



Research

The Growth Impacts of Framework-Consistent Tax Reform

GORDON GRAY, DOUGLAS HOLTZ-EAKIN | NOVEMBER 10, 2017

Executive Summary

The authors specified a complete tax reform plan – the “AAF Plan” – consistent with the principles of the [Unified Framework for Fixing Our Broken Tax Code](#) (“Framework”) issued by the White House, House of Representatives, and Senate. The AAF Plan features:

- Strong pro-growth investment incentives in the form of immediate and permanent expensing of non-structures investment, a 20 percent corporate tax rate, and a 25 percent pass-through tax rate.
- A pro-competitive reform to territorial income taxation.
- Aggressive base broadening totaling over \$4 trillion over the 10-year budget window, yielding a static tax loss of roughly \$1 trillion.

EY evaluated the macroeconomic impacts of the AAF Plan using two alternative approaches: (a) an open-economy, overlapping generations model, and (b) a closed-economy, dynamic, stochastic general equilibrium model. It found that:

- The AAF Plan enhances investment, labor supply, real wages and economic growth. Of note, after-tax wages are projected to rise by slightly over 7 percent.
- The ultimate level of Gross Domestic Product (GDP) rises by between 2.4 and 3.7 percent; in some circumstances it could be as high as 4.5 percent.
- Growth generates revenue feedback of between \$660 and \$690 billion over 10 years.
- Sensitivity analyses indicate the revenue feedback could range from \$400 to \$890 billion.

The EY approaches can capture only changes in growth of the trend, supply-side of the economy. In practice, there will likely be shorter-run, rapid increases in economic growth as GDP rises above trend. In this sense, the estimates presented are conservative indicators of the growth consequences of the AAF Plan.

THE *Dynamic* SCORE

OF A PRO-GROWTH, BASE-BROADENING TAX REFORM PLAN

The Economic Benefits of Tax Reform



7.5%▲

INVESTING *more*

Investment will increase by 7.5% — **promoting future growth** and giving Americans the resources they need to be more productive.



7.2%▲

EARNING *more*

The after-tax wage rate will increase by 7.2%, **giving Americans more money for their labor.**



3.5%▲

LIVING *better*

Consumption will increase by 3.5%, with **more Americans enjoying the fruits of their labor** and reflecting enhanced prosperity.

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1. Introduction

A central component of the current debate over tax reform is its potential to raise capital investment, productivity, real wages, and the standard of living in the United States. One way to illuminate this issue is to undertake dynamic scoring of tax reform proposals, which reveals the growth effects of any legislation and the concomitant feedbacks on federal revenues and the budget.

This paper conducts such an exercise for the “AAF Plan.” The reform – specified prior to the release of the Jobs and Tax Cuts Act (JTCA) in the House of Representatives – is designed based on the [Unified Framework for Fixing Our Broken Tax Code](#) (“Framework”) issued by the White House, House of Representatives, and Senate. The approach to specifying the AAF Plan is laid out in Section 2, while details of the specification are in Section 3. Given the nature of this process, the AAF Plan should best be thought of as a close cousin to the JTCA and (likely) the soon-to-be released Chairman’s mark of the Senate Finance Committee.

AAF retained EY to conduct the actual scoring for three reasons. First, despite the obvious temptations, it is unwise to grade one’s own work. The goal is to get an independent gauge of the potential of the AAF Plan.

Second, if one undertakes his or her own modeling of a reform, then there is the possibility of iterating to mold the tax reform to the models’ strengths. EY simply took the AAF Plan and evaluated it. The results of that evaluation are contained in Tables 1 and 2; sensitivity analyses are presented in Appendix A. In each case, these tables were provided directly by EY and were not modified by AAF.

Finally, the approaches taken by EY closely resemble techniques used by the Joint Committee on Taxation (JCT) when doing dynamic scoring for federal budget purposes. Specifically, EY employs both an open-economy, overlapping-generations model and a dynamic, stochastic general equilibrium model. (EY provided Appendix B, a full description of the models.) The former features forward-looking decision making in a global setting and is useful for analyzing proposals that affect investment decisions in the presence of global capital flows. The latter captures the heterogeneity of the household sector that ranges from myopic to long-term planners.

2. Developing the AAF Plan

The starting point for the AAF Plan is the Framework as published and the recognition that the Fiscal Year 2018 budget resolution contains a reconciliation instruction that permits tax reform to lose up to \$1.5 trillion over the next 10 years. While the Framework was ambiguous on the duration of the ability to “expense” (immediately write off) capital expenditures, our approach was to make it immediate and permanent. Similarly, the corporate rate of 20 percent and pass-through rate of 25 percent are both permanent, but begin January 1, 2019. The provision provides a strong incentive for firms to invest in 2018 (and deduct at the current rate of 35 percent) while facing a reduced rate of taxation on the returns to investment. Therefore, the economic impact should be felt quickly.

To meet the \$1.5 limit on revenue losses, AAF chose to use all of the corporate tax expenditures identified by the JCT as base broadeners in addition to those specified in the Framework. AAF had identified the rough budgetary impact as part of its [Tax Reform Initiative Group](#). Without the benefit of a static scoring capability, we worried that this might be insufficient. So, in addition, the AAF Plan does not repeal the individual alternative minimum tax. This is a departure from the Framework, but yielded an EY estimate of a static loss of \$1.1 trillion.

The presence of a tax loss adds an additional consideration to the analysis. In the EY models, this loss has to be offset and the ratio of debt-to-GDP returned to its original level. Since this can be done in a variety of ways, it is necessary to standardize this offset. The results contain two variants: 1) reduce transfer payments between years 11 and 30 to offset the deficit (our preferred approach), and 2) raise individual income taxes between years 11 and 30 to provide the offset.

3. Details of the AAF Plan

The item-by-item details of the AAF plan are listed below.

Summary

Figure 1: Major Provisions

Individual Reforms

| Rate Structure | Income Range | | | Tax Rate |
|----------------------------------|------------------------------------------------------------------------------------------|-----------------------|-----------------------|----------|
| | Single Taxpayers | Married Taxpayers | Head of Household | |
| | 0-\$37,500 | 0-\$75,000 | 0-\$50,000 | 12 |
| | > \$37,500 -\$190,000 | > \$75,000 -\$230,000 | > \$50,000 -\$210,000 | 25 |
| | >\$190,000 | >\$230,000 | >\$210,000 | 35 |
| Standard Deduction | \$12,000 | \$24,000 | \$17,000 | |
| Child Tax Credit | \$1,500 total, \$1,000 refundable | | | |
| Dependent Credit | \$500 non-refundable | | | |
| Itemized Deductions | Eliminates all but mortgage interest, charitable donation and qualified medical expenses | | | |
| Personal and Dependent Exemption | Eliminated | | | |
| Estate and GST | Eliminated | | | |

Business Reforms

| | |
|-------------------|------------------------------------------------------------------|
| Corporate Rate | 20% (phased in) |
| Pass-Through Rate | 25% (phased in) |
| Corporate AMT | Eliminated |
| Expensing | Full expensing for qualifying property (excludes structures) |
| Business Interest | Limited to 30% of taxable income |
| Base Broadening | Eliminates many existing credits, deductions and other tax items |

International Reforms

| | |
|--------------------------------|----------------------------------|
| Participation Exemption System | 95% dividends received deduction |
|--------------------------------|----------------------------------|

| | |
|-----------------------------|------------------------------------------------------------------------------------------|
| Deemed Repatriation | 8.75% on cash or cash equivalents, 3.75 % on other deferred income; payable over 8 years |
| Other International Reforms | Base erosion protection measures and other key reforms to the international tax system |

Individual Tax Provisions

Individual Reforms

| Rate Structure | Income Range | | | Tax Rate |
|-----------------------------------|------------------------------------------------------------------------------------------|-----------------------|-----------------------|----------|
| | Single Taxpayers | Married Taxpayers | Head of Household | |
| | 0-\$37,500 | 0-\$75,000 | 0-\$50,000 | 12 |
| | > \$37,500 -\$190,000 | > \$75,000 -\$230,000 | > \$50,000 -\$210,000 | 25 |
| | >\$190,000 | >\$230,000 | >\$210,000 | 35 |
| Standard Deduction | \$12,000 | \$24,000 | \$17,000 | |
| Child Tax Credit | \$1,500 total, \$1000 refundable | | | |
| Dependent Credit | \$500 non-refundable | | | |
| Itemized Deductions | Eliminates all but mortgage interest, charitable donation and qualified medical expenses | | | |
| Personal and Dependent Exemptions | Eliminated | | | |
| Estate and GST | Eliminated | | | |

Tax Rates: This reform proposal assumes a 12 percent, 25 percent and 35 percent rate structure. The tax brackets are set forth in Table 1 and are indexed to chained consumer price index for all urban consumers (C-CPI-U).

Figure 2: Tax Brackets

| Income Range | | | Tax Rate |
|-----------------------|-----------------------|-----------------------|----------|
| Single Taxpayers | Married Taxpayers | Head of Household | |
| 0-\$37,500 | 0-\$75,000 | 0-\$50,000 | 12 |
| > \$37,500 -\$190,000 | > \$75,000 -\$230,000 | > \$50,000 -\$210,000 | 25 |
| >\$190,000 | >\$230,000 | >\$210,000 | 35 |

Standard Deduction: This reform proposal assumes a standard deduction of \$12,000 for single filers, \$17,000 for heads of households, and \$24,000 for married couples filing jointly.

Child Tax Credit (CTC): The proposal assumes a CTC of \$1,500, not indexed for inflation, with \$1,000 refundable. The proposal also assumes a new \$500 credit for dependents. Claimants of the refundable credit must provide a valid social security number.

Deduction for Mortgage Interest, Charitable Donations, Qualified Medical Expenses: The proposal retains

these provisions as under current law.

Other Deductions and Exemptions: The proposal eliminates all other itemized deductions and personal and dependent exemptions.

Estate and Generation-Skipping Tax (GST): The proposal eliminates the estate tax and GST.

Business Tax Provisions

Business Reforms

| | |
|-------------------|-------------------------------------------------------------|
| Corporate Rate | 20% (effective 1/1/19) |
| Pass-Through Rate | 25% (effective 1/1/19) |
| Corporate AMT | Eliminated |
| Expensing | Full expensing for qualifying property (exclude structures) |
| Business Interest | Limited to 30% of taxable income |
| Base Broadening | Many existing credits, deductions and other tax items |

Corporate Tax Rates: The proposal assumes a reduction in the corporation income tax to 20 percent by 1/1/2019.

Pass-Through Rates: The proposal creates a 25 percent tax rate for pass-through businesses effective 1/1/2019. This provision includes the “70/30” rule to minimize abuse.

Expensing: The proposal assumes full expensing for section 167 property.

Business Interest: The proposal limits interest deductions to 30 percent of adjusted taxable income and allows for carryforwards.

Additional Deductions and Credits: The proposal eliminates many existing credits, deductions, and other tax items. Provisions eliminated or assumed to be eliminated in the proposal, and other reforms: terminate clean renewable energy bonds and qualified energy conservation bonds; repeals section 48 incremental energy credit; repeals credit for electricity production from renewable resources; repeals credit for investment in advanced energy property; repeals deduction for expenditures on energy efficient commercial building property; repeals expensing of oil and gas exploration and development costs; repeals percentage depletion for oil and natural gas wells; repeals percentage depletion for coal and hard mineral fossil fuels; increases geological and small integrated geophysical amortization period for independent producers to seven years; amortization of air pollution control facilities; repeals credits for alternative technology vehicles; repeals exclusion of energy conservation subsidies provided by public utilities; repeals credit for plug-in electric vehicles; repeals expensing of exploration and development costs for nonfuel minerals; excess of percentage over cost depletion for nonfuel minerals; repeals expensing of timber-growing and reforestation expenses; special rules for mining reclamation reserves; imposes full tax on nuclear recommissioning reserve funds; repeals exclusion of contributions in aid of construction for water and sewer utilities; repeals exclusion of earnings of certain environmental settlement funds; repeals expensing of soil and water conservation expenditures, cost of raising dairy and breeding cattle, and costs of fertilizer and soil conditioner; repeals exclusion from income for cost-sharing payments; repeals

exclusion for cancellation of indebtedness income of farmers; repeals five-year carryback of net operating losses attributable to farming; repeals the rehabilitation credit; repeals the deferral of gain for non-dealer installment sales; repeals the deferral of gain on like-kind exchanges; amortization of business start-up expenses; exemption from imputed interest rules; special rules for magazine, paperback book, and record returns; repeals the completed contract rule method; repeals cash accounting, other than agriculture; repeals credit for employer-paid FICA on tips; repeals the deduction for income attributable to domestic production activities; credit for the cost of carrying tax-paid distilled spirits in wholesale inventories; ordinary gain or loss treatment for sale or exchange of Fannie Mae and Freddie Mac preferred stock by certain financial institutions; repeals last in, first out; repeals lower of cost method; specific identification for homogeneous products; election of gain or loss on sale or exchange of Brownfield property; income recognition rule for gain or loss from section 1256 contracts; inclusion of income arising from business indebtedness; eliminates expensing of section 179 property; taxes income from credit unions; expands pro-rata interest expense disallowance for company-owned life insurance; repeals small life insurance company taxable income adjustment; repeals special deduction for Blue Cross and Blue Shield companies; repeals tax-exempt status and election to be taxed only on investment income for small property and casualty insurance companies; interest rate and discounting period assumptions for revenue of property and casualty insurance companies; proration for property and casualty companies; deferral of tax on capital construction funds of shipping companies; repeals empowerment zone tax incentives; repeals New Markets tax credit; repeals District of Columbia tax incentives; repeals credit for Indian reservation employment; repeals rules for recovery zone economic development bonds (QZABs, QSCBs, and tribal economic development bonds); eliminates requirement that financial institutions allocate interest expense attributable to tax-exempt interest; repeals deduction for charitable contributions of companies; repeals provisions for employee stock ownership plans (ESOPs); deferral of taxation on spread on employee stock purchase plans; credit for disabled access expenditures; repeals credit for orphan drug research; premium subsidy on COBRA continuation coverage; tax credit for small businesses purchasing employee insurance; exclusion of disaster migration payments; exclusion of interest on public purpose state and local government bonds; repeals exclusion of interest on private activity bonds; limits net operating loss deduction to 90 percent of pre-net operating taxable income (no change to present-law carryback or carryforward rules).

International Tax Provisions

International Reforms

| | |
|--------------------------------|-------------------------------------------------------------------------------------------------|
| Participation Exemption System | 95% dividends received deduction |
| Deemed Repatriation | 8.75% on cash or cash equivalents, 3.75% on other deferred income; payable over 8 years |
| Other International Reforms | Includes base erosion protection measures and other key reforms to the international tax system |

Participation Exemption System: The proposal assumes moving to a participation exemption system for the taxation of foreign income through the adoption of a deduction for 95 percent of dividends received by domestic corporations from certain foreign corporations.

Treatment of Deferred Income: The proposal assumes a deemed repatriation, payable over 8 years, on deferred foreign income of 8.75 percent on cash or cash equivalents and 3.5 percent on all other income.

Other International Reforms: The proposal includes base erosion protection measures and other key reforms to the international tax system. These include: limitation on losses with respect to controlled foreign corporations; treatment of low-taxed foreign income as subpart F income; deduction for foreign-derived

intangible income derived from trade or business within the United States; transfer of intangible property to U.S. shareholders; elimination of inclusion of foreign-based company oil related income; inflation adjustment of *de minimis* exception for foreign-based company income; repeal of inclusion based on withdrawal of previously excluded subpart F income from qualified investment; modification of stock attribution rules for determining status as a controlled foreign corporation; elimination of requirement that a corporation must be controlled for 30 days before subpart F inclusions apply; permanent extension of look-through rule for controlled foreign corporations; denial of deduction for interest expense of U.S. shareholders who are members of worldwide affiliated groups with excess domestic indebtedness (30 percent of earnings before interest, tax, depreciation and amortization); limitation on income shifting through intangible property transfers; rules relating to certain related party amounts paid or accrued in hybrid transactions or with hybrid entities; repeal of section 902 indirect foreign tax credit, determination of section 960 credit on a current year basis; acceleration of election to allocate interest, etc., on a worldwide basis; rules related to source of income from sales of inventory determined solely on basis of production activities; prevention of avoidance of tax through reinsurance with non-taxed affiliates; taxation of passenger cruise gross income of foreign corporations and nonresident alien individuals; restriction on insurance business exception to passive foreign investment company rules; modification of limitation on earning stripping, and limitation on treaty benefits for certain deductible payments.

4. Results

The results are presented in Tables 1 and 2, which contain a blizzard of numbers. To focus the discussion, consider the final column (“Long run”) for the second panel (“Deficits financed by a reduction in transfer payments”). In Table 1, the DSGE model indicates that the AAF Plan raises work (labor supply) by 0.3 percent, the after-tax wage rate by 7.4 percent, capital stock and investment by 6.2 percent and consumption by 1.4 percent. In short, the incentives in the pro-growth tax reform deliver more work, better pay, and a higher standard of living.

The results in Table 2 are even stronger, likely due to the fact that the overlapping generations model is better suited to analyze forward-looking investment incentives and international capital flows.

An important issue is what fraction of the increase will occur within the 10-year budget window, particularly with respect to the budgetary impacts. In Table 1, \$689 billion of the \$1.1 trillion tax loss is offset by growth-related revenue, while in Table 2 the offset is \$661 billion. The relatively high revenue feedback (as shown in Appendix A, it reaches as high as \$890 billion under certain circumstances) likely reflects the very powerful and large pro-growth reforms.

Table 1. Estimated macroeconomic impacts of AAF tax reform plan using the EY DSGE model of the US economy

Percent change from current law baseline (unless otherwise stated)

| | | | | |
|--|--|-------------------------------------------------------------|--|-------------------------------------------------------|
| | | Deficits financed by an increase in individual income taxes | | Deficits financed by a reduction in transfer payments |
|--|--|-------------------------------------------------------------|--|-------------------------------------------------------|

| Macroeconomic indicator | 2018-22 | 2023-27 | 2017-27 | Long-run | 2018-22 | 2023-27 | 2017-27 | Long-run |
|--------------------------------|---------|---------|---------|----------|---------|---------|---------|----------|
| Gross domestic product | 1.2% | 2.0% | 1.6% | 1.8% | 1.2% | 2.0% | 1.6% | 2.4% |
| Consumption | -0.6% | -0.8% | -0.3% | 1.0% | -0.6% | -0.8% | -0.3% | 1.4% |
| Investment | 9.8% | 12.9% | 11.4% | 4.9% | 9.8% | 12.9% | 11.4% | 6.2% |
| Capital stock | 1.6% | 4.1% | 2.8% | 4.9% | 1.6% | 4.1% | 2.8% | 6.2% |
| After-tax wage rate | 0.9% | 1.1% | 1.0% | 2.1% | 0.9% | 1.1% | 1.0% | 7.4% |
| Labor supply | 1.6% | 2.5% | 2.0% | 0.1% | 1.6% | 2.5% | 2.0% | 0.3% |
| Job equivalents | 0.9% | 2.0% | 1.5% | 1.8% | 0.9% | 2.0% | 1.5% | 2.4% |
| Macroeconomic feedback (\$bil) | — | — | \$265 | — | — | — | \$265 | — |
| Excluding interest on debt | — | — | \$689 | — | — | — | \$689 | — |

Note: Macroeconomic impacts estimated with the EY QUEST Dynamic Stochastic General Equilibrium Model of the US Economy. In this model, tax policy affects the incentives to work, save and invest, and to allocate capital and labor among competing uses. Representative individuals and firms incorporate the after-tax return from work and savings into their decisions of how much to produce, save, and work. The estimates are for a tax reform plan as specified by the American Action Forum that includes the following major provisions: (1) a reduction of corporate income tax rate to 20%, (2) a reduction of the pass-through business income tax rate to 25% (applied to 30% of pass-through income with the remaining 70% of pass-through income taxed as wages), (3) permanent 100% bonus depreciation, (4) a limitation of net interest expenses to 30% of adjusted taxable income, (5) the repeal of the domestic production activities deduction, (6) a 95% dividend exemption, (7) a one-time toll tax on unrepatriated foreign earnings, (8) a consolidation of individual income tax brackets to 12%, 25%, and 35%, (9) an approximately doubling of the standard deduction, (10) repeal of personal exemptions, (11) an increase of the child tax credit to \$1,500, and (12) the repeal of all itemized deductions except for the home mortgage interest deduction, the deduction for charitable contributions, and the deduction for qualified medical expenses. Macroeconomic feedback takes into account (1) changes in revenue due to changes in economic activity, (2) interest payments on new debt, and (3) changes in interest payments on existing debt that is rolled over due to changes in interest rates. Two deficit financing simulations are presented for comparison. In the first simulation deficits beyond ten years are financed by a reduction in transfer payments from the federal government. The deficit reduction through individual income tax rates simulation allows deficits for 10 years after the policy change and then gradually increases individual income tax rates to reduce the debt-to-GDP ratio to the initial level in the long run. Because households in the DSGE model have limited foresight, they have a very small reaction inside the budget window to the deficit reduction and rate increases that will eventually

occur in the long run. It is estimated, on a conventional basis, that the policy will reduce revenue \$1.1 trillion over the budget window.

Source: EY analysis.

Table 2. Estimated macroeconomic impacts of AAF tax reform plan using the EY OLG model of the US economy

Percent change from current law baseline (unless otherwise stated)

| Macroeconomic indicator | Deficits financed by an increase in individual income taxes | | | | Deficits financed by a reduction in transfer payments | | | |
|--------------------------------|-------------------------------------------------------------|---------|---------|----------|-------------------------------------------------------|---------|---------|----------|
| | 2018-22 | 2023-27 | 2017-27 | Long-run | 2018-22 | 2023-27 | 2017-27 | Long-run |
| Gross domestic product | 1.3% | 1.8% | 1.6% | 2.8% | 1.3% | 1.8% | 1.5% | 3.7% |
| Consumption | -1.0% | 0.5% | -0.3% | 2.5% | -1.0% | 0.5% | -0.2% | 3.5% |
| Investment | 11.8% | 8.3% | 10.0% | 6.4% | 11.6% | 8.1% | 9.9% | 7.5% |
| Capital stock | 1.1% | 2.5% | 1.8% | 6.4% | 1.1% | 2.5% | 1.8% | 7.5% |
| After-tax wage rate | 1.8% | 3.0% | 2.4% | 3.9% | 1.8% | 3.0% | 2.4% | 7.2% |
| Labor supply | 1.3% | 1.1% | 1.2% | 0.1% | 1.3% | 1.1% | 1.2% | 0.8% |
| Job equivalents | 1.0% | 2.2% | 1.6% | 5.4% | 1.0% | 2.1% | 1.6% | 6.3% |
| Macroeconomic feedback (\$bil) | — | — | \$248 | — | — | — | \$237 | — |
| Excluding interest on debt | — | — | \$670 | — | — | — | \$661 | — |

Note: Macroeconomic impacts estimated with the EY QUEST Overlapping Generations Model of the US Economy. In this model, tax policy affects the incentives to work, save and invest, and to allocate capital and labor among competing uses. Representative individuals and firms incorporate the after-tax return from work and savings into their decisions of how much to produce, save, and work. The estimates are for a tax reform plan as specified by the American Action Forum that includes the following major provisions: (1) a reduction of corporate income tax rate to 20%, (2) a reduction of the pass-through business income tax rate to 25% (applied to 30% of pass-through income with the remaining 70% of pass-through income taxed as wages), (3) permanent 100% bonus depreciation, (4) a limitation of net interest expenses to 30% of adjusted taxable income, (5) the repeal of the domestic production activities deduction, (6) a 95% dividend exemption, (7) a one-time toll tax on

unrepatriated foreign earnings, (8) a consolidation of individual income tax brackets to 12%, 25%, and 35%, (9) an approximately doubling of the standard deduction, (10) repeal of personal exemptions, (11) an increase of the child tax credit to \$1,500, and (12) the repeal of all itemized deductions except for the home mortgage interest deduction, the deduction for charitable contributions, and the deduction for qualified medical expenses.

Macroeconomic feedback takes into account (1) changes in revenue due to changes in economic activity, (2) interest payments on new debt, and (3) changes in interest payments on existing debt that is rolled over due to changes in interest rates. Two deficit financing simulations are presented for comparison. The first simulation allows deficits for 10 years after the policy change and then implements across-the-board increases in individual income tax rates to reduce the debt-to-GDP ratio to the initial level over the following 20 years. The second simulation allows deficits for 10 years after the policy change and then adjusts government transfers to reduce the debt-to-GDP ratio to the initial level over the following 20 years. It is estimated, on a conventional basis, that the policy will reduce revenue \$1.1 trillion over the budget window.

Source: EY analysis.

Appendix A. Sensitivity analysis of AAF Tax Reform Plan

Table A1. Macroeconomic impact of tax reform plan using the EY QUEST DSGE Model: Aggressive Federal Reserve and low labor elasticity

Percent change from current law baseline (unless otherwise stated)

| Macroeconomic indicator | Deficits financed by an increase in individual income taxes | | | | Deficits financed by a reduction in transfer payments | | | |
|--------------------------------|-------------------------------------------------------------|---------|---------|----------|-------------------------------------------------------|---------|---------|----------|
| | 2018-22 | 2023-27 | 2017-27 | Long-run | 2018-22 | 2023-27 | 2017-27 | Long-run |
| Gross domestic product | 0.9% | 1.7% | 1.3% | 1.8% | 0.9% | 1.7% | 1.3% | 2.2% |
| Consumption | -0.8% | -0.3% | -0.6% | 0.9% | -0.8% | -0.3% | -0.6% | 1.2% |
| Investment | 9.0% | 11.9% | 10.5% | 4.8% | 9.0% | 11.9% | 10.5% | 6.0% |
| Capital stock | 1.5% | 3.8% | 2.6% | 4.8% | 1.5% | 3.8% | 2.6% | 6.0% |
| After-tax wage rate | 1.7% | 2.5% | 2.1% | 2.1% | 1.7% | 2.5% | 2.1% | 7.4% |
| Labor supply | 0.6% | 0.8% | 0.7% | 0.1% | 0.6% | 0.8% | 0.7% | 0.2% |
| Job equivalents | 0.7% | 1.7% | 1.2% | 1.8% | 0.7% | 1.7% | 1.2% | 2.2% |
| Macroeconomic feedback (\$bil) | — | — | \$159 | — | — | — | \$159 | — |

| | | | | | | | | | | |
|----------------------------|--|---|---|-------|---|--|---|---|-------|---|
| Excluding interest on debt | | — | — | \$565 | — | | — | — | \$565 | — |
| | | | | | | | | | | |

Note: Macroeconomic impacts estimated with the EY QUEST Dynamic Stochastic General Equilibrium Model of the US Economy. In this model, tax policy affects the incentives to work, save and invest, and to allocate capital and labor among competing uses. Representative individuals and firms incorporate the after-tax return from work and savings into their decisions of how much to produce, save, and work. The estimates are for a tax reform plan as specified by the American Action Forum that includes the following major provisions: (1) a reduction of corporate income tax rate to 20%, (2) a reduction of the pass-through business income tax rate to 25% (applied to 30% of pass-through income with the remaining 70% of pass-through income taxed as wages), (3) permanent 100% bonus depreciation, (4) a limitation of net interest expenses to 30% of adjusted taxable income, (5) the repeal of the domestic production activities deduction, (6) a 95% dividend exemption, (7) a one-time toll tax on unrepatriated foreign earnings, (8) a consolidation of individual income tax brackets to 12%, 25%, and 35%, (9) an approximately doubling of the standard deduction, (10) repeal of personal exemptions, (11) an increase of the child tax credit to \$1,500, and (12) the repeal of all itemized deductions except for the home mortgage interest deduction, the deduction for charitable contributions, and the deduction for qualified medical expenses. Macroeconomic feedback takes into account (1) changes in revenue due to changes in economic activity, (2) interest payments on new debt, and (3) changes in interest payments on existing debt that is rolled over due to changes in interest rates. Two deficit financing simulations are presented for comparison. It is estimated, on a conventional basis, that the policy will reduce revenue \$1.1 trillion over the budget window. In the first simulation deficits beyond ten years are financed by a reduction in transfer payments from the federal government. The deficit reduction through individual income tax rates simulation allows deficits for 10 years after the policy change and then gradually increases individual income tax rates to reduce the debt-to-GDP ratio to the initial level in the long run. Because households in the DSGE model have limited foresight, they have a very small reaction inside the budget window to the deficit reduction and rate increases that will eventually occur in the long run. The DSGE sensitivity simulations vary Federal Reserve response parameters that do not change long run outcomes. The sensitivity runs also vary labor supply response parameters. Because marginal income tax rates on labor in the long run individual income tax deficit reduction simulation are near their current law values there is little change to long run labor response. These two factors account for the near identical long run individual income tax deficit reduction results across the sensitivity simulations.

Table A2. Macroeconomic impact of tax reform plan using the EY QUEST OLG Model: Low values for key parameters

Percent change from current law baseline (unless otherwise stated)

| Macroeconomic indicator | Deficits financed by an increase in individual income taxes | | | | Deficits financed by a reduction in transfer payments | | | |
|-------------------------|-------------------------------------------------------------|---------|---------|----------|-------------------------------------------------------|---------|---------|----------|
| | 2018-22 | 2023-27 | 2017-27 | Long-run | 2018-22 | 2023-27 | 2017-27 | Long-run |
| Gross domestic product | 0.8% | 1.0% | 0.9% | 2.5% | 0.8% | 1.1% | 1.0% | 3.2% |

| | | | | | | | | | | |
|--------------------------------|--|-------|------|-------|------|--|-------|------|-------|------|
| Consumption | | -0.5% | 0.7% | 0.1% | 2.1% | | -0.5% | 0.6% | 0.0% | 2.9% |
| Investment | | 6.8% | 3.4% | 5.1% | 5.8% | | 6.9% | 4.0% | 5.4% | 6.7% |
| Capital stock | | 0.9% | 1.6% | 1.2% | 5.7% | | 0.9% | 1.6% | 1.2% | 6.6% |
| After-tax wage rate | | 1.9% | 2.9% | 2.4% | 6.3% | | 1.9% | 2.8% | 2.4% | 9.8% |
| Labor supply | | 0.8% | 0.7% | 0.7% | 0.2% | | 0.8% | 0.7% | 0.7% | 0.6% |
| Job equivalents | | 0.7% | 1.6% | 1.1% | 7.8% | | 0.6% | 1.6% | 1.1% | 8.8% |
| | | | | | | | | | | |
| Macroeconomic feedback (\$bil) | | — | — | -\$6 | — | | — | — | \$1 | — |
| Excluding interest on debt | | — | — | \$400 | — | | — | — | \$407 | — |
| | | | | | | | | | | |

Note: Macroeconomic impacts estimated with the EY QUEST Overlapping Generations Model of the US Economy. In this model, tax policy affects the incentives to work, save and invest, and to allocate capital and labor among competing uses. Representative individuals and firms incorporate the after-tax return from work and savings into their decisions of how much to produce, save, and work. The estimates are for a tax reform plan as specified by the American Action Forum that includes the following major provisions: (1) a reduction of corporate income tax rate to 20%, (2) a reduction of the pass-through business income tax rate to 25% (applied to 30% of pass-through income with the remaining 70% of pass-through income taxed as wages), (3) permanent 100% bonus depreciation, (4) a limitation of net interest expenses to 30% of adjusted taxable income, (5) the repeal of the domestic production activities deduction, (6) a 95% dividend exemption, (7) a one-time toll tax on unrepatriated foreign earnings, (8) a consolidation of individual income tax brackets to 12%, 25%, and 35%, (9) an approximately doubling of the standard deduction, (10) repeal of personal exemptions, (11) an increase of the child tax credit to \$1,500, and (12) the repeal of all itemized deductions except for the home mortgage interest deduction, the deduction for charitable contributions, and the deduction for qualified medical expenses. Macroeconomic feedback takes into account (1) changes in revenue due to changes in economic activity, (2) interest payments on new debt, and (3) changes in interest payments on existing debt that is rolled over due to changes in interest rates. Two deficit financing simulations are presented for comparison. In the first simulation deficits beyond ten years are financed by a reduction in transfer payments from the federal government. The deficit reduction through individual income tax rates simulation allows deficits for 10 years after the policy change and then gradually increases individual income tax rates to reduce the debt-to-GDP ratio to the initial level in the long run. It is estimated, on a conventional basis, that the policy will reduce revenue \$1.1 trillion over the budget window.

Table A3. Macroeconomic impact of tax reform plan using the EY QUEST DSGE Model:

Passive Federal Reserve and high labor elasticity

Percent change from current law baseline (unless otherwise stated)

| | | | |
|--|--|-------------------------------------------------------------|-------------------------------------------------------|
| | | Deficits financed by an increase in individual income taxes | Deficits financed by a reduction in transfer payments |
|--|--|-------------------------------------------------------------|-------------------------------------------------------|

| Macroeconomic indicator | 2018-22 | 2023-27 | 2017-27 | Long-run | 2018-22 | 2023-27 | 2017-27 | Long-run |
|--------------------------------|---------|---------|---------|----------|---------|---------|---------|----------|
| Gross domestic product | 1.4% | 2.3% | 1.9% | 1.8% | 1.4% | 2.3% | 1.9% | 2.5% |
| Consumption | -0.4% | 0.0% | -0.2% | 1.0% | -0.4% | 0.0% | -0.2% | 1.4% |
| Investment | 10.9% | 15.4% | 13.1% | 4.9% | 10.9% | 15.4% | 13.1% | 6.2% |
| Capital stock | 1.7% | 4.5% | 3.1% | 4.9% | 1.7% | 4.5% | 3.1% | 6.2% |
| After-tax wage rate | 1.5% | 2.5% | 2.0% | 2.1% | 1.5% | 2.5% | 2.0% | 7.4% |
| Labor supply | 1.1% | 1.4% | 1.3% | 0.1% | 1.1% | 1.4% | 1.3% | 0.4% |
| Job equivalents | 1.0% | 2.3% | 1.7% | 1.8% | 1.0% | 2.3% | 1.7% | 2.5% |
| Macroeconomic feedback (\$bil) | — | — | \$348 | — | — | — | \$348 | — |
| Excluding interest on debt | — | — | \$796 | — | — | — | \$796 | — |

Note: Macroeconomic impacts estimated with the EY QUEST Dynamic Stochastic General Equilibrium Model of the US Economy. In this model, tax policy affects the incentives to work, save and invest, and to allocate capital and labor among competing uses. Representative individuals and firms incorporate the after-tax return from work and savings into their decisions of how much to produce, save, and work. The estimates are for a tax reform plan as specified by the American Action Forum that includes the following major provisions: (1) a reduction of corporate income tax rate to 20%, (2) a reduction of the pass-through business income tax rate to 25% (applied to 30% of pass-through income with the remaining 70% of pass-through income taxed as wages), (3) permanent 100% bonus depreciation, (4) a limitation of net interest expenses to 30% of adjusted taxable income, (5) the repeal of the domestic production activities deduction, (6) a 95% dividend exemption, (7) a one-time toll tax on unrepatriated foreign earnings, (8) a consolidation of individual income tax brackets to 12%, 25%, and 35%, (9) an approximately doubling of the standard deduction, (10) repeal of personal exemptions, (11) an increase of the child tax credit to \$1,500, and (12) the repeal of all itemized deductions except for the home mortgage interest deduction, the deduction for charitable contributions, and the deduction for qualified medical expenses. Macroeconomic feedback takes into account (1) changes in revenue due to changes in economic activity, (2) interest payments on new debt, and (3) changes in interest payments on existing debt that is rolled over due to changes in interest rates. Two deficit financing simulations are presented for comparison. It is estimated, on a conventional basis, that the policy will reduce revenue \$1.1 trillion over the budget window. In the first simulation deficits beyond ten years are financed by a reduction in transfer payments from the federal government. The deficit reduction through individual income tax rates simulation allows deficits for 10 years after the policy change and then gradually increases individual income tax rates to reduce the debt-to-GDP ratio to the initial level in the long run. Because households in the DSGE model have limited foresight, they

have a very small reaction inside the budget window to the deficit reduction and rate increases that will eventually occur in the long run. The DSGE sensitivity simulations vary Federal Reserve response parameters that do not change long run outcomes. The sensitivity runs also vary labor supply response parameters. Because marginal income tax rates on labor in the long run individual income tax deficit reduction simulation are near their current law values there is little change to long run labor response. These two factors account for the near identical long run individual income tax deficit reduction results across the sensitivity simulations.

Table A4. Macroeconomic impact of tax reform plan using the EY QUEST OLG Model:

High values for key parameters

Percent change from current law baseline (unless otherwise stated)

| Macroeconomic indicator | Deficits financed by an increase in individual income taxes | | | | Deficits financed by a reduction in transfer payments | | | |
|--------------------------------|-------------------------------------------------------------|---------|---------|----------|-------------------------------------------------------|---------|---------|----------|
| | 2018-22 | 2023-27 | 2017-27 | Long-run | 2018-22 | 2023-27 | 2017-27 | Long-run |
| Gross domestic product | 1.9% | 2.7% | 2.3% | 3.3% | 1.8% | 2.6% | 2.2% | 4.5% |
| Consumption | -1.8% | 0.3% | -0.7% | 3.0% | -1.7% | 0.4% | -0.6% | 4.4% |
| Investment | 17.9% | 14.2% | 16.1% | 7.7% | 17.5% | 13.3% | 15.4% | 9.2% |
| Capital stock | 1.4% | 3.7% | 2.5% | 7.7% | 1.4% | 3.6% | 2.5% | 9.2% |
| After-tax wage rate | 1.8% | 3.2% | 2.5% | 3.3% | 1.8% | 3.1% | 2.5% | 6.5% |
| Labor supply | 1.9% | 1.7% | 1.8% | 0.1% | 1.8% | 1.6% | 1.7% | 0.9% |
| Job equivalents | 1.5% | 2.8% | 2.1% | 4.7% | 1.4% | 2.7% | 2.1% | 5.8% |
| Macroeconomic feedback (\$bil) | — | — | \$543 | — | — | — | \$511 | — |
| Excluding interest on debt | — | — | \$986 | — | — | — | \$960 | — |

Note: Macroeconomic impacts estimated with the EY QUEST Overlapping Generations Model of the US Economy. In this model, tax policy affects the incentives to work, save and invest, and to allocate capital and labor among competing uses. Representative individuals and firms incorporate the after-tax return from work and savings into their decisions of how much to produce, save, and work. The estimates are for a tax reform plan as specified by the American Action Forum that includes the following major provisions: (1) a reduction of corporate income tax rate to 20%, (2) a reduction of the pass-through business income tax rate to 25% (applied

to 30% of pass-through income with the remaining 70% of pass-through income taxed as wages), (3) permanent 100% bonus depreciation, (4) a limitation of net interest expenses to 30% of adjusted taxable income, (5) the repeal of the domestic production activities deduction, (6) a 95% dividend exemption, (7) a one-time toll tax on unrepatriated foreign earnings, (8) a consolidation of individual income tax brackets to 12%, 25%, and 35%, (9) an approximately doubling of the standard deduction, (10) repeal of personal exemptions, (11) an increase of the child tax credit to \$1,500, and (12) the repeal of all itemized deductions except for the home mortgage interest deduction, the deduction for charitable contributions, and the deduction for qualified medical expenses.

Macroeconomic feedback takes into account (1) changes in revenue due to changes in economic activity, (2) interest payments on new debt, and (3) changes in interest payments on existing debt that is rolled over due to changes in interest rates. Two deficit financing simulations are presented for comparison. In the first simulation deficits beyond ten years are financed by a reduction in transfer payments from the federal government. The deficit reduction through individual income tax rates simulation allows deficits for 10 years after the policy change and then gradually increases individual income tax rates to reduce the debt-to-GDP ratio to the initial level in the long run. It is estimated, on a conventional basis, that the policy will reduce revenue \$1.1 trillion over the budget window

Appendix B. The EY QUEST Overlapping Generations and Dynamic Stochastic General Equilibrium Models

The Joint Committee on Taxation (JCT) employs three different models to perform dynamic scoring. Each model presents a unique framework in which to consider the effects of tax policy on the US economy. The oldest model used by the JCT is the Macroeconomic Growth Model (MEG), which was developed by Joel Prakken of Macroeconomic Advisers. The JCT also leases an overlapping generations model (OLG) from Tax Policy Advisers. The most recently developed model, the dynamic stochastic general equilibrium (DSGE) model, was developed solely by economists at the JCT.

EY Quantitative Economics and Statistics (“EY QUEST”) has developed its own OLG and DSGE models for policy analysis. The EY QUEST OLG model builds upon the Auerbach and Kotlikoff (1984) and Fullerton and Rogers (1992) OLG models and also includes several of the enhancements developed by Diamond and Zodrow. The DSGE model relies on the input of a former JCT economist who worked extensively with and helped develop the JCT DSGE model.

EY QUEST Overlapping Generations General Equilibrium Model of the US Economy

The EY QUEST Overlapping Generations General Equilibrium Model of the US Economy (“EY QUEST OLG Model”) is similar to general equilibrium models that have been used by the Congressional Budget Office, JCT, and US Treasury Department.^[1] In this model, tax policy affects the incentives to work, save and invest, and to allocate capital and labor among competing uses. Representative individuals and firms incorporate the after-tax return from work and savings into their decisions of how much to produce, save, and work.

The general equilibrium methodology accounts for changes in equilibrium prices in factor (i.e., capital and labor) and goods markets and simultaneously accounts for the behavioral responses of individuals and businesses to changes in taxation. Behavioral changes are estimated in the OLG framework, whereby representative individuals incorporate changes in current and future prices when deciding how much to consume and save in each period of their life.

An overview of the model follows:

Production

Firm production is modeled with the constant elasticity of substitution (CES) functional form, in which firms choose the optimal level of capital and labor subject to the gross-of-tax cost of capital and gross-of-tax wage. The model includes industry-specific detail through use of differing costs of capital, factor intensities, and production function scale parameters. Such a specification accounts for differential use of capital and labor between industries as well as distortions in factor prices introduced by the tax system. The cost of capital measure models the extent to which the tax code discriminates by asset type, organizational form, and source of finance.

The industry detail included in this model corresponds approximately with three-digit North American Industry Classification System (NAICS) codes and is calibrated to a stylized version of the 2014 US economy. Because industry outputs are typically a combination of value added (i.e., the capital and labor of an industry) and the finished production of other industries (i.e., intermediate inputs), each industry's output is modeled as a fixed proportion of an industry's value added and intermediate inputs to capture inter-industry linkages. These industry outputs are then bundled together into consumption goods that are purchased by consumers.

Consumption

Consumer behavior is modeled through use of an OLG framework that includes 55 generational cohorts (representing adults aged 21 to 75). Thus, in any one year, the model includes a representative individual optimizing lifetime consumption and savings decisions for each person aged 21 through 75 (i.e., 55 representative individuals) with perfect foresight. For each generational cohort, the endowment of human capital changes with age — growing early in life and declining later in life — following the estimate of Altig et al. (2001).^[2] The model can be run with 55 generational cohorts (one for each age) or 660 generational cohorts (one for each age and each of 12 income groups). The latter specification includes, for each age, a representative individual for each income decile plus a breakout of the top and bottom 2% of the income distribution.

The utility of representative individuals is modeled as a CES function, allocating a composite commodity consisting of consumption goods and leisure over their lifetimes. Representative individuals optimize their lifetime utility through their decisions of how much to consume, save, and work in each period subject to their preferences and the after-tax returns from work and savings in each period. In determining their labor supply, representative individuals respond to the after-tax return to labor, as well as their overall income levels, in determining whether to work and thereby earn income that is used to purchase consumption goods or to consume leisure by not working.

Other features

The model includes a simple characterization of both federal and state and local governments. Government spending is assumed to be used for either (1) transfer payments to representative individuals or (2) the provision of public goods. Public goods are assumed to be provided by the government in fixed quantities through the purchase of industry outputs as specified in a Leontief function. This spending in the model can be financed by collecting taxes or borrowing. Borrowing, however, cannot continue indefinitely in this model so toggles are included to allow government transfers, government provision of public goods, or government tax policy to be used to achieve a selected debt-to-GDP ratio after a selected number of years. This selected debt-to-GDP ratio

could be, for example, the initial debt-to-GDP ratio or the debt-to-GDP ratio a selected number of years after policy enactment.

Additionally, the EY GE Model is an open economy model that includes both capital and trade flows between the United States and the rest of the world. International capital flows are modeled through the constant portfolio elasticity approach of Gravelle and Smetters (2006).^[3] This approach assumes that international capital flows are responsive to the difference in after-tax rates of return in the United States and the rest of the world through a constant portfolio elasticity expression. Trade is modeled through use of the Armington assumption, wherein products made in the United States versus the rest of the world are imperfect substitutes.

Table B1. EY QUEST OLG Model key parameters

| | Central | Low | High |
|---------------------------------------|---------|-----|------|
| Intertemporal substitution elasticity | 0.4 | 0.3 | 0.5 |
| Intratemporal substitution elasticity | 0.6 | 0.5 | 0.7 |
| Leisure share of time endowment | 0.4 | 0.3 | 0.5 |
| International capital flow elasticity | 3.0 | 1.0 | 5.0 |
| Capital-labor substitution elasticity | 0.8 | 0.5 | 1.0 |
| Adjustment costs | 5.0 | 7.5 | 2.5 |
| | | | |

Source: Central key parameters are generally from Joint Committee on Taxation, Macroeconomic Analysis of the “Tax Reform Act of 2014,” February 2014 (JCX-22-14) and Jane Gravelle and Kent Smetters, “Does the Open Economy Assumption Really Mean That Labor Bears the Burden of a Capital Income Tax?,” *Advances in Economic Analysis and Policy* 6(1) (2006): Article 3.

EY QUEST Dynamic Stochastic General Equilibrium Model of the US Economy

The EY QUEST Dynamic Stochastic General Equilibrium Model of the US Economy (“EY QUEST DSGE Model”) provides three additional analytic capabilities for macroeconomic analysis as compared to the EY OLG and the JCT MEG and OLG models:

- It has the ability to assume people make decisions under uncertain future tax rates, with more information about future policy than is assumed in myopic models, like MEG, and less information than is assumed in perfect foresight models, like the JCT OLG model. For example, in the DSGE model households will react differently to an anticipated change in taxes than an unanticipated change. In MEG every change is unanticipated, while in OLG every change is anticipated.
- DSGE also allows for the analysis of different household decisions between low-income and high-income earners, which can potentially provide important additional information about the distributional impacts of tax policy. For example, the DSGE model can tell us how consumption and labor decisions might differ between high income and low income households in response to a policy change.
- The DSGE model has the ability to model the effects of monetary policy and expectations of future monetary policy, which is useful in scenarios where the Federal Reserve is constrained by a Federal funds rate that is near zero.

Overview

This model is a DSGE model that is consistent with microeconomic foundations. The model is based on the neoclassical growth framework^[4] and incorporates new Keynesian price frictions (e.g., sticky prices) and adjustment costs. Households in the model supply labor and capital to firms. Firms produce investment, consumption, and housing goods. Because the firms exist in a monopolistically competitive market with sticky prices, the model produces persistent price growth or inflation. This sticky price feature combined with adjustment costs on the investment good comprise a common set of rigidities for a new Keynesian DSGE model^[5]. The real economy is closed in the model. Therefore, all goods produced by firms are consumed in the model and all goods consumed or invested are produced by firms in the model. Thus, the DSGE model cannot yet consider international flows of capital goods or services. A central monetary authority exists in the model and it sets the nominal interest rate according to a prescribed rule which all other households and firms are aware of.

What does DSGE mean?

The term “dynamic” refers to the fact that decision makers in the model (households and firms) take the passage of time explicitly into account. For instance, households value consumption today slightly higher than they value planned consumption in the next period. Because each period in the model corresponds to one quarter of a year, DSGE is a model of quarterly behavior of the US economy.

The term “stochastic” means that any uncertain outcomes in the model can be assigned finite mathematical probabilities by the decision makers inside the model. This differs from the MEG model where decision makers are myopic and have an unchanging expectation of the future. This also differs from the OLG model where decision makers have perfect foresight or knowledge of all future outcomes and do not prepare for multiple outcomes. Because businesses and individuals inside the DSGE model make decisions with a view of the future as a constantly changing path subject to random variations (e.g., tax policy), the DSGE model can account for the effect of uncertainty or, alternatively, certainty (i.e., information) on the economy.

The DSGE model includes random variables in the processes describing Federal taxes, Federal government consumption, transfer payments, and monetary policy. Decision makers in the model know the exact values of future Federal tax variables up to two and a half years into the future. Tax rates beyond two and a half years are assumed to persist at previous known levels following a stochastic process. That is, individuals and businesses think tax rates may be higher or lower than current tax rates, but they are uncertain which outcome will prevail.

This is a less extreme information assumption than perfect foresight imposed by the OLG model yet larger than the myopic information assumption imposed by the MEG model. Unlike the OLG or MEG models, the stochastic component of DSGE allows EY to model the effect of anticipated changes against unanticipated changes in the tax code.

Finally, the term “general equilibrium” refers to the fact that we intend to model all markets of the real US economy. This means that all real variables of the model are constructed to be consistent with national income accounting and correspond to real, inflation adjusted, variables in the National Income and Product Accounts.

Model Features

A medium scale, new Keynesian, DSGE model [6], as typically found at organizations like the Federal Reserve or International Monetary Fund[7], contains five types of agents: a large number of identical households referred to as a representative agent, a large number of monopolistically competitive firms producing an intermediate good, a final good producing firm that has zero profit, a central monetary authority that sets nominal interest rates according to a simple rule, and a government that levies a lump sum tax against the representative agent. The dollar amount of the tax is determined by what the government needs to finance its spending. The DSGE model introduces several features to this framework to make the model more useful for tax policy analysis. It adds a second group of households, often referred to as non-savers or rule-of-thumb agents in the literature; it incorporates a separate good and production sector for residential housing; it allows governments to levy taxes proportional to income earned in the economy and to issue debt to pay for tax cuts; and it allows agents to deduct depreciation of capital from their capital tax liability following a predetermined schedule.

The model distinguishes between two types of households: those who save and those who do not. Savers have access to capital markets and can invest in the production of housing or the production of all other goods. Savers can also invest in a risk free government bond that is used to fund temporary government deficits. Households that do not save do not have access to capital markets or bond markets. Both types of households are able to purchase the housing good that is not consumed entirely each period but depreciates slowly over time. Non-savers and savers therefore face different optimization problems over different time horizons. Each period non-savers must choose the amount of labor they supply and the amount of goods they consume along with the amount of housing they purchase and hold for later periods. Savers face the same tradeoffs in a given period but they must also balance consumption today with the choice of investing in capital or bonds. The fraction of savers in the model population is chosen to be consistent with the empirical literature[8]. Savers are chosen to represent the top 41 percent of the income distribution. Key parameter values are listed in table B2.

Government in the DSGE model can sustain permanently higher levels of debt resulting from temporary deficits as long as fiscal solvency is maintained. Fiscal solvency means that the expected value of government debt cannot grow faster than the output of the economy for an infinite period of time. In order to insure fiscal solvency in the DSGE model Federal government consumption or the Federal government transfer payment are reduced in response to heightened levels of debt that persist for five years. Government consumption is part of GDP but is not valued by households and does not act as an input to production.

Model Calibration

The DSGE model is calibrated such that the consumption share of output and investment share of output match US data from 2010. The ratios of non-Saver housing to Saver housing and non-Saver income to Saver income

are set to match averages from the Internal Revenue Service Statistics of Income and the Federal Reserve Survey of Consumer Finances.

Tax rates on individual income are generated using the EY QUEST microsimulation model, which allows calculation of effective marginal and average tax rates after taking into account all of the exclusions, exemptions, deductions, and credits that make up the present law individual tax system. Labor income taxes include the payroll tax, income taxes on wages and salaries, and a fraction of the individual income tax applied to sole proprietorships and pass-through entities. The marginal tax rate on labor income for savers is the effective marginal labor income tax rate for those in the top 41 percent of the income distribution among filers with positive labor income; the tax rate on labor income for non-savers is the effective marginal labor income tax rate for the remaining 59 percent. Deductions for household income taxes are set so that average tax liabilities for savers and non-savers match those found in the EY QUEST individual income tax microsimulation model. To determine the total effective marginal and average tax rates on capital, tax rates on dividends and capital gains are averaged with tax rate on corporations and a fraction of pass through business income not attributable to labor.

The model allows savers to deduct a certain fraction of new capital purchases immediately from their capital tax liability. This feature gives the DSGE model the ability to explicitly model the investment incentives of proposals to alter bonus depreciation, similar to Edge and Rudd[9]. The remaining fraction is then deducted according to a fixed, constant schedule. The size of the fraction which can be deducted immediately is set to match statistics on deductions reported on the IRS Form 4562.

Linkages in the model

Changes in tax rates on labor income influence a household's willingness to work, both by affecting their marginal return to labor (the substitution effect) and by affecting their disposable income (the income effect). After a tax change has been implemented in the short run, the substitution effect typically dominates the income effect. In the long run, once wealth has been significantly impacted by the change in after-tax income, the income effect will dominate the substitution effect. For instance, if reduced tax rates on labor income lead to an increased supply of labor, higher disposable labor income, and therefore to increased saving and increased wealth over time, households eventually choose to enjoy more leisure and begin to reduce labor. If households become aware of a future labor income tax change they will adjust to the change in future income by changing labor now. In such a case the income effect can play a larger role in the short run and households will make smaller adjustments in the long run.

Changes in taxes on capital income have a direct impact on saver's investment decisions. Reductions in tax rates on capital income increase the return to investment. Savers sacrifice consumption initially in order to invest more. Lower consumption makes savers work harder as the marginal benefit for supplying additional hours of labor is higher. The wage rate falls initially because savers are willing to work more hours, thus creating an excess supply of labor. Because non-savers do not own capital, the short-run fall in the wage rate reduces incentives for them to work in early periods. In the longer run, as the increase in investment results in a build-up of capital, the marginal product of labor increases, firms demand more labor, and the wage rate increases. The increased wage rate leads non-savers to supply more labor to the economy. Conversely, in the long run, the buildup in the capital stock leads to more capital income accruing to savers, which reduces savers' incentive to work, causing their supply of labor to decrease.

Temporary changes to the fraction of new capital which can be deducted from saver households' tax liabilities temporarily alter the cost of capital and lead to short lived investment responses. In the case of a permanent

change to this fraction households will change investment instantly and permanently with little change from short run to long run.

Table B2. EY QUEST DSGE Model key parameters

| | Central | Low | High |
|---------------------------------------|---------|------|------|
| Labor supply elasticity | 0.35 | 0.20 | 0.50 |
| Intertemporal substitution elasticity | 0.46 | 0.46 | 0.46 |
| Adjustment costs | 8.00 | 8.00 | 8.00 |
| Federal reserve inflation response | 1.50 | 1.75 | 1.25 |

Source: Central key parameters are generally from Joint Committee on Taxation, Macroeconomic Analysis of the “Tax Reform Act of 2014,” February 2014 (JCX-22-14) and Frank Smets and Rafael Wouters, “Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach,” *American Economic Review* 97(3) 2007: 586-606

[1] See, for example, Shinichi Nishiyama, “Fiscal Policy Effects in a Heterogeneous-Agent Overlapping-Generations Economy With an Aging Population,” Congressional Budget Office, Working Paper 2013-07, December 2013; Joint Committee on Taxation, Macroeconomic Analysis of the “Tax Reform Act of 2014,” February 2014 (JCX-22-14); Joint Committee on Taxation, Macroeconomic Analysis of Various Proposals to Provide \$500 Billion in Tax Relief, March 2005 (JCX-4-05); and, The President’s Advisory Panel on Federal Tax Reform, Simple, Fair, & Pro-Growth: Proposals to Fix America’s Tax System, November 2005.

[2] See David Altig, Alan Auerbach, Laurence Koltikoff, Kent Smetters, and Jan Walliser, “Simulating Fundamental Tax Reform in the United States,” *American Economic Review* 91(3) (2001): 574-595.

[3] See Jane Gravelle and Kent Smetters, “Does the Open Economy Assumption Really Mean That Labor Bears the Burden of a Capital Income Tax?,” *Advances in Economic Analysis and Policy* 6(1) (2006): Article 3.

[4] Robert M. Solow, “A contribution to the theory of economic growth,” *Quarterly Journal of Economics*, 70(1), 1956.

[5] Lawrence J. Christiano, Martin Eichenbaum, and Charles L. Evans, “Nominal rigidities and the dynamic effects of a shock to monetary policy,” *Journal of Political Economy*, 113(1), 2005.

[6] Jesus Fernandez-Villaverde, “The econometrics of DSGE models,” *SERIES: Journal of the Spanish Economic Association*, 1, 2010.

[7] See the Estimated Dynamic Optimization Model, <https://www.federalreserve.gov/econres/edo-models-about.htm>

and the Global Integrated Monetary and Fiscal Model,

<https://www.imf.org/en/Publications/WP/Issues/2016/12/31/The-Global-Integrated-Monetary-and-Fiscal-Model-GIMF-Theoretical-Structure-23615>.

[8] See N. Traum and S.C.S. Yang, “Monetary and Fiscal policy interactions in the post-war US,” *European Economic Review*, 55(1), 2011; and, Luca Guerrieri Christopher J. Erceg and Christopher Gust, “Sigma: A new open economy model for policy analysis,” *The International Journal of Central Banking*, 2(1), 2006.

[9]R.M. Edge and J.B. Rudd, “General-equilibrium effects of investment tax incentives,” *Journal of Monetary Economics*, 2011.