yields the same results as the algebraic analysis in previous sections. The gains to the worker are given by trapezoid ABCE, the overwhelming majority of which is the reduction in tax at the original quantity (rectangle ABCD). This result corresponds to the conclusion that the utility gain from a reduction in tax is well-approximated by the fixed-quantities change in tax. Second, the increase in government revenues from the change in quantities (rectangle DEFG) accounts for the overwhelming majority of the reduction in excess burden (trapezoid CEFG). This result corresponds to the observation of the previous two sections that the behavioral response matters in assessing the fiscal impact, not the utility impact. In the limiting case of a differential tax change, the fixed-quantities change in tax is exactly equal to the change in worker surplus and the change in excess burden is entirely reflected in an offsetting increase in revenues. Lastly, the increase in output (rectangle FGHI) far exceeds the social gain of increased work (trapezoid CEFG).

Now consider a comparison of a labor market with no tax and a labor market with an income tax (Figure 2). The revenue raised by the tax is $t_1 Q_1$. The triangle CDE is the excess burden of the tax. Relative to the scenario with the tax, repealing the tax entirely increases the quantity of labor supplied from Q_1 to Q_0. The worker benefits by the elimination of the tax paid (rectangle ABCD) and the increase in surplus resulting from the increase in hours worked (triangle CDE). There is no gain to employers because of the assumption of an infinitely elastic demand curve.

This figure illustrates the lessons typically drawn from partial equilibrium tax incidence. First, taxes impose excess burden. The total burden of the tax exceeds the revenue raised by the tax. Second, the economic incidence of the tax is determined by the price changes that result from the tax, not the legal obligation to pay the tax. In this analysis, the worker bears the burden of the tax because the gross wage is fixed and the net wage falls. However, had labor demand been less than infinitely elastic a portion of the burden would have been shifted to the employer.

The intuitions offered by this analysis can be misleading when used to evaluate real-world policy changes. First, in the case of a tax cut, the analysis suggests gains to the public on top of the tax cut. But this result depends critically on the fact that the tax change is large. In the case of a tax increase, it suggests losses on top of the observed tax increase, but this conclusion assumes the tax increase is measured at post-reform

Figure 1: Supply and Demand Analysis of a Small Tax Change

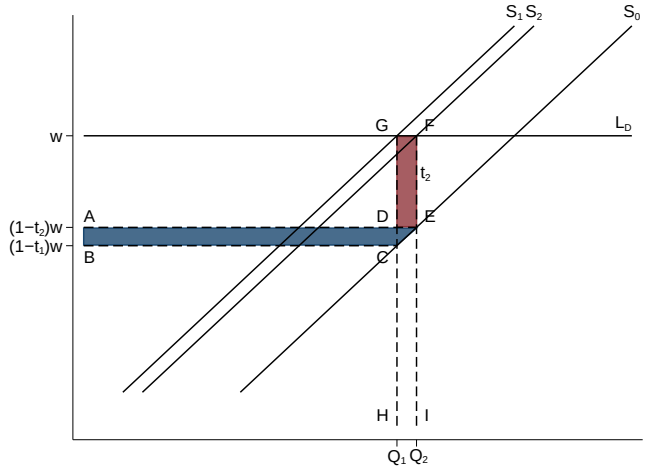
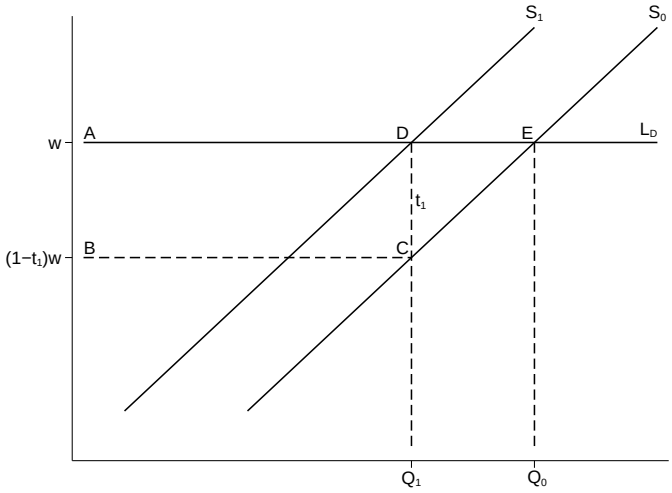


Figure 2: Supply and Demand for Labor with a Labor Income Tax



income levels when such increases are typically measured at pre-reform levels. Given this practice, utility losses will typically be smaller than the proposed tax increase. Second, the analysis suggests that repealing the tax offers a free lunch. However, the hypothetical underlying this free lunch requires either offsetting lump-sum tax changes that are not shown or changes in spending policy elsewhere, the impacts of which will almost certainly have disparate effects on different people.

3 Welfare Analysis of Tax Changes in Competitive Models

The prior section shows that the fixed-quantities change in tax approximates the utility impact of a tax change in a simple labor supply model with fixed wages. This section extends the analysis to more general

competitive models with variable prices and demonstrates that the same basic conclusion holds. However, with variable prices, the economic incidence of a tax change can differ from the statutory incidence of a tax change. Importantly, price changes only reallocate income between groups and do not change the aggregate effect on incomes except to the extent they affect deficits, such as by shifting income between tax bases that are taxed at different rates. When price changes are substantial, the resulting reallocation of income can cause the true utility impacts of a policy change to differ substantially from what those impacts would appear to be assuming fixed prices. The incidence assumptions used in distribution analysis can be understood as assumptions about the price changes that would result from proposed tax changes.

3.1 A general competitive model

The validity of the fixed-quantities change in tax as an approximation of the utility impact of a tax change is an application of the envelope theorem. Thus, if an envelope theorem applies in a general competitive model, the fixed-quantities change in tax will continue to have this interpretation. In general, an envelope theorem will apply when the behavior of economic actors can be represented as the solution of a suitably well-behaved maximization problem. Consider an agent's optimization problem of the form

$$V^i\left(p\left(\eta\right),\eta\right)=\max_{x_i} f^i\left(x_i\right) \quad s.t. \quad g^i\left(x_i,p\left(\eta\right),\eta\right)\geq 0 \tag{3.1}$$

where f is a utility function, g the household budget constraint, x a vector of choice variables, p a set of prices, and η a set of parameters determining the tax system. If all prices are taken as fixed, this would be a standard consumer problem. The distinct feature of this paper is the assumption that the prices are assumed to be functions of the tax system but the specification of that relationship is placed outside the scope of the model. (An implicit relationship between the tax system and prices would, of course, arise in any partial or general equilibrium model.) Thus, when applying the envelope theorem, the derivative of the budget constraint with respect to the parameter η must include the impact of η on prices. The validity of the application of the envelope theorem in this setting depends on an assumption that these derivatives exist. I do not explore in this paper the conditions under which equilibrium prices are differentiable functions of the tax rate, but rather focus on evaluating the utility impact of tax changes under the assumption that such a relationship exists.[17]

The dollar-valued utility impact of a tax change in this framework is

[17]The existence of price derivatives is necessary but not sufficient for the result. It is highlighted here because it is a non-standard assumption.

$$\frac{1}{\lambda_i}\frac{\partial V^i}{\partial \eta} = \frac{\partial g^i}{\partial p}\frac{\partial p}{\partial \eta} + \frac{\partial g^i}{\partial \eta}. \tag{3.2}$$

The fixed-quantities change in tax is again the key quantity in assessing the utility impacts of a potential tax change on the public. However, in this more general setting, the derivative of the budget constraint for agent i depends not only on the direct impact of η on the tax system, but also the impact of that change in the tax system on prices. This dependence is what causes the economic incidence of tax changes to differ from the statutory incidence of tax changes.

Price changes reallocate the utility impact of tax changes across agents, but they affect the aggregate dollar-valued utility impact only to the extent they affect government deficits. The aggregate dollar-valued utility impact is the sum across agents of the impact of the tax change on the budget constraint both directly and via prices:

$$\sum_i \frac{1}{\lambda_i}\frac{\partial V^i}{\partial \eta} = \sum_i \left[\frac{\partial g^i}{\partial p}\frac{\partial p}{\partial \eta} + \frac{\partial g^i}{\partial \eta}\right]. \tag{3.3}$$

Provided the choice set is the same for all i, then the set of variables held constant in the differentiation in the application of the envelope theorem is the same for all i and

$$\sum_i \frac{1}{\lambda_i}\frac{\partial V^i}{\partial \eta} = \frac{\partial \left(\sum_i g^i\right)}{\partial p}\frac{\partial p}{\partial \eta} + \frac{\partial \left(\sum_i g^i\right)}{\partial \eta}. \tag{3.4}$$

The sum of the budget constraint over all non-governmental actors is equal to the government budget deficit.[18] Thus, denoting the deficit by D,

$$\sum_i \frac{1}{\lambda_i}\frac{\partial V^i}{\partial \eta} = \frac{\partial D}{\partial p}\frac{\partial p}{\partial \eta} + \frac{\partial D}{\partial \eta}. \tag{3.5}$$

The aggregate dollar-valued utility impact is the direct impact of the tax change on the deficit, $\frac{\partial D}{\partial \eta}$, plus the impact of changes in prices induced by the tax change on the deficit, $\frac{\partial D}{\partial p}\frac{\partial p}{\partial \eta}$. In other words, the aggregate utility impact is the impact on the deficit evaluated at fixed quantities while allowing prices to vary. Price changes matter for the aggregate utiltiy impact only to the extent they affect deficits, such as by shifting income across tax bases to which different tax rates apply or changing the interest rate on government debt. Otherwise, price changes merely reallocate income between different non-governmental agents.

The treatment of prices as being determined outside the model but in ways that depend on the tax system points to a fundamental incompleteness of the model. The model does not impose government budget balance, require market clearing, stipulate a fixed world price, or make any other assumption that would

[18] This claim assumes either a closed economy or includes foreign governments in the sum. I set aside state and local governments here for simplicity.

determine prices. As a result, this model allows for the consideration of the utility impact of tax changes under a range of assumptions about how prices change in response to tax changes. For purposes of motivating and interpreting distribution analysis—as well as for clarifying the source of disagreements between analysts offering different distribution analyses—specifying the model in this way offers clear advantages.

As in section 2.3, if the budget constraint can be expressed as a discounted sum, the impact of the tax change on utility in present value can be expressed as a discounted sum of period-by-period tax changes. If the analysis were extended to reflect uncertainty, the utility impact would be based on the expectation of all future period-by-period tax changes.

While the fixed-quantities change in tax does not directly depend on future policies, it does depend on expectations about future policies to the extent those expectations affect the impact of current legislation on prices. If deficit-increasing legislation is expected to result in an increase in interest rates over the next decade because no offsetting policy changes are expected to be enacted before that time, for example, then such price impacts would need to be incorporated into the analysis. Similarly, if deficit financing a business tax cut reduces or reverses positive wage impacts that could result from a financed business tax cut, these impacts would also need to be incorporated into the analysis.

Finally, nothing about this derivation changes the basic observation of section 2.2 that quantity changes do matter for assessing the impact of tax legislation on fiscal sustainability.

3.2 Two factors, two agents, and linear taxes

To illustrate the application of the general result, consider a stylized one-period economy with two factors of production, two agents, and linear taxes. Assume a constant returns to scale production function $F(k,l)$, where k is the capital stock. Assume that there exists a worker with utility function $u^w(c,l)$ and an investor with utility function $u^i(c,k)$. The assumption that the capital stock enters the utility function directly could be motivated by the idea that the investor can shift capital into the United States from other countries at some cost. The government imposes linear taxes τ_l and τ_k on labor and capital income respectively. Assume factor markets are competitive.

Applying the envelope theorem yields

$$\frac{1}{u_c^w}\frac{\partial V^w}{\partial \tau_l} = -wl + (1-\tau_l)\frac{\partial w}{\partial \tau_l}l \tag{3.6}$$

$$\frac{1}{u_c^i}\frac{\partial V^i}{\partial \tau_l} = (1-\tau_k)\frac{\partial r}{\partial \tau_l}k \tag{3.7}$$

$$\frac{1}{u_c^w}\frac{\partial V^w}{\partial \tau_k} = (1-\tau_l)\frac{\partial w}{\partial \tau_k}l \tag{3.8}$$

$$\frac{1}{u_c^i}\frac{\partial V^i}{\partial \tau_k} = -rk + (1-\tau_k)\frac{\partial r}{\partial \tau_k}k. \tag{3.9}$$

The wl and rk terms in equations 3.6 and 3.9 reflect the statutory incidence of a change in labor or capital taxation on the utility of the worker and the investor, respectively. The terms involving price changes in all four equations reflect the difference between statutory incidence and economic incidence. Changes in relative prices can shift the burden of a tax increase or the benefits of a tax cut from one actor to another. Put differently, the impact of a change in the tax rate on utility is the direct impact of that change on the agent bearing the statutory incidence of the tax adjusted for the change in prices that results. Note that the price changes that matter are measured on an after-tax basis. The dependence of the utiltiy impacts on after-tax prices is intuitive as the consumption of workers and investors depends on the after-tax returns to their activities. Finally, note that the right-hand side of each equation above is the derivative of each agent's budget constraint with respect to the change in the tax rate including the role of changing prices, as would be expected from the general result of the previous section.

The impact of a change in each tax rate on government revenues, $R = \tau_k rk + \tau_l wl$, is given by

$$\frac{\partial R}{\partial \tau_l} = wl + (\tau_l - \tau_k)\frac{\partial w}{\partial \tau_l}l + \left[\tau_k r\frac{\partial k}{\partial \tau_l} + \tau_l w\frac{\partial l}{\partial \tau_l}\right] \tag{3.10}$$

$$\frac{\partial R}{\partial \tau_k} = rk + (\tau_l - \tau_k)\frac{\partial w}{\partial \tau_k}l + \left[\tau_k r\frac{\partial k}{\partial \tau_k} + \tau_l w\frac{\partial l}{\partial \tau_k}\right]. \tag{3.11}$$

The first term in each of the revenue equations is the impact of a change in the tax rate on revenues assuming no change in prices or quantities. The second term is the impact of a change in prices on revenues assuming no change in quantities or tax rates. The third term is the impact of a change in quantities on revenues assuming no change in tax rates and prices.

Define the fixed-quantities change in tax to be the sum of the first two terms:

$$\left.\frac{\partial R}{\partial \tau_l}\right|_{q_0} = wl + (\tau_l - \tau_k)\frac{\partial w}{\partial \tau_l}l \tag{3.12}$$

$$\left.\frac{\partial R}{\partial \tau_k}\right|_{q_0} = rk + (\tau_l - \tau_k)\frac{\partial w}{\partial \tau_k}l. \tag{3.13}$$

Then the impact of the tax change on utility per unit of fixed-quantities tax change is

$$\frac{\frac{1}{u_c^w}\frac{\partial V^w}{\partial \tau_l}}{\left.\frac{\partial R}{\partial \tau_l}\right|_{q_0}} = -1 + \frac{(1-\tau_k)\frac{\partial w}{\partial \tau_l}l}{wl + (\tau_l - \tau_k)\frac{\partial w}{\partial \tau_l}l} \tag{3.14}$$

$$\frac{\frac{1}{u_c^i}\frac{\partial V^i}{\partial \tau_l}}{\left.\frac{\partial R}{\partial \tau_l}\right|_{q_0}} = \frac{-(1-\tau_k)\frac{\partial w}{\partial \tau_l}l}{wl + (\tau_l - \tau_k)\frac{\partial w}{\partial \tau_l}l} \tag{3.15}$$

$$\frac{\frac{1}{u_c^w}\frac{\partial V^w}{\partial \tau_k}}{\left.\frac{\partial R}{\partial \tau_k}\right|_{q_0}} = \frac{(1-\tau_l)\frac{\partial w}{\partial \tau_k}l}{rk + (\tau_l - \tau_k)\frac{\partial w}{\partial \tau_k}l} \tag{3.16}$$

$$\frac{\frac{1}{u_c^i}\frac{\partial V^i}{\partial \tau_k}}{\left.\frac{\partial R}{\partial \tau_k}\right|_{q_0}} = -1 - \frac{(1-\tau_l)\frac{\partial w}{\partial \tau_k}l}{rk + (\tau_l - \tau_k)\frac{\partial w}{\partial \tau_k}l}. \tag{3.17}$$

Summing the impact on the worker and investor for each tax change yields

$$\frac{1}{u_c^w}\frac{\partial V^w}{\partial \tau_l} + \frac{1}{u_c^i}\frac{\partial V^i}{\partial \tau_l} = -\left.\frac{\partial R}{\partial \tau_l}\right|_{q_0} \tag{3.18}$$

$$\frac{1}{u_c^w}\frac{\partial V^w}{\partial \tau_k} + \frac{1}{u_c^i}\frac{\partial V^i}{\partial \tau_k} = -\left.\frac{\partial R}{\partial \tau_k}\right|_{q_0}. \tag{3.19}$$

Thus, as would be expected, the fixed-quantities change in tax determines the aggregate dollar-valued utility impact of the tax change.

In the fixed-wage model of section 2, the direct change in tax was sufficient to assess the utility impact of a tax change. In this more general setting, knowledge of the change in prices that will result from the change in tax law is also required. Notably, this piece of information is required both for the aggregate fixed-quantities change in tax as well as the allocation of that change to different agents. The change in prices can affect the aggregate fixed-quantities change in tax by inducing a shift in income between tax bases to which different tax rates apply. Any utility gain attributable to this effect fundamentally reflects a transfer of resources between the government and the public. In addition to the potential revenue impact, the change in prices also determines the incidence of the tax change, including whether the tax is borne by those obligated to pay the tax to the government, or whether the burden is shifted to other economic actors.

Equations 3.14-3.17 provide the link between macroeconomic analyses of tax changes and distribution analyses of tax changes. The right-hand side of each equation can be interpreted as the implied incidence assumptions for macroeconomic analysis. Interpreted in this way, these equations clarify the implicit assumptions in distribution analysis of individual and business tax changes. First, if the share of a tax change incident on labor is assumed to be constant, wages are assumed to change contemporaneously with any changes in the fixed-quantities change in tax. If a time-varying share is used, this strong assumption about

timing is relaxed. However, if the time-varying share is selected to reflect the transition to a new steady state for a single, permanent tax change, then any changes in tax related to timing shifts will be passed through to wages in a manner for which the time-varying shares are not well-suited. Second, if incidence assumptions are not allowed to vary with the details of the policy, then wages may not vary with those details either. For the same reason, if incidence assumptions do not differ for temporary and permanent policies, then wage impacts are assumed to be identical for temporary and permanent policies as well. Finally, if the same incidence assumptions are used regardless of the aggregate cost of a proposal, the effects of deficits on wages are ignored.

4 Welfare Analysis of Tax Changes in Non-Competitive Models and Welfare Analysis of Large Tax Changes

The previous sections have established the usefulness of the fixed-quantities change in tax in estimating the utility impact of tax changes in competitive models and its centrality in conducting welfare analysis of tax changes. This section explores settings in which the basic approach fails and how the results would need to be modified to deal with these variations.

4.1 A model with externalities

Consider a one-period, two-worker version of the fixed-wage model of section 2, but assume that the labor supply of the first worker affects the well-being of the second worker. Then the impact of a change in the labor tax rate on the utility of each agent is

$$\frac{\partial V^1}{\partial \tau} = -u_c^1 w_1 l_1 \tag{4.1}$$

$$\frac{\partial V^2}{\partial \tau} = -u_c^2 w_2 l_2 + \phi \frac{\partial l_1}{\partial \tau}, \tag{4.2}$$

where ϕ is the marginal utility impact of an increase in the labor supply of worker one on worker two. The fixed-quantities change in tax is no longer equal to the aggregate welfare impact. The general result of section 3.1 fails in this case because the envelope theorem no longer delivers a fixed-quantities result for worker two. While it delivers a fixed-quantities result in terms of the quantities under worker two's control, the quantities chosen by the other worker also matter. An estimate of the impact of the first worker's behavior on the second worker's well-being is required for a full welfare analysis.

4.2 A model with market power

Consider a model in which there are two goods. The first good is produced by a monopolist and the second good is produced by a competitive firm. A worker supplies labor and an investor supplies capital and receives the profits of the two firms. There is a linear tax on labor income and a linear tax on business income imposed at the entity level. Firms can deduct a fraction ρ of their capital costs. The impact of a tax change on utility is

$$\frac{1}{\lambda^w}\frac{\partial V^w}{\partial \tau_k} = (1-\tau_l)\frac{\partial w}{\partial \tau_k}l - \frac{\partial p_1}{\partial \tau_k}c_1 - \frac{\partial p_2}{\partial \tau_k}c_2 \tag{4.3}$$

$$\frac{1}{\lambda^i}\frac{\partial V^i}{\partial \tau_k} = \frac{\partial r}{\partial \tau_k}k + \frac{\partial \pi^{AT,1}}{\partial \tau_k} + \frac{\partial \pi^{AT,2}}{\partial \tau_k} \tag{4.4}$$

$$\frac{\partial \pi^{AT,1}}{\partial \tau_k} = -\pi^{PT,TAX,1} + (1-\tau_k)\left[-\frac{\partial w}{\partial \tau_k}l_1 - \frac{1-\rho\tau_k}{1-\tau_k}\frac{\partial r}{\partial \tau_k}k_1\right] \tag{4.5}$$

$$\frac{\partial \pi^{AT,2}}{\partial \tau_k} = -\pi^{PT,TAX,2} + (1-\tau_k)\left[\frac{\partial p_2}{\partial \tau_k}c_2 - \frac{\partial w}{\partial \tau_k}l_2 - \frac{1-\rho\tau_k}{1-\tau_k}\frac{\partial r}{\partial \tau_k}k_2\right], \tag{4.6}$$

where c_1 is consumption of the monopoly good, c_2 is consumption of the other good, l is labor, $\pi^{PT,TAX,i}$ is the pre-tax taxable income of firm i, and $\pi^{AT,i}$ is the after-tax profit of firm i.

Define the fixed-quantities change in tax to be

$$\left.\frac{\partial R}{\partial \tau_k}\right|_{q_0} = \pi^{PT,TAX,1} + \pi^{PT,TAX,2} + (\tau_l - \tau_k)\frac{\partial w}{\partial \tau_k}l - \rho\tau_k\frac{\partial r}{\partial \tau_k}k + \tau_k\left(\frac{\partial p_1}{\partial \tau_k}c_1 + \frac{\partial p_2}{\partial \tau_k}c_2\right). \tag{4.7}$$

Thus

$$\frac{1}{\lambda^w}\frac{\partial V^w}{\partial \tau_k} + \frac{1}{\lambda^i}\frac{\partial V^i}{\partial \tau_k} = -\pi^{PT,TAX,1} - \pi^{PT,TAX,2} + (\tau_k - \tau_l)\frac{\partial w}{\partial \tau_k}l + \rho\tau_k\frac{\partial r}{\partial \tau_k}k - \frac{\partial p_1}{\partial \tau_k}c_1 - \tau_k\frac{\partial p_2}{\partial \tau_k}c_2 \tag{4.8}$$

$$= -\left.\frac{\partial R}{\partial \tau_k}\right|_{q_0} - (1-\tau_k)\frac{\partial p_1}{\partial \tau_k}c_1. \tag{4.9}$$

The welfare impact of a change in the business tax rate in this model is not the opposite of the fixed-quantities revenue impact. Instead, there is an additional term attributable to the price change of the good produced by the monopolist. While the government budget is the beneficiary of the increase in economic activity to the extent of the tax wedge, the consumer is the beneficiary of the reduction in price. Thus, the welfare gain of a tax cut exceeds the fixed-quantities revenue loss.

Why does the general result of section 3.1 not apply? In the monopoly case, the envelope theorem continues to apply to each agent's decision-making problem, but the monopolist optimizes over the price in addition to quantities. Thus, in aggregating the utility impacts across all non-governmental agents, there is a term missing that would be required to neutralize all price changes in determining the aggregate welfare

impact. An estimate of the impact of the tax change on pricing behavior is required for a full welfare analysis.

4.3 A model with behavioral imperfections

A third scenario in which the basic result can be invalidated is one of behavioral imperfections. Consider, for example, the repeal of the Affordable Care Act's individual mandate to purchase health insurance included in the Tax Cuts and Jobs Act. Fiedler (2020) suggests that the repeal of the mandate materially reduced health insurance coverage. If all of these people did not want to purchase health insurance and only did so because they were forced to by the mandate, repeal of the mandate would have slight positive effects on their well-being equal to the excess of the cost of insurance over the value they place on it. Under the fixed-quantities approach this would be approximated by the value of the penalty itself.[19] However, many of the individuals who will lose coverage according to estimates such as Fiedler (2020), Congressional Budget Office (2017), and Congressional Budget Office (2018) will lose Medicaid coverage for which they are eligible at no cost. While it is possible that these individuals assess the hassle costs of signing up for Medicaid in excess of the value of coverage, this is unlikely to fully explain the behavior. As a result, it is likely necessary to adjust welfare analyses for the welfare cost of coverage losses that results from the underlying behavioral imperfections.

4.4 Other complex incidence channels

The equivalence between the fixed-quantities change in tax and the utility impact of tax legislation can break down not just due to the presence of classic market failures, but also in economic settings that might be better characterized as featuring complexity. This section considers four illustrative examples: optimization frictions, tax avoidance resulting in transfers, charitable giving, and recessions.

The question of what role constraints on people's ability to respond to changes in tax law play in determining behavior has received substantial attention in the empirical literature on taxation (Chetty et al. 2011, Chetty 2012). The relevance of optimization frictions for computing the utility impact of tax changes is ambiguous. In general, the presence of optimization frictions will increase the potential gains from behavioral changes. However, because some of the agents who will respond to a tax change will find that the tax change encourages behavioral change in the opposite direction from the change that was suppressed due to frictions, the presence of frictions could either increase or decrease the utility impact of the change in tax law. Moreover, the required adjustment will be history dependent as the history of policy and other changes will affect the distribution of people relative to the threshold cost of adjustment at the time of a

[19] If the people who drop coverage are selected relative to the rest of the market, their departure may lead to additional effects on others mediated by price changes that should be included in the analysis.

tax change. Absent large optimization frictions, however, the utility adjustments required would likely be modest relative to the tax change. Separate from their implications for estimating the utility impact of tax changes, optimization frictions will generally cause an important difference between short-run and long-run behavioral changes that matters for estimating the revenue impacts of those changes.

The conceptual framework of this paper is closely related to the framework of Feldstein (1999) establishing that the elasticity of taxable income is sufficient to compute the deadweight loss of the income tax. Parallel to the analysis of Chetty (2009) and Gillitzer and Slemrod (2016), then, it is possible for the benchmark result here to fail when avoidance and evasion reflect a combination of real costs and transfers. If these responses are quantitatively important, the utility impact of a tax change on the person affected by that change is unchanged—the envelope theorem continues to apply—but a portion of the impact of behavioral responses on government revenues should be offset by an equal and opposite impact on members of the public. The relevance and magnitude of such potential transfers will depend on the specific tax change proposed.

The tax code offers a substantial subsidy to high-income families that make charitable contributions. Determining the utility impact of a change in the tax treatment of charitable giving would require a complex array of assumptions. For example, the change might affect the quantity of services provided in ways that are inconsistent with the derivations of this paper. Assumptions about whether, and to what extent, both the donor and the recipients of charitable services benefit from giving could also lead to sharply different economic analyses depending on the assumptions made. These adjustments could be large relative to the direct impact of the tax change depending on the nature of the externalities involved in the nonprofit sector.

Finally, the benchmark results assume that all people and resources are fully employed. When people are unemployed, additional economic activity by one actor may deliver benefits for other actors by inducing additional activity. Thus, just as in the case of an externality discussed above, an adjustment to the distribution analysis could be warranted to adjust for these spillover effects. (Adjustments to the revenue estimate may also be warranted in this case.) The practical implementation of this type of adjustment would be a challenge, however, as the implementation of the adjustment would require not just an estimate of the dollar-denominated welfare impact resulting from the spillovers but also an allocation of that impact to households across the income distribution.

4.5 Large tax changes and higher-order approximations

The envelope theorem yields a first-order approximation to the utility impact of tax changes that applies only in the case of small tax changes. Thus, large tax changes can also break the basic result. Consider the imposition of a cap on an existing deduction, such as the limit on business interest deductions imposed by

the Tax Cuts and Jobs Act. Rather than slightly reducing the tax benefit of debt, in which case changes in borrowing would leave the individual or firm roughly indifferent, the imposition of the cap creates a wedge between the cost and benefit equal to the initial tax rate. If affected businesses respond by reducing their debt load, that change in borrowing will generate no feedback onto the government budget constraint and generate benefits elsewhere. Note, however, that there is no guarantee that the incidence remains on the affected party. To the extent that this cap changes the cost of capital and through that affects prices, for example, the incidence of the benefits from this behavioral response could shift to other groups just as with any other tax change. A similar logic would apply to proposals to repeal or limit other tax preferences, such as the deduction for mortgage interest or the exclusion for employer-paid health insurance premiums.[20]

Another potential failure that can be viewed as a large tax change arises when legislation or regulation creates new avoidance strategies. The first dollar of tax avoided using a new tax planning technique will likely be achieved at a cost substantially less than one dollar. Changes in compliance costs can operate similarly. Changes in quantities resulting from changes in compliance requirements can be ignored for modest tax changes, consistent with the general result. However, legislation or regulation that requires a significant change in how people comply may induce behavioral responses that deliver larger welfare gains.[21]

In these and other cases, a higher-order approximation can be used to generate a higher quality estimate. A second order approximation would generally find a slightly higher utility gain for a tax cut and a slightly lower utility loss for a tax increase relative to the first-order approximation under benchmark assumptions. Notably, however, the differences between the first-order approximation and the second-order approximation are not reflective of the mere existence of excess burden. As discussed above, the potential utility gain made possible by a reduction in distortions is reflected in the impact of a change in economic activity on the government budget constraint. The implementation of a second-order adjustment is discussed in greater detail in section 5.4 below.

5 Implications for Practice

The derivations above establish that the fixed-quantities change in tax is the primary ingredient in the welfare analysis of tax changes. This section first reviews the value of distribution analysis in light of these derivations and then offers guidance in conducting distribution analysis. Table 1 summarizes current approaches to distribution analysis at the Joint Committee on Taxation, the U.S. Treasury, and the Tax Policy Center, and under the fixed-quantities approach.

[20] The scenarios discussed in this section highlight that the taxable income elasticity is sufficient for the deadweight loss of changes in the tax rate, not the tax base.

[21] See Berger et al. (2018) for an example of how compliance costs can be incorporated into a distribution analysis.

Table 1: Key Methodological Assumptions in Distribution Analysis as Conducted by the Joint Committee on Taxation, U.S. Treasury, Tax Policy Center, and under the Fixed-Quantities Approach

	Joint Committee on Taxation	U.S. Treasury	Tax Policy Center	Fixed-Quantities Approach
Years for which Analysis Is Produced	Select years (e.g. every other)	First year, fully phased-in law[a]	Select years	Select years
Price Changes Reflected in Estimate of Aggregate Tax Change to Be Distributed				
Income tax changes[b]	n/a[c]	n/a	n/a	yes
Payroll tax changes	yes	yes	yes	yes
Corporate tax changes	no	no	no	yes
Estate tax changes	not distributed	n/a	n/a	yes
Excise tax changes	varies	yes	yes	yes
Quantity Changes Reflected in Aggregate Tax Change to Be Distributed				
Stroke-of-the-pen (e.g. itemization)	yes	yes	yes	yes
Microeconomic behavior (e.g. avoidance)	usually	no	no	rarely
Macroeconomic behavior (e.g. labor supply)	no	no	no	no
Timing of Price Changes Reflected in Incidence Assumptions				
Income tax changes	n/a	n/a	n/a	real-time
Payroll tax changes	long-run	long-run	long-run	real-time
Corporate tax changes	real-time	long-run	long-run	real-time
Estate tax changes[d]	not distributed	n/a	n/a	real-time
Excise tax changes	long-run	long-run	long-run	real-time
Deficit Impacts Reflected in Incidence Assumptions	No	No	No	Yes
Timing of Tax Payment Reflected in Distribution Analysis				
Income tax changes	when liability incurred	when liability incurred	when liability incurred	when liability incurred
Payroll tax changes	when liability incurred	when liability incurred	when liability incurred	when liability incurred
Corporate tax changes	when liability incurred	when liability incurred	when liability incurred	when liability incurred
Estate tax changes	not distributed	when liability incurred	when liability incurred	when liability incurred
Excise tax changes	when liability incurred	when income is earned	when income is earned	when liability incurred
Primary measure(s) of impact	percent change in tax, change in average tax rate	percent change in after-tax income	percent change in after-tax income	dollar change in tax, percent change in after-tax income, financed percent change in after-tax income

Note: A value of n/a indicates that the analysis assumes no price changes occur in response to a change in the stated tax, and thus there are no price changes to be reflected in the aggregate tax change or for which an assumption about timing is required.

[a] Treasury's "fully phased-in law" concept is intended to reflect the tax system as it would exist in the long run, typically modeled as the law as it would apply at the end of the budget window adjusted for inflation.

[b] The fixed-quantities approach highlights the fact that different individual income tax changes should be distributed in different ways. Under current approaches at the Joint Committee on Taxation, U.S. Treasury, and Tax Policy Center almost all individual tax changes are distributed in the same manner.

[c] JCT distributes about 5 percent of changes in pass-through taxes to labor income, a price change that would be relevant for distributing the individual income tax that is not reflected in the aggregate tax change (though one that would be negligible in most cases).

[d] As discussed in section 5.4, there is some ambiguity as to the meaning of statutory incidence in the case of the estate tax given that the taxpayer is dead by the time the tax is due. For purposes of this table I treat the assumption that the tax is borne by the decedent as the absence of a price change.

5.1 The value of distribution analysis

In the popular press, distribution analysis is often described as showing whose taxes would go up and whose taxes would go down as a result of proposed legislation. However, under the fixed-quantities approach, distribution analysis does not necessarily show the change in tax payments that would be observed as a result of proposed tax change.[22] Instead, it shows the change in after-tax incomes ignoring certain behavioral responses. Not only does measuring this impact ignoring these behavioral responses more closely align with an intuitive understanding of what it means to get a tax cut, but the analysis of this paper shows that it yields a valid measure of the utility impact of the tax change and is the key ingredient in a welfare analysis

[22] Current approaches used by the Joint Committee on Taxation, U.S. Treasury, and Tax Policy Center share this feature even though they do not exactly follow the fixed-quantities approach.

of that change. This is the real value of distribution analysis: distribution analysis is an intuitive and readily accessible form of welfare analysis.

As distribution analysis is welfare analysis, a further implication of this perspective is that trade-offs between equity and efficiency are reflected in distribution analyses. A distribution analysis for an equity-decreasing, efficiency-enhancing, revenue-neutral reform would show income gains at the top, income losses at the bottom, and an increase in mean incomes. These impacts would correspond to utility losses at the bottom and utility gains at the top. The increase in efficiency would be reflected in the increase in mean incomes. For this type of proposal, a distribution analysis offers a richer depiction of the impacts than summary statements about equity and efficiency and one that is more intuitive. Moreover, a separate analysis of efficiency is not only redundant, it is likely to cause confusion by suggesting further gains not already captured in the distribution analysis.

In the case of a revenue-losing tax cut, the utility changes reported in a distribution analysis exceed the fiscally sustainable level. In the case of a revenue-raising tax increase, the utility losses ignore the benefits the tax increase makes possible. In these cases the distribution analysis provides accurate short-term results that are simply not indicative of the ultimate effects due to the fiscal imbalance. However, this misleading picture is ultimately rooted in the misleading nature of the benefits promised by the policy. It is not a weakness of the mode of analysis. As discussed in greater detail in section 5.7 below, a reasoned assessment of the merits of a deficit-increasing or deficit-reducing policy requires a judgment about how the change in the deficit will affect future policymaking. No trick of economic analysis can avoid this requirement.

The preceding discussion assumes that distribution analyses provide a full analysis of the utility impacts of tax legislation. However, as discussed in section 4, there are a variety of ways economic complexity can make it challenging to reflect all the economic effects of legislation in the distribution analysis. Nonetheless, in these contexts it will generally be more useful to make these adjustments to the revenue and distribution analysis itself, so they can be appropriately contextualized with other impacts of the legislation, rather than examine them separately where it can be more difficult to put the different considerations on the same footing.

An alternative question that is often suggested as a motivation for distribution analysis is "who gets the tax cut" or "who pays for the tax increase", where the tax cut or tax increase is defined as the change in revenues shown in a revenue estimate. An analysis intended to answer this question would show the change in tax payments inclusive of the same set of behavioral responses reflected in the revenue estimate. However, this quantity is not of significant economic interest. It is possible to cut the tax rate and see taxes paid go up in the short run, such as when a change in the capital gains tax rate causes taxpayers to realize much larger gains at the new lower rate. It is long-standing practice at both the Joint Committee on Taxation and the

U.S. Treasury to take steps to remove this type of behavior from their distribution analysis (Cronin 1999). Even when behavior is not this extreme, it can still result in a change in taxes paid that bears little relation to any common understanding of what it means to get a tax cut—let alone an accurate welfare analysis. More practically, it is unclear how taxes should be assigned to different people or groups under this approach as economic incidence assumptions relate to burden or utility, not the change in tax payments. An analysis of the change in tax payments relates more closely to questions of statutory incidence.

A second potential motivation for distribution analysis could be evaluating whose taxes were cut on the basis of a fixed-quantities, fixed-prices analysis. Sample family calculations that compare the income taxes a family would pay under current law and under a proposed alternative could be understood as a form of fixed-quantities, fixed-prices analysis. Such an analysis can be useful in illustrating the mechanics of a tax change. However, it does not answer a question of particular economic interest except in cases where it is reasonable to expect modest price changes. The key practical differences between a distribution analysis as currently conducted and a fixed-quantities, fixed-prices analysis would be assigning the employer portion of payroll taxes to business owners and the entirety of the corporate tax to corporate shareholders. But, while the mechanics of constructing this type of analysis are similar to those of constructing existing distribution tables, the conceptual motivation for such an analysis is radically different.

Finally, it is worth noting that this paper focuses on the distribution analysis of proposed tax legislation. Another common use of distribution analysis is to evaluate who bears the economic burden of the U.S. tax system as in effect in a specific year. Early studies of the distribution of the tax burden typically focused on this latter question, and estimates of the distribution of the burden as in effect in a specific year are regularly produced by a number of public and private organizations (Pechman and Okner 1974; Browning and Johnson 1979; Congressional Budget Office 2019). More recent analyses of the income distribution also implicitly require an answer to this question for certain estimates (Piketty, Saez and Zucman 2018; Auten and Splinter 2019). The framework of this paper does not apply to this type of exercise. This type of tax change is, of course, a large tax change. But, perhaps even more importantly, is not entirely clear what thought experiment motivates the exercise and how it can be made rigorous. A complete investigation of this issue is beyond the scope of this paper.[23]

5.2 Estimating the fixed-quantities change in tax

The first step in conducting a distribution analysis is estimating the fixed-quantities change in tax. The specific derivations of this paper apply only to the models in which each result was generated, but they

[23]Saez and Zucman (2019) highlight the conceptual challenges implicit in analyses that distribute the existing tax burden and argue for a substantial change in approach. However, their proposed approach suffers from potentially even more severe weaknesses.

provide a guide more broadly. Namely, the quantity of tax to be distributed is the change in tax evaluated at fixed quantities and recognizing the impact of changing prices on different tax bases and thus tax revenues. Note, however, that these price changes should be reflected in distribution analyses for each year only to the extent they have occurred in that year. In other words, price changes that are expected to occur only after a lengthy period of transition can be ignored in first-decade distribution analyses, and price changes that are expected to take effect immediately should be included immediately.

At present, distribution analyses appear to include these types of effects in an inconsistent manner. Most organizations estimate the revenue and distributional impacts of payroll tax changes under the assumption that total compensation does not change. This assumption serves to include estimated impacts on wages and benefits in the analysis, which can matter as different components of the compensation package are taxed in different ways. For example, the employer portion of the payroll tax is exempt from individual income taxes. An increase in the employer payroll tax rate would have negative impacts on individual income tax receipts to the extent it causes gross wages to fall. On the other hand, analysts that implicitly assume rapid decreases in pre-tax returns and increases in wage rates in response to a change in business taxation should include in the fixed-quantities tax change the shift between the corporate tax base and the individual tax base. This type of effect does not appear to be widely incorporated into distribution analysis.

In the case of excise taxes, the excise tax offset reflects exactly this type of price change (Sheiner 1994). Under the assumption of fixed nominal GNP used in conventional revenue estimates, an excise tax increase reduces factor incomes, shifting income across tax bases. The excise tax offset is thus appropriately included in the aggregate fixed-quantities tax change to be distributed.[24] In this light, it makes sense that the methodology for analyzing a carbon tax proposed by Horowitz et al. (2017) distributes the excise tax offset. However, this approach is not adopted universally.

5.3 Allocating the fixed-quantities change in tax

The second step in conducting a distribution analysis is to allocate the fixed-quantities change in tax to different economic actors. Again, the derivations of this paper provide a guide as to how this should be done, not a specific formula. Namely, the burden of tax changes should be assigned to the party bearing the statutory incidence of the tax and then shifted to other parties based on estimates of price changes that would result from the change in tax.

At present, distribution analyses typically assign the burden of tax changes to parties based on assumed incidence shares. A representative set of assumptions would be that 100 percent of the income tax is borne

[24]The assumption of fixed nominal GNP is not the source of the excise tax offset, but it does help determine the specific price changes that result and thus what the offset is. Different assumptions about the price level or nominal GNP can change the value of the excise tax offset in different modeling exercises.

by payers, 100 percent of the payroll tax is borne by workers and the self-employed, and the corporate tax is borne by both workers (25 percent) and investors and lenders (75 percent). Assumed incidence shares can be interpreted as assumptions about the price changes that would result from a change in tax. These shares correspond to the assumptions that income and employee-side payroll tax changes do not cause any price changes, employer-side payroll tax increases cause a decrease in gross wage rates equal to the tax, and corporate tax increases cause a decrease in (pre-tax) wages and an increase in (pre-tax) returns.

This analysis clarifies a frequent confusion that arises from the language used to describe incidence assumptions in distribution analysis. Incidence assumptions are frequently expressed as shares of the aggregate tax change borne by different people or groups, and these shares typically sum to 100 percent as noted above. That these shares sum to 100 percent does not indicate that the underlying economic model ignores excess burden. Rather, as a general matter, excess burden is not relevant for the computation. This irrelevance is because, under the conceptual framework set forth in this paper, excess burden is the source of feedback onto the government's budget constraint.

While it will often be reasonable to assume that the incidence of a tax change on a particular group lies between zero and 100 percent this is not guaranteed. The analysis of this paper helps clarify the conditions under which it may be appropriate to assume the incidence of a tax change on some group lies outside this range. Namely, this type of overshifting requires price movements that compound the tax change. For example, a reduction in the corporate tax rate would generate over-shifting to labor if the average after-tax return to capital falls in response to the tax cut.[25] In effect, such a tax cut would feature an increase in inframarginal capital taxes that offsets part of the cost of a reduction in the marginal capital tax rate, even as the benefits of the marginal rate reduction are largely (or entirely) shifted to labor. While it is likely reasonable to view this type of effect as rare in the case of a simple change in the rate, it can arise more readily when many tax changes are combined in one proposal.[26]

At present, some analysts adopt incidence shares that reflect an assumed long-run while others use time-varying incidence assumptions. Under the long-run approach, the incidence assumptions are intended to be consistent with the price changes that would have occurred once the tax changes under consideration had been in effect for a long period of time. The assumption that employer payroll taxes are borne by workers, for example, may apply only after a period of adjustment. However, under the long-run approach this transitional period would be ignored. Similarly, an analysis that assumes fixed incidence shares for

[25] The emphasis on price changes here is effectively a reduced form version of the conditions expressed in terms of the primitives of an economic model developed in analyses such as Harberger (1962).

[26] A further issue that can arise in this context is incidence on foreign workers and investors. Distribution analyses are often constructed to represent the domestic population, and thus the total burden of a tax change may sum to more or less than 100 percent of the fixed-quantities change in tax even in scenarios in which the basic result of section 3 holds. If the incidence of a tax change on foreigners is important in a particular analysis it is likely appropriate to supplement a domestic distribution analysis with analysis of the impacts on foreigners.

corporate tax changes is a long-run approach. Distributing corporate tax changes using time-dependent shares, in contrast, recognizes that the price impacts of corporate tax changes evolve over time.

The fixed-quantities approach set out in this paper mandates the time-varying approach: incidence assumptions should be specified for consistency with the price impacts as they play out over time following enactment of the legislation. The benefits of a tax cut or the costs of a tax increase are not shifted from the agents bearing the statutory incidence of the change to other agents unless or until price changes manifest to shift the impact. Moreover, as tax legislation generally is not balanced budget, there is not necessarily a well-defined long-run equilibrium to which the economy is heading, thus raising questions about the coherence of the long-run approach.

Ideally, the allocation of the fixed-quantities change in tax to different groups would be guided by the results of empirical research on tax incidence. However, the implicit analytic requirements are severe: year-by-year estimates of the incidence of tax changes that are unique to the specific tax changes proposed. Thus, in practice, incidence assumptions will likely be driven by a combination of empirical research, modeling, and judgment. That said, recent research in tax incidence, such as Benzarti and Carloni (2019), demonstrates the potential for empirical research to better distinguish between short-, medium-, and long-run incidence effects. The conceptual framework of this paper highlights the importance of doing so.

Though generally ignored under current approaches to distribution analysis, deficits potentially matter for purposes of allocating the fixed-quantities change in tax to different actors. Changes in interest rates, like any other price, can affect incidence. One scenario in which deficits could matter is in the case of a deficit-financed tax cut on business income. In this case, deficits, by increasing interest rates, could work against the mechanism that would otherwise shift the incidence of a business tax cut from business owners and lenders to workers. A second scenario in which deficits could matter is that by changing interest rates they could affect financial flows between borrowers and lenders, including both the government and private actors. Thus, deficit-financed tax cuts, by increasing interest rates, can induce a transfer from borrowers to lenders. Because price changes matter in computing the aggregate fixed-quantities change in tax and the government is a substantial net borrower, an increase in interest rates resulting from deficit-financed tax cuts could not only affect the relative incidence on different actors, but also increase the aggregate fixed-quantities tax cut.

Finally, changes in asset prices could also affect the incidence of tax changes. The discussion in this paper has ignored this issue—as distribution analysis generally does in practice—but the general model of section 3 would naturally show this channel as another means by which incidence can be shifted from parties that bear the statutory incidence of a tax change to other parties. Were such effects to be included in the analysis, they would make assumptions about future policy changes more important as such changes would

likely have an outsized effect on the price of financial assets.

5.4 Adjustments for more complex welfare impacts

In addition to estimating the aggregate fixed-quantities change in tax and allocating it to different actors, analysts must choose whether and how to implement any further adjustments to their analysis to reflect any of the more complex economic issues reviewed in section 4 that can invalidate the equivalence between the fixed-quantities change in tax and the utility impact of tax legislation. One set of scenarios that may require such an adjustment is those involving large changes to targeted tax provisions that apply to industries with complex structure, such as repeal of the exclusion for employer health insurance or the deduction for charitable contributions. At the opposite extreme, the assumption underlying current distribution analyses that people can switch between claiming the standard deduction and itemizing could be motivated as just such an adjustment. This latter class of responses could also include other types of timing and certain financial or accounting responses that are perhaps most responsive to taxation (Slemrod 1992).

In the case of large tax changes, one plausible approach is to inflate or deflate the fixed-quantities change in tax to account for the otherwise omitted second-order gain of the behavioral response. A simple triangle approximation for the ratio of the second-order burden impact to the fixed-quantities tax change is $0.5\varepsilon\Delta\tau/(1-\tau)$, where the elasticity is with respect to the net-of-tax rate.[27] As would be expected, the adjustment is increasing in the size of a tax change. For a small tax change, the term vanishes. In addition, the adjustment is increasing in the relevant behavioral elasticity. Thus, even in the case of a larger tax change the adjustment may remain small if the elasticity is small. Notably, the adjustment can be small even for what may seem like a relatively large tax change. Take, for example, the reduction in the corporate tax rate from 35 percent to 21 percent in the Tax Cuts and Jobs Act. Even setting aside the potential for offsetting impacts from repeal of the domestic production activities deduction and other provisions of the legislation, an elasticity of the corporate tax base with respect to the tax rate of 0.5 after ten years would imply that the fixed-quantities change in tax would need to be inflated by only 5 percent. An elasticity of 1 would require an adjustment of only 11 percent. Of course, in the immediate years after enactment, the adjustment would be even smaller. In practice, the offsetting effects from other provisions of the law would mute these impacts even more.[28] Importantly, the validity of the basic fixed-quantities approximation does not depend on a small elasticity. Rather, as emphasized throughout, the first-order welfare impacts of

[27] The burden term is second order despite only including a single term in $\Delta\tau$ because the fixed-quantities change in tax itself includes a term in $\Delta\tau$.

[28] In the case of taxes that are small relative to the tax system, such as a narrowly targeted excise tax, it is a familiar result that distortions result primarily from the interaction of the small tax with the rest of the tax system and not from the tax itself. With that motivation, it may also be useful to think of the notion of smallness relevant here as a measure of the tax's size relative to the entire tax system. Repealing a modest excise tax does not necessarily require any adjustments to the benchmark formulas.

changes in behavior generally affect the government's budget balance, not the public.

A second salient case to consider is that of the estate tax. At present, the Joint Committee on Taxation does not distribute changes to the estate tax in its analyses, likely due to uncertainty about incidence. The U.S. Treasury, among others, includes the estate tax in its distribution tables and assumes the incidence of the estate tax is on decedents. Under the logic of this paper, a tax change should be assigned to the actor bearing the statutory incidence of the tax and shifted to other agents on the basis of price changes. It is reasonable to think changes to the estate tax do not cause substantial changes in the equilibrium rate of return, capital stock, or wages (Kopczuk 2017; Poterba 2017). This assumption would suggest that the incidence of the estate tax should remain on the party bearing the statutory incidence. But who bears the statutory incidence? The legal obligation to pay the estate tax lies with the decedent's estate, and the decedent is dead by the time the tax is paid. The assumption that the decedent pays the tax amounts to an assumption that the decedent would have consumed more, worked less, or otherwise responded during life had the tax not existed. The assumption that the heir pays the tax amounts to an assumption that the decedent's behavior would have been unchanged, effectively forcing the heir to respond. Recent research into the estate tax also raises questions parallel to those for the charitable deduction mentioned above: perhaps both the decedent and the heir benefit from the inheritance? This paper does not aim to resolve the question of who bears the incidence of the estate tax (or any other tax discussed), but the conceptual framework can be helpful in understanding how these questions relate to the construction of a distribution analysis.

The fixed-quantities change in tax and the allocation of that change in tax to different actors may also be affected by state and local tax policies. Most directly, state and local governments that rely on federal tax law in determining tax liabilities will experience a corresponding change in revenues and the federal legislation will cause an analogous fixed-quantities change in (state) tax. Behavioral responses that affect federal revenues may also affect state and local revenues. When quantitatively important, a supplemental revenue estimate and distribution analysis for state and local taxes could be produced in a manner analogous to those proposed here. State and local government action can also affect the incidence of tax changes. For example, if the cap on the state and local tax deduction for federal income taxes were to induce a behavioral response on the part of state governments, that response would potentially shift the incidence of the cap from those directly affected to other groups.

More generally, the frontier of economic research largely consists of the theoretical and empirical examination of scenarios in which the simplifying assumptions adopted benchmark models do not hold. This means that the next steps for methodological improvement in the applied analysis of tax policy will consist of identifying tractable ways to modify the basic result in this paper for quantitatively important departures

from its simplifying assumptions.[29] However, before those modifications can be identified and implemented, a clear conceptual framework for the basic result must be developed. That framework is what this paper seeks to provide.

5.5 Variation in the policy regime over time

As discussed above, incidence assumptions should reflect the rate at which price changes play out over time. A parallel set of timing issues faces analysts in specifying the policy regime for the analysis. The U.S. Treasury has historically produced tables for the first year of the budget window and under "fully phased-in law", where the latter is intended to reflect the law as it will apply in the last year of the budget period adjusted for inflation (U.S. Treasury 2015). In contrast, the Joint Committee on Taxation has tended to follow more closely the specification of the law in a given year (see, e.g., Joint Committee on Taxation (2017*a*)). In the case of the legislative debate leading to enactment of the Tax Cuts and Jobs Act, organizations producing distribution tables adopted an explicitly time-dependent specification of the policy. This choice likely reflected the important temporal components of the policy itself, including the expiration of most provisions affecting individuals at the end of 2025, the complex schedule of phase-ins and phase-outs affecting business provisions, and changes in inflation adjustments.[30]

The importance of accurately reflecting the policy regime is a strong argument for a time-varying approach on its own, but the conceptual framework of this paper adds further support for this approach. There is little reason to think price changes necessarily occur contemporaneously with changes in policies, especially when considering changes in business taxation. Tax legislation generally increases or decreases the deficit, which leads to time-dependent impacts on interest rates and potentially other prices. Moreover, the interpretation of distribution analyses becomes substantially more opaque when they reflect time-shifted, long-run incidence results. Finally, when tax legislation leads to changes in deficits, it is not clear how meaningful it is to speak of long-run incidence. While there is a clear sense in which enough time has passed for prices to adjust, there is not necessarily a new steady-state to which the economy is transitioning.

5.6 Distributing consumption and excise taxes

The analysis of this paper usefully informs debates about the distribution of consumption and excise taxes. There are two primary methods of distributing these taxes: the sources method and the uses method (Cronin

[29] An alternative approach, of course, would be to use a microfounded economic model to conduct welfare analysis directly. Welfare impacts in such models could be converted to dollar tax changes using the marginal utilities implicit in the specification and these results could be reported as a form of distribution analysis.

[30] See, for example, TPC Staff (2017), which includes distinct distribution analyses for 2018, 2025, and 2027, and Joint Committee on Taxation (2017*a*), which includes disribution analyses for 2019, 2021, 2023, 2025, and 2027.

1999; Rosenberg 2015). Under the uses method, taxes are assumed to be borne by consumers. Under the sources method, taxes are assumed to be borne by labor, certain capital income, and (in some analyses) income from public programs, typically with adjustments for variation in consumption patterns by income. Consumption tends to be large relative to income at low income levels and small relative to income at high income levels. Thus, a shift from income to consumption taxation measured using an income classifier and the uses method shows a more regressive shift of the tax burden than the same shift measured using the sources method (though the latter is still regressive). I do not attempt a comprehensive reconciliation of the methods here, but focus on two primary implications of the conceptual framework proposed in this paper for this debate.

First, in the framework set forth in this paper, distribution analysis reports the change in well-being for a specific family in a specific year. This analysis facilitates more accurate evaluation of time-varying policies. Proponents of the sources method sometimes justify it on the grounds that it provides a fairer comparison of income and consumption taxes by removing the impact of variation in the timing of consumption and savings decisions. However, this justification is lacking as it both assumes policy changes are permanent and reports estimates that don't accord with the real-world impacts of a policy. Distribution analysis must be able to handle scenarios in which policymakers consider temporary policies and should align with real-world impacts. That said, the fixed-quantities approach to distribution analysis does not mandate the uses method. Rather, it directs analysts to adopt incidence assumptions based on the available evidence about the incidence of proposed tax changes. The sources method could still be appropriate if consumption tax changes induce price changes that shift the incidence of those consumption tax increases away from consumers. Nonetheless, the fixed-quantities approach does suggest some caution in the increasing use of the sources method in conducting distribution analysis and, particularly, in the justification for it based on presentational fairness.

Second, under the fixed-quantities approach, both the aggregate fixed-quantities change in tax and the allocation of that change in tax should reflect changes in prices resulting from a change in tax law. In the case of excise taxes, one manifestation of changes in prices is the excise tax offset. Importantly, the distribution of the excise tax offset should be consistent with the distribution of the excise tax itself. Thus, if the tax is distributed by the uses method an analogous uses method distribution of the offset is required. If the tax is distributed by the sources method a sources method distribution of the offset is required. The uses method is often motivated by the assumption that the price level increases to accommodate the increase in the excise tax. Under this assumption, the offset reflects an increase in spending on public programs that are either implicitly or explicitly indexed, such as Medicare benefits or Social Security payments, and an increase in tax brackets and other parameters of the tax code. This offset tends to be progressive. In contrast, the sources method is often motivated by the assumption that the price level remains constant following implementation

of a tax increase and thus incomes fall. Under this assumption, the offset reflects a reduction in taxes resulting from lower incomes. This offset tends to be regressive. Notably, just as the distribution of the tax differs markedly across the two methods, the distribution of the offset differs as well. Ensuring that the excise tax offset is included in any distribution analysis of an excise tax change and ensuring that the distribution of the offset is consistent with that of the tax itself would reduce some apparent differences between the distribution of excise taxes under the sources method and under the uses method.[31]

5.7 Distributing deficits

Distribution analyses for deficit-increasing tax changes overstate the sustainable utility gains and distribution analyses for deficit-reducing tax changes overstate the required utility losses. In both cases, the welfare analysis to which a distribution analysis contributes is indicative of only short- and medium-term impacts, and is misleading about the long-term impacts.

This incompleteness is an unavoidable result of the incomplete nature of the policy, not a limitation of the analysis itself. A reasoned assessment of how future policymakers will respond, whether through action or inaction, is a necessary ingredient in an economically grounded assessment of a proposed deficit-increasing or deficit-reducing policy. Put differently, a revenue estimate and distribution analysis for a tax cut can tell you by how much burden is reduced and at what cost, but the reader of those analyses must make a judgment as to whether that impact is desirable based on their views about the magnitude and distribution of the burden reduction, the fiscal cost, and the likely future policy impacts. Similarly, a revenue estimate and distribution analysis for a tax increase can tell you how much burden is imposed and on whom and for what revenue gain, but the reader must make a judgement as to whether that impact is desirable. In both cases, the fiscally unbalanced legislation may cause future legislation that would not have occurred otherwise or it may preempt future legislation that would otherwise have occurred.

Notably, while the need for an assessment of future legislative action is essential in the case of deficit-increasing or deficit-reducing legislation, it is still relevant in the case of balanced-budget legislation. Balanced-budget legislation reflects a fiscally viable set of policy impacts that can be judged in isolation, but that does not imply that the legislation would not lead to future legislative action. Perhaps the most straightforward case in which the potential for current legislation to affect future legislation is relevant is one in which legislators schedule provisions to phase in, phase out, or otherwise expire. In doing so, legislators may moderate fiscal impacts or achieve notional budget balance even as a reasoned assessment of the ultimate

[31] In a model with no nominal rigidities, the incidence of the tax does not depend on whether the price level increases or decreases, but these assumptions nonetheless offer a convenient intuition for understanding why the distribution of the excise tax offset should differ across the two scenarios. The missing link between the two is the impact on interest rates, which is set aside here for simplicity.

consequences of the legislation may suggest larger fiscal impacts. Such an approach was used in both the Economic Growth and Tax Relief Act of 2001 and the Tax Cuts and Jobs Act of 2017, among other legislation. Thus, the relative inattention to issues of political economy and the policymaking process is not unique to the evaluation of policies that increase or decrease the deficit, it is only that in such scenarios it is unavoidable.

For these reasons, it is often useful to supplement a distribution analysis for a proposed policy with an additional analysis of the proposed policy combined with stylized offsetting policies that would render it fiscally balanced. Indeed, such an analysis is essential in illustrating the true economic tradeoffs facing policymakers: the choice between taxes and spending or between one set of taxes and another set of taxes. The challenge in conducting such an analysis, of course, is that policymakers do not specify what any future offsetting policies should be, so analysts will fundamentally be incorporating their own judgment about what those policies could be when conducting such analyses.

There is a close relationship between this type of hypothetical, financed analysis and a present value welfare analysis. Conditional on an assumption about future policy, the disaggregate annual welfare analysis can be summarized by discounting and summing the utility impacts for all future years. Among other auxiliary assumptions, this requires an assumption about a discount rate and a decision about whether, and, if so, how to deal with changes in the relative position of households across the income distribution from year to year.

Notably, any analysis of the efficiency impacts of a deficit-increasing or deficit-reducing proposal is necessarily making assumptions about financing, and thus an efficiency analysis of tax legislation should include a distribution analysis consistent with those financing assumptions, while recognizing that both analyses are for hypothetical deficit-neutral alternative policies. A macroeconomic analysis that assumes offsets for a policy under consideration should likewise be accompanied by a distribution analysis reflecting those offsets.

An important implication of the perspective set forth in this paper is that the deficit is rarely itself the key object of analytic interest. While changes in deficits can affect estimated burden impacts or revenue impacts through a variety of channels, it will rarely be the case that any single piece of legislation has a truly material impact on deficit sustainability in the short or medium term. The true test of any deficit-increasing legislation is the desirability of the tax cut or spending it delivers, and the test of any deficit-reducing legislation is the desirability of the transfer to the future it delivers.

5.8 The role of growth in the analysis of tax legislation

As highlighted throughout this paper, growth, a change in quantities, is largely irrelevant in determining the direct utility impact of tax legislation on the public. This observation stands in contrast to the public debate about taxes, in which claims about growth—and the benefits of growth—are central. It is thus worth explicitly considering the appropriate role of growth in the analysis.

As established in section 2.2, changes in quantities do matter in assessing the fiscal impact of tax changes. A consequences of this is that growth can finance a seemingly free tax cut, it can reduce deficits without imposing a net tax increase on the public, and it can do a combination of both. However, these benefits will be reflected in distribution and revenue estimates. Treating growth as being of independent value on top of the revenue and distribution analysis risks double counting the benefits of growth. When the assumptions necessary for the envelope theorem to hold are violated, the assumptions underlying revenue estimates and fixed-quantities distribution analysis can be tweaked to deliver useful results, as in the standard practice of reflecting taxpayers' decisions to itemize deductions rather than claim the standard deduction in distribution analysis.[32] Doing so will generally deliver clearer and more readily interpretable guidance for policymakers than a direct evaluation of growth, which reflects many of the same economic effects already captured in revenue and distribution analysis. This remains true even in the case of larger tax changes for which the envelope theorem approach may be less suitable.[33]

Discussion of tax legislation frequently focuses on medium-term changes in output for deficit-increasing or deficit-reducing proposals. But medium-term growth is not necessarily indicative of long-term growth impacts, nor is medium-term growth for a fiscally unbalanced proposal what matters in determining the scale of future policies required to restore budget balance. Rather, it is the impact on output over the indefinite future for the original fiscally unbalanced proposal and the additional policies enacted to restore budget balance. Medium-term growth for a fiscally unbalanced policy is not indicative of either the sign or magnitude of this more relevant measure. Indeed, in many macroeconomic models, any net rate cut will increase output by at least some amount in the medium term and any net rate increase will reduce output by at least some amount in the medium term. Using the sign of medium-term growth impacts is thus primarily an indicator of whether there was a net rate cut.

Finally, discussions of growth often generate confusion by ignoring the costs of generating additional income. Increases in output from tax changes typically result from increased use of inputs: more hours of work and more capital investment. But both of these come at a cost. In the former case, to the workers

[32] The same holds true for arguments that there are important externalities associated with income taxation, as in Jones (2019) or Piketty, Saez and Stantcheva (2014).

[33] Though the public debate about dynamic scoring and macroeconomic analysis places great emphasis on the uncertainty of the results, that uncertainty plays no role in this argument.

spending longer hours on the job, and, in the latter, to investors consuming less today or investing less elsewhere. Indeed, many discussions of tax changes discuss job impacts that are largely irrelevant for welfare as if they are a substantial economic gain for workers. Focusing on revenue and distribution analysis can reduce the risk of confusion on these points.

6 Conclusion

The fixed-quantities change in tax offers an approximation to the utility impact of a change in tax law in a specific year. Together with a revenue estimate, a distribution analysis provides all of the information necessary for a quantitative welfare analysis of proposed tax legislation or regulations. Growth, a change in quantities, offers no benefits not already reflected in one of these analyses. As noted at the outset, the common framing of tax analysis around the revenue, distribution, and economic effects of tax legislation risks misleading policymakers and the public. Economic analysis organized around the transfers resulting from tax changes—the impacts on revenues and burden—provides a clear and compelling illustration of the tradeoffs involved.

The framework of this paper has four major implications for changes in the conduct of distribution analysis. First, distribution analysis should be conducted for a specific year. Second, the incidence assumptions used in distribution analysis should vary over time, consistent with the rate at which prices change following enactment of the legislation. Third, the total change in tax distributed should ignore quantity changes but reflect the impact of price changes on tax bases and thus revenues. Fourth, distribution analysis should reflect the role of deficits in determining the incidence of tax changes.

This approach to welfare analysis clarifies an important distinction between academic tax theory and policy analysis. Academic tax theory frequently presumes a budget constraint and evaluates the question of how best to tax. The level of revenues does not play an important role. Yet raising revenues is the primary purpose of the tax system and real-world tax legislation frequently changes the level of revenues collected. Thus, the policy process requires a fundamentally different lens through which to evaluate changes in tax policy that focuses on the levels of utility and the level of revenues. Revenue estimates and distribution analysis provide exactly that.

Finally, trade-offs between equity and efficiency appear in a distribution analysis itself. An equity-decreasing, efficiency-enhancing, revenue-neutral tax reform will manifest as income losses for low-income families, income gains for high-income families, and an increase in mean incomes. Of course, the federal tax system does not reflect the frontier of feasible policy options and it would be possible to enact equity-increasing, efficiency-enhancing tax reforms. Policymakers who achieve this would be able to point to

distribution analyses that show progressive income gains even as revenue estimates show no net cost to the government or, alternatively, to distribution analyses that show no income losses even as revenues increase. Moreover, in the case of a revenue-neutral, efficiency-enhancing reform, a distribution analysis would show which groups benefit and which groups are hurt. In practice, however, most tax legislation does not offer a trade-off between equity and efficiency, as it is either a tax increase that reduces the deficit or a tax cut that increases the deficit, and thus the ultimate effects on both equity and efficiency exist only as hypotheticals.

A Quantitative analyses of the Tax Cuts and Jobs Act

A.1 The Joint Committee on Taxation

Selection from the Joint Committee on Taxation conventional revenue estimate for the Tax Cuts and Jobs Act (Joint Committee on Taxation 2017*b*):

JOINT COMMITTEE ON TAXATION
December 18, 2017
JCX-67-17

ESTIMATED BUDGET EFFECTS OF THE CONFERENCE AGREEMENT FOR H.R. 1, THE "TAX CUTS AND JOBS ACT"

Fiscal Years 2018 - 2027

[Billions of Dollars]

Provision	Effective	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2018-22	2018-27
I. Individual Tax Reform													
A. Simplification and Reform of Rates, Standard Deductions, and Exemptions													
1. 10%, 12%, 22%, 24%, 32%, 35%, and 37% income tax rate brackets (sunset 12/31/25) [1][2]	tyba 12/31/17	-94.1	-135.3	-140.9	-146.4	-152.0	-158.1	-164.3	-171.1	-52.0	[3]	-668.7	-1,214.2
2. Modify standard deduction ($12,000 for singles, $24,000 for married filing jointly, $18,000 for HoH) (sunset 12/31/25) [2]	tyba 12/31/17	-57.2	-82.6	-84.7	-87.5	-90.7	-92.9	-95.7	-99.1	-30.0	[3]	-402.6	-720.4
3. Repeal of deduction for personal exemptions (sunset 12/31/25) [2]	generally tyba 12/31/17	93.3	137.1	141.6	146.4	151.8	157.6	163.3	169.2	51.3	---	670.1	1,211.5
4. Alternative inflation measure [2]	tyba 12/31/17	0.8	2.1	5.5	8.2	10.4	12.8	16.6	20.0	25.6	31.5	27.0	133.5
B. Treatment of Business Income of Individuals, Trusts, and Estates													
1. Allow 20 percent deduction of qualified business income and certain dividends for individuals and for gross income of agricultural or horticultural cooperatives (sunset 12/31/25) [4]	generally tyba 12/31/17	-27.7	-47.1	-49.9	-51.8	-52.8	-52.2	-53.6	-53.2	-24.2	-1.9	-229.5	-414.5
2. Disallow active passthrough losses in excess of $500,000 for joint filers, $250,000 for all others (sunset 12/31/25)	tyba 12/31/17	9.5	16.2	17.2	18.0	18.8	19.6	20.4	19.4	9.3	1.3	79.7	149.7
C. Reform of the Child Tax Credit													
1. Modification of child tax credit: $2,000 not indexed; refundable up to $1,400 indexed down to nearest $100 base year 2018; $2,500 refundability threshold not indexed; $500 other dependents not indexed; phase outs $200K/$400K not indexed (sunset 12/31/25) [2]	tyba 12/31/17	-29.3	-67.7	-69.2	-70.4	-71.4	-73.8	-74.9	-76.0	-40.7	---	-308.1	-573.4
2. Require valid Social Security number of each child to claim refundable and non-refundable portions of child credit, non-child dependents and any child without a valid Social Security number still receives $500 non-refundable credit (sunset 12/31/25) [2]	tyba 12/31/17	---	3.9	3.8	3.8	3.7	3.8	3.7	3.7	3.0	0.5	15.2	29.8

(pages omitted)

Provision	Effective	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2018-22	2018-27
2. Repeal of fair market value method of interest expense apportionment	tyba 12/31/17	[5]	0.1	0.1	0.1	[5]	[5]	[5]	[5]	[5]	[5]	0.3	0.6
Total of International Tax Reform		**68.9**	**42.6**	**26.0**	**28.0**	**22.9**	**22.5**	**36.7**	**48.7**	**29.1**	**-0.8**	**188.2**	**324.4**
NET TOTAL		**-135.7**	**-280.0**	**-258.8**	**-220.8**	**-178.3**	**-137.9**	**-120.1**	**-114.6**	**-40.6**	**32.9**	**-1,074.0**	**-1,456.0**

Joint Committee on Taxation

NOTE: Details may not add to totals due to rounding. The date of enactment is generally assumed to be December 22, 2017.

Legend for "Effective" column:

apa = amounts paid after
apisasd = and placed in service after such date
apoaa = amounts paid or accrued after
apoia = amounts paid or incurred after
apoii = amounts paid or incurred in
apoio/a = amounts paid or incurred on or after
ar = advance refunding
bia = bonds issued after
cmi = contributions made in
da = distributions after
Da = dispositions after
dda = decedents dying after
DOE = date of enactment
doia = discharges of indebtedness after
dosaeia = divorce or separation agreements entered into after
eca = exchanges completed after
fc = for charitable
feoqb = for expansion of qualifying beneficiaries
gma = gifts made after
lai = losses accrued in
mba = months beginning after
paa = property acquired after
ppisa = property placed in service after
ptyba = partnership taxable years beginning after
sa = sales after
seada = sales exchanges and dispositions after
seado/a = sales, exchanges and dispositions on or after
spo/a = service provided on or after
sppoga = specified plants planted or grafted after
ta = transactions after
Ta = transfers after
teia = transactions entered into after
ti = transfers in
topia = transfers of partnership interests after
tyba = taxable years beginning after

Selection from the Joint Committee on Taxation macroeconomic analysis of the Tax Cuts and Jobs Act (Joint Committee on Taxation 2017*c*):

- TABLE 1 -
ESTIMATED BUDGET EFFECTS OF THE CONFERENCE AGREEMENT FOR H.R.1
Fiscal Years 2018 - 2027

[Billions of Dollars]

Provision	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2018-22	2018-27
Conventional estimate.....	-135.7	-280.0	-258.8	-220.8	-178.3	-137.9	-120.1	-114.6	-40.6	32.9	-1074.0	-1,456.0
Additional Effects Resulting from Macroeconomic Analysis	32.2	34.4	36.6	38.5	37.0	40.5	46.5	47.8	35.5	35.5	178.8	384.6
NET TOTAL	-103.5	-245.6	-222.2	-182.3	-141.3	-97.4	-73.6	-66.8	-5.1	68.4	-895.2	-1071.4

Joint Committee on Taxation

NOTE: Details may not add to totals due to rounding

Selection from the Joint Committee on Taxation distribution analysis of the Tax Cuts and Jobs Act (Joint Committee on Taxation 2017*a*):

JOINT COMMITTEE ON TAXATION
December 18, 2017
JCX-68-17

DISTRIBUTIONAL EFFECTS OF
THE CONFERENCE AGREEMENT FOR H.R.1,
THE "TAX CUTS AND JOBS ACT"

Calendar Year 2019

INCOME CATEGORY (2)	CHANGE IN FEDERAL TAXES (3)		FEDERAL TAXES (3) UNDER PRESENT LAW		FEDERAL TAXES (3) UNDER PROPOSAL		Average Tax Rate (4)	
							Present Law	Proposal
	Millions	Percent	Billions	Percent	Billions	Percent	Percent	Percent
Less than $10,000.....	-$396	-5.6%	$7.0	0.2%	$6.6	0.2%	9.1%	8.6%
$10,000 to $20,000.....	-$1,792	(5)	-$2.4	-0.1%	-$4.2	-0.1%	-0.7%	-1.2%
$20,000 to $30,000.....	-$2,982	-13.5%	$22.1	0.7%	$19.1	0.6%	3.9%	3.4%
$30,000 to $40,000.....	-$5,416	-11.5%	$47.0	1.5%	$41.5	1.4%	7.9%	7.0%
$40,000 to $50,000.....	-$6,728	-10.0%	$67.3	2.1%	$60.6	2.0%	10.9%	9.9%
$50,000 to $75,000.....	-$23,046	-8.7%	$265.3	8.2%	$242.3	8.2%	14.8%	13.5%
$75,000 to $100,000.....	-$22,437	-8.0%	$279.5	8.7%	$257.1	8.7%	17.0%	15.6%
$100,000 to $200,000.....	-$70,372	-7.5%	$939.8	29.1%	$869.4	29.3%	20.9%	19.4%
$200,000 to $500,000.....	-$65,485	-9.0%	$724.3	22.4%	$658.8	22.2%	26.4%	23.9%
$500,000 to $1,000,000..	-$23,947	-9.4%	$254.7	7.9%	$230.8	7.8%	30.9%	27.8%
$1,000,000 and over.....	-$36,853	-5.9%	$624.1	19.3%	$587.2	19.8%	32.5%	30.2%
Total, All Taxpayers.....	**-$259,454**	**-8.0%**	**$3,228.7**	**100.0%**	**$2,969.3**	**100.0%**	**20.7%**	**19.0%**

Source: Joint Committee on Taxation
Detail may not add to total due to rounding.

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(1) This table is a distributional analysis of the proposal in revenue table JCX-67-17, excluding the following sections: I. Tax Reform for Individuals: D.4.-D.7., E.1-E.2, F., and I.2.-I.13. Under section H., the distribution analysis does not include the effect of the cost-sharing reductions and change in Medicaid spending.
(2) The income concept used to place tax returns into income categories is adjusted gross income (AGI) plus: [1] tax-exempt interest, [2] employer contributions for health plans and life insurance, [3] employer share of FICA tax, [4] worker's compensation, [5] nontaxable Social Security benefits, [6] insurance value of Medicare benefits, [7] alternative minimum tax preference items, [8] individual share of business taxes, and [9] excluded income of U.S. citizens living abroad. Categories are measured at 2017 levels.
(3) Federal taxes are equal to individual income tax (including the outlay portion of refundable credits), employment tax (attributed to employees), excise taxes (attributed to consumers), and corporate income taxes. The estimates of Federal taxes are preliminary and subject to change. Individuals who are dependents of other taxpayers and taxpayers with negative income are excluded from the analysis. Does not include indirect effects.
(4) The average tax rate is equal to Federal taxes described in footnote (3) divided by income described in footnote (2).
(5) For returns in the $10,000 to $20,000 income category, Federal taxes would decrease from -$2.412 billion to -$4.204 billion.

JOINT COMMITTEE ON TAXATION
December 18, 2017
JCX-68-17

DISTRIBUTIONAL EFFECTS OF
THE CONFERENCE AGREEMENT FOR H.R.1,
THE "TAX CUTS AND JOBS ACT"

Calendar Year 2021

INCOME CATEGORY (2)	CHANGE IN FEDERAL TAXES (3)		FEDERAL TAXES (3) UNDER PRESENT LAW		FEDERAL TAXES (3) UNDER PROPOSAL		Average Tax Rate (4)	
							Present Law	Proposal
	Millions	Percent	Billions	Percent	Billions	Percent	Percent	Percent
Less than $10,000.....	-$60	-0.9%	$6.9	0.2%	$6.9	0.2%	8.2%	8.1%
$10,000 to $20,000.....	$1,920	(5)	-$4.9	-0.1%	-$3.0	-0.1%	-1.4%	-0.8%
$20,000 to $30,000.....	$1,948	8.6%	$22.5	0.6%	$24.5	0.7%	3.7%	4.0%
$30,000 to $40,000.....	-$1,956	-4.1%	$47.7	1.4%	$45.7	1.4%	7.6%	7.3%
$40,000 to $50,000.....	-$3,522	-4.8%	$73.7	2.1%	$70.1	2.1%	10.9%	10.4%
$50,000 to $75,000.....	-$18,819	-6.6%	$283.4	8.1%	$264.6	8.1%	14.7%	13.7%
$75,000 to $100,000.....	-$20,583	-6.9%	$300.3	8.6%	$279.8	8.5%	16.8%	15.6%
$100,000 to $200,000.....	-$64,835	-6.4%	$1,017.6	29.1%	$952.7	29.1%	20.9%	19.6%
$200,000 to $500,000.....	-$61,510	-7.7%	$799.8	22.9%	$738.3	22.5%	26.5%	24.4%
$500,000 to $1,000,000..	-$21,661	-7.8%	$279.4	8.0%	$257.8	7.9%	31.0%	28.4%
$1,000,000 and over.....	-$29,845	-4.4%	$671.8	19.2%	$642.0	19.6%	32.4%	30.7%
Total, All Taxpayers.....	**-$218,927**	**-6.3%**	**$3,498.3**	**100.0%**	**$3,279.4**	**100.0%**	**20.7%**	**19.3%**

Source: Joint Committee on Taxation
Detail may not add to total due to rounding.

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(1) This table is a distributional analysis of the proposal in revenue table JCX-67-17, excluding the following sections: I. Tax Reform for Individuals: D.4.-D.7., E.1-E.2, F., and I.2.-I.13. Under section H., the distribution analysis does not include the effect of the cost-sharing reductions and change in Medicaid spending.
(2) The income concept used to place tax returns into income categories is adjusted gross income (AGI) plus: [1] tax-exempt interest, [2] employer contributions for health plans and life insurance, [3] employer share of FICA tax, [4] worker's compensation, [5] nontaxable Social Security benefits, [6] insurance value of Medicare benefits, [7] alternative minimum tax preference items, [8] individual share of business taxes, and [9] excluded income of U.S. citizens living abroad. Categories are measured at 2017 levels.
(3) Federal taxes are equal to individual income tax (including the outlay portion of refundable credits), employment tax (attributed to employees), excise taxes (attributed to consumers), and corporate income taxes. The estimates of Federal taxes are preliminary and subject to change. Individuals who are dependents of other taxpayers and taxpayers with negative income are excluded from the analysis. Does not include indirect effects.
(4) The average tax rate is equal to Federal taxes described in footnote (3) divided by income described in footnote (2).
(5) For returns in the $10,000 to $20,000 income category, Federal taxes would increase from -$4.888 billion to -$2.969 billion.

A.2 The Tax Policy Center

Selection from the Tax Policy Center macroeconomic analysis of the Tax Cuts and Jobs Act (Page et al. 2017):

TABLE 2

Deficit Effects of Tax Proposals in the Tax Cuts and Jobs Act

Billions of dollars, fiscal years 2018–37

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2018–27	2028–37
Increase in deficit without macroeconomic feedback or interest costs	136	280	259	221	178	138	120	115	41	-33	1,454	-415
Impact of macroeconomic feedback on the deficit without interest costs	-28	-25	-20	-19	-21	-22	-23	-25	-5	1	-186	-3
Increase in deficit with macroeconomic feedback and without interest costs	108	255	239	201	158	116	97	90	36	-32	1,268	-418

Sources: Joint Committee on Taxation (JCT) and Urban-Brookings Tax Policy Center (TPC) macroeconomic models.
Notes: Estimates without economic feedback for fiscal years 2018–27 are from JCT, *Estimated Budget Effects of the Conference Agreement for H.R. 1, the "Tax Cuts and Jobs Act" (JCX-67-17)*; estimates for fiscal years 2028–37 are TPC calculations based on extensions of JCT estimates. Estimates of impact on the deficit caused by macroeconomic feedback are calculations using TPC's macroeconomic models.

Selection from the Tax Policy Center distribution analysis of the Tax Cuts and Jobs Act (TPC Staff 2017):

TABLE 1

Distribution of Federal Tax Change of the Conference Agreement for the Tax Cuts and Jobs Act

By expanded cash income percentile, 2018[a]

Expanded cash income percentile[b]	Percent change in after-tax income[c]	Share of total federal tax change (%)	Average federal tax change (dollars)	Average federal tax rate[d]	
				Change (% points)	Under the proposal (%)
Lowest quintile	0.4	1.0	-60	-0.4	3.7
Second quintile	1.2	5.2	-380	-1.1	7.6
Middle quintile	1.6	11.2	-930	-1.4	12.4
Fourth quintile	1.9	18.4	-1,810	-1.6	15.8
Top quintile	2.9	65.3	-7,640	-2.2	23.3
All	2.2	100.0	-1,610	-1.8	18.1
Addendum					
80-90	2.0	13.1	-2,970	-1.6	18.5
90-95	2.2	9.6	-4,550	-1.8	20.2
95-99	4.1	22.1	-13,480	-3.1	22.2
Top 1 percent	3.4	20.5	-51,140	-2.3	30.3
Top 0.1 percent	2.7	7.9	-193,380	-1.8	31.6

Source: Urban-Brookings Tax Policy Center Microsimulation Model (version 0217-1)

Notes: Number of Alternative Minimum Tax (AMT) taxpayers (millions): Baseline: 5.2; Proposal: 0.2. Itemizers (millions): Baseline: 46.5, Proposal: 19.3.

(a) Calendar year. Baseline is current law. Proposal includes provisions contained in the conference agreement for the Tax Cuts and Jobs Act as filed on 12/15/2017. Excludes the effects of repealing the Affordable Care Act's Individual Shared Responsibility Payment (i.e., "individual mandate").

(b) Percentiles include both filing and non-filing units but excludes those that are dependents of other tax units. Tax units with negative adjusted gross income are excluded from their respective income class but are included in the totals. The income percentile classes used in this table are based on the income distribution for the entire population and contain an equal number of people, not tax units. The breaks are (in 2017 dollars): 20% $25,000; 40% $48,600; 60% $86,100; 80% $149,400; 90% $216,800; 95% $307,900; 99% $732,800; 99.9% $3,439,900. For a description of expanded cash income, see http://www.taxpolicycenter.org/TaxModel/income.cfm

(c) After-tax income is expanded cash income less: individual income tax net of refundable credits; corporate income tax; payroll taxes (Social Security and Medicare); estate tax; and excise taxes.

(d) Average federal tax (includes individual and corporate income tax, payroll taxes for Social Security and Medicare, the estate tax, and excise taxes) as a percentage of average expanded cash income.

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