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Dynamic Scoring: An Assessment of Fiscal Closing Assumptions

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Abstract

Analysis of fiscal policy changes using general equilibrium models with forward-looking agents typically requires a counterfactual adjustment to some fiscal instrument in order to achieve the debt sustainability implied by the government's intertemporal budget constraint. The choice of fiscal instrument can induce economic behavior unrelated to the policy change in models where Ricardian Equivalence does not hold. In this article, we use an overlapping generations framework to examine the effects of alternative fiscal closing assumptions on projected changes to economic aggregates following a change in tax policy, assessing the extent to which the bias associated with a particular fiscal instrument can be mitigated. While we find quantitative differences in projected macroeconomic activity across alternative fiscal instruments, these differences tend to shrink as the closing date is delayed. Ultimately, the choice of fiscal instrument becomes relatively unimportant if fiscal closing can be delayed sufficiently into the future.

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General equilibrium models with forward-looking, rational agents have become a workhorse for analyzing the macroeconomic effects of proposed changes to federal fiscal policy over the ten-year "budget window" both within government and private research institutions.[1] Obtaining a solution to these models, however, typically requires the modeler to assume adjustments to fiscal policy counterfactual to the proposal in order to keep public debt on the sustainable path implied by the government's intertemporal budget constraint. Auerbach (2005), Elmendorf (2015), Gale and Samwick (2017), and Auerbach et al. (2017) emphasize that these fiscal closing assumptions may induce economic behavior unrelated to the policy proposal, as the models typically used for policy analysis do not exhibit the Ricardian equivalence property. While Diamond and Moomau (2003), Altshuler et al. (2005), Congressional Budget Office (2005), and Joint Committee on Taxation (2006a, 2006b) provide evidence that budget-window projections of macroeconomic activity following a tax policy change are sensitive to alternative fiscal instruments used for the closing assumption, there is little evidence that exists to show how well the within-budget-window bias associated with a particular fiscal instrument can be mitigated.

The purpose of this article is to provide a quantitative assessment of the within-budget-window effects associated with alternative fiscal instruments used by modelers to obtain long-run fiscal sustainability and the extent to which the bias associated with each particular fiscal instrument can be mitigated.[2] Since a goal of policy analysis is to model a current proposal as closely as possible to the legislation as written, which generally does not provide future guidance for resolving long-run fiscal imbalances, we choose to examine the use of two nondistortionary fiscal instruments for adjustment: lump-sum net transfer payments and nonvalued government consumption. As these fiscal instruments are commonly used (Zodrow and Diamond 2013; Page and Smetters 2016; DeBacker, Evans, and Phillips 2019; Moore and Pecoraro 2020), our assessment aims to provide for increased confidence in budget-window analyses that attempt to mitigate the bias introduced by fiscal closing assumptions.

In our analysis, we use the overlapping generations model of Moore and Pecoraro (2020), henceforth referred to as MP-OLG, to repeatedly simulate a tax policy change, each time varying only the fiscal instrument used for

adjustment and the implementation timing of the closing assumption. We find that while quantitative differences in key macroeconomic aggregates and prices projected over the budget window can be observed across alternative fiscal instruments, these differences tend to shrink as the closing date is delayed. The choice of a fiscal instrument to be used for adjustment therefore becomes less important for the analysis, given that debt is on a sustainable path, because forward-looking agents discount the future when making current decisions.

Fiscal Sustainability

The Government's Budget Constraint

In the class of dynamic general equilibrium models with rational, forward-looking agents, the government typically faces a recursive budget constraint of the form:

$$TR_t + G_t = T_t + B_{t+1} - (1 + \rho_t)B_t, \tag{1}$$

where TR_t denotes lump-sum net transfers to households, G_t is government consumption expenditures, T_t is tax revenue, and B_t is the stock of public debt which is serviced at a rate of interest ρ_t. Equation (1) determines the path of debt for a given sequence of $\{TR_{t+i}, G_{t+i}, T_{t+i}, \rho_{t+i}\}_{i=0}^{\infty}$. Since forward-looking agents condition on this information when making current decisions, public debt must be on "sustainable" path such that the sequence of revenues and outlays allow for the debt to be serviced over an infinite horizon.

Budgetary implications associated with a sustainable debt path can be shown by performing recursive substitutions of equation (1) and allowing time to approach infinity:

$$\lim_{k\to\infty} \sum_{i=0}^{k-1} \left(\frac{TR_{t+i} + G_{t+i}}{\prod_{s=0}^{i}(1+\rho_{t+s})} \right) = \lim_{k\to\infty} \sum_{i=0}^{k-1} \left(\frac{T_{t+i}}{\prod_{s=0}^{i}(1+\rho_{t+s})} \right) - B_t + \lim_{k\to\infty} \frac{B_{t+k}}{\prod_{s=0}^{k-1}(1+\rho_{t+s})}.$$

Ruling out explosive debt paths requires:

$$\lim_{k\to\infty} \frac{B_{t+k}}{\prod_{s=0}^{k-1}(1+\rho_{t+s})} = 0, \tag{2}$$

so that debt cannot indefinitely grow at rate larger than its rate of interest along any sustainable debt path. Satisfaction of the no-Ponzi condition (2) implies the following intertemporal government budget constraint:

$$\sum_{i=0}^{\infty}\left(\frac{TR_{t+i}+G_{t+i}}{\prod_{s=0}^{i}(1+\rho_{t+s})}\right)=\sum_{i=0}^{\infty}\left(\frac{T_{t+i}}{\prod_{s=0}^{i}(1+\rho_{t+s})}\right)-B_t. \qquad (3)$$

Although the government's budget can be in total deficit or surplus in any given period, equation (3) implies that the present discounted value of tax receipts net of the debt position at time t must be sufficient to finance the present discounted value of outlays in any feasible equilibrium.

The Fiscal Closing Assumption

A tax policy change that is not revenue neutral will alter the present discounted value of receipts on the right-hand side of equation (3). If the policy-induced change to cumulative deficits implies that debt will indefinitely grow at a rate larger than its rate of interest and therefore violate equation (2), there must be a compensating adjustment to some fiscal instrument so that equation (3) holds. While this adjustment may in principle occur through any fiscal instrument available to the government, it is common practice for the modeler to choose either lump-sum net transfers or nonvalued government consumption expenditures. This involves the respecification of $\{TR_{t+i}, G_{t+i}\}_{i=0}^{\infty}$ in some fashion not specified in the actual policy proposal under analysis.

A change to either fiscal instrument for purposes of achieving debt sustainability will be internalized by all agents either directly through their individual budget constraint or indirectly through general equilibrium and thereby introduce counterfactual behavior into the analysis. A change in net transfer payments will alter the present discounted value of lifetime income anticipated by those households receiving them in the initial equilibrium. This may introduce a nonnegligible income effect to these households, who would respond by altering their savings or labor supply plans. A change in government expenditures, on the other hand, will alter the quantity of final goods purchased. This may induce a nonnegligible change in the rate of capital accumulation, as firms would desire to use a different quantity of capital in combination with labor when production levels change in response to the change in government expenditures. Thus, the projected macroeconomic activity over the budget window will therefore depend not only on the tax policy being modeled but also on the fiscal closing assumption chosen.

Simulations

Model and Policy Experiment

The MP-OLG model is a large-scale overlapping generations model developed specifically for the macroeconomic analysis of tax policy proposals. Since the modeling framework, calibration, and solution algorithm used for the analysis in this article is completely specified in Moore and Pecoraro (2020), details are omitted here for brevity. The core characteristics of the MP-OLG model are common to general equilibrium models of this class, such as those in Nelson et al. (2019): finitely lived cohorts of households make labor supply, saving, and consumption choices, discounting utility generated by future choices relative to current choices. Firms demand labor and private productive capital each period for production and sale of an output good that can be transformed by households into a consumable good or a return-bearing financial asset. Taxes are collected on income by a government and, along with public bond issues, are used to finance expenditures and transfer payments. These outlays typically include lump-sum net transfer payments to households[3] and nonvalued government consumption expenditures.

A distinguishing feature of the MP-OLG model is the incorporation of an internal tax calculator that explicitly models major provisions in the Internal Revenue Code to determine federal taxes on household income. Each household is aware of the degree to which their income, tax-preferred consumption choices, and household demographics affect their tax liability. The multiple dimensions of household heterogeneity present in the model—age, labor productivity, family composition, wealth endowments, and residential choice—allow this detailed tax system to reflect a reality where many households do not pay federal income tax while receiving refundable credits (Joint Committee on Taxation 2019), and effective marginal tax rates are not monotonically increasing in labor income due to the phase-in and -outs of various tax provisions (Congressional Budget Office 2019). This contrasts with the tax treatment of household income typically specified in overlapping generations models, where smooth tax functions are used to approximate the federal income tax system.[4]

Using the MP-OLG model, we repeat a tax policy change performed in Moore and Pecoraro (2020). We simulate a permanent 10 percent reduction in the US federal statutory tax rates applied to ordinary income—which includes wage income, interest income, short-term capital gains, nonqualified dividends, and pass-through business income—relative to 2018 present tax law, assuming that any expiring tax provisions in our steady-state

baseline are permanent. The policy change is unanticipated by agents, after which time all agents are assumed to have perfect foresight regarding both future fiscal policy and economic conditions. We repeatedly simulate this policy change, varying only the fiscal instrument and implementation timing of the closing assumption imposed: adjustments using 100 percent lump-sum net transfer payments and 100 percent nonvalued government consumption expenditures are made in turn contemporaneously with the policy change in year 1, as well as in years 11, 21, and 31 following the policy change. In each case, we allow adjustment to occur in a linearly decreasing fashion over ten years following the specified closing date.

The two fiscal instruments used to obtain long-run fiscal balance in our analysis were chosen because they are nondistortionary and support the goal of deviating from the proposed policy change as little as possible. Alternatively, distortionary income tax changes may be used for the fiscal closing assumption.[5] Given the complicated system of household income taxation in the MP-OLG model, there exist many combinations of changes to statutory rates, deductions, and credits that can be made to obtain long-run fiscal balance. Results using an arbitrarily chosen income tax change to close the model may therefore not be generalizable to other overlapping generations models, which vary in the specification of income tax detail.

Results and Discussion

Tables 1 and 2 show the responses of key macroeconomic variables due to the tax policy change where lump-sum net transfer payments and nonvalued government consumption expenditures are used in turn as the fiscal instrument for adjustment. These responses are expressed as average annual percent changes relative to the present-law baseline over the ten-year budget window.[6] For ease of comparison, we highlight cases where these absolute differences are greater than 0.1 percentage points.

We note two important patterns. First, the response of aggregates is qualitatively consistent across all eight fiscal closing assumptions. In each case, the policy change is projected to increase economic activity in labor, capital, and product markets while generating a large loss in tax revenue. Second, there are large quantitative differences in the response of aggregates across fiscal instruments when the fiscal closing assumption is imposed shortly after the policy change, such as in years 1 and 11. We refer to these differences as the "bias" associated with each particular fiscal closing instrument.

Table 1. Fiscal Closing with Lump-Sum Transfers.

Ten-year Average Annual Percent Change Relative to Present-law Baseline	Year Fiscal Closing Imposed			
	1	11	21	31
Aggregates				
Output	1.6	1.5	1.4	1.3
Productive capital stock	1.4	1.1	0.8	0.7
Effective labor supply	1.7	1.7	1.6	1.6
Market consumption	−0.1	−0.0	−0.1	−0.1
Housing capital stock	−0.5	−0.3	−0.4	−0.4
Federal tax revenue	−2.7	−2.9	−3.0	−3.1
Prices				
Real return to capital	−0.1	0.2	0.3	0.4
Real wage rate	−0.1	−0.3	−0.3	−0.3

Note: Highlighted cells indicate an absolute difference greater than 0.1 percent from the corresponding average of the two alternatives.

Table 2. Fiscal Closing with Government Expenditures.

Ten-year Average Annual Percent Change Relative to Present-law Baseline	Year Fiscal Closing Imposed			
	1	11	21	31
Aggregates				
Output	1.3	1.3	1.2	1.3
Productive capital stock	1.3	0.7	0.7	0.7
Effective labor supply	1.4	1.6	1.5	1.5
Market consumption	−0.0	−0.3	−0.1	−0.2
Housing capital stock	−0.3	−0.4	−0.4	−0.5
Federal tax revenue	−3.0	−3.0	−3.1	−3.0
Prices				
Real return to capital	−0.1	0.4	0.4	0.3
Real wage rate	−0.1	−0.3	−0.3	−0.3

Note: Highlighted cells indicate an absolute difference greater than 0.1 percent from the corresponding average of the two alternatives.

The quantitative differences in the projections arise because each fiscal instrument induces additional behavioral responses from counterfactual policy assumptions. Consider the results in table 1 where net transfer payments to households decrease to stabilize the path of debt: effective labor supply is relatively high due to an income effect as there is an anticipated reduction in households' present discounted value of lifetime income. Since

this raises the marginal product of capital, more business capital investment occurs. As a result, aggregate output increases by relatively more when fiscal closing is imposed in earlier years than in later years. Similarly, consider the results in table 2 where government consumption expenditures decrease to achieve fiscal sustainability: the increase in business capital is relatively smaller, which reflects the reduced production of output in response to less government purchases.

Our main finding, evident from a comparison of tables 1 and 2, is that the bias associated with each particular fiscal instrument tends to weaken on average over the ten-year budget window the further that the fiscal closing date is pushed into the future. Figure 1 shows the extent to which this result holds on an annual basis for aggregate output and the private inputs to the aggregate production function—the productive capital stock and effective labor supply. As with the ten-year averages, the annual absolute percentage point differences in policy-induced responses across fiscal instrument tend to shrink the further into the future that fiscal closing is imposed. This result occurs because households who discount future utility give less weight to the effects of future fiscal policy when making current decisions and zero weight to effects occurring after their lifetime. As the fiscal closing date is delayed, provided debt remains on a sustainable path, the additional economic activity induced by each fiscal instrument becomes less important for decisions made over the budget window.

As an alternative to using 100 percent net transfer payments or government consumption as the fiscal instrument for adjustment, we also report results using both fiscal instruments simultaneously in table 3 where each instrument finances half of the necessary adjustment. Cases where the absolute difference from the corresponding average of the two previous alternatives is greater than 0.1 percentage points are highlighted in gray. Our results show that, when imposed at a given time after the budget window, this hybrid fiscal closing assumption generates aggregate responses that are good approximations of a simple average of the alternative two assumptions.

The extent to which fiscal closing can be delayed depends on both the model's baseline calibration of the government's fiscal position and the size of the deficit or surplus effect particular to the policy change. For example, using the MP-OLG model, we cannot simulate the policy analyzed here while imposing fiscal closing in year 41 with either fiscal instrument. With the model's initial baseline calibrated to target the relative size of 2018 present-law US federal tax revenues, net transfer payments, public investment, and public debt and debt servicing costs, there are not sufficient

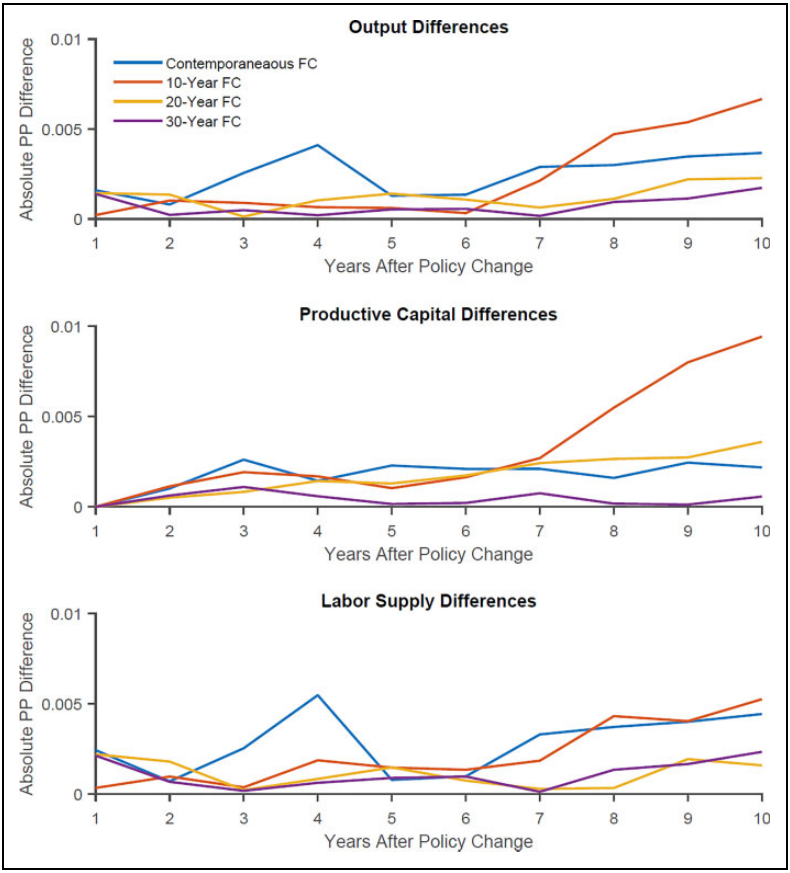

Figure 1. Absolute percentage point differences in aggregates under different fiscal closing assumptions.

resources available to return debt to a sustainable path following four decades of debt financing for this particularly large policy change.[7]

Our findings obtain when households discount future utility while making current decisions. A caveat may apply to specifications where households care relatively more about the future than the present. This occurs if, for example, households are assigned subjective discount factors in excess of unity inclusive of mortality risk. In such a case, delay of the fiscal closing date further into the future can more strongly influence the current behavior of households, therefore weakening the ability to

Table 3. Fiscal Closing with 50 Percent Lump-Sum Transfers and 50 Percent Government Expenditures.

Ten-year Average Annual Percent Change Relative to Present-law Baseline	Year Fiscal Closing Imposed			
	1	11	21	31
Aggregates				
Output	1.7	1.4	1.3	1.3
Productive capital stock	1.4	0.9	0.8	0.8
Effective labor supply	1.8	1.6	1.6	1.6
Market consumption	−0.1	−0.0	−0.1	−0.2
Housing capital stock	−0.5	−0.3	−0.4	−0.4
Federal tax revenue	−2.6	−3.1	−3.0	−3.0
Prices				
Real return to capital	−0.0	0.3	0.4	0.4
Real wage rate	−0.2	−0.3	−0.3	−0.3

Note: Highlighted cells indicate an absolute difference greater than 0.1 percent from the corresponding average of the two alternatives.

mitigate the bias associated with a particular fiscal closing instrument within the budget window.

Conclusion

This article has examined the effects of different fiscal closing assumptions on budget-window projections of macroeconomic activity following a change in tax policy, assessing the extent to which the bias associated with a particular fiscal instrument adjusted to maintain long-run fiscal balance can be mitigated. Focusing on two commonly used fiscal instruments—lump-sum net transfer payments and nonvalued government consumption—we have found that the quantitative differences in projections across fiscal instruments tend to shrink as the fiscal closing date is delayed. This result implies that the choice of fiscal instrument used to achieve the fiscal sustainability implied by the government's intertemporal budget constraint becomes less important for the budget-window policy analysis as the closing date is pushed further into the future.

The mechanism which drives our findings is the behavior of forward-looking agents who discount future utility when making current decisions. Since this is a common characteristic of macroeconomic models, we expect our findings to be generally relevant for other models that require long-run fiscal balance. To the extent that the bias associated with the choice of a

particular fiscal instrument is mitigated by delay of the fiscal closing date, our assessment provides for increased confidence in budget-window analyses produced by such models.

Authors' Note

This research embodies work undertaken for the staff of the Joint Committee on Taxation, but as members of both parties and both houses of Congress comprise the Joint Committee on Taxation, this work should not be construed to represent the position of any member of the Committee. This work is integral to the Joint Committee on Taxation staff's work and its ability to model and estimate the macroeconomic effects of tax policy changes. Any errors are our own.

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Notes

1. The "budget window" is at present the immediate ten-year period over which the budgetary effects of US federal tax and spending changes are measured. For budget-window macroeconomic analyses of the recently enacted PL 115-97 "Tax Cuts and Jobs Act" using such models, see Joint Committee on Taxation (2017), Penn Wharton Budget Model (2017), and DeBacker, Evans, and Phillips (2019).
2. Leeper and Yang (2008) explore a related but distinct line of inquiry focused on how the long-run macroeconomic transition across steady states depends on alternative financing schemes.

3. In our context, a decrease (an increase) in lump-sum net transfer payments to households can be interpreted either as a decrease (an increase) in lump-sum transfers or an increase (a decrease) in lump-sum taxes to households.
4. The smooth tax functions used in Bénabou (2002) and Gouveia and Struass (1994) are among those commonly used to approximate the federal income tax system. See Guner, Kaygusuz, and Ventura (2014) for a survey.
5. As some combination of distortionary and nondistortionary fiscal instruments may be used to resolve any future fiscal imbalances induced by a current policy change, they will have implications for economic activity and efficiency outside of the budget window. Attempting to incorporate the variety of potential responses of future lawmakers for this purpose is beyond the scope of this article.
6. The average annual percentage change in the level of economic aggregate over the ten-year budget window is a common reporting convention of government scoring agencies (see, e.g., Joint Committee on Taxation 2017).
7. The possibility of sovereign debt default has been ruled out by assumption in the overlapping generations model of Moore and Pecoraro (2020). See Evans, Kotlikoff, and Phillips (2013) for incorporating sovereign debt default as an alternative long-run state to fiscal sustainability.

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