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The Economic Effects of the Clinton Tax Proposal

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Abstract

Taxes impinge on individual and business decisions to work, save and invest. Using a dynamic computable general equilibrium model that we created for the National Center for Policy Analysis (the "NCPA-DCGE Model"), we simulate the effects on the U.S. economy of the tax proposal advanced by presidential candidate Hillary Clinton. The plan will generate $615 billion in tax revenue over 10 years. However, we find that moderate negative impacts on output, investment, overall employment and household well-being. We also find the proposal would increase the size of the public sector by 49,000 workers in 2016. We briefly compare our findings with other published estimates and contrast the methodology underlying our model with that of other models.

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Introduction

Compared with other presidential election year cycles, the 2016 campaign takes place in a perplexing period of slow economic growth. Economic growth heading into in the 2016 political election year (excluding recessions such as the Great Recession of 2008) is the lowest in the last 15 elections. Today's economy has grown only by 1.2 percent in the second quarter of 2016, far below the post-World War II average of 2.6 percent.[1]

To meet their policy objectives, presidential candidates have released tax proposals geared toward promoting growth. In contrast to the Republican Donald Trump's plan which emphasizes tax cuts and aims for tax efficiency, Democrat Hillary Clinton's plan stresses public investments and substantial tax equity.[2]

Both candidates face challenges on how best to reinvigorate growth back to its historical trend. Public spending and lower interest rates have failed to improve the labor participation rate, GDP growth or productivity. The U.S. unemployment rate is down and most of the jobs lost since 2008 have been recovered. But wages remain mostly flat with the historically low labor force participation remaining a major issue. While the low participation rate explained in part by the advent of retirement among Baby Boomers, not all of it is demographic.

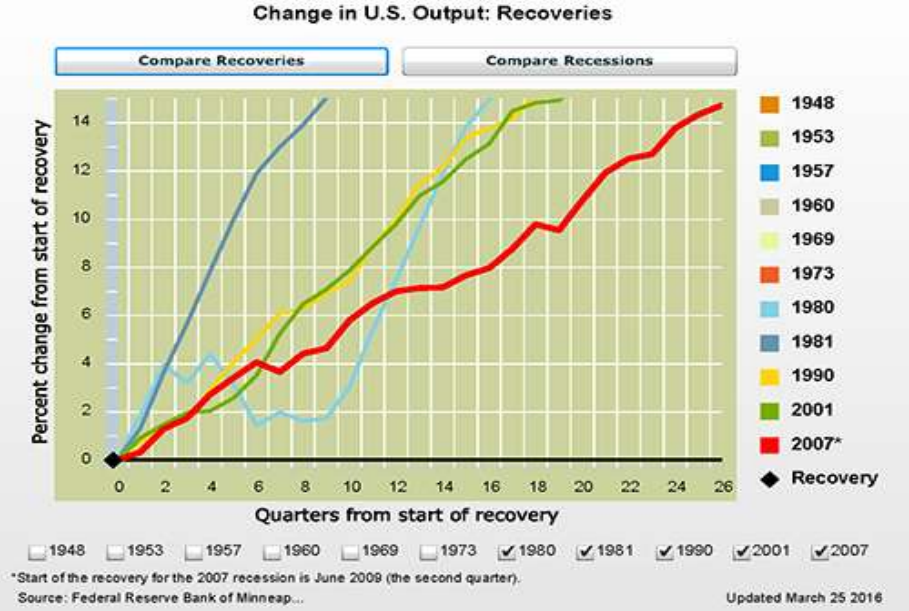
During 2015 (fourth quarter of 2014 to the fourth quarter of 2015), real GDP increased 2.0%, compared with an increase of 2.5% during 2014. Real GDP measured in 2009 dollars is only 10% higher than the pre-crisis peak of 2007. Other indicators also point to a sluggish recovery: As of December 2015 the number of employees increased only by 2.2% since November 2007.

[1] MarketWatch, Economcy, Economic Calendar, http://www.marketwatch.com/economy-politics/calendars/economic.
[2] Quote Trump v. Cruz

(Papadimitriou, Nikforos, & Zezza, 2016)[3] Nearly seven years after the end of the Great Recession, voters continue to believe that the economy is the foremost issue facing the next president.[4]

To better understand the depth of the Great Recession of 2008, economists at the Federal Reserve Bank of Minneapolis have examined past recessions.[5] They have concluded that the recovery from this latest recession has been exceptionally weak in terms of economic growth, i.e. percentage change in GDP, compared with the previous 10 recessions. Figure 1 below contrasts the recoveries from 1980, 1981, 1990, 2001 and 2007. Post-Great Recession employment growth showed similar lagging trends.

Figure 1



[3] Papadimitriou, D. B., Nikforos, M., & Zezza, G. (2016). Destabilizing an unstable economy. Retrieved from http://www.levyinstitute.org/pubs/sa_3_16.pdf

[4] Suffolk University Political Research Center, "Suffolk University/USA Today Poll Shows 61 Percent Alarmed about Presidential Election," (June/July 2016) http://www.suffolk.edu/documents/SUPRC/7_11_2016_corrected_final_national_marginals.pdf

[5] Federal Reserve Bank of Minneapolis. (2014). The Recession and the Recovery in Perspective. Retrieved from https://www.minneapolisfed.org/publications_papers/studies/recession_perspective/

While the deepest previous recession took 46 months to restore employment to its previous peak, employment continued to decrease for 77 months after the latest recession ended in 2009.

To reach "broadly shared prosperity," in this slow growth environment, the Clinton tax proposals seek to promote growth by shifting the tax burden to high income taxpayers. The proposals are clearly predicated on a normative objective to diminish income inequality and to restore 'fairness' to the tax code. In this report, we focus on the efficiency effects of the Clinton tax proposal, leaving the debate over equity for another time where we can outline the distributional effects.

We apply the academic literature to the problem of explaining the effects of proposed tax changes on wages, earnings, saving and investment. We apply a computer model to simulate the behavioral responses to such tax changes and how they flow through the U.S. economy. This paper summarizes the results of our application of that model of the Clinton proposals and offers a brief contrast to previously published analyses.

The debate over federal tax policy ties into the broader debate over how best to satisfy three competing goals:

(1) to increase economic efficiency, as measured by the performance of standard economic indicators, such as GDP and private sector employment;

(2) to increase equity, as measured by the proposal's fairness toward low-income earners and

(3) to provide revenues to finance government expenditures.

While tension between these objectives is unavoidable in any tax reform debate, there is a growing consensus that the existing U.S. tax system is highly inefficient, particularly for how it discourages business investment and household work effort. Thus a key goal of the analysis is to answer the question: How will the Clinton plan improve upon these inefficiencies?

The Clinton tax plan seeks to make the tax code even more progressive. Therefore, it most likely will suppress positive effects on such indicators as GDP and private sector employment.

Our analysis is based on the dynamic computable general equilibrium model the Beacon Hill Institute has built under contract with the National Center for Policy Analysis – the NCPA-DCGE Model.

The purpose of the NCPA-DCGE Model is to examine U.S. tax policy changes for their effects on major economic indicators, including:

- Gross Domestic Product (GDP);
- capital investment;
- private sector employment; and
- Government tax revenues, employment and spending.

Dynamic CGE models are the most appropriate tools for assessing the impacts of taxes.[6] In an earlier study, we found significant benefits from the implementation of a national retail sales tax, (Bhattarai, Haughton and Tuerck, 2007; see also Jokisch and Kotlikoff, 2005). That study utilized a tax model that was built to show only how a particular tax proposal would affect the economy. This study is based on micro-consistent data from a Social Accounting Matrix (SAM 2017) for benchmarking a model that can be applied to a wide variety of proposed tax changes.

The debate over the short and long-term effects of taxation and its relationship to economic growth is at the center of public finance scholarship.[7] It has taken some time for the economic literature –

[6] For a useful primer on CGE models see "Taxes in a CGE Model," Mary E. Burfisher in *Introduction to Computable General Equilibrium Models,* (New York: Cambridge University Press, 2011) 174-207.
[7] Cecil E. Bohanan, John B. Horowitz and James E. McClure, "Saying too Little Too Late: Public Finance Textbooks and the Excess Burdens of Taxation." Econ Journal Watch 11(3), September 2014: 277-296.

as well as public sentiment – to recognize that taxes impose measurable negative effects as opposed to neutral effects on the economy. A recent and extensive literature review notes the deleterious effects of taxes – particularly corporate and income taxes – on economic performance.[8]

Tax rates are critical for explaining the comparative performance of national economies (Prescott, 2003). In a widely-quoted paper, Prescott (2002) explains that lower American tax rates induce workers to allocate more time to work than their European counterparts. This conclusion follows from an understanding of the sensitivity of labor supply (the "elasticity" of labor supply) to taxes on labor income.[9]

The economy does not remain in its current state when governments raise or lower taxes. Taxes influence behavior and set into action a series of events that change economic behavior. Consider the work-leisure calculus. Taxpayers divide their time between work and non-work, which we call "leisure." Lower tax rates on work make leisure less attractive and thus induce taxpayers to work more. Higher tax rates make leisure more attractive and thus induce taxpayers to work less.

Consider also the saving-consumption calculus. Taxpayers must decide how to allocate their after-tax income between consumption and saving. That matters to the economy because capital spending is financed from saving, and capital spending increases production and raises the demand for labor. Lower tax rates on the return to saving induce taxpayers to save more, thus fueling investment. Higher tax rates have the opposite effect.

[8] William McBride, "What Is the Evidence on Taxes and Growth?" Tax Foundation (December 18, 2012) http://taxfoundation.org/article/what-evidence-taxes-and-growth.

[9] Edward C. Prescott, and Johanna Wallenius, (2008). "The Modern Theory of Aggregate Labor Supply and the Consequences of Taxes," in *Cutting Taxes to Increase Prosperity*, (Reykjavik, RSE, Icelandic Research Center of Social and Economic Affairs, 2008) 9-24.

It is thus important to understand how economic "agents" (taxpayers) respond to incentives and disincentives to work and save brought about by tax law changes. It is also important to understand how tax law changes affect federal, state and local government revenues. Lower tax rates usually reduce revenues but less so to the extent that they encourage work and saving. Higher tax rates usually increase revenues but less so to the extent that they discourage work and saving.

We provide an explanation of our approach to the Clinton tax proposal in the sections that follow. After describing her plan, we make several assumptions in running the NCPA-DCGE model. In analyzing the Clinton proposal, we assume that its components go into effect in calendar year 2017. All changes are against a baseline, no-tax-change scenario.

The Clinton Tax Proposal Outlined

The details of the Clinton proposal are dispersed among several policy issues on the campaign web site.[10] Essentially the plan calls for higher taxes on high income earners, estate and gift taxes and business tax reforms. It also includes restrictions on corporate inversions, the abolition of tax incentives for coal, oil and gas industries.

[10] Hillary for America "Raising incomes and fighting inequality: A plan to raise American incomes, https://www.hillaryclinton.com/issues/plan-raise-american-incomes/ Accessed July 12, 2016. https://www.hillaryclinton.com/briefing/factsheets/2016/06/22/stronger-together-hillary-clintons-plan-for-an-economy-that-works-for-everyone-not-just-those-at-the-top/ We also refer to plan details outlined by the Tax Policy Center http://www.taxpolicycenter.org/publications/analysis-hillary-clintons-tax-proposals/full and the Tax Foundation, http://taxfoundation.org/article/details-and-analysis-hillary-clinton-s-tax-proposals

BHI Modeling of the Clinton Plan

As noted in the section above, the Clinton Plan focuses on the federal individual income tax, business taxes and estate and gifts tax. The candidate is expected to release a plan for low and middle income tax cuts in the near future which will provide another opportunity to fully model the proposal.

Since the Clinton proposal targets individuals in the very highest income tax brackets with an array of changes to tax rate and deductions, the task of modeling these changes in personal income tax rates is relatively straight forward.

Fortunately, IRS data in "Table 1.2: All Returns: Adjusted Gross Income, Exemptions, Deductions, and Tax Items, by Size of Adjusted Gross Income and by Marital Status" contains data on AGI and taxable income for incomes over $5 million. We use this data to estimate that the Clinton "surcharge" would raise $17.8 billion in additional tax revenue in 2017.

Currently, the top income decile in the NCPA-CDGE model pays $956.56 billion in personal income taxes. Therefore, the Clinton "surcharge" would represent a tax increase of 1.86% for the top income decile, which when applied to the top tax bracket of 39.6% brings the top rate to 40.97% (39.6% x 1.86% = 0.74% + 39.6% = 40.33%).

The Clinton proposal calls for a minimum tax of 30% of Adjusted Gross Income (AGI) paid by taxpayers with an AGI over $1 million dollars. Using the same IRS table, we estimate that this tax change would raise personal income tax revenues by $34.1 billion in 2017 on a static basis.

This represents a tax increase of 3.56% for the highest income decile, therefore we raise the tax on the top income decile by another 1.41%.

The Clinton proposal calls for limiting the tax value of itemized deductions to 28%. As a result taxpayers in the brackets at and above 28% would feel the impact of the tax change. Using the same table as above, we calculate that the change would raise $38.4 billion dollars in 2017. As a result we raise the rate for the top income decile by 4.01% and the top decile by 1.59 percentage points.

The Clinton proposal also changes the capital gains schedule by extending the holding period of assets that qualify for the 23.8% tax rate to six years from the current one year. The Clinton Plan calls for a gradual reduction in the capital gains rate over the holding period between three-years and six years. Since the IRS does not publish current data on capital gains realization by length of time that owners held the assets, we assume that the Clanton Plan capital gains rates for assets held longer than one-year apply proportionally. We assume the new capital gains rate would be an average of 33.7% on assets held more than a year, up from the current rate of 23.8%, for an increase of 9.9 percentage points. We apply the 9.9% to assets held for more than a year, and get an increase in tax revenue of $40.5 billion in 2017. This represents a 4.24% increase in total tax paid by the top income decile and we raise the tax on the top decile by another 1.68%.

The Clinton proposal also calls for ending the preferential tax treatment of "carried interest." Carried interest refers to the managing partner's interest in the profits of an investment services partnership (ISP). When the partnership sells an investment and realizes the capital gains, the gains are usually split between the managing partners at 20% and the limited partners at 80%. If

the assets were held more than one year, the gains are taxed at the long-term capital gains rate of 23.8%.

The Clinton proposal would recharacterize the managing partners gain as ordinary income and tax it at the personal income tax rate, or 42.7% in the highest tax bracket, for a difference of 18.9%. We utilized IRS capital gains data from Table 1A. Short-Term and Long-Term Capital Gains and Losses, by Asset Type 2009 and partnership data from Table 5. Partnerships with Income (or Loss) Allocated to Partners, by Selected Industrial Group, Tax Year 2013 to estimate that the plan would raise $1.96 billion in 2017.

On a static basis, the Clinton personal income tax proposals would raise $36 billion in new revenue in 2017, rising to $85 billion in 2026. All of the revenue would be generated by raising taxes on tax filers in the top decile of the income distribution. Using microdata from the IRS, we estimate that tax filers in the top income decile pay 77.5 % of all personal income tax collections. Too project the amount of personal income taxes paid by tax filers in the top decile, we apply the 77.5% to the total personal income tax collections CBO projects for each year from 2017 through 2026.

To project the average tax increase on the top decile, we divide the revenue that would be raised by the Clinton proposals by the total tax paid by the top decile. As a result, the tax filers in the top decile would pay 2.6% more in taxes in 2016, rising to 4.0% in 2026. This represents a tax increase of 1.03% for the top income decile in 2017 (39.6% x 2.6% = 1.03%) and 1.58% in 2026. Therefore we raise the top tax rate by another 1.03 percentage points on the top income decile in 2017 and 1.58 percentage points in 2026%.

The Clinton proposal calls for returning the Estate and Gift Tax exemption back to 2009 levels of $3.5 million for a single filer and $7 million for a couple. She would also raise the top rate to 45% from the current 40% rate. To model the estate and gift tax changes, we estimate the static revenue change using IRS data.

which yields $5.8 billion in 2017, increasing to $11 billion in 2026, and $81 billion over ten years. These become our inputs for the model simulation.

The Clinton Proposals leave the U.S. Corporate Income Tax virtually untouched aside from disavowing certain deductions for insurance companies and "cut the billions of wasteful tax subsidies oil and gas companies have enjoyed for too long and invest in clean energy."[11]

Here, we only model the cut to subsidies for oil and gas companies. We use The Joint Committee on Taxation's report "Estimates of Federal Tax Expenditures for Fiscal Years 2015 – 2019 for fossil fuel subsidies. Table XI displays the results. In total, the tax expenditures for oil and gas companies totals $38.27 billion over ten years, which translates into corporate tax rate changes of 0.9 percentage points in 2017, rising to 1.41 percentage points in 2026.

Table XI: Corporate Tax Changes under the Clinton Proposals Relative to Benchmark:

Oil and Gas Tax Expenditures	**2017 - 2026**
Expensing of exploration and development costs	12.58
Excess Percentage over Cost Depletions	19.61
Amortization of geological and geophysical expenditures	1.17
Amortization of air pollution control facilities	3.62
Depreciation recovery 15-year MACRS for natural gas distribution line	1.27
Total	**38.27**

[11] Hillary Clinton, The Issues, Climate Change, https://www.hillaryclinton.com/issues/climate/.

We modeled the Clinton Tax Plan assume it would be implemented in 2017 and report the results for 2017 and 2026. We also report changes in tax revenue over the ten year period from 2017 – 2026. Table 1 displays the results against a baseline of no tax policy change.

Table X: Changes in Revenue under the Clinton Plan Relative to Benchmark: Results of the NCPA-DCGE Model

Change in Revenue	2017		2026		2017-2016 10-year cumulative	
	Change ($billion)	% Change	Change ($billion)	% Change	Change ($billion)	% Change
Federal Revenue	54.09	1.61	70.47	1.41	615.41	1.71
Social Security Tax	(2.45)	(0.20)	(6.96)	(0.34)	-47.42	(0.34)
Personal Income Tax	47.55	2.92	62.97	2.97	548.47	3.43
Corporate Income Tax	3.55	1.14	5.31	1.00	43.08	1.22
Excise Taxes	(0.08)	(0.14)	(0.16)	(0.21)	-1.25	(0.16)
Estate and Gift Taxes	5.71	26.13	9.68	25.94	75.31	30.78
Trade Duties	(0.04)	(0.14)	(0.08)	(0.21)	-0.64	(0.16)
Other Taxes and Fees	(0.14)	(0.14)	(0.28)	(0.21)	-2.15	(0.16)
State and Local Revenue	(4.62)	-0.19	(10.67)	(0.31)	(77.53)	(0.26)
Total Government Revenue	49.48	0.86	59.80	0.70	537.88	0.82

In 2017, the Clinton proposals personal income tax hikes would increase U.S. federal tax revenue by $54.09 billion (measured against baseline) and revenues would increase by $70.47 billion in 2026.

Personal income tax revenues would increase by $47.55 billion in 2016 and increase by $62.97 billion in 2017. Over the ten-year period the personal income tax hikes would increase federal tax

receipts by $548.47 billion Estate and gift tax would increase by $75.71 billion in 2017, $9.68 billion in 2026 and $75.31 billion over the ten-year period.

Corporate income taxes would increase by $3.55 billion in 2017 and $5.31 billion lower in 2026. Over the ten-year period corporate income taxes would increase by $43.08 billion.

The higher tax rates would negatively affect the tax base for Social Security taxes, excise taxes, trade duties and other taxes and fees. As a result, revenues from these taxes would decrease by $51.46 billion over the ten-year period.

In total, the Clinton tax proposals would increase federal revenue by $54.091 billion in 2017, increase revenues by $70.47 billion in 2026 and increase revenues by $615.41 billion over the ten-year period. State and local, taxes would decrease by $4.62 billion in 2017, $10.67 billion in 2026 and $77.53 billion over the period.

Table 2: Economic Effects of Clinton Tax Plan from the NCPA-DCGE Model

	2017		2026	
	Change	% Change	Change	% Change
Private Employment (000)	(207)	(0.14)	(265)	(0.14)
Public Employment (000)	49	1.88	54	2.07
Total Employment (000)	(159)	(0.11)	(211)	(0.11)
Real GDP ($billion)	(103)	(0.59)	(184)	(0.87)
Personal Income ($billion)	(47)	(0.28)	(103)	(0.42)
Business Investment ($billion)	(19)	(0.71)	(48)	(1.05)
Imports ($billion)	(1.54)	(0.05)	(7.22)	(0.17)
Exports ($billion)	(1.94)	(0.07)	(7.51)	(0.22)
Net Trade Balance ($billion)	0.40	0.02	0.30	0.04

Tax policy proposals create changes in economic activity. Taxpayers who experience a decrease in the after-tax reward to work and saving will work and save less. Federal government will see a gain in revenue while state and local governments capture decreased tax revenues as a result of the decrease in economic activity.

In 2017, the Clinton tax proposals would bring about the destruction 207,000 private sector jobs, a change of 0.14 percent against baseline. Public employment, however, would increase by 49,000 jobs. Real GDP would decrease by $103 billion or by 0.59 percent. Personal income would decrease by $47 billion and business investment will decrease by $19 billion. The trade balance would improve by $0.40 billion.

The trend would continue in 2026 with the destruction of 265,000 private sector jobs (a change of 0.14 percent) over baseline, and create 54,000 public sector jobs. Real GDP would decrease by $184 billion. Personal income would decrease by $103 billion and business investment would decrease by $48 billion. The trade balance would improvement by $0.30 billion.

Comparison of NCPA-DCGE National Model Revenue Estimates with Tax Policy Center and Tax Foundation Estimates

Table X Comparison with other estimates

$ billions Type of Tax	Tax Foundation (a) 2016-25	Tax Policy Center (b) 2016-26	NCGE- DCGE (c) 2017-26
Individual	381	781	549
Corporate	11	136	43
Estate	106	161	75
Total	**498**	**1,077**	**615**

[a] Tax Foundation

[b] Pomerleau and Schuyler (2016); Urban-Brookings Tax Policy Center calculations Auxier, R., Burman, L., Nunns, J., and Rohaly, J. "An Analysis of Hillary Clinton's Tax Proposals" Tax Policy Center. Mar. 3, 2016.

The NCPA-DCGE model generates different results than those reported by the Tax Foundation (TF) and the Tax Policy Center (TPC). TF uses a nine-year window while TPC and our model use a 10-year window. However, our estimates begin in Calendar Year 2017. Our model shows a $615 billion increase in revenue while TF maintains an increase of $498 billion and $1,077 billion for TPC.

We think the changes to the estate and gift taxes would generate less revenue than expected. TPC gravitates to the most optimistic with $161 billion while TF estimates $106 billion. Our model shows a low estimate of $75 billion.

Overall the estimates vary significantly. TPC think the Clinton Tax plan will generate $1,077 brillion while TF thinks roughly less than half of that amount ($498 billion) would find its way into the Treasury.

The differences in the estimates may be ascribed to assumptions on behavioral responses to tax law changes in each model. TP uses an elasticity calculated by the Congressional Budget Office and the Joint Committee on Taxation.[12] TPC relies on two studies to incorporate elasticities while NCPA-DGCE draws from a wider group of estimates from the economic literature (See Appendix below). [13]

[12] http://taxfoundation.org/article/details-and-analysis-hillary-clinton-s-tax-proposals
[13] http://www.taxpolicycenter.org/publications/analysis-hillary-clintons-tax-proposals/full

Conclusion

As currently presented, the Clinton tax proposal would increase taxes on high income earners, impose new business taxes, increase estate and gift taxes and make other changes to make the current progressive U.S. tax system more "equitable." According to our NCPA-DCGE model, the plan would generate $615 billion over 10 years with most of that increase coming from the individual income tax. The plan would give up 265,000 private sector jobs over a decade and business investment would be diminished by $48 billion in 2026 with $19 billion of that amount taking place in the first year. Approximately 65,000 new public sector jobs would be created but overall the economy would forego 184,000 jobs. The plan would have no effect on the nation's trade balance.

The Clinton changes to the individual income tax are substantial, particularly with the implementation of the so-called "Buffet Rule," a minimum tax and the conversion of carried interest from capital gains taxation to income taxation. The introduction of a new capital gains short- and long-term schedule may discourage investment.

The expectations underlying the Clinton tax proposals may be over-optimistic since high income households already pay more than one third of all individual income taxes according to the

OECD and the IRS.[14] The candidate's tax policy advisors have yet to demonstrate how the Clinton plan will transcend the slow growth trend coming out of the Great Recession.

The risk is that the since higher rates distort the incentives to work, save and invest the Clinton Plan will diminish the tax base. It will increase deadweight losses on the economy and deprive the government of revenue.

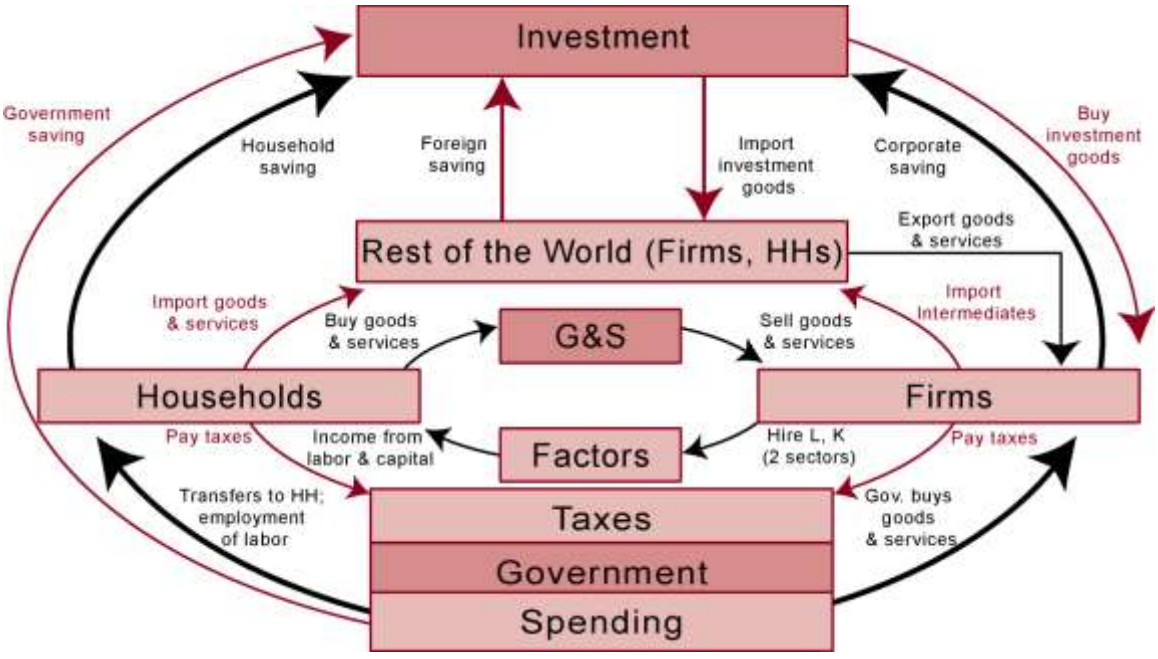
[14] Need footnote here. Hubbard and Cato citation. Over the last 30 years, the U.S. Internal Revenue Service tells us, "High-income households have become responsible for more of the income tax burden. The 10 percent highest-income taxpayers now pay 69.8 percent of all income taxes, up from 54.7 percent in 1986.

Appendix A: Overview of the BHI Model

The most appropriate tool for quantifying these effects is a Dynamic Computable General Equilibrium (DCGE) model. Since their beginnings in the 1970s, CGE models have been used to address tax issues, and are routinely used by government agencies such as the U.S. Treasury, the Congressional Budget Office, and International Trade Commission for policy analysis. A very clear early exposition is provided in Shoven and Whalley (1984, 1992).

We have constructed a large, 60,000-variable, disaggregated national DCGE model of the United States economy. The essence of our model is shown in Figure A-1, which is heavily inspired by Berck et al. (1996), and where arrows represent flows of money (for instance, households buying goods and services) and goods (for instance, households supplying their labor to firms).

Figure A-1: Circular Flow in a CGE Model



Households own the factors of production – land and capital – and are assumed to maximize their lifetime "utility", which they derive from consumption (paid for out of after-tax income) and leisure, both now and in the future. Households must decide how much to work, and how much to save. They are also forward-looking, so that if they see a tax change in the future, they may react by changing their decisions even now. By eliminating the personal income tax, corporate income tax, payroll taxes and estate taxes at the federal level, the proposed tax reforms would raise lifetime utility.

The other major actor is the government, which imposes taxes and uses the revenue to spend on goods and services, as well as to make transfer payments to households. We have calibrated the model to the micro-consistent benchmark equilibrium from the base year data in SAM 2017 so that the effects of the tax proposals will be neutral for its effect on the deficit that is, if revenues fall, spending falls by an equal amount.

There is a production sector where producers/firms buy inputs (labor, capital, and intermediate goods that are produced by other firms), and transform them into outputs. Producers are assumed to maximize profits and are likely to change their decisions about how much to buy or produce depending on the (after-tax) prices they face for inputs and outputs. Capital depreciates over time, and is reconstituted through investment, which is undertaken in anticipation of future profits. A tax policy can increase the levels of investment and capital stock by removing the sector-specific distortions caused by the existing tax system in the benchmark economy.

To complete the model, there is a rest-of-the world sector that sells goods (U.S. exports) and purchases goods (U.S. imports). Trade is represented by the standard Armington assumption, which uses a constant-elasticity-of-transformation function to determine the allocation between

domestic sales and exports. The model assumes a steady-state growth rate for quantities of all goods and services.

Complex as it may seem, Figure A-1 is still relatively simple, because it lumps all households into one group, and all firms into another. To provide further detail it is necessary to create *sectors*; our model has 55 economic sectors. Each sector is an aggregate that groups together segments of the economy. We separate households into ten deciles classes and firms into 27 industrial sectors. In addition, we distinguish between 11 types of taxes and funds (eight at the federal level and three at the state and local level) and two categories of government spending. To complete the model, there are three factor sectors (labor, capital and retained earnings), an investment sector, and a sector that represents the rest of the world. The choice of sectors was dictated by the availability of suitably disaggregated data (for households and firms), and the purposes of the model. The underlying data are gathered into a 55 by 55 social accounting matrix, which includes an input-output table as one of its components.

The Formal Specification of the Model

Infinitely-lived households allocate lifetime income to maximize the present value of lifetime utility (LU^h), which itself is a time-discounted Constant-Elasticity-of Substitution (CES) aggregation of a composite consumption good (C_t^h) and leisure (L_t^h), with an elasticity of substitution between consumption and leisure given by σ_u^h (as in Bhattarai 2001, 2007). Note that the composite consumption good is in turn a Cobb-Douglas aggregation of 27 domestically-produced, and 27 imported, goods and services.

The representative household faces a wealth constraint where the present value of consumption and leisure cannot exceed the present value of its full disposable income (J_t^h), which gives lifetime wealth (W^h). Under current tax rules, this implies

$$\sum_{t=0}^{\infty} \mu(t)(P_t(1+t^{vc})C_t^h + w_t^h(1-t_l)L_t^h) = W^h \quad (1)$$

where $\mu(t)$ is a discount factor, P_t is the price of consumption, C_t^h is composite consumption, t^{vc} is the sales tax on consumption, t_l represents taxes on labor income, and w_t^h is the wage rate.

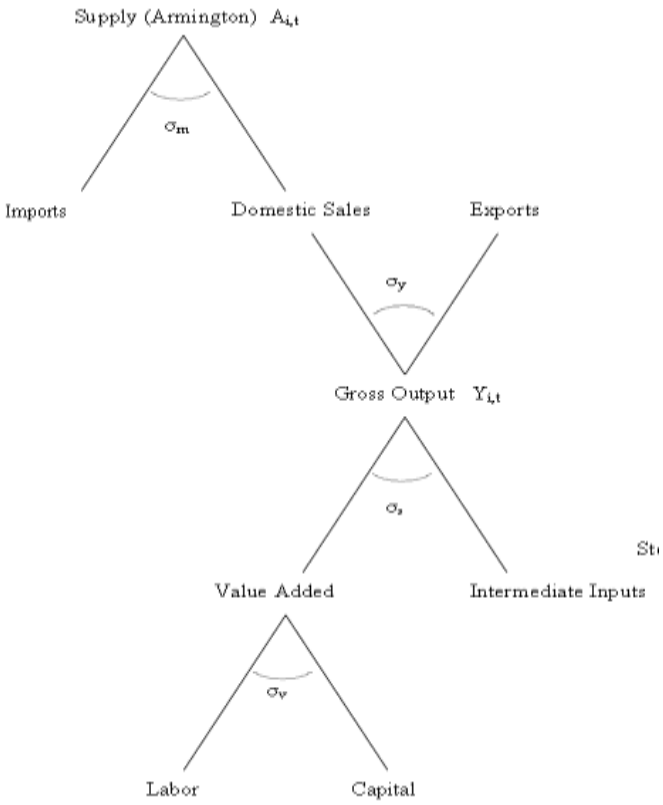
The structure of production is summarized in Figure A-2. Starting at the bottom, and for each of the 27 production sectors, producers combine labor (which comes from seven different categories of households) and capital (using a CES production function, with elasticity of substitution σ_v) to create value-added, which is in turn combined with intermediate inputs – assumed to be used in fixed ("Leontief") proportions – to generate gross output. This output may be exported or sold domestically, modelled with a constant elasticity of transformation (CET) export function between the U.S. markets and all other economies. The domestic supply is augmented by imports, where we use a CES function between domestically supplied goods and imports.

The underlying growth rate in the NCPA-DCGE model is determined by the growth rate of labor and capital. Labor supply, which is equivalent to the household labor endowment less the demand for leisure, rises in line with population. The capital stock (*K*) for any sector in any period is given by the capital stock in the previous period (after depreciation) plus net investment (*I*). On a balanced-growth path, where all prices are constant and all real economic variables grow at a constant rate, the capital stock must grow at a rate fast enough to sustain growth. This condition can be expressed as:

$$I_{i,T} = K_{i,T}(g_i + \delta_i), \tag{2}$$

where the subscript *T* denotes the terminal period of the model, δ_i is the depreciation rate, and g_i is the steady state growth rate for sector *i* and is assumed uniform across sectors for the benchmark economy.

Figure A-2. Nested Structure of Production and Trade



Although the time horizon of households and firms is infinite, in practice the model must be computed for a finite number of years. Our model is calibrated using data for 2015 and stretches out for 35 years (i.e. through 2050). To ensure that households do not eat into the capital stock prior to the (necessarily arbitrary) end point, a "transversality" condition is needed, characterizing the steady state that is assumed to reign after the end of the time period under consideration. We

assume, following Ramsey (1928) that the economy returns to the steady state growth rate of three percent at the end of the period.

The model also requires a number of identities. After-tax income is either consumed or spent on savings. Net consumption is defined as gross consumption spending less any consumption tax. The flow of savings is defined as the difference between after-tax income and gross spending on consumption, and gross investment equals national saving plus foreign direct investment.

A zero trade balance is a property of a Walrasian general equilibrium model; export or import prices adjust until the demand equals supply in international markets. However, foreign direct investment (FDI) plays an important role in the U.S. economy, as exports and imports are not automatically balanced by price adjustments. Therefore our Walrasian model is modified here to incorporate capital inflows so that the FDI flows in whenever imports exceed exports. Thus

$$FDI_t = \sum_i PM_{i,t} M_{i,t} - \sum_i PE_{i,t} E_{i,t} \qquad (3)$$

where for period t, FDI_t is the amount of net capital inflows into the U.S. economy, $\sum_i PM_{i,t} M_{i,t}$ is the volume of imports and $\sum_i PE_{i,t} E_{i,t}$ is the volume of exports. For the base run we assume inflows and outflows of FDI to balance out to zero intertemporally by the last year of the model horizon.

Calibration to steady state

The model is truly "dynamic" in that it is optimized over time, and is calibrated using data for 2015. The model is programmed in GAMS (General Algebraic Modeling System), a specialized program that is widely used for solving CGE models (Brooke et al. 1998). The core of the model is programmed in the mathematical programming for system of Arrow–Debreu type general equilibrium (MPSGE) code, which was written by Thomas Rutherford (1995) to facilitate the development of market-clearing dynamic CGE models; see also Lau et al. (2002).

The model is calibrated to ensure that the baseline grows along a balanced growth path. In the benchmark equilibrium, all reference quantities grow at the rate of labor force growth, and reference prices are discounted on the basis of the benchmark rate of return. The balance between investment and earnings from capital is restored here by adjustment in the growth rate g_i that responds to changes in the marginal productivity of capital associated with changes in investment. Readjustments of the capital stock and investment continue until this growth rate and the benchmark interest rates become equal.

If the growth rate in sector *i* is larger than the benchmark interest rate, then more investment will be drawn to that sector. The capital stock in that sector rises as more investment takes place, leading to diminishing returns on capital. Eventually the declining marginal productivity of capital retards growth in that sector.

To solve the model, we allow for a time horizon sufficient to approximate the balanced-growth path for the economy. Currently the model uses a 35-year horizon, which can be increased if the model economy does not converge to the steady state.

Behavioral Elasticities of Substitution in Consumption and Production

Our DCGE model simulates the effects of tax changes. The structure of the model depends not only on the magnitudes in the social accounting matrix, but also on the behavioural parameters, which reflect how consumers and producers react to changes in prices. These parameters are mainly in the form of elasticities of substitution, but also include depreciation and discount rates, share parameters, and an assumed steady state growth rate. The parameters we use are set out in Table A-1, and are comparable to those found in the existing literature; including Tuerck et al. (2006), Bhattarai and Whalley (1999), Killingsworth (1983), Kotlikoff (1993, 1998), Kydland and Prescott (1982), Ogaki and Reinhart (1998a, 1998b), Piggott and Whalley (1985), and Reinert and Roland-Holst (1992).

Table A-1. Basic Parameters of the NCPA-DCGE Model

Steady state growth rate for sectors (g)	0.03
Net interest rate in non-distorted economy (r *or* ϱ)	0.03
Sector specific depreciation rates (δ_i)	0.02 – 0.19
-	-
Elasticity of substitution for composite investment, σ	1.5
Elasticity of transformation between U.S. domestic supplies and exports to the Rest of the World (ROW), σ_ε (can be sector-specific)	2.0
Elasticity of substitution between U.S. domestic products and imports from the Rest of the World (ROW), σ_m	0.5 -1.5
Inter-temporal elasticity of substitution, σ_{Lu}	0.98
Intra-temporal elasticity of substitution between leisure and composite goods, σ_u	1.5
Elasticity of substitution in consumption goods across sectors, σ_C	2.5
Elasticity of substitution between capital and labor, σ_v	1.2
Reference quantity index of output, capital and labor for each sector, Q_{rf}	$(1+g)^{t-1}$
Reference index of price of output, capital and labor for each sector, P_{rf}	$1/(1+r)^{t-1}$

A few further comments are in order. The *intertemporal elasticity of substitution* (σ_{Lu}) measures the responsiveness of the composition of a household's current and future demand for the composite consumption good to relative changes in the rate of interest, and is a crucial determinant of household savings. There is little consensus in the literature about a reasonable value for this

elasticity: Ogaki and Reinhart (1998a,1998b) estimate it to be between zero and 0.1 in the case of durable goods; Hall (1988) finds it to be very small, even negative, while Hansen and Singleton (1983) note the lack of precision in the estimates of σ_{Lu}. Auerbach and Kotlikoff (1998) assume it to be about 0.25; Kydland and Prescott (1982) assume it to be 1.0. We have 0.98 value in this model.

The *intratemporal elasticity of substitution between consumption and leisure* (σ_u) determines how consumers' labor supply responds to changes in real wages. Indirect evidence on this elasticity is derived from various estimates of labor supply elasticities that are available in the literature (Killingsworth 1983). Here we adopt a value of 1.5 for this substitution elasticity. Further discussion on how to derive numerical values of substitution elasticities from labor supply elasticities is provided in earlier studies on tax incidence analysis (Bhattarai and Whalley 1999).

The *intratemporal elasticity of substitution among consumption goods* (σ_C) captures the degree of substitutability among goods and services in private final consumption. A higher value implies more variation in consumption choices when the relative prices of goods and services change. Consistent with Piggott and Whalley (1985), we specify a value of 2.5 for this parameter.

The *Armington elasticity of transformation* (σ_e) determines the sale of domestically-produced goods between the home and foreign markets in response to relative prices between these two markets. The *Armington substitution elasticity* (σ_m) determines how the domestic and import prices affect the composition of demand for home and foreign goods. Higher values of these elasticities mean a greater impact of the foreign exchange rate in domestic markets. Reinert and Roland-Holst (1992) report estimates of substitution elasticities for 163 U.S. manufacturing

industries and find these elasticities to be between 0.5 and 1.5. Piggott and Whalley (1985) suggest central tendency values of these elasticities to be around 1.25.

Early estimates of the *elasticity of substitution between capital and labor* (σ_v) may be found in Arrow, Chenery, Minhas, and Solow (1961). They estimated constant elasticities of substitution for U.S. manufacturing industries using a pooled cross country data set of observations on output per man hour and wage rates for a number of countries; we use a value of 1.2.

References

Arrow JK; Chenery HB; Minhas BS; Solow RM. 1961. Capital-Labor Substitution and Economic Efficiency, *The Review of Economics and Statistics*, 43(3): 225-250.

Auerbach, A.J and Kotlikoff LJ. 1987. *Dynamic Fiscal Policy*, Cambridge University Press.

Auxier R, Burman L, Nunns J, and Rohaly J. 2016. An Analysis of Hillary Clinton's Tax Proposals. Tax Policy Center of the Urban Institute and Brookings Institution. March 3. http://www.taxpolicycenter.org/publications/analysis-hillary-clintons-tax-proposals/full

Bachman, P, Haughton J, Kotlikoff LJ, Sanchez-Penalver A, Tuerck D. 2006. Taxing Sales under the FairTax: What Rate Works? *Tax Notes*, 663-682.

Berck P, Golan E, Smith B, Barnhart J Dabalen A. 1996. Dynamic Revenue Analysis for California. Summer 1996. University of California at Berkeley and California Department of Finance.

Burfisher, M. 2011. *Introduction to Computable General Equilibrium Models*, Cambridge University Press: New York, 174-207.

Burger A, Zagler M. 2008. US Growth and Budget Consolidation in the 1990s: Was There a Non-Keynesian effect? *International Economics and Economic Policy* 5:225–235.

Bhattarai K. 2001. Welfare and Distributional Impacts of Financial Liberalization in a Developing Economy: Lessons from Forward Looking CGE Model of Nepal. Working Paper No. 7, *Hull Advances in Policy Economics Research Papers*.

Bhattarai, K. 2007. Welfare Impacts of Equal-yield Tax Reforms in the UK economy, *Applied Economics*, 39 (10-12): 1545-1563.

Bhattarai, K, Whalley J. 1999. The Role of Labour Demand Elasticities in Tax Incidence Analysis with Heterogeneous Labour, *Empirical Economics*, 24: 599-619.

Brooke A, Kendrick D, Meeraus A, Raman R. 1998. *GAMS: A User's Guide*, GAMS Development Corporation, Washington DC.

Council of Economic Advisers (U.S.) 2014. *Economic Report of the President*, US Government Printing Office, Washington DC.

Gillis, M. 2008. Historical and Contemporary Debate on Consumption Taxes in *United States Tax Reform in the 21st Century*, Zodrow GR & Mieszkowski P., eds. Cambridge University Press.

Hall, R. 1988. Intertemporal Substitution in Consumption. *Journal of Political Economy* 96:2 (339-57).

Hansen LP and Singleton KJ. 1983 Stochastic Consumption, Risk Aversion, and the Temporal Behavior of Asset Returns, *Journal of Political Economy*, 91 (2), 249-265.

Haughton J and Khandker SR. 2009. *Handbook on Poverty and Inequality*, World Bank, Washington DC.

Hubbard RG, O'Brien AP, 2008. *Economics*. Pearson: Prentice Hall, Upper Saddle River, New Jersey. 598-632,

Killingsworth M. 1983. *Labor Supply*, Cambridge University Press.

Kotlikoff LJ, Jokisch S. 2005. Simulating the Dynamic Macroeconomic and Microeconomic Effects of the FairTax, *NBER* Working Paper 11858, Cambridge, MA.

Kotlikoff, LJ. 1993. The Economic Impact of Replacing Federal Income Taxes with a Sales Tax, Policy *Analysis* 193, http://www.cato.org/pubs/pas/pa193.html.

Kotlikoff LJ. 1998. Two Decades of A-K Model, NBER Working Paper, Cambridge MA.

Kydland FE, Prescott EC. 1982. Time to Build and Aggregate Fluctuations, *Econometrica*, 50:1345-70.

Laffer, A, Moore S, Williams J. 2015. Policy Matters: How States Can Compete to Win, in *Rich States, Poor States: The American Legislative Exchange Laffer State Economic Competitiveness Index*, 8th edition, 30-63.

Lau, MI, Pahlke A, Rutherford TF. 2002. Approximating Infinite-horizon Models in a Complementarity Format: A Primer in Dynamic General Equilibrium Analysis, *Journal of Economic Dynamics and Control* 26(4): 577-60.

McBride W. 2012. What Is the Evidence on Taxes and Growth? Tax Foundation. http://taxfoundation.org/article/what-evidence-taxes-and-growth. (December).

Ogaki M, Reinhart CM. 1998. Intertemporal substitution and Durable Goods: Long-run Data, *Economics Letters* 61: 85-90.

Papadimitriou, D. B., Nikforos, M., & Zezza, G. (2016). Destabilizing an unstable economy. Retrieved from http://www.levyinstitute.org/pubs/sa_3_16.pdf

Piggot J and Whalley J. 1985. UK Tax Policy and Applied General Equilibrium Analysis. Cambridge: Cambridge University Press.

Pomerleau K, Schuyler M. 2016. Details and Analysis of Hillary Clinton's Tax Proposals. Tax Foundation Fiscal Fact. January. http://taxfoundation.org/article/details-and-analysis-hillary-clinton-s-tax-proposals

Prescott, EC. 2003. Why Do Americans Work So Much More than Europeans?" Federal Reserve Bank of Minneapolis Research Department Staff Report, 28.

Prescott, EC and Wallenius J. 2008. The Modern Theory of Aggregate Labor Supply and the Consequences of Taxes, in *Cutting Taxes to Increase Prosperity*, Reykjavik, RSE, Icelandic Research Center of Social and Economic Affairs,9-24.

Ramsey, FP. 1928. A Mathematical Theory of Saving, *Economic Journal*, 38 (152): 543-59.

Reinert KA, Roland-Holst DW. 1992. Armington Elasticities for United States Manufacturing Sectors, *Journal of Policy Modeling*, 14(631-639).

Romer C., Romer D. 2010. The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks, *American Economic Review* 100, (763-801).

Rutherford TF. 1995. Applied General Equilibrium Modeling with MPSGE as a GAMS Subsystem: An Overview of the Modeling Framework and Syntax, *Computational Economics*, 14:1-46.

Shoven JB, Whalley J. 1984. Applied General-Equilibrium Models of Taxation and International Trade: An Introduction and Survey, *Journal of Economic Literature*. 22(3)1007-1051.

Shoven JB, Whalley J. 1992. *Applying General Equilibrium*, Cambridge University Press.