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Dynamic Scoring of Tax Plans

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This paper gives an overview of the methodology behind the short- and long-run dynamic scoring of tax plan proposals by the Tax Policy Center in conjunction with the Penn-Wharton Budget Model. Following the practice of official government estimators, we use a Keynesian model to estimate the short-term effects of policy changes on output relative to its full-employment level. That model assumes tax policy can influence the economy by changing the demand for goods and services. For example, a tax cut could encourage consumers to spend more and businesses to invest more, raising demand and thus total employment. In the long-run, demand-side stimulus is ineffective because we assume the economy returns to full employment. We estimate the long-run effects on potential output using the Penn Wharton Budget Model, which reflects how taxes can affect incentives to work, save, and invest. The model also reflects the effects of budgetary policies on interest rates and the resultant effects on investment decisions.

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INTRODUCTION

The Urban-Brookings Tax Policy Center (TPC) has partnered with the Penn Wharton Budget Model (PWBM) to develop new dynamic scoring estimates of tax proposals. This approach makes it possible to estimate how tax policy affects the national economy and how changes in the national economy, in turn, affect federal revenues. TPC and PWBM have produced short- and long-run estimates of the economic and revenue effects of the tax plans of Hillary Clinton and Donald Trump, as well as the "Better Way" blueprint of the House Republicans. Those analyses are described in separate documents. This paper explains our methodology for dynamic scoring.

HOW DOES DYNAMIC SCORING DIFFER FROM TPC'S USUAL ANALYSIS?

TPC uses its large-scale microsimulation model to estimate the revenue effects of tax policy changes. Those "conventional" revenue estimates reflect changes in microeconomic behavior, such as consumption of taxed goods or capital gains realizations, but exclude macroeconomic responses, such as changes in the size of the economy, the overall price level, investment, and employment.

Dynamic scoring expands conventional analysis by incorporating the macroeconomic effects of policy proposals.[1] For example, reducing marginal tax rates on labor earnings may encourage people to work more, thereby increasing overall labor supply and output. Or, a policy that increases deficits may push up interest rates and crowd out private capital investment, lowering the capital stock and output. Macroeconomic changes in turn can affect revenues, because changes in output generally imply changes in taxable incomes.

In theory, by incorporating macroeconomic effects, dynamic scoring could improve revenue forecasts. However, predicting economic effects requires us to make assumptions about very uncertain economic relationships and behavioral responses. For our base case estimates, TPC and PWBM have incorporated assumptions that we consider to lie within the central range of opinion of economists. However, we also show how alternative assumptions, reflecting the (sometimes wide) range of uncertainty about key parameters, can affect the estimates.

We find that our approach to dynamic estimates generally has limited impact on our revenue estimates, compared with our conventional analysis. Tax policies that result in large revenue losses when estimated conventionally typically result in large revenue losses when estimated dynamically, using our models and the range of assumptions that we consider reasonable. Plus, dynamic analysis takes additional time and introduces additional uncertainty. In

[1] Conventional revenue estimates do include so-called micro-dynamic effects from changes in the marginal tax rates, which reflect changes in the incentives to claim deductions and/or report taxable income. Micro-dynamic responses would not, however, include any overall change in the labor supply or output

addition, conventional scoring is the method most often used by the Joint Committee on Taxation, the official government scorekeeper for tax legislation. For those reasons, conventional scoring remains an important tool in evaluating tax policy, and TPC will continue to display traditional analysis alongside dynamic estimates.

HOW TPC AND PWBM DYNAMICALLY SCORED THE TAX PLANS

To estimate macroeconomic effects, analysts generally rely on models of the economy—equations that represent economic relationships. Those models attempt to capture the effects that policy changes may have on such activities as household consumption, labor supply, and business investment. Changes to those activities affect the economy and, in turn, revenues.

Different economic models can capture different types of effects on the economy. For our analysis, we include results from two different models: TPC's Keynesian model that captures short-run effects on aggregate demand, and PWBM's overlapping generations (OLG) model that captures longer-term effects on the economy's potential output.

The two models use different approaches in producing estimates. The Keynesian model consists of equations that relate aggregate variables such as consumption, investment, and output. Those relationships are based largely on how those variables have behaved in the past. Qualitatively, the predictions of the Keynesian model are fairly simple: policies such as tax cuts that increase aggregate demand are estimated to boost output, while policies such as tax increases have the opposite effect. The effects on output estimated using the Keynesian model can be viewed as shifts in actual output relative to its potential level—shifts that would result in changes in the unemployment rate, for example.

By contrast, the PWBM assumes full employment for those who choose to work and is based on choices by households of how much to work and save in order to maximize their well-being. Those households are forward-looking, so their choices depend on both current and future levels of wages and interest rates, as well as government policies. Because the PWBM incorporates forward-looking households, future policy changes can affect the current economy. However, in the PWBM output is always at its potential level and unemployment is always at its natural rate—the rate consistent with full employment and stable inflation—so the model is less well-suited to estimate short-term fluctuations in output.

Those different approaches can lead to very different results. The Keynesian model, for example, shows that tax policies that increase the deficit will tend to boost economic output, all else being equal, because they increase aggregate demand. By contrast, the OLG model shows that policies that increase the deficit dampen output in the absence of other changes in marginal incentives to work, save, or invest because higher deficits crowd out investment in productive capital goods.

The details of the model are discussed further in the appendixes.

APPENDIX A

THE SHORT-RUN KEYNESIAN MODEL

The Keynesian model assumes tax policy can influence the economy by changing the overall demand for goods and services. For example, cutting tax rates increases after-tax income; consumers spend some of that extra income, increasing demand. Businesses boost hiring to meet the additional demand, which raises total output (GDP) and taxable incomes. This demand increase typically has the greatest impact on economic output in the first few years after a policy change until actions of the Federal Reserve (Fed) and the normal equilibrating forces in the economy return output to its full employment level. In contrast, long term output is determined by the economy's potential—a function of labor supply, capital stock, and productivity.

The Tax Policy Center's Keynesian model estimates both direct and indirect effects:

1. **Direct effects:** We first estimate the direct effect of tax policy changes on demand, based on the size and distribution of the proposed changes. The distribution of tax changes is important because different households adjust their spending behavior by varying amounts in response to any change in after-tax income. For instance, lower-income households are likely to spend more of a tax cut than higher-income households. This pattern can be described using the marginal propensity to consume: the fraction of each additional dollar that is spent instead of saved. Based on a review of economic research we assume that the marginal propensity to consume declines from 0.9 for the lowest quintile of households, to 0.55 for the top 0.1 percent.[2] Direct effects also include changes in business investment. For example, a plan that allows firms to expense their investments would increase the incentive to purchase capital goods such as factories or computers.

2. **Indirect effects:** Indirect effects can either increase or offset the direct effects of a tax policy on demand. For example, when households spend more, businesses may increase hiring or investment, further raising economic output and incomes of wage earners and investors. Or, growing demand may lead to higher interest rates, which reduce capital investment. The direction and magnitude of these indirect effects depend on the monetary policy response to the tax changes. When the economy is near full employment, the Fed is likely to respond to higher spending by raising interest rates to reduce demand in order to keep inflation in check. Higher rates would reduce demand for investment and durable goods, offsetting some of the direct effects of a change in tax policy.

[2] These assumptions are broadly similar to those used by the Congressional Budget Office in its fiscal policy analysis.

The Keynesian model assumes that in 2017 the Fed would adjust interest rates to offset changes in demand, but by a smaller amount than usual because interest rates are already almost as low as they can be, and the Fed's desired future path for rates appears uncertain.[3] As a result, the direct effects of a tax change would be reduced by about a sixth. In later years, the model assumes a full monetary response, implying that indirect effects would reduce the impact of the direct effects by half.[4]

[3] The Fed has raised the federal funds rate above the zero rates that prevailed during and after the Great Recession, but has since held that rate steady at between 0.25 and 0.5 percent, With rates near zero, the Fed is less likely to respond to fiscal policy with changes in rates—especially if those fiscal policies reduce aggregate demand.
[4] This matches the central assumption used by the Congressional Budget Office for the size of indirect effects.

APPENDIX B

THE PENN WHARTON OVERLAPPING GENERATIONS BUDGET MODEL

Penn Wharton's overlapping generations model *simulates* the economic and budgetary outcomes that result from household decisions about how much to work and save over their lifetimes. Households are assumed to differ in working ability and to face uncertain wages and longevity. They make their decisions based on current and anticipated future economic conditions (such as wages and interest rates) and government policies (such as marginal tax rates). The PWBM OLG model allows users to select different levels of responsiveness to after-tax wages and rates of return on saving by altering labor supply and savings elasticities. Labor and capital markets determine the wages and the rental rate of capital that clear those markets. The model produces various outputs related to the economy as well as the federal budget.

Capital is allowed to flow internationally based on user-controlled parameter settings. At one extreme, no capital is assumed to flow internationally, consistent with a "closed economy" setting. At the other extreme, capital flows can be assumed to be very robust, consistent with a "small open economy" setting. In reality, by holding almost a quarter of the world's capital stock, the US economy lies between these two extremes and is better thought of as a "large open economy," a setting that the user can also select.

The OLG model includes detailed modeling of salient government taxes and major programs like Social Security that have a first-order effect on household labor supply and savings decisions. Households face a progressive tax rate schedule on their taxable income, which is reduced by a deduction function (representing major exclusions as well as standard and itemized deductions) that varies by income and can be changed by policy. Taxable income includes wage income as well as pass-through capital income that is normally taxed at the household level. The corporate side is taxed based on domestically-earned income subject to salient tax provisions, including the percentage of new investment that businesses can expense. As a result, a change in tax rates and the percentage of investment that can be expensed can alter the value of existing capital relative to new capital investment (Tobin's q), thereby producing wealth effects. Corporate income is taxed at a flat effective rate that is smaller than the statutory rate, representing various tax preferences. The OLG model is being updated to take account of the cost to businesses of adjusting their investment spending, which will slightly reduce the speed at which new investment can be deployed.

Importantly, the model allows for unbalanced tax reforms. In the academic literature, tax-based OLG models are typically used to simulate the impact of different possible tax regimes that raise the same amount of revenue. This assumption, however, is not tenable for analyzing the tax plans considered here. Accordingly, the PWBM OLG model allows for the analysis of tax changes

that might increase or decrease debt held by the public. Except in the extreme case of a small open economy assumption, debt and capital compete to some degree for household savings, so more debt over time generally reduces the nation's capital stock and GDP. Because households, though, are forward looking, "exploding" debt paths can't be solved (households can't rationally expect outcomes that are infeasible). To avoid this problem, the model imposes a "closure rule" starting in 2040 that stabilizes the level of debt. In particular, government consumption is assumed to be reduced so the value of the debt-GDP ratio in 2040 that the model simulation estimates, is maintained indefinitely thereafter. (Different policies, therefore, can have different long-run debt levels, based on their 2040 debt-GDP value.) The closure rule, therefore, reduces the long-run negative effects on the capital stock that result from tax plans that produce more debt. In effect, the closure rule imposes policy changes that are not contained within the tax plan to prevent the debt path from exploding.

Allowing for tax reforms that alter the deficit often produces results that differ from those typically estimated using general equilibrium models, especially if international capital flows are not assumed to be as robust as is consistent with a small open economy. In particular, increasing debt, by reducing investment and output, can sometimes make the dynamic effects of tax cuts on revenues negative instead of positive over the long run. However, plan specifics matter. For example, a reduction in the corporate income tax rate rewards, in part, existing capital. This reform, therefore, can increase debt while only modestly affecting new investment. In contrast, an increase in expensing will have larger impact on the level of new investment even if it produces additional deficits.

The PWBM also aims to capture the short-run impact of policies. In the short run, policies have a direct impact through two primary channels. The life cycle, or permanent income hypothesis (PIH), channel implies that a tax cut will increase current consumption, current GDP, and household saving—the tax cut increases lifetime after-tax income and households spend some of that extra income and save the rest. However, some households, especially nearing retirement, could save a large portion of a wage tax reduction for retirement. (Older households, who are generally retired, will consume more of the tax savings immediately.) The impact on current consumption through the PIH channel, therefore, is most applicable for households who have enough savings before the tax cut to smooth their consumption over time.

As a result, the PIH channel would likely under predict immediate increases in consumption and GDP from a tax cut, because many households in economy are, in fact, liquidity constrained—they would like to borrow in order to increase their current consumption but are unable to do so, implying that they spend almost all their current income. Households with few assets, therefore, have a higher marginal propensity to consume out of an increase in income than those with less wealth. Accordingly, a second channel in the PWBM OLG model—liquidity constraints—captures the fact that many households would like to borrow against future resources, including wages or Social Security income (which is illegal to borrow against). A

broader-based tax cut in the PWBM, therefore, stimulates short-run consumption and GDP more than a narrow-based tax cut targeting savers.

The model also incorporates various labor market frictions. Workers face a fixed cost of working that produces lower labor participation for poorer and older households, consistent with the data. [5]

The PWBM dynamic OLG model is normally integrated with the PWBM stochastic microsimulation static model. However, for this collaboration, the PWBM dynamic model was integrated with the conventional revenue and marginal tax rates estimated by TPC using the TPC microsimulation model. Integration between the OLG dynamic and the TPC conventional analysis is achieved as follows. For each new policy alternative, the OLG model is first run in "static mode," where the effects of policies are incorporated while holding household savings and labor supply decision rules fixed. (For example, the static mode assumes that the labor supplied by households does not change even if a tax plan alters work incentives.) The OLG model is then run in "dynamic mode," which incorporates the effects of altered incentives on household savings and labor supply. Percentage changes in revenues are then calculated between the OLG static and dynamic modes. Those percentage deltas are then applied to the revenue estimates from the TPC microsimulations. Of course, the "levels" of economic variables in the dynamic OLG model and the TPC static model will differ. But the key identifying assumption is that the changes are robust to different static tax and revenue estimates coming from the TPC model. Overall, this approach captures both the inherent richness of microsimulation models along with the behavioral changes of the OLG environment.

On the PWBM website, the user can select from 256 different combinations of key parameter values, including the degree of international capital flow, the labor supply elasticity, the savings elasticity, and federal outlays. Justification for the allowable ranges of each parameter as well as their default settings can be found here.

The PWBM OLG model is calibrated using the following datasets: the Current Population Survey, the Panel Study of Income Dynamics, the Internal Revenue Service's Statistics of Income, the Social Security Administration's Public Use Files, the National Centers for Health Statistics Vital Statistics, the Bureau of Economic Analysis Integrated Macro Accounts, the Federal Reserve Board's Survey of Consumer Finances and Financial Accounts of the United States, the National Cancer Institute US Mortality Data, and the Bureau of Labor Statistics.

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[5] Economic research suggests that, even in slack labor markets, nominal wages tend not to decline. While this downward nominal wage rigidity is not yet operative in the model, simulations are generally checked to determine if nominal wages fall. This constraint does not appear to be material for the simulations reported. The model is being updated to add labor market matching costs, which will capture some of these labor market frictions in more detail.

White papers with more model details can be found here.

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