Analysis and Modeling of "Tax Cut and Jobs Act"

Final Report
November 27, 2017

prepared by
Inforum
&
Quantria Strategies

Analysis and Modeling of "Tax Cuts and Jobs Act"

Final Report

November 27, 2017

Executive Summary

An ongoing policy goal of the new congress and administration is comprehensive tax reform. One legislative expression of this goal is the U.S. Senate Committee on Finance "Tax Cuts and Jobs Act" ("Senate Tax Plan"). Briefly, the Senate Tax Plan makes significant changes to tax rates, deductions and credits of individuals; would lower the maximum corporate tax rate; reform the way the profits of multinational corporations are taxed; modify the tax treatment of interest expense; change the tax treatment of the income of pass-through entities; and extend certain cost recovery provisions.

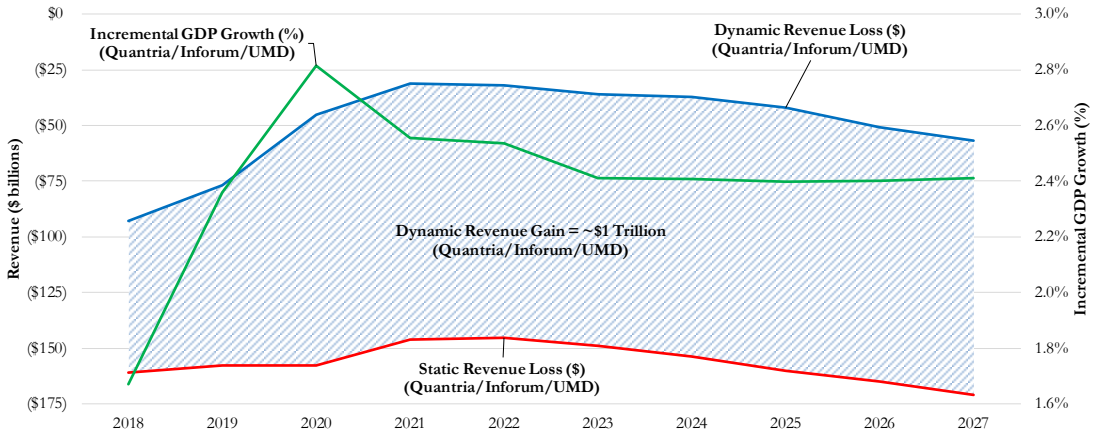
In this study, we have teamed with Quantria Strategies to perform a macroeconomic, or sometimes called "dynamic," analysis of the Senate Tax Plan[1]. Together, we aim to estimate the dynamic impact of the Senate Tax Plan on the U.S. deficit, GDP, employment, household income, and impacts on industry output and growth.

This project leverages the capabilities of Quantria Strategies' suite of individual, corporate and investment tax models with Inforum's detailed interindustry macroeconomic *Lift* model of the U.S. economy. Quantria Strategies has used its models to supply detailed effective personal and corporate tax rates under current law and the proposed law, as well as projected impacts on cost of capital by industry. The Quantria Strategies conclusions become inputs into the *Lift* model.

In the end, this analysis provides quantitative estimates of the revenue effects and macroeconomic and industry impacts of the Senate Tax Plan. We find that the Senate tax plan, when scored statically against a current law baseline, negatively impacts the deficit by ~$1.6T. When considering the macroeconomic growth that the *Lift* model found, the plan negatively impacts the deficit by ~$500BN. As a result, there is revenue of over ~$1T attributable to the dynamic growth that the tax plan creates, as shown in Figure 1.

[1] This research was supported by Koch Industries. However, the firms who prepared the report are fully responsible for the study design and findings.

Figure 1. Estimated Revenue and GDP Effects



To use the Inforum *Lift* model to analyze impacts of the Senate Tax Plan, a baseline scenario is first developed from which to estimate these changes. It has been designed to be very similar to the current 10-year baseline published by the Congressional Budget Office (CBO). An alternative scenario is developed which implements the Senate Tax Plan, and incorporates several additional changes that are expected to occur in response to the plan. We examine the macroeconomic feedback from the Senate Tax Plan, as well as constraints in the economy which affect the dynamic behavior. Both scenarios are run from 2017 to 2027, with the tax reform provisions assumed to begin to take effect as provided for in the Senate Tax Plan.

Our assumptions and findings include:

Individual

- We have used information from Quantria on changes in tax rates on several sources of personal income. This results in a reduction in the average effective Personal federal income rate from 13.8% to 13.0% by 2020, from 14.3% to 13.5% by 2025, and from 14.6% to 13.8% by 2027.
- We find that the reduction in the Personal federal income tax rate raises real Personal disposable income and Personal consumption. Real personal disposable income per household is $3,883 higher in 2020 and $3,598 higher in 2027.
- Real personal consumption is $370 billion higher than the baseline in 2020 and $499 billion higher in 2027. On a household basis, these real personal consumption increases amount to $2,830 and $3,452, respectively.
- Statically calculated (using baseline income) 10 year tax revenue loss from personal taxes is estimated to be $1,182 billion.
- The *Lift* model's incorporation of dynamic response yields a total personal tax revenue loss of $534 billion, so that the dynamic response gains back about 55 percent of the static revenue loss through the personal tax side.
- We treated modifications to the Affordable Care Act (ACA) that were part of the Senate Tax Plan as reductions in government-provided social benefits.

Corporate/Business

- Using detailed analysis on effective corporate tax rate by industry from Quantria, we obtain a reduction in the economy-wide average effective Corporate income tax rate from 18.7% to 16.8% by 2027.[2]
- We find that fixed investment is stimulated both through increased economic activity (demand effect) and a reduction in the cost of capital (price effect). Total investment is higher by $236 billion in 2020 and $158 billion by 2027.
- Statically calculated (using baseline income) 10 year tax revenue loss from corporate taxes (baseline profits) is estimated to be $704 billion.
- Dynamic calculations estimate a corporate tax revenue loss of $512, gaining back about 27% of the static revenue loss.

Macroeconomic

- We find that real GDP increases by $506 billion in 2020 and by $494 billion by 2027.
- We assume an increase in total labor force participation in response to stronger economic growth. By 2027, the labor force participation rate is 61.5%, compared with 60.95% in the baseline. In 2027, this represents about 1.5 million additional people in the labor force.
- We assume that average labor productivity increases in response to stronger investment. In 2027, productivity is 6% higher than in the baseline.
- We find that total household employment increases by 3.2 million jobs by 2020, and by 1.5 million jobs in 2027.
- We find that the federal deficit increases by $45 billion by 2020, and by $57 billion by 2027.
- The total 10 year federal deficit is higher by $500 billion. The static calculations indicated a 10 year deficit increase of $1,567 billion.

Background

The analysis in this paper quantifies likely impacts of personal and corporate income tax cuts, introducing the feedback effects of additional rounds of spending from consumption and investment, but also incorporating supply constraints, and other pushbacks that may be expected from the macroeconomic environment.

The *Lift* model[3] is a highly detailed and internally consistent model, with about 1,400 macroeconomic variables, and over 10,000 industry and commodity level variables that are forecast for each year. However, for tax analysis, it can be helped immensely by coupling with a microsimulation tax model. Such a model contains a database of tax records for firms and households that preserve the inherent diversity and differences in size of taxable incomes, as well as special characteristics of the agents that are relevant to the analysis. This type of model can compute the average tax rate changes implicit in a

[2] These effective tax rates exclude the following sectors due to certain unresolvable data anomalies that arise from bridging two different data sets: Utilities, Other Real Estate, Federal Reserve Banks, Oil & Gas Extraction, Mining, and Mining Support Activities.

[3] The Lift model is fully described in Meade (2013), and more briefly in Appendix B.

certain proposed rate bracket, while also considering the removal of special deductions and credits, or the additions of other.

The elements of this analysis of the impacts of personal and corporate tax cuts include the following core assumptions:

Table 1. Components of the Senate Tax Plan

Components	***Description***
Individual Income Tax	*Tax Rates:* 10%, 12%, 22%, 24%, 32%, 35%, 38.5% (sunset 12/31/25)
	Individual AMT: Repealed (Sunset 12/31/25).
	Standard deduction: Increased to $12,000 for Single, $18,000 for Head of Household, and $24,000 for Married filing jointly (sunset 12/31/25).
	Interest, Dividends and Capital Gains: Taxed at current rates
	Itemized Deductions: Eliminated all itemized deductions (including SALT) other than mortgage interest and charitable (sunset 12/31/25)
	Personal Exemptions: Repealed (sunset 12/31/25)
	Modification of child credit to $2,000 not indexed (sunset 12/31/25)
Corporate Tax	*Tax Rate:* Corporate tax rate 20% effective 2019
	Corporate AMT: Repealed
	Business Tax Preferences: Repealed
Pass-through Entities	*Tax Rate:* Deduct 17.4% of qualified income (sunset 12/31/25)
	Restrictions: If partnership or S-corporation, the percentage of total business income eligible is limited to 50% of W-2 wages (sunset 12/31/25).
	Disallow active pass-through losses in excess of $500,000 for joint filers, $250,000 for all others (sunset 12/31/25).
Cost Recovery Provisions	Full and immediate expensing for 5 years then revert to accelerated depreciation (MACRS) in year 6.
Net Interest Deductibility	Limit deductions to 30% of adjusted taxable income, carryforward of denied deduction.
Repatriation of Foreign Source Income	U.S. businesses with international operations would be taxed on existing foreign profits at a tax rate of 10%. If these repatriated earnings had been re-invested, the rate would be 5%. Going forward, there would be a 50% inclusion of foreign profits and a 12.5% rate on U.S. income from overseas customers.
Affordable Care Act	Reduce ACA individual shared responsibility payment amount to zero.

Quantria has run simulations with their micro model on these provisions, to determine 3 types of inputs that can then be incorporated as assumptions to the *Lift* model. These are:

1. Reduction of the average federal personal income tax in the model from the baseline, over a forecast interval of 2018 to 2025, with these provisions expiring in 2026 and 2027.
2. Reductions in the corporate tax rate for the same period.
3. Changes in the cost of capital by sector, and their effects on fixed investment.

This exercise is intended to aid in understanding the full dynamics of the economy in response to the Senate tax plan, and to quantify the changes in important economic variables, such as employment, GDP, federal government revenue and expenditures, personal income and consumption and investment and trade.

The analysis is done using a scenario approach. This analysis starts with a baseline scenario developed for the Inforum *Lift* model that is calibrated to be similar to the 2017 CBO 10 year baseline, from 2018 to 2027[4]. The baseline is modified to incorporate cuts in the personal income tax rates and the corporate tax rate. The tax cuts which we implement in this study we assume to start in 2018, except for the corporate rate reduction which starts in 2019. We also model the impact of the cut in the corporate tax rate on the cost of capital and business investment.

We have made assumptions about changes in *effective* personal and corporate tax rates. These are different from the legislated rates (corporate) or a simplification of a complicated tax system (personal). Our approach has been to start with the proposed percentage reduction in the legislated rates, and then calculate the relevant percentage reduction in the effective tax rates. The next sections introduce the components of the tax cut analysis.

Personal Income Tax: Static Calculations

We will first present some static calculations of revenue loss, where the economy does not respond positively to tax cuts. These are useful as an unrealistic upper bound to the revenue cost, and are comparable to estimates from other static models used for tax policy analysis. These are also helpful for comparing with the full impacts including macroeconomic feedback ("dynamic scoring") within the *Lift* model. After this presentation, we turn to an examination of the dynamic analysis.

Although the *Lift* model does not contain detail on households by income level, filing status, types of income received or age, such information is available in the Quantria model, and is used to calculate aggregate personal income tax rates for several categories of personal income, which are then applied in the model. Appendix A.1 explains the modeling of individual taxes in more detail.

Changes in Effective Tax Rates for Components of Personal Income

Quantria has modeled the effects of the tax reform proposals on the effective tax rates for 6 categories of income. We have modified the accounting for personal income, adjusted personal income, and the personal federal income tax rate. Proprietors' income has been divided into four pieces, and these four pieces have been separately identified in the personal income accounting. We have also distinguished taxable dividend and interest income as income sources with their own effective tax rates. The tax base consists of:

1. Taxable wages and salaries.
2. Taxable dividend income.
3. Taxable interest income.
4. Proprietors' income.
5. Partnership income.
6. S-corporations.

[4] See CBO (2017).

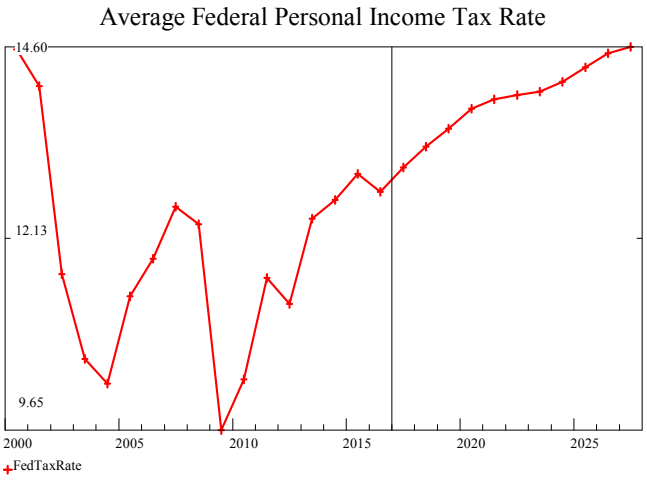
7. Other pass-through income.
8. Other personal income.

Each component has its own tax rate and calculated tax. In addition, we have the option of specifying different tax rates for each component over time.

The *Lift* model has been modified for this study to calculate tax rates on these several parts of the tax base. The total Personal federal income tax is calculated by multiplying each tax rate by the corresponding component of the Adjusted personal income described above.

Figure 2 shows the historical pattern for this tax rate and the projection in the baseline. This rate, expressed as a percent, is currently about 12.7 percent, but is projected to rise up to 14.60 percent by 2027. We have estimated effective tax rates for these components for the recent history and the projection period consistent with the aggregate tax rate.

Figure 2. Baseline Federal Income Tax Assumption



Tax rates were applied separately to 7 categories of taxable income, as described in appendix A.1. The static revenue loss (using baseline income) is shown in table 2 below.

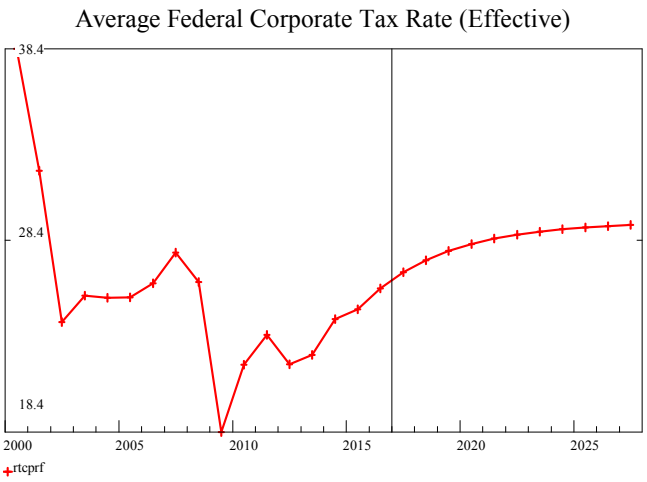
Table 2. Total Federal Personal Income Tax Revenue, Static Calculation

	Baseline	Tax Cut Scenario	Revenue Loss / DI Gain
2018	1,735	1,636	-100
2019	1,834	1,730	-103
2020	1,925	1,818	-107
2021	2,016	1,905	-111
2022	2,106	1,991	-115
2023	2,201	2,081	-119
2024	2,305	2,181	-124
2025	2,423	2,293	-129
2026	2,538	2,404	-134
2027	2,652	2,513	-140
Total			**-1,182**

Reduction of the Corporate Income Tax

Corporate income tax in the *Lift* model is based on NIPA data on corporate profits before and after taxes. Although the legislated corporate tax rate in the U.S. is 35 percent, the effective tax rate is lower, and differs by industry. The overall rate has averaged between 18 and 38 percent since 2000, for the most part staying between 20 and 25 percent. The CBO projects the rate to rise gradually and then flatten.

Figure 3. Corporate Tax Rate: CBO



In this analysis, we have reduced the legislated federal corporate from 35% to 20%. However, due to other provisions in the tax reform package we have modeled, the impact on the average rate is less than this, and the effective tax rate is different for each industry, based on calculations by Quantria.

The Quantria results provided effective corporate tax rates by industry, as described in Appendix A.2. The statically calculated revenue loss is shown in Table 3.

Table 3. Static Revenue Loss / Cash Flow Gain from Corporate Tax Cut

	Baseline	Tax Cut Scenario	Corporate Tax Cut
2018	410	349	-61
2019	415	353	-61
2020	412	351	-61
2021	430	365	-65
2022	454	386	-68
2023	474	403	-71
2024	493	420	-74
2025	521	444	-78
2026	544	463	-81
2027	570	485	-85
Total			**-704**

Repeal of the Individual ACA Mandate

We have modeled the repeal of the Individual mandate recommended in the Senate tax plan. Using figures from JCT, we have assumed the following static revenue gain. We have made the change in *Lift* simply by reducing the portion of government social benefits classified as Refundable tax credits. While the program is actually quite complicated, and the effects are really a combination of reductions in both penalties and benefits, we believe the revenue impact of this assumption is quite accurate. The year-by-year static assumptions are shown in Table 4.

Table 4. Static spending reduction estimates of ACA Mandate repeal

	Baseline	Tax Cut Scenario	ACA Mandate Reduction
2018	135	135	0
2019	138	131	7
2020	141	131	10
2021	145	116	29
2022	150	112	38
2023	155	114	41
2024	160	116	44
2025	166	119	47
2026	172	122	50
2027	178	125	53
Total			**318**

A Note on Static and Dynamic Revenue Estimates

The revenue estimates shown above are static estimates, much like those done by CBO and other tax analysts. These estimates are useful for estimating an upper bound on the revenue loss. However, in the presence of tax cuts, consumers have additional Disposable income. Increases in Disposable income can be expected to stimulate Personal consumption expenditures and Personal savings, thereby increasing demand for consumer goods and services. Reductions in the Corporate tax rate will increase corporate tax flow and reduce the cost of capital investment. This should increase the level of investment in both equipment, intellectual property and business structures, such as manufacturing plants and commercial office buildings. However, the dynamic analysis also imposes constraints. The model (and the economy) have difficulty operating above potential GDP, or tolerating low unemployment rates for extended periods of time. Potential GDP is a concept explaining the average trend real GDP that can be supported with the given labor force, labor productivity and hours worked, with a "full" employment rate. In this sense, to be above potential is to have an unemployment rate below full, and we leave the possibility open for the model to report a negative unemployment rate, even though this is impossible in the real economy. Obtaining a calculated negative unemployment rate is a sign that we are asking too much GDP to be generated for the given supply potential of the economy. This supply potential can be increased if labor force participation increases, or if labor productivity increases.

In the dynamic analysis, each change described above was implemented separately in a dynamic run of the *Lift* model. In the final results, all tax changes were applied together. This scenario incorporates the multiplier effects of consumption and investment, but also involves some "push back" from constraints in the labor market, and the effects on interest rates and prices.

Combined Tax Cuts in the Dynamic Scenario

The immediate effect of both personal and corporate tax cuts is stimulatory. Personal tax cuts result in higher disposable income. Disposable income is then divided into savings (modeled as determined by a flexible savings rate) and personal consumption. Unless consumers save all the additional personal disposable income, then personal consumption increases. Spending on personal consumption is divided into 83 categories of spending, which create demands for consumer goods industries directly, and for many other industries indirectly. The additional rounds of spending stimulate additional jobs and income, which allows for additional spending. This multiplier effect of a tax cut is well-known in the macroeconomic literature. Increases in investment occur in response to the better economy, but also in response to the reduction in the cost of capital. Investment in equipment and structures generates demand in the investment industries, which also create further jobs and income.

The majority of the tax cuts are projected to occur in 2018. The unemployment rate projected in the baseline for 2018 is 4.7 percent, and the baseline projection calls for an unemployment rate in the 4 – 5 percent range over the period 2018 to 2027. Additional consumer and investment spending is bumping into supply constraints, which can be understood as the level of production that the economy can produce without overheating (generating high inflation and interest rates). Some of the additional spending leaks out as imports. Both consumer and investment goods are partially imported from abroad. Sectoral prices and the GDP price level rise, as do wages, in response to the additional demand. This affects U.S. competitiveness, which implies that a higher share of demand will be imported, and less will be exported, generating a deterioration in the trade balance. Higher prices also raise the cost of

government purchases. This, combined with personal and corporate tax cuts, are associated with an increase in the federal deficit.

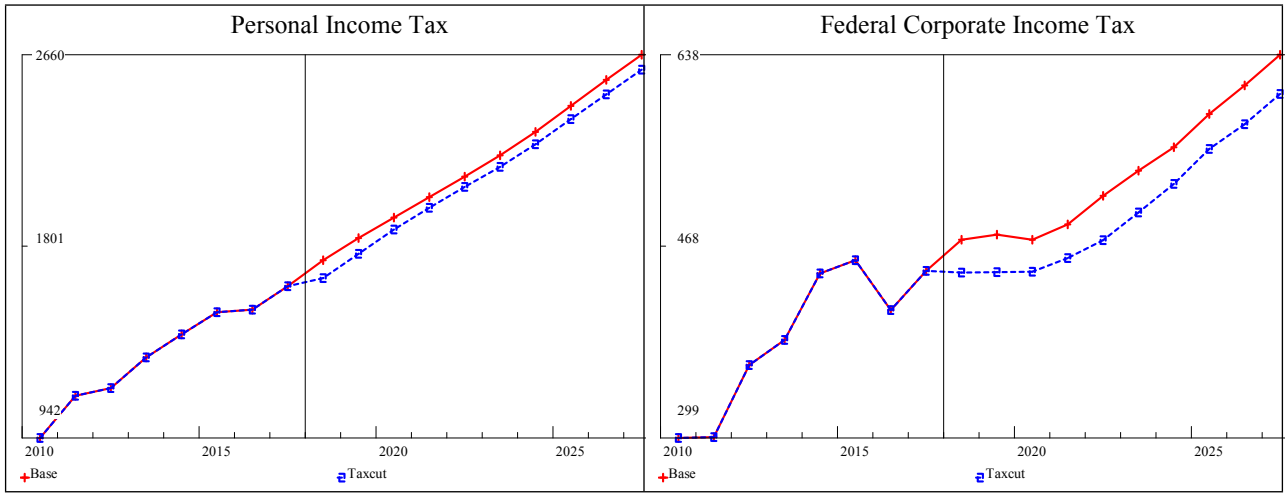
As mentioned above, the *Lift* model has been designed to allow lower rates of unemployment than are historically observed, but this is often viewed as a signal that some constraint has not been adequately accounted for. Conversely, it may be possible that a constraint may be alleviated. Currently, the U.S. economy is operating with an historically low labor force participation rate, and slow rates of labor productivity growth. Many economists agree that stronger demand pressures in the economy, and the associated higher wages will tempt many workers back into the labor force. In addition, the increase in investment will result in a higher capital stock, which should stimulate labor productivity. As an illustration of these effects, we have increased the labor force participation rate and the growth rate of labor productivity to model these effects.

In order to explore other possible features of a consistent and feasible tax reform trajectory, we have explored using several additional assumptions and mechanisms in the analysis:

1. The labor force participation rate has been adjusted to rise back closer to the historical norm than the standard CBO projection. However, after 2022 it declines again, due to demographic composition.
2. We have modeled an increase in average labor productivity across industries in response to additional capital investment.
3. We have adjusted the long-run interest rates downward slightly, to reduce the average interest rate paid on the Federal Debt. This reduces the deficit, but also reduces personal income growth from what it would have been otherwise.

The next several figures summarize some key results from the scenarios. In each graph, the baseline is in red ('x') and the tax cut scenario is in blue (squares).

Figure 4



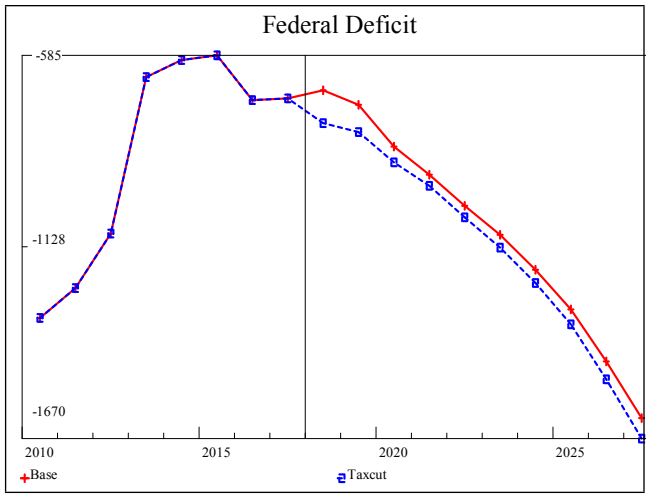


Figure 4 shows graphs of the personal and corporate tax liabilities, and the federal deficit, showing the difference between the CBO baseline and the full tax cut scenario. The blue line incorporates the dynamic response, in which the tax base is raised from the static scenario, due to increased output, wages and income. Statically calculated (using baseline income) 10 year tax revenue loss from personal taxes is estimated to be $1,182 billion. The Lift model's incorporation of dynamic response yields a total personal tax revenue loss of $534 billion, so that the dynamic response gains back about 55 percent of the static revenue loss. Statically calculated (using baseline profits) corporate profits tax liabilities imply a revenue loss of $704 billion. Dynamic calculations estimate a corporate tax revenue loss of $512, gaining back about 27% of the static revenue loss.

Figure 5

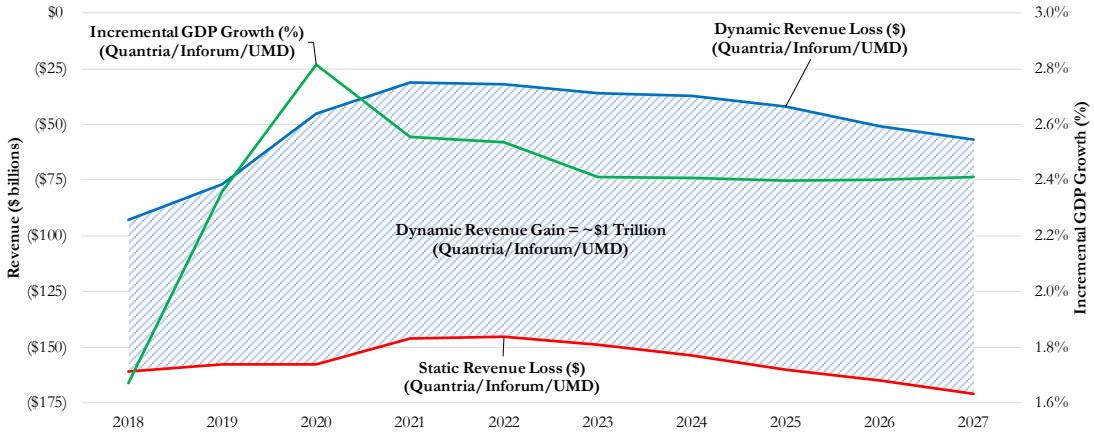


Figure 5 shows the combined dynamic revenue gain, which is the difference between the statically calculated revenue loss and the revenue loss calculated by the LIFT model. The federal deficit is worse than in the baseline, reaching a value of $1,670 billion by 2027, a difference of $57 billion. Total 10 year

revenue loss is estimated to be $500 billion. The static calculations indicated a 10 year deficit increase of $1,567 billion.

Figure 6

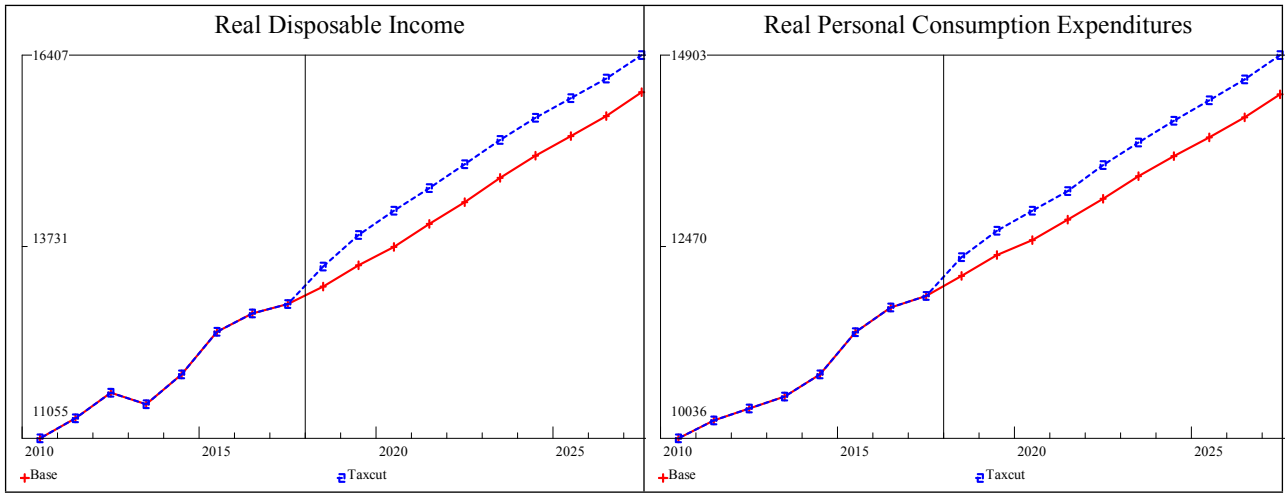


Figure 6 shows the impact of the combined tax reform on real Disposable income. Real disposable income has increased both because of an increase in Personal income (see table 10) and through the fact that tax rates are lower. Personal consumption expenditures also increase in the tax cut scenario, generating increased demand for consumer goods and services, but also for additional imports.

Figure 7

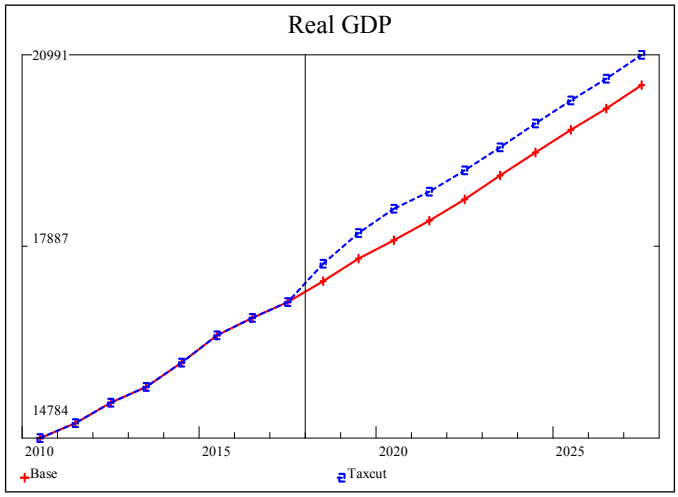
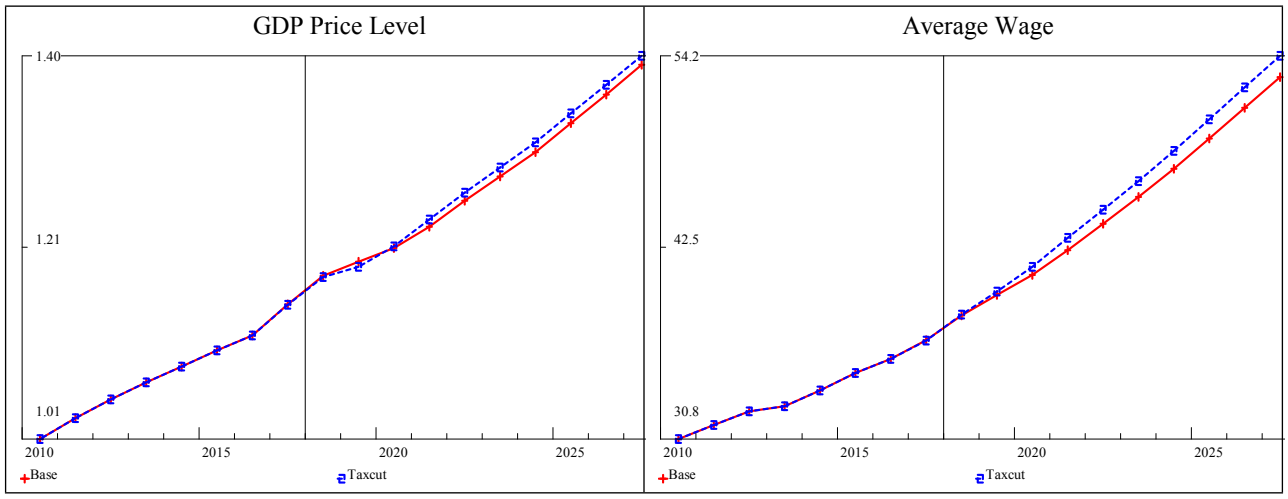


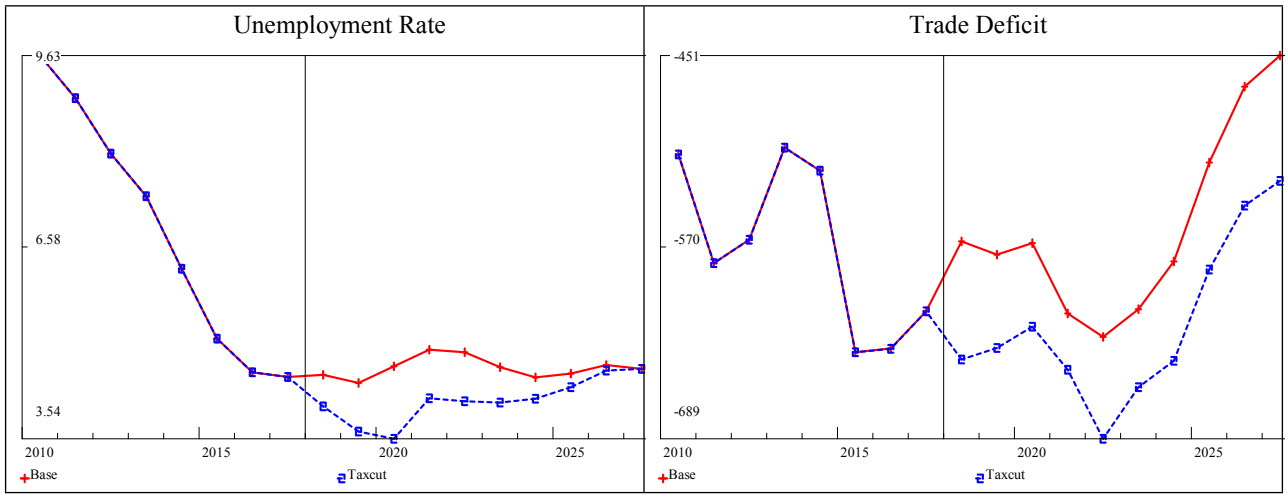
Figure 7 shows that real GDP is higher by $494 billion by 2027, due partly to increased Personal consumption, but also due to higher real investment spending.

Figure 8



In figure 8, we see that both prices and wages are stimulated by the additional demand. However, we have also increased supply potential by increasing both labor force participation and labor productivity growth. Otherwise inflation would be much higher. The average wage rises relative to the base, partly due to a stronger economy, partly due to higher labor productivity and partly to higher prices.

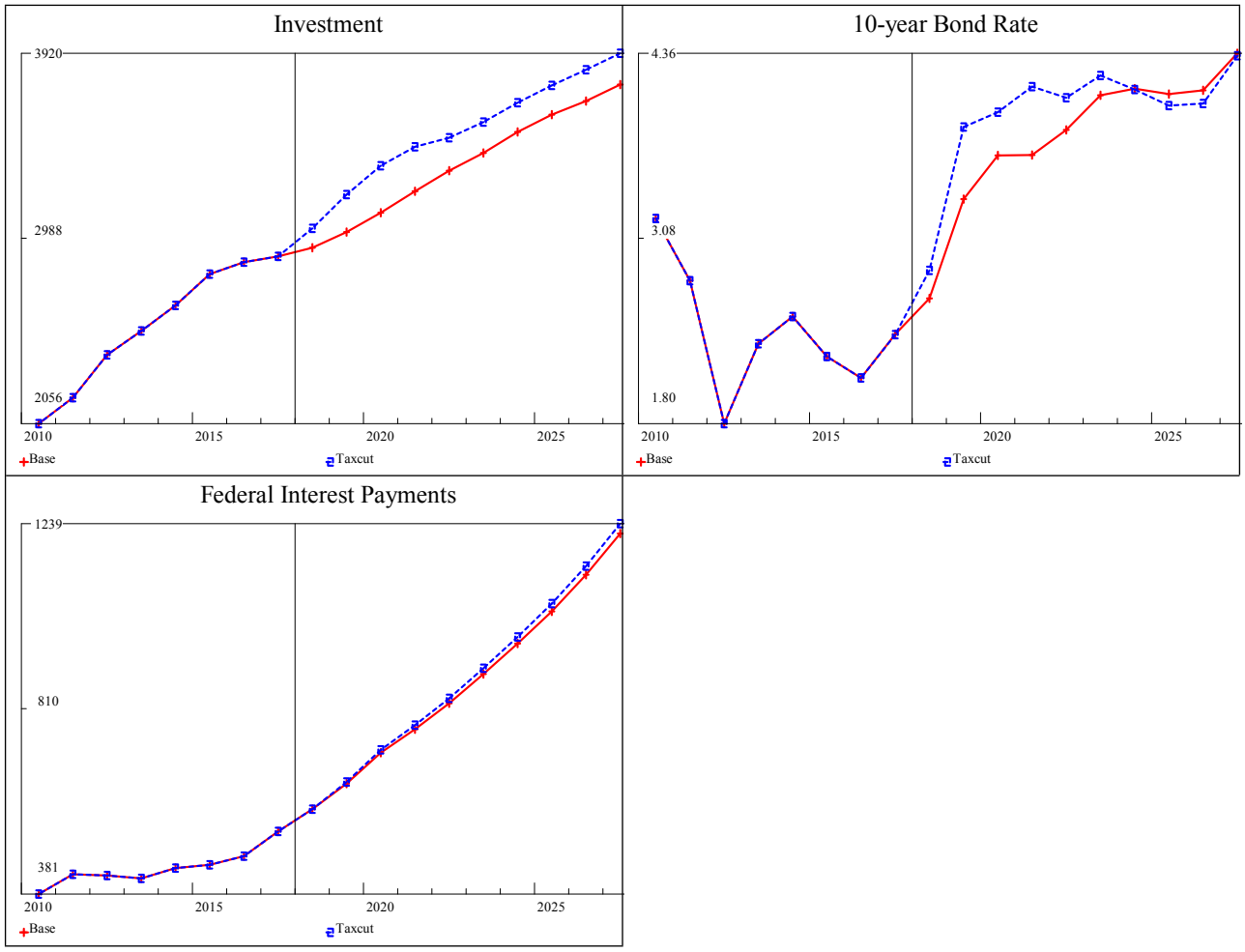
Figure 9



The unemployment rate drops sharply in 2018 and 2019, due to increases in real GDP and jobs. We assume that labor force participation and average labor productivity growth return to historical norms, thus increasing the available supply of labor. Eventually, this results in an unemployment rate about equal to that in the baseline by 2027. This pattern results largely from the combination of the increased labor force and productivity we have assumed, combined with a retraction of the personal tax cuts.

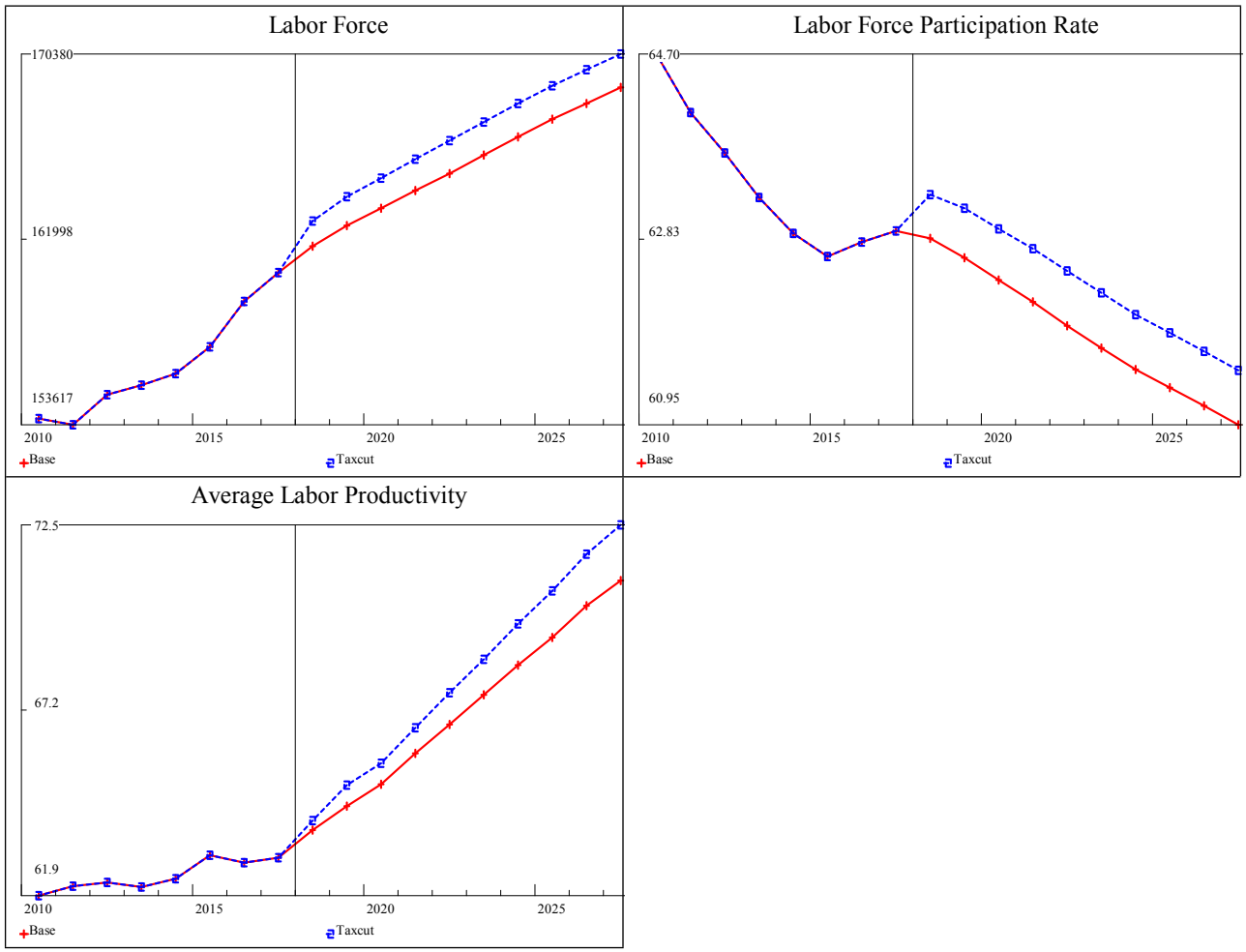
The trade deficit is worse in the tax cut scenario, mainly due to an increase in imports, as both consumption and investment goods have a significant import content.

Figure 10



Investment increases significantly relative to the baseline, reaching its maximum difference in 2020, where it is $236 billion higher (see table 7a) than the baseline in real terms, a difference of about 7.6%. Due to additional borrowing requirements from the government and business sectors, the 10 year bond rate also increases relative to the base. (Note that this rate also helps determine the average rate paid on the federal debt, and so affects the Interest payments portion of government expenditures.)

Figure 11



The graphs in figure 11 illustrate the sources of the increased supply potential in the economy, which are the higher labor force participation rate, and the increase in average labor productivity growth. The last two graphs show the difference in Social security and Medicare transfer payments. We have examined the potential of reducing the cost of these programs to a constant real per beneficiary payout.

In tables 8 through 10 following the conclusions, the first version ('a') of each table shows the alternative as differences from the baseline, and the 2nd version ('b') shows both scenarios in levels.

Conclusions and Next Steps

This analysis has demonstrated how the Senate Tax Plan could ripple through the economy. The exercise used the *Lift* model, which embodies a full interindustry economic core, so that it includes the multiplier effects of personal consumption and investment expenditures to the domestic industries that supply these expenditures. It also embodies the generation of additional jobs and income in these industries that generate further demand. However, *Lift* is also an aggregative, or macro model. Jobs by industry sum to total employment, and the aggregate unemployment rate is an aggregate comparison of

total household employment and the projected labor force. At some point, additional stimulus cannot permanently push the economy to a level of employment much below what is considered "full employment" (between 4 and 5.5 percent). We have modeled how increases in labor force participation and labor productivity may be brought about due to economic stimulus and increased investment, enabling higher potential GDP than would otherwise be available. We have made all assumptions explicit and the model incorporates the effects of these assumptions and their interactions in a fully consistent way.

Personal income is built up from income flows of Wages and salaries, Proprietors' income, and Dividends at an industry level, in addition to including the impacts of assumptions about government social benefits payments, such as Social Security and Medicare. Total federal tax revenues are built up from personal, corporate and indirect taxes. The federal government accounting includes a detailed breakdown of expenditures by budget categories for defense and nondefense spending, as well as transfers and interest payments. Interest payments are based on the Federal debt and the applicable interest rate.

Table 8a. Macroeconomic Summary
(Differences from Base)

Titles of Alternate Runs
Line 1: Baseline
Line 2: Tax Reform

Alternatives are shown in deviations from base values.

	2018	2020	2025	2027
Macro Aggregates				
Gross Domestic Product (GDP)	20,386	21,677	26,327	28,505
	318	642	835	878
Real GDP	17,318	17,987	19,772	20,497
	289	506	474	494
Real Exports	2,273	2,503	2,874	3,045
	10	21	-19	-26
Real Imports	2,890	3,096	3,496	3,673
	76	82	98	113
Real Personal Consumption	12,096	12,553	13,858	14,404
	240	370	469	499
Gross Private Fixed Investment	2,940	3,117	3,609	3,762
	98	236	149	158
Federal Budget Deficit	-685	-844	-1,305	-1,613
	-93	-45	-42	-57
Effective Federal Personal Income Tax Rate	13.3	13.8	14.3	14.6
	-0.8	-0.8	-0.8	-0.8
Effective Federal Corporate Tax Rate	27.4	28.2	29.1	29.2
	-3.5	-3.6	-3.7	-3.7
Real Disposable Income	13,174	13,726	15,276	15,886
	280	507	526	521
Prices				
Personal Consumption Deflator	1.16	1.20	1.33	1.39
	0.00	0.00	0.01	0.00
GDP Deflator	1.18	1.21	1.34	1.40
	0.00	0.00	0.01	0.01
Exports Deflator	1.29	1.32	1.47	1.55
	0.00	0.00	0.03	0.03
Imports Deflator	1.19	1.22	1.31	1.36
	0.00	0.00	0.00	0.00
Average Wage	38.36	40.83	49.14	52.87
	0.04	0.49	1.16	1.32
Employment				
Total Household Employment	154,329	155,746	159,766	161,012
	1,895	3,190	1,804	1,453
Unemployment Rate	4.5	4.7	4.6	4.6
	-0.5	-1.1	-0.2	0.0
Taxes				
Federal Personal Income Tax	1,738	1,929	2,431	2,660
	-80	-53	-59	-69
Federal Corporate Income Tax	474	474	585	638
	-29	-28	-31	-35
Federal Deficit	-685	-844	-1,305	-1,613
	-93	-45	-42	-57
Trade Balance	-566	-568	-518	-451
	-73	-52	-66	-78

Table 8b. Macroeconomic Summary
(Levels)

Titles of Alternate Runs
Line 1: Baseline
Line 2: Tax Reform

Alternatives are shown in deviations from base values.

	2018	2020	2025	2027
Macro Aggregates				
Gross Domestic Product (GDP)	20,386	21,677	26,327	28,505
	20,703	22,320	27,162	29,383
Real GDP	17,318	17,987	19,772	20,497
	17,607	18,494	20,246	20,991
Real Exports	2,273	2,503	2,874	3,045
	2,283	2,523	2,854	3,019
Real Imports	2,890	3,096	3,496	3,673
	2,966	3,178	3,595	3,786
Real Personal Consumption	12,096	12,553	13,858	14,404
	12,336	12,923	14,326	14,903
Gross Private Fixed Investment	2,940	3,117	3,609	3,762
	3,038	3,353	3,758	3,920
Federal Budget Deficit	-685	-844	-1,305	-1,613
	-778	-889	-1,347	-1,670
Effective Federal Personal Income Tax Rate	13.3	13.8	14.3	14.6
	12.5	13.0	13.5	13.8
Effective Federal Corporate Tax Rate	27.4	28.2	29.1	29.2
	23.9	24.7	25.3	25.5
Real Disposable Income	13,174	13,726	15,276	15,886
	13,454	14,234	15,801	16,407
Prices				
Personal Consumption Deflator	1.16	1.20	1.33	1.39
	1.16	1.20	1.33	1.39
GDP Deflator	1.18	1.21	1.34	1.40
	1.18	1.21	1.35	1.41
Exports Deflator	1.29	1.32	1.47	1.55
	1.29	1.32	1.50	1.58
Imports Deflator	1.19	1.22	1.31	1.36
	1.18	1.22	1.31	1.36
Average Wage	38.36	40.83	49.14	52.87
	38.40	41.32	50.30	54.19
Employment				
Total Household Employment	154,329	155,746	159,766	161,012
	156,223	158,936	161,569	162,466
Unemployment Rate	4.5	4.7	4.6	4.6
	4.0	3.5	4.4	4.6
Taxes				
Federal Personal Income Tax	1,738	1,929	2,431	2,660
	1,657	1,876	2,371	2,592
Federal Corporate Income Tax	474	474	585	638
	445	446	554	603
Federal Deficit	-685	-844	-1,305	-1,613
	-778	-889	-1,347	-1,670
Trade Balance	-566	-568	-518	-451
	-640	-619	-584	-529

Table 9a. Federal Receipts and Expenditures
(Differences from Base)

Titles of Alternate Runs
Line 1: Baseline
Line 2: Tax Reform

Alternatives are shown in deviations from base values.

	2018	2020	2025	2027
RECEIPTS	3,870	4,203	5,239	5,713
	-98	-57	-65	-77
Current tax receipts	2,393	2,592	3,240	3,538
	-106	-76	-84	-97
Personal current taxes	1,738	1,929	2,431	2,660
	-80	-53	-59	-69
Taxes on production & imports	153	158	184	196
	2	5	6	6
Taxes on corporate income	474	474	585	638
	-29	-28	-31	-35
Taxes from rest of world	28	31	40	44
	0	0	0	0
Contributions for social insurance	1,339	1,458	1,811	1,983
	8	19	20	20
Income receipts on assets	55	58	73	77
	0	0	0	0
Current transfer receipts	93	105	125	125
	0	0	0	0
Current surplus of govt. enterprises	-9	-10	-10	-10
	0	0	0	0
CURRENT EXPENDITURES	4,555	5,047	6,543	7,326
	-5	-12	-23	-20
Consumption Expenditures	989	1,020	1,137	1,198
	0	2	7	8
Federal defense	600	618	680	714
	0	0	0	0
Federal nondefense	389	402	457	484
	0	3	6	7
Current transfer payments	2,924	3,253	4,301	4,841
	-5	-22	-47	-51
Government social benefits	2,276	2,563	3,465	3,920
	-5	-21	-47	-52
To persons	2,254	2,538	3,432	3,883
	-5	-21	-47	-52
Social Security	1,011	1,149	1,548	1,747
	0	0	0	0
Medicare	775	909	1,346	1,557
	0	0	0	0
Other transfers to persons	468	480	538	579
	-5	-21	-47	-52
To rest of world	22	25	33	37
	0	0	0	0
Oth current transfer payments	647	691	836	921
	0	0	1	0
Grants-in-Aid to S&L Govt	591	632	770	850
	0	0	1	0
Interest payments	577	707	1,036	1,216
	0	7	17	23
Govt subsidies	66	67	70	72
	0	0	0	0
Federal Deficit	-685	-844	-1,305	-1,613
	-93	-45	-42	-57

Table 9b. Federal Receipts and Expenditures (Levels)

Titles of Alternate Runs
Line 1: Baseline
Line 2: Tax Reform

Alternatives are shown in deviations from base values.

	2018	2020	2025	2027
RECEIPTS	3,870	4,203	5,239	5,713
	3,772	4,146	5,174	5,636
Current tax receipts	2,393	2,592	3,240	3,538
	2,286	2,516	3,156	3,441
Personal current taxes	1,738	1,929	2,431	2,660
	1,657	1,876	2,371	2,592
Taxes on production & imports	153	158	184	196
	156	163	190	202
Taxes on corporate income	474	474	585	638
	445	446	554	603
Taxes from rest of world	28	31	40	44
	28	31	40	44
Contributions for social insurance	1,339	1,458	1,811	1,983
	1,347	1,477	1,830	2,003
Income receipts on assets	55	58	73	77
	55	58	73	77
Current transfer receipts	93	105	125	125
	93	105	125	125
Current surplus of govt. enterprises	-9	-10	-10	-10
	-9	-10	-10	-10
CURRENT EXPENDITURES	4,555	5,047	6,543	7,326
	4,549	5,035	6,521	7,306
Consumption Expenditures	989	1,020	1,137	1,198
	990	1,023	1,144	1,205
Federal defense	600	618	680	714
	600	618	681	714
Federal nondefense	389	402	457	484
	389	405	463	491
Current transfer payments	2,924	3,253	4,301	4,841
	2,918	3,232	4,254	4,790
Government social benefits	2,276	2,563	3,465	3,920
	2,271	2,541	3,418	3,868
To persons	2,254	2,538	3,432	3,883
	2,249	2,516	3,385	3,831
Social Security	1,011	1,149	1,548	1,747
	1,011	1,149	1,548	1,747
Medicare	775	909	1,346	1,557
	775	909	1,346	1,557
Other transfers to persons	468	480	538	579
	462	458	491	528
To rest of world	22	25	33	37
	22	25	33	37
Oth current transfer payments	647	691	836	921
	647	690	836	922
Grants-in-Aid to S&L Govt	591	632	770	850
	591	632	771	851
Interest payments	577	707	1,036	1,216
	577	715	1,053	1,239
Govt subsidies	66	67	70	72
	66	67	70	72
Federal Deficit	-685	-844	-1,305	-1,613
	-778	-889	-1,347	-1,670

Table 10a. Personal Income
(Differences from Base)

Titles of Alternate Runs
Line 1: Baseline
Line 2: Tax Reform

Alternatives are shown in deviations from base values.

	2018	2020	2025	2027
Total adjusted tax base of personal income	13,061	13,992	16,959	18,221
	183	461	586	589
Wages and salaries	8,778	9,389	11,300	12,166
	130	283	289	289
IRS taxable wages and salaries	7,993	8,550	10,290	11,078
	118	258	263	263
Other wages and salaries	785	839	1,010	1,088
	12	25	26	26
Personal interest income	1,614	1,740	2,476	2,677
	0	61	174	167
IRS taxable interest income	110	118	168	182
	0	4	12	11
Other interest income	1,504	1,622	2,308	2,496
	0	57	162	155
Personal dividend income	977	1,037	1,125	1,182
	55	112	142	150
IRS taxable dividend income	267	284	308	323
	15	31	39	41
Other dividend income	710	753	817	858
	40	81	103	109
Proprietors' income	1,545	1,664	2,033	2,204
	-2.8	25.6	53.595	50.583
IRS proprietors' income	372	401	490	531
	-1	6	13	12
IRS partnership income	261	281	344	373
	0	4	9	9
IRS S-corporations income	445	479	585	634
	-1	7	15	15
Other proprietors' income	467	503	614	666
	-1	8	16	15
Other personal income	148	161	25	-8
	0	-20	-72	-68
Total federal personal income tax	1,738	1,929	2,431	2,660
	-80	-53	-59	-69
Federal personal income tax rate	13.3	13.8	14.3	14.6
	-0.8	-0.8	-0.8	-0.8
Tax Rates				
Wages & salaries	12.7	12.7	12.7	12.7
	-0.7	-0.7	-0.7	-0.7
Interest income	22.3	22.3	22.3	22.3
	-1.6	-1.6	-1.6	-1.6
Dividend income	17.4	17.4	17.4	17.4
	-0.6	-0.6	-0.6	-0.6
Proprietors' income	15.1	15.1	15.1	15.1
	-1.7	-1.7	-1.7	-1.7
Partnership income	29.4	29.4	29.4	29.4
	-3.4	-3.4	-3.4	-3.4
S-corporations	31.6	31.6	31.6	31.6
	-2.7	-2.7	-2.7	-2.7
Other proprietors' income	25.4	25.4	25.4	25.4
	-2.5	-2.5	-2.5	-2.5
Tax Liabilities				
Wages & salaries	1,018	1,088	1,310	1,410
	-43	-31	-42	-48
Interest income	24	26	37	40
	-2	-1	0	-1
Dividend income	47	50	54	56
	1	3	5	5
Proprietors' income	56	61	74	80
	-6	-6	-7	-8
Partnership income	77	83	101	110
	-9	-8	-9	-10
S-corporations	140	151	185	200
	-12	-11	-11	-13
Other proprietors' income	118	128	156	169
	-12	-11	-12	-13
Subotal of above taxes	1,480	1,586	1,917	2,066
	-84	-64	-77	-88
Other NIPA taxes	257	343	514	594
	4	11	18	19
Implicit tax rate of other NIPA tax	2.0	2.5	3.0	3.3
	0.0	0.0	0.0	0.0
NIPA tax (tpf)	1,738	1,929	2,431	2,660
	-80	-53	-59	-69

Table 10b. Personal Income
(Levels)

Titles of Alternate Runs
Line 1: Baseline
Line 2: Tax Reform

Alternatives are shown in deviations from base values.

	2018	2020	2025	2027
Total adjusted tax base of personal income	13,061	13,992	16,959	18,221
	13,243	14,453	17,545	18,810
Wages and salaries	8,778	9,389	11,300	12,166
	8,908	9,672	11,589	12,455
IRS taxable wages and salaries	7,993	8,550	10,290	11,078
	8,111	8,807	10,553	11,341
Other wages and salaries	785	839	1,010	1,088
	796	865	1,036	1,113
Personal interest income	1,614	1,740	2,476	2,677
	1,614	1,801	2,649	2,844
IRS taxable interest income	110	118	168	182
	110	122	180	193
Other interest income	1,504	1,622	2,308	2,496
	1,504	1,679	2,469	2,651
Personal dividend income	977	1,037	1,125	1,182
	1,032	1,149	1,267	1,332
IRS taxable dividend income	267	284	308	323
	282	315	347	365
Other dividend income	710	753	817	858
	750	835	920	968
Proprietors' income	1,545	1,664	2,033	2,204
	1541.7	1689.8	2086.2	2254.8
IRS proprietors' income	372	401	490	531
	372	407	503	543
IRS partnership income	261	281	344	373
	261	286	353	381
IRS S-corporations income	445	479	585	634
	444	486	600	649
Other proprietors' income	467	503	614	666
	466	511	630	681
Other personal income	148	161	25	-8
	148	141	-47	-76
Total federal personal income tax	1,738	1,929	2,431	2,660
	1,657	1,876	2,371	2,592
Federal personal income tax rate	13.3	13.8	14.3	14.6
	12.5	13.0	13.5	13.8
Tax Rates				
Wages & salaries	12.7	12.7	12.7	12.7
	12.0	12.0	12.0	12.0
Interest income	22.3	22.3	22.3	22.3
	20.7	20.7	20.7	20.7
Dividend income	17.4	17.4	17.4	17.4
	16.8	16.8	16.8	16.8
Proprietors' income	15.1	15.1	15.1	15.1
	13.4	13.4	13.4	13.4
Partnership income	29.4	29.4	29.4	29.4
	26.0	26.0	26.0	26.0
S-corporations	31.6	31.6	31.6	31.6
	28.9	28.9	28.9	28.9
Other proprietors' income	25.4	25.4	25.4	25.4
	22.9	22.9	22.9	22.9
Tax Liabilities				
Wages & salaries	1,018	1,088	1,310	1,410
	974	1,058	1,267	1,362
Interest income	24	26	37	40
	23	25	37	40
Dividend income	47	50	54	56
	47	53	58	61
Proprietors' income	56	61	74	80
	50	54	67	73
Partnership income	77	83	101	110
	68	74	92	99
S-corporations	140	151	185	200
	128	141	174	188
Other proprietors' income	118	128	156	169
	106	117	144	156
Subotal of above taxes	1,480	1,586	1,917	2,066
	1,397	1,522	1,840	1,979
Other NIPA taxes	257	343	514	594
	261	354	532	613
Implicit tax rate of other NIPA tax	2.0	2.5	3.0	3.3
	2.0	2.5	3.0	3.3
NIPA tax (tpf)	1,738	1,929	2,431	2,660
	1,657	1,876	2,371	2,592

References

Bureau of Economic Analysis (2009) *Concepts and Methods of the U.S. Input-Output Accounts*, Accessed at: http://www.bea.gov/papers/pdf/IOmanual_092906.pdf.

Bureau of Economic Analysis (2016) *Concepts and Methods of the U.S. National Income and Product Accounts*, Accessed at: http://www.bea.gov/national/pdf/all-chapters.pdf.

Congressional Budget Office (2017) *The Budget and Economic Outlook: 2017 to 2027,* Washington, DC: Congressional Budget Office. Accessed at https://www.cbo.gov/sites/default/files/115th-congress-2017-2018/reports/52370-outlook_0.pdf.

Meade, Douglas (2013) *The Inforum LIFT Model: Technical Documentation*, November, IERF, Inc., College Park, MD.

Appendix A – Detail on the Modeling Plan

This Appendix addresses the components of modeling the the tax reform plan.

A.1 Modeling the Impact of Effective Tax Rates for Personal Income Tax

Quantria relied on their individual microsimulation model to estimate the revenue and economic effects of individual provisions contained in the Senate Bill. These features included:

- Income tax brackets of 10, 12, 22, 24, 32, 35 and 38.5 percent.
- Increased standard deduction amounts of $12,000/$24,000/$18,000 (single/joint/head-of-household). Provisions sunset in 2026.
- Repeal of deduction for personal exemptions. Provision sunsets in 2026.
- Alternative inflation measure (i.e., chain weighed CPI).
- 17.4 percent deduction for certain pass-through income of individuals.
- Modification of the child tax credit to $2,000 (not indexed). Provision sunsets in 2026.
- Repeal of certain itemized deductions. Provision sunsets in 2026.
- Repeal of the Alternative Minimum Tax (AMT).

Modifications to the Affordable Care Act (ACA) that were part of the Senate bill were not included. They are treated in the LIFT model as a reduction in government social benefits.

Once these provisions were estimated, effective tax rates were calculated for individuals under both current law and the tax reform plan for different types of income, including: wages and salary, interest income, dividend income and the income of pass-through entities (i.e., sole proprietorships, partnerships and S-corporations). Table A-1 below shows the assumptions provided by Quantria.

Table A-1. Effective Tax Rates

Effective Tax Rates	Current Law	Tax Reform
Wages & salaries	12.73	12.01
Interest income	22.27	20.69
Dividend income	17.44	16.80
Proprietors' income	15.10	13.38
Partnership income	29.40	26.02
S-corporations	31.60	28.92
Other proprietors' income	25.37	22.85

The *Lift* model generates components of personal income from several components of income for 66 private sector industries. Personal income is then used to derive the tax base for individual income taxes.

The model estimates Personal income[5] as shown in the following table. Several components of Personal income relate to income by industry. For example, Compensation of employees is calculated in the model for 71 private and government industries, Dividend income is based on Corporate profits after tax for 66 private-sector industries. Proprietors' income (pass-through income) is calculated for the same 66 private industries. The number shown in table 2 is the sum of the industry detail. The figures in table A-2 are historical. The model calculates Personal income in the projection period by building it up from the pieces. Therefore, the dynamic response of Personal income to a a cut in Personal federal income tax hinges on the response of Wage and salary disbursements, Proprietor's income, Dividends, Transfer payments, etc.

Table A-2. Personal Income Components: 2005-2016 (billions of dollars)

	2005	2010	2014	2015	2016
Compensation of employees	7,087	7,961	9,248	9,703	10,111
Wage and salary disbursements	5,692	6,378	7,471	7,810	8,104
Supplements	1,395	1,584	1,781	1,896	2,011
Proprietors income w. IVA&CCADJ	979	1,033	1,338	1,376	1,422
Rental income of prsns w. CCADJ	238	403	606	657	703
Dividends	578	545	926	954	852
Personal interest income	1,088	1,195	1,301	1,411	1,467
Transfer payments to persons	1,517	2,325	2,550	2,653	2,777
Federal	1,084	1,758	1,887	1,964	2,045
State and local	407	524	613	645	686
Business current transfer payments	26	43	46	43	45
Less: Contributions for social insurance	873	984	1,162	1,220	1,274
Personal income	**10,614**	**12,477**	**14,807**	**15,534**	**16,057**

The largest single component of Personal income is Compensation of employees, comprising about 63 percent of Personal income in 2016. The next largest component is Transfer payments to persons, which in turn consists of Federal, State & local and Business transfer payments. Transfer payments in total comprised about 17 percent of Personal income in 2016. Other large categories of personal income include Proprietors income and Personal interest income. Note that Contributions to social insurance figures as a subtraction in the calculation of Personal income.

Note that these data are from the *National Income and Product Accounts* (NIPA) produced by the Bureau of Economic Analysis (BEA). As such, they don't correspond exactly to similar measures tabulated by the IRS in the *Statistics of Income* (SOI) and other databases. The *Lift* model is based on BEA NIPA and Input-Output tables, which have been reconciled by Inforum to be consistent in current and constant prices.

[5] We follow the precedent of capitalizing the first word of model variables, to make it clear when a variable title that includes the word 'and' is referring to one variable.

To obtain a more relevant estimate of the Personal income tax base, which is more similar to the IRS measure of Adjusted Gross Income (AGI) as well as to reduce the volatility in the ratio of taxes to income, the *Lift* model uses an adjusted measure of personal income (*piadj*). This variable is constructed as follows:

$piadj = pi - trp + trpret + trpmr - oli - 0.5*ynin - 0.5*yri + soci$

where:

pi = Personal income
trp = Personal current transfer payments
trpret = Benefits from retirement plans
trpmr = Military medical insurance
oli = Other labor income
ynin = Net interest
yri = Rental income
soci = Contributions for social insurance

Federal and state and local taxes collected are actually based on Adjusted Gross Income (AGI). The calculation of Adjusted personal Income is an attempt to get closer to the IRS measure of AGI. Note that BEA derives its own measure of AGI, which is published periodically. Like BEA, the Inforum measure first removes the taxable portion of Personal current transfer payments. Social Security is partially taxed now. Retirement plan benefits and Military medical insurance are added back in, as they are taxable. Other labor income, which includes employer contributions for employee pension and insurance funds, is also removed. Contributions for social insurance are added back in, as these are part of taxable income, but not Personal income. Some part of what BEA classifies as rental income and net interest are not taxed. We have taken a rough estimate of 0.5 as the share which is not subject to tax.

Table A-3. Main Components of the Adjusted personal income used in the Lift Model

	2005	2010	2014	2015	2016
Personal income	10,614	12,477	14,807	15,534	16,057
Adjusted personal income (tax base)	8,233	9,134	11,101	11,604	11,908
Proprietors (pass-through) income	979	1,033	1,338	1,376	1,422
Dividends	578	545	926	954	852
Other	6,676	7,557	8,837	9,274	9,635
Wages & salaries	5,692	6,378	7,471	7,810	8,104
Retirement plan benefits	12	13	15	16	14
Military retirement	3	5	5	6	5
Interest income	849	960	1,047	1,117	1,164
Rental income	119	201	303	329	351

The composition of the Adjusted personal income (the tax base) in terms of its components is shown in Table A-3, for the same historical years. Note that the largest component is Other, of which the largest subcomponent is Wages and salaries. Proprietors income, and the taxable part of interest income are also large, both over one trillion in 2016.

Changes in Effective Tax Rates for Components of Personal Income

Quantria has modeled the effects of the tax reform proposals on the effective tax rates for 6 categories of income. we have modified the accounting for personal income, adjusted personal income, and the personal federal income tax rate. Proprietors' income has been divided into four pieces, and these four pieces have been separately identified in the personal income accounting. We have also distinguished taxable dividend and interest income as income sources with their own effective tax rates. The tax base consists of:

1. Taxable wages and salaries.
2. Taxable dividend income.
3. Taxable interest income.
4. Proprietors' income.
5. Partnership income.
6. S-corporations.
7. Other pass-through income.
8. Other personal income.

Each component has its own tax rate and calculated tax. In addition, we have the option of specifying different tax rates for each component over time.

As mentioned above, the *Lift* model has been modified for this study to calculate tax rates on these several parts of the tax base. The total Personal federal income tax is calculated by multiplying each tax rate by the corresponding component of the Adjusted personal income described above.

Figure 2 shows the historical pattern for this tax rate and the projection in the baseline. This rate, expressed as a percent, is currently about 12.7 percent, but is projected to rise up to 14.6 percent by 2027. We have estimated effective tax rates for these components for the recent history and the projection period consistent with the aggregate tax rate. The results of these calculations are shown in Table A-4.

Table A-4. Main Components of the Adjusted personal income used in the *Lift* Model, Baseline

	2015	2018	2020	2025	2027
Total adjusted tax base of personal income	11,604	13,037	13,950	16,901	18,169
Wages and salaries	7,810	8,767	9,372	11,274	12,142
IRS taxable wages and salaries	7,112	7,983	8,534	10,266	11,057
Other wages and salaries	698	784	838	1,008	1,086
Personal interest income	1,411	1,613	1,736	2,470	2,678
IRS taxable interest income	96	109	118	168	182
Other interest income	1,316	1,503	1,618	2,303	2,496
Personal dividend income	954	964	1,015	1,093	1,147
IRS taxable dividend income	261	264	278	299	314
Other dividend income	693	701	737	794	833
Proprietors' income	1,376	1,545	1,662	2,028	2,199
IRS proprietors' income	332	372	401	489	530
IRS partnership income	233	261	281	343	372
IRS S-corporations income	396	445	478	584	633
Other proprietors' income	416	467	502	613	665
Other personal income	52	149	165	35	3
Total federal personal income tax	1,504	1,735	1,925	2,423	2,652
Federal personal income tax rate	13.0	13.3	13.8	14.3	14.6
Current Law					
Effective Tax Rates					
Wages & salaries	12.73	12.73	12.73	12.73	12.73
Interest income	22.27	22.27	22.27	22.27	22.27
Dividend income	17.44	17.44	17.44	17.44	17.44
Proprietors' income	15.10	15.10	15.10	15.10	15.10
Partnership income	29.40	29.40	29.40	29.40	29.40
S-corporations	31.60	31.60	31.60	31.60	31.60
Other proprietors' income	25.37	25.37	25.37	25.37	25.37
Tax Liabilities					
Wages & salaries	905	1,016	1,086	1,307	1,408
Interest income	21	24	26	37	40
Dividend income	46	46	48	52	55
Proprietors' income	50	56	60	74	80
Partnership income	68	77	83	101	109
S-corporations	125	141	151	184	200
Other proprietors' income	105	118	127	155	169
Subtotal of above taxes	1,321	1,479	1,583	1,911	2,061
Rate of subtotal / tax base	11.4	11.3	11.3	11.3	11.3
Other NIPA tax	182	257	342	512	592
Implicit tax rate of other NIPA tax	1.57	1.97	2.45	3.03	3.26
NIPA tax (tpf)	1,504	1,735	1,925	2,423	2,652

Figure A-1. Baseline Federal Income Tax Assumption

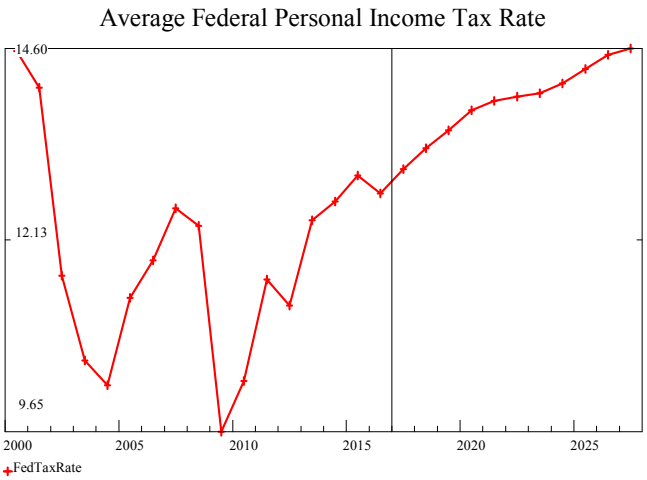


Table A-5 shows the modifications expected to the rate on each part of income, and shows the implications of these changes in a static sense. In other words, these are the changes in tax revenue that would ensue if the economy had no response to the tax rate changes.

Table A-5. Main Components of the Personal Tax Base used in the *Lift* Model, Tax Cut Scenario

	2015	2018	2020	2025	2027
Effective Tax Rates					
Wages & salaries	12.73	12.01	12.01	12.01	12.01
Interest income	22.27	20.69	20.69	20.69	20.69
Dividend income	17.44	16.80	16.80	16.80	16.80
Proprietors' income	15.10	13.38	13.38	13.38	13.38
Partnership income	29.40	26.02	26.02	26.02	26.02
S-corporations	31.60	28.92	28.92	28.92	28.92
Other proprietors' income	25.37	22.85	22.85	22.85	22.85
Tax Liabilities					
Wages & salaries	905	959	1,025	1,233	1,328
Interest income	21	23	24	35	38
Dividend income	46	44	47	50	53
Proprietors' income	50	50	54	65	71
Partnership income	68	68	73	89	97
S-corporations	125	129	138	169	183
Other proprietors' income	105	107	115	140	152
Subtotal of above taxes	1,321	1,379	1,476	1,782	1,921
Rate of subtotal / tax base	11.4	10.6	10.6	10.5	10.6
Percent reduction in average tax rate		6.7	6.7	6.8	6.8
Other NIPA tax	288	257	342	512	592
Implicit tax rate of other NIPA tax	1.57	1.97	2.45	3.03	3.26
NIPA tax (tpf)	1,504	1,636	1,818	2,293	2,513
Total percent reduction		5.74	5.54	5.34	5.26
Total personal tax cut (static)		**100**	**107**	**129**	**140**

A.2 Effective Corporate Tax Rates by Industry

We estimated the revenue effects of a subset of provisions relating to business income. These provisions were:

- 20 percent corporate tax rate beginning in 2019.
- Repeal of the corporate AMT.
- Increase in the Section 179 deduction to $1 million, phased-out beginning at $2.5 million and an expanded definition of qualified property.
- Limit net interest expense to 30% of adjusted taxable income.
- Temporary 100% bonus depreciation. Provision sunsets beginning in 2023.

Once these provisions were estimated, we provided INFORUM with detailed estimates of their effect on the effective tax rates and user cost-of-capital for 66 private industries that conform to the detail used in the LIFT model.

Certain business provisions affect individuals through their receipt of pass-through income from sole proprietorships, partnerships and S-corporations. We estimated the share of each provision that accrues to individuals and allocated this share to individuals to conform to the conventions adopted in the LIFT model.

Table A-6 shows the current law and tax reform corporate profits tax rate by industry.

Table A-6. Effective Corporate Profits Tax Rates by Industry

		Current Law	Proposed Law
1	Farms	11.63%	11.13%
2	Forestry, fishing, and related activities	8.78%	11.50%
3	Oil and gas extraction	11.45%	10.16%
4	Mining, except oil and gas	18.25%	13.93%
5	Support activities for mining	25.28%	19.28%
6	Utilities	12.40%	-8.91%
7	Construction	10.79%	12.33%
8	Food and beverage and tobacco products	26.43%	25.09%
9	Textile mills and textile product mills	22.36%	19.63%
10	Apparel and leather and allied products	24.08%	22.25%
11	Wood products	11.49%	11.36%
12	Paper products	14.70%	11.19%
13	Printing and related support activities	18.81%	18.04%
14	Petroleum and coal products	5.53%	4.53%
15	Chemical products	19.12%	17.60%
16	Plastics and rubber products	22.09%	20.33%
17	Nonmetallic mineral products	13.61%	12.73%
18	Primary metals	26.06%	23.25%
19	Fabricated metal products	24.97%	24.30%
20	Machinery	21.63%	18.11%
21	Computer and electronic products	22.23%	19.19%
22	Electrical equipment, appliances, and components	9.56%	5.57%
23	Motor vehicles, bodies and trailers, and parts	17.69%	11.31%
24	Other transportation equipment	29.11%	22.84%
25	Furniture and related products	15.15%	14.19%
26	Miscellaneous manufacturing	20.97%	20.49%
27	Wholesale trade	24.63%	19.80%
28	Motor vehicle and parts dealers	25.06%	23.39%
29	Food and beverage stores	22.63%	18.28%
30	General merchandise stores	31.45%	24.42%
31	Other retail	28.05%	23.18%
32	Air transportation	10.00%	9.74%
33	Rail transportation	33.04%	26.99%
34	Water transportation	13.28%	10.44%
35	Truck transportation	16.79%	14.34%
36	Transit and ground passenger transportation	10.82%	10.77%
37	Pipeline transportation	24.68%	24.05%
38	Other transportation and support activities	29.32%	24.33%
39	Warehousing and storage	16.43%	17.60%
40	Publishing industries, except internet (includes software)	17.34%	14.43%
41	Motion picture and sound recording industries	22.07%	17.48%
42	Broadcasting and telecommunications	20.67%	15.88%
43	Data processing, internet publishing, and other informatior	19.89%	14.64%
44	Federal Reserve banks, credit intermediation, and related a	16.09%	10.37%
45	Securities, commodity contracts, and investments	23.63%	18.03%
46	Insurance carriers and related activities	21.58%	15.05%
47	Funds, trusts, and other financial vehicles	0.13%	0.49%
48	Housing services	3.38%	3.20%
49	Other real estate	9.86%	-7.57%
50	Rental and leasing services and lessors of intangible assets	25.75%	20.14%
51	Legal services	13.14%	21.35%
52	Miscellaneous professional, scientific, and technical service:	19.51%	19.43%
53	Computer systems design and related services	20.60%	19.16%
54	Management of companies and enterprises	15.72%	10.67%
55	Administrative and support services	19.71%	19.35%
56	Waste management and remediation services	24.55%	19.43%
57	Educational services	25.51%	19.99%
58	Ambulatory health care services	16.63%	18.63%
59	Hospitals	25.98%	22.92%
60	Nursing and residential care facilities	25.98%	22.92%
61	Social assistance	23.27%	21.59%
62	Performing arts, spectator sports, museums, and related ac	10.23%	17.29%
63	Amusements, gambling, and recreation industries	11.63%	16.25%
64	Accommodation	7.12%	9.47%
65	Food services and drinking places	16.80%	13.87%
66	Other services, except government	12.87%	15.93%

Calibration of Results

After examining their results, and in close consultation with INFORUM staff, we determined that there were two major discrepancies between our estimates of the tax reform plan and the version estimated within the LIFT model. First, *Lift* relies on estimates of income and profits that closely follow the U.S. National Income and Product Accounts (NIPA) and these measures do not always conform to tax-related

concepts. Second, our estimates of the business provisions were necessarily incomplete and did not include all the provisions or the international tax reforms.

To adjust for these differences, we have calibrated their effective tax rates to target JCT's estimate of the overall tax reform plan.

A.3 User Cost of Capital

The reduction in the corporate tax rate is in the proportion from 35% to 20%. The cost of capital, specified as the user cost of capital, is obtained as:

$$UCC_t = (r_t - \pi_t + \delta)\ \frac{1 - TZ}{1 - T}$$

where:

UCC is the user cost of capital
r is the opportunity cost of funds, where 5% would be .05
π is the inflation rate on capital goods
δ is the average depreciation rate
T is the corporate tax rate
Z is the net present value of depreciation

Quantria has calculated the user cost of capital by industry and by asset type. We have assumed that for the first 5 years of the tax reform, the statutory corporate tax rate will be reduced from 35% to 20%, and expensing will be allowed. For the second 5 years, depreciation is assumed to return to MACRS (Modified Accelerated Cost Recovery System). Changes in the effective rate by industry have been used to calculate changes in investment by industry from the base case. We assume an elasticity of investment to the user cost of 0.75%.

In the econometric investment models investment is considered as comprised of two components. Expansion of the capital stock, or net investment, is directly affected by the user cost of capital, as this changes the relative price of capital with respect to other production factors, and so changes the optimal capital stock. Replacement investment is determined by depreciation or wearing out of the existing capital stock.

As described in the documentation of the Quantria user cost model in sections C.3 and C.4, the user cost is calculated at at detailed level by industry by asset type. For this study, the user cost calculations for equipment were taken at the industry level. For structures, certain industries were matched to major categories of non-residential construction in the *Lift* model. For intellectual property investment, the aggregate user cost calculation was used.

A.4. International Provisions

Quantria did not provide estimates of the package of international tax reform provisions contained in the Senate bill. Instead, they have relied on the estimates provided by JCT[6] and allocated these amounts to industries according to their own estimates of foreign sourced earnings that appear on 10-Ks filed with the Securities and Exchange Commission (SEC).

[6] JCX-59-17, November 17, 2017.

Appendix B – The LIFT Model

B.1 Overview

As mentioned above, Input-Output (IO) relationships form the core of the *Lift* model. Output by commodity is determined using the IO identity, relating production to consumption, investment, government, exports and sales to other industries. Imports are not given to the IO calculation from outside, but are determined jointly with output. Prices and incomes are forced into consistency through the fundamental IO price identity, and the aggregate price level is determined as current price GDP divided by constant price GDP. As we describe below, the IO database underlying LIFT is unique, making full use of the data available from the Bureau of Economic Analysis.

Despite its industry basis, *Lift* is a full macroeconomic model, with more than 1000 macroeconomic variables ("macrovariables") determined either by econometric equation, exogenously or by identity. The econometric equations tend to be those where behavior is more naturally modeled in the aggregate, such as the personal savings rate, or the 3-month Treasury bill rate. A block of the model called "the accountant" relates the industry detail to the National Income and Product Accounts (NIPA), and implements the national accounts identities, which provide closure between the product and income side of GDP. Hundreds of identities are used to collect detailed results into aggregates. For example, total corporate profits are simply the total of corporate profits by industry. An equation for the effective corporate tax rate is used to determine total profits taxes, which is a source of revenue in the Federal government account. Equations for contribution rates for social insurance programs and equations for transfer payments out of these programs can be used to study the future solvency of the trust funds. Certain macrovariables provide important levers for studying effects of government policy. Examples are the monetary base and the personal tax rate. Others, such as potential GDP and the associated GDP gap provide a framework for perceiving tightness or slack in the economy.

Although many IO based models are computable general equilibrium (CGE) models, *Lift* is not. It allows for disequilibrium, but embodies tendencies to return to equilibrium over the medium- to long-run time frame. For example, a shock such as an oil price increase, a tax rate increase, or a sudden imposition of a large carbon tax will depress GDP and jobs for a few years, but the economy will eventually return to its long-run potential GDP growth path. The relationships in the model are for the most part estimated econometrically, on time series data. Optimizing, forward-looking behavior is not imposed on the model explicitly, but many of the equations in the model use economic concepts of optimization in their specification.

The software in which *Lift* runs was also developed by Inforum. The G7 program is used for developing large datasets, which can include matrices and vectors. G7 is integrated with a software framework called *Interdyme*, which is a set of C++ classes and code infrastructure which facilitate the development of models such as *Lift* that use matrices, vectors and macrovariables. In addition to *Lift*, Inforum has developed, or helped international partners develop, over 50 models using this framework. The framework makes it easy to extend *Lift* by quickly adding additional modules which explore some segment of the economy in more detail, such as the electric power sector, or light-duty vehicle transportation.

Development of *Lift* began in the early 1980s, and grew out of earlier Inforum work with IO models of the US and other countries. Since that time, the model has developed further both through graduate student dissertations and other development by students and researchers, and through work on projects with a large variety of clients and other users. Properties of the model have been examined

both through historical simulation, forecasting, and scenario analysis. *Lift* continues to benefit from ongoing development, extensions, sharing ideas with clients and international partners, and internal discussion and seminars.

The next section provides a "tour" through the model's operation, providing a hands-on overview of the workings of the model. After this, some examples of applications of the model are reviewed in section 1.3. The LIFT database is described in section 1.4, as the understanding of the data is crucial to understanding the model. Finally, we conclude with an outlook for the future development of the model, and discuss other ways it can be extended.

B.2 A Tour Through Lift

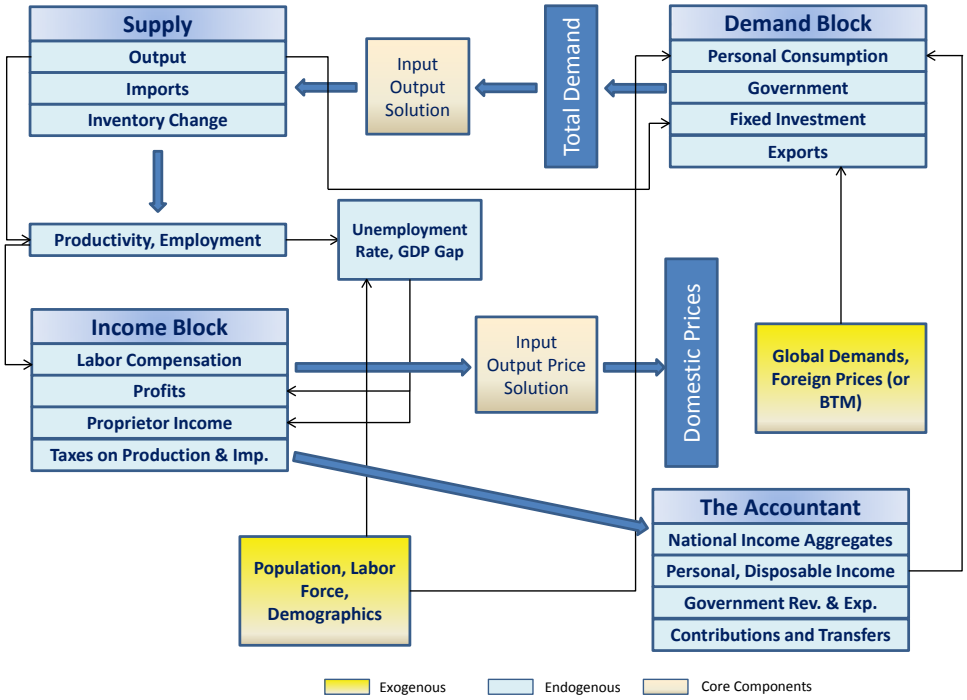
Before describing individual equations or parts of the model, it might be helpful to watch the entire model in operation. This should make the model less of a black box, and help to put the components of the model in perspective. Figure C.1 shows a summary diagram of the model.

For each year of the forecast, first guesses are made for several important endogenous variables, such as output and prices by industry, import shares, and many macrovariables. Fixes for exogenous variables are also done here.[7] Then the model loop begins. This loop will continue to run until outputs and other variables converge.

The model loop begins on the real side, where the expenditure components of GDP are calculated in constant prices. Before starting the expenditure calculations, estimates of final demand prices are made, based on the best current estimate of producer prices by product. Next, the savings function is called, to determine how much of real disposable income will result in total expenditures on consumption. From total expenditures, total population and an income distribution function, the distribution of per-capita expenditures for five income classes are calculated. The cross-section equations of consumption per age-weighted population are calculated next. Once this is done, relative consumption prices, age-weighted population and consumption per age-weighted population are combined in the PADS function to get consumption by category. PADS allows the classification of consumption goods into related expenditure groups. For example, consumption categories 19 to 23 are in the food group. PADS also allows for group, sub-group and individual commodity price parameters. Motor vehicles prices affect the demand for public transportation, since motor vehicles and public transport are substitutes within the Transportation group.

[7] Fixes, in the Interdyme modeling framework, are assumptions which can be imposed on either endogenous or exogenous variables.

Figure B.1 Summary Diagram of the *Lift* Model



After personal consumption, exports are calculated. If the model is run with the Inforum bilateral trade model (BTM), then exports are exogenous. However, if one wants to relax the dependence on BTM, then export equations are available which use information from BTM in the form of weighted foreign demands and foreign prices. The equipment investment equations are estimated by industry. A capital flow matrix converts investment by purchasing industry to investment by commodity. The construction equations are for 26 categories of private construction. Though each has a different form, common variables are interest rates, disposable income and sectoral output.

Federal and state and local consumption and investment expenditures are specified exogenously in real terms, but *Lift* allows for detailed control of these expenditures. For example, defense purchases of aircraft can be specified independently of missiles, ships or tanks. Capital consumption allowances of government are endogenous, based on depreciation of government capital stock, which is also calculated in the model.

At this point, all final demand expenditure categories except for imports and inventory change have been calculated. This means the model is ready to use the Seidel input-output solution to solve jointly for output, imports and inventory change. Note that the A-matrix[8] coefficients are specified to change over time, according to trends for each row. However, individual coefficients can be fixed, to model changes in price or technology.

The investment output loop is helpful in obtaining consistency between construction and equipment investment and output. Both of these categories of demand depend on output, but since they generate

[8] The "A-matrix" is another term for the input-output direct coefficients matrix, which shows the share of each other commodity needed to make a unit of the given commodity's output.

final demand, they also contribute to output. It's best to bring investment and output into agreement before moving on to calculate employment and prices.

Once the investment output loop has converged, the labor productivity equations can be calculated, which forecast the ratio of output to hours worked. Next the average hours equations are solved, which determine the average hours per employed person per year. Together, the productivity, average hours and output forecast generate employment by industry in the private sector. Adding in exogenous projections of government and domestic employment, we obtain total civilian employment, on the establishment basis, which is then adjusted to the household basis. Subtracting this employment from exogenous labor force projections yields unemployment, and then we calculate the unemployment rate. This is a pivotal variable in the model. Now the real side of the model is finished. For almost all of the equations in the real side, we needed information on relative prices (and the aggregate price level as well, to generate real disposable income). However, until the price side of the model has been run, these prices must only be guesses. Next the model turns to the important job of forecasting prices.

Prices are forecast as a markup over unit intermediate and labor costs. However, all components of value added are calculated first. Some are then scaled so that value added by commodity and prices are consistent. The first item of business is to get hourly labor compensation by industry, which we will call the "wage rate", although it also includes supplements. The "wage" equations relate the growth of the wage rate to growth in the ratio of M2 to GDP, expected inflation, and the growth in labor productivity. Multiplying the wage rate by the total hours worked per industry gives total labor compensation per industry. Next the total labor compensation is split into wages *per se*, and supplements such as employer contributions for social insurance and other labor income.

Labor compensation is the largest component of income, usually about 60% of GDP, and certainly has the largest effect on prices. However, it is also important to determine the components of capital income. Corporate profits are needed to be able to calculate corporate profits taxes, and retained earnings and capital consumption allowances are the large components of business savings, which is an important part of the savings-investment identity. Furthermore, dividends, proprietors' income, interest income and rental income all contribute to personal income.

The corporate profits equations relate the ratio of economic profits over labor compensation to a measure of aggregate tightness (the GDP gap), changes in industry output, and the prices of oil and agriculture as supply variables. Economic profits are defined as profits plus the inventory valuation adjustment plus the capital consumption adjustment. The proprietors' income equations take many forms, but typical right hand side variables are measures of tightness, the change in industry output, the change in GDP, and the change in the aggregate deflator. The two other large components of value added that have industry equations are corporate and non-corporate capital consumption allowances. The main explanatory variables are book value estimates of capital stock, which are formed by cumulating current price investment.

The equations for net interest, rental income, business transfer payments, inventory valuation adjustments, and government subsidies are aggregate equations, which are then shared out to industries, based on the share in the last year of data. Indirect business taxes are determined by multiplying exogenous indirect tax rates by output by industry.

Before calculating prices, value added by component is summed to total value added by industry, and then passed through the product-industry bridge to obtain value added by product. This product-industry bridge is derived from the IO make matrix, which shows the distribution of the production of

any given product across various industries. We assume that value added can be allocated by the same distribution, and so use this bridge to translate value added by industry into value added by commodity, and vice versa. Once value added at the product level has been obtained, commodity prices are calculated using the IO equation for prices that also takes account of the import composition of intermediate consumption.

Once the price-income loop has converged, the "Accountant" is run. This part of the model consists of numerous regression equations and identities that estimate economic aggregates that are part of the National Income and Product Accounts. For example, it is here that corporate profits by industry are aggregated to total corporate profits, and profits taxes and dividends are calculated. The Accountant is also responsible for calculating all the components of Federal and State & local expenditures and receipts. Finally, the Accountant ensures that the necessary national accounting identities hold. For example, for nominal net exports to rise, some component of savings (business, personal, government) must rise in tandem.

All loops iterate until convergence is reached. Once the model has converged for a given year, several housekeeping activities are performed, which include the updating of "buckets" which are used in the calculations of capital stocks and other types of stock variables.

Hopefully, this tour has given a good overall picture of how the *Lift* model works. Next we will turn to examine several of the most important pieces of the model.

B.3 Some Applications of Lift

For a sampling of some recent studies done using the model, please visit http://www.inforum.umd.edu/index.html.

B.4 The LIFT Model Database

As described above, *Lift* is an interindustry model in that most equations are estimated at an industry or commodity level, and the price and output solution by commodity uses the fundamental input-output identities. With a model of this type, a large part of the initial development and subsequent maintenance relates to the data. The database of LIFT consists not only of input-output matrices, and vectors of expenditures, value added and employment, but also numerous macroeconomic variables. Although we are extremely fortunate in having high quality data available from BEA, Inforum extends the BEA data by:

- Estimating detailed IO tables from the annual IO table controls
- Deflating the tables to constant dollars
- Reconciling value added by commodity and value added by industry.
- Incorporating employment and hours worked data that are consistent with the IO framework.

Listed below are some characteristics of the current model database.

- The input-output tables are based on the 2007 U.S. benchmark input-output study, updated using the time series of annual IO tables available from BEA, from 1997 to 2014.

- The model has 121 input-output commodity sectors, 83 personal consumption expenditure categories, and 71 industries. The industry classification is used for value added, investment, employment, hours and labor productivity.
- Defense spending is linked from 24 categories in the National Income and Product Accounts (NIPA) to the 121-sector level by a detailed defense bridge. Government construction is handled separately from private construction, or from other government spending.
- Nominal GDP is the same whether calculated as the sum of income or expenditure categories. This allows the four major balance identities to hold.
- All macrovariables have been updated to somewhere between 2014 and 2015. All NIPA data is updated through 2015.
- There are a total of almost 200 vectors and matrices whose history and forecast can be viewed in *G7*, or printed using the *Compare* program. All expenditure vectors are also calculated and stored in current prices, to make verification of the GDP identity easier.

B.5 Exogenous Variables

As described above, the *Lift* model is an interindustry macroeconomic model, in which final demands, value added, employment and other variables are determined by regression equations at the industry, commodity or category level. The macroeconomic aggregates in the model are generally formed by adding up detailed variables. The software used to implement the model, called *G7/Interdyme*, provides a flexible facility called 'fixes' for imposing assumptions. Some variables are purely exogenous, and must be fixed. These variables are usually specified in absolute terms, either in levels, growth rates or indexes. Other variables are determined endogenously, but may be fixed to a different value to implement a specific scenario, or to otherwise modify the behavior of the model. These fixes may be either multiplicative ("mul") or additive ("cta", which stands for "constant term adjustment"). A particular type of fix, called an 'equation fix', allows one to specify an equation for a variable in the fixes file. This may be to replace an existing model equation on the fly, or to make an otherwise exogenous variable endogenous, by specifying a rule for its calculation that relates it to other matrix, vector or macroeconomic variables. There are currently about 800 macroeconomic variables. There are upwards of 25,000 detailed sectoral variables calculated by the model.

The minimum requirement for generating a scenario with *Lift* is to specify values for all exogenous variables, using fixes. The process of running the model and using fixes is described in more detail in the *Users Guide*.[9] Here is a list of most of the exogenous variables in *Lift*.

1. Population, by single year of age. (The model can also be run with a Demographic Projections Module, which takes fertility rates, mortality rates, and net immigration by age as exogenous).

2. Labor force participation rates for men and women, by the main 3 BLS age categories (16-19, 20-64, and 65+).

3. Exchange rates with major trading partners' currencies. An overall 'exchange rate scalar' is also used to move the average dollar rate up or down.

[9] Meade (2016).

4. Federal defense, nondefense and state & local spending in real terms, by several categories of expenditure (defense is the most detailed). Note that two large components, compensation of employees and consumption of fixed capital, are determined endogenously.

5. Employment and hours worked for Federal defense, nondefense, state and local and federal and state and local government enterprises. Wage rates for these sectors are also exogenous.

6. Money supply (M2) and monetary base.

7. Demographic variables used in the personal consumption equations.

8. Average Federal Personal Income tax rate on adjusted personal income (may be determined in another model, or using an equation fix.)

9. Ratio of total state and local personal income taxes to federal personal income taxes.

10. Ratio of state and local other tax payments to personal income.

11. Legislated federal corporate tax rate. Effective corporate tax rates are endogenous, but also usually fixed. The same is true for state and local corporate tax rates.

12. Investment tax credit rate.

13. State and local contributions to S&L insurance funds.

14. Contribution rates to social insurance funds.

15. Social security payroll tax rate and other social security related variables.

16. Medicare rate of premiums paid to expenditures. Total medicare expenditures, part B and part D.

17. Direct relief transfers from Federal to state and local governments for medical care, mostly Medicaid.

18. Federal current taxes and contributions from rest of world, dividends from rest of world.

19. Current surplus of government enterprises.

20. Dividends, interest, rents and royalties received by State and local governments.

21. NAIRU – Non-accelerating inflation rate of unemployment (usually taken from CBO).

22. Number of "multiple jobs holders" This is essentially the difference between the BLS payroll employment (sum of jobs by industry) and household employment, which are shown in parts A and B of the employment report. The household employment measure is used to calculate the unemployment rate.

23. Percentage of federal debt held by the public. Percent domestic share of federal interest payments.

24. Outstanding loans of state & local governments.

25. Rates of interest paid by federal and state and local governments on debt.

26. Federal grants-in-aid.

27. Interest receipts from trust funds.

28. Federal share of total taxes on production and imports (TOPI).

29. State and local transfer receipts from persons, business and rest of world.

30. State and local current transfers to rest of world.

31. Labor productivity growth is determined by equations which have a time trend and pro-cyclical component. These are usually adjusted to target potential GDP growth.

32. Interest rate equations are estimated for the 3-month T-bill rate, the 10-year rate, the AAA bond rate, and the average mortgage interest rate. In the recent environment of quantitative easing, these equations have either been overridden (3-month), or adjusted downward in the near term.

B.6 Development of the Lift Model

The *Lift* model is under continuous development. The current version is the 3rd major version developed with the Inforum *Interdyme* software, though earlier versions in FORTRAN preceded these.

B.7 Lift Industries

Sec #	Code	Description	2007 NAICS	IdLift 3 Commodities
1	111CA	Farms	111-12	1, 2
2	113FF	Forestry, fishing, and related activities	113-15	3
3	211	Oil and gas extraction	211	4, 5
4	212	Mining, except oil and gas	2121-3	6, 7, 8
5	213	Support activities for mining	2131	9
6	22	Utilities	2211-3	10-12
7	23	Construction	2301-3	13, 14
8	311FT	Food and beverage and tobacco products	311, 3121-2	15-18
9	313TT	Textile mills and textile product mills	313-4	19
10	315AL	Apparel and leather and allied products	315-6	20
11	321	Wood products	321	21
12	322	Paper products	322	22
13	323	Printing and related support activities	323	23
14	324	Petroleum and coal products	324	24
15	325	Chemical products	3251-6, 3259	25-27
16	326	Plastics and rubber products	3261-2	28, 29
17	327	Nonmetallic mineral products	327	30
18	331	Primary metals	3311-4, 33151-2	31, 32
19	332	Fabricated metal products	332	33
20	333	Machinery	3331-6, 3339	34-40
21	334	Computer and electronic products	3341-6	41-46
22	335	Electrical equipment, appliances, and components	3351-3, 3359	47-49
23	3361MV	Motor vehicles, bodies and trailers, and parts	3361-3	50, 51
24	3364OT	Other transportation equipment	3364-6, 3369	52-54
25	337	Furniture and related products	337	55
26	339	Miscellaneous manufacturing	3391, 3399	56, 57
27	42	Wholesale trade	42	58
28	441	Motor vehicle and parts dealers	441	59
29	445	Food and beverage stores	445	60
30	452	General merchandise stores	452	61
31	4A0	Other retail	442-4, 446-8, 451, 453-4	62
32	481	Air transportation	481	63
33	482	Rail transportation	482	64
34	483	Water transportation	483	65
35	484	Truck transportation	484	66
36	485	Transit and ground passenger transportation	484, S00201	67
37	486	Pipeline transportation	486	68
38	487OS	Other transportation and support activities	487-8, 492	69
39	493	Warehousing and storage	493	70
40	511	Publishing industries, except internet (includes software)	511	71, 72
41	512	Motion picture and sound recording industries	512	73
42	513	Broadcasting and telecommunications	5151-2, 517	74, 75
43	514	Data processing, internet publishing, and other information services	5,182,519	76
44	521CI	Federal Reserve banks, credit intermediation, and related activities	521-2	77
45	523	Securities, commodity contracts, and investments	5231-2, 5239	78-79
46	524	Insurance carriers and related activities	524	80
47	525	Funds, trusts, and other financial vehicles	525	81
48	HS	Housing services	n/a	82
49	ORE	Other real estate	531	83
50	532RL	Rental and leasing services and lessors of intangible assets	532-3	84, 85
51	5411	Legal services	5411	86
52	5412OP	Miscellaneous professional, scientific, and technical services	5412-4, 5416-9	87, 89-91
53	5415	Computer systems design and related services	5415	88
54	55	Management of companies and enterprises	55	92
55	561	Administrative and support services	561	93
56	562	Waste management and remediation services	562	94
57	61	Educational services	611	95
58	621	Ambulatory health care services	6211-6, 6219	96-102
59	622	Hospitals	622	103
60	623	Nursing and residential care facilities	623	104
61	624	Social assistance	624	105
62	711AS	Performing arts, spectator sports, museums, and related activities	711-2	106
63	713	Amusements, gambling, and recreation industries	713	107
64	721	Accommodation	721	108
65	722	Food services and drinking places	722	109
66	81	Other services, except government	8111-4, 812-4	110-113
67	GFGD	Federal general government defense	S00500	116
68	GFGN	Federal general government nondefense	S00600	117
69	GFE	Federal government enterprises	491, S00102	114
70	GSLG	State and local general government	S00700	118
71	GSLE	State and local government enterprises	S00203	115

B.8 Lift Commodities

Sec #	Description	2007 NAICS	BEA-74
1	Crop production	111	1
2	Animal production	112	1
3	Forestry, fishing and agriculture support activities	113, 114, 115	2
4	Crude oil extraction	211 pt.	3
5	Natural gas extraction	211 pt.	3
6	Coal mining	2121	4
7	Metal ore mining	2122	4
8	Nonmetallic mineral mining	2123	4
9	Support activities for mining	2131	5
10	Electric utilities	2211	6
11	Natural gas distribution	2212	6
12	Water, sewage and other systems	2213	6
13	New construction	2301, 2302	7
14	Maintenance and repair construction	2303	7
15	Dairy products, meat and seafood	3115, 3116, 3117	8
16	Other foods	3111, 3112, 3113, 3114, 3118, 3119	8
17	Beverages	3121	8
18	Tobacco	3122	8
19	Textiles and textile products	313, 314	9
20	Apparel and leather	315, 316	10
21	Wood products	321	11
22	Paper	322	12
23	Printing	323	13
24	Petroleum and coal products	324	14
25	Resin, synthetic rubber and fibers	3252	15
26	Pharmaceuticals	3254	15
27	Other chemicals	3251,3253,3255,3256,3259	15
28	Plastic products	3261	16
29	Rubber products	3262	16
30	Nonmetallic mineral products	327	17
31	Iron and steel	3311,3312,33151	18
32	Nonferrous metals	3313,3314,33152	18
33	Fabricated metal products	332	19
34	Agriculture, construction and mining machinery	3331	20
35	Industrial machinery	3332	20
36	Commercial and service industry machinery	3333	20
37	Ventilation, heating, air-conditioning and ventilation equipment	3334	20
38	Metalworking machinery	3335	20
39	Engine, turbine and power transmission equipment	3336	20
40	Other general purpose machinery	3339	20
41	Computers and peripheral equipment	3341	21
42	Communications and audio-video equipment	3342, 3343	21
43	Semiconductors and other electronic components	3344	21
44	Electromedical and electrotherapeutic apparatus	334510, 334517	21
45	Search, detection and navigation equipment	334511	21
46	Measuring and control instruments, and media	334512,3,4,5,6,8,9, 3346	21
47	Household appliances	3352	22
48	Electrical equipment	3353	22
49	Other electrical equipment and components	3351,3359	22
50	Motor vehicles	3361,3362	23
51	Motor vehicle parts	3363	23
52	Aerospace products and parts	3364	24
53	Ship and boat building	3366	24
54	Other transportation equipment	3365,3369	24
55	Furniture	337	25
56	Medical equipment and supplies, dental labs, ophthalmic goods	3391	26
57	Miscellaneous manufacturing	3399	26
58	Wholesale trade	42	27
59	Motor vehicle and parts dealers	441	28
60	Food and beverage stores	445	29

Sec #	Description	2007 NAICS	BEA-74
61	General merchandise stores	452	30
62	Other retail	442-4,446-8,451,453-4	31
63	Air transportation	481	32
64	Rail transportation	482	33
65	Water transportation	483	34
66	Truck transportation	484	35
67	Transit and ground passenger transportation	484, S00201	36
68	Pipeline transportation	486	37
69	Transportation support, sightseeing, couriers	487,488,492	38
70	Warehousing and storage	493	39
71	Publishing, except internet and software	511, exc. 5112	40
72	Software	5112	40
73	Motion picture and sound recording	512	41
74	Broadcasting: Cable, TV and radio	5151, 5152	42
75	Telecommunications	517	42
76	Information and data processing	5182,519	43
77	Banks, credit cards and finance	521,522	44
78	Securities and commodities brokers	5231-2	45
79	Other financial investment activities	5239	45
80	Insurance	524	46
81	Funds, trusts and other financial vehicles	525	47
82	Housing services	n/a	48
83	Other real estate	531	49
84	Rental and leasing of goods	532	50
85	Royalties	533	50
86	Legal services	5411	51
87	Architectural, engineering and related services	5413	52
88	Computer systems design and related services	5415	53
89	Scientific research and development services	5417	52
90	Advertising	5418	52
91	Other professional, scientific and technical services	5412, 5414, 5416, 5419	52
92	Management of companies and enterprices	55	54
93	Administrative and support services	561	55
94	Waste management and remediation	562	56
95	Educational services	611	57
96	Offices of physicians	6211	58
97	Offices of dentists	6212	58
98	Offices of other health practitioners	6213	58
99	Outpatient care centers	6214	58
100	Medical and diagnostic laboratories	6215	58
101	Home health care services	6216	58
102	Other ambulatory health care services	6219	58
103	Hospitals	622	59
104	Nursing and residential care facilities	623	60
105	Child care and social assistance	624	61
106	Performing arts, spectator sports and museums	711,712	62
107	Amusements, gambling and recreation	713	63
108	Accomodation	721	64
109	Food services and drinking places	722	65
110	Automotive repair and maintenance	8111	66
111	Other repair and maintenance, personal services	8112,-3,-4, 812	66
112	Religious, grantmaking and other organizations	813	66
113	Private households	814	66
114	Postal service and federal government enterprises	491, S00102	69
115	State and local government enterprises	S00203	71
116	Federal government defense	S00500	67
117	Federal government nondefense	S00600	68
118	State and local general government	S00700	70
119	Scrap, used and secondhand	S00401, S00402	72
120	Noncomparable imports	S00300	73
121	Rest of the world adjustment to final uses	S00600	74

B.9 Lift Personal Consumption Categories

#	PCE Category Title	Unpub09
1	New cars	6
2	New light trucks	9
3	Used cars and trucks	11,15
4	Tires, tubes, accessories and other parts	18
5	Furniture and furnishings	22
6	Household appliances	27
7	Glassware, tableware and utensils	30
8	Tools and equipment for house and garden	33
9	Video and audio equipment	38
10	Photographic equipment	45
11	Information processing equipment	46
12	Sporting equipment, supplies, guns, ammunition, musical instruments	50,59
13	Sports and recreational vehicles	51
14	Books	58, 67
15	Jewelry and watches	61
16	Therapeutic appliances, eyeglasses, contacts	64
17	Luggage and similar personal items	68
18	Telephone and fax equipment	69
19	Cereals and bakery products	74
20	Meat, poultry, eggs, dairy and seafood (off premise)	77,82,83
21	Fruits and vegetables (off premise)	88,91
22	Nonalcoholic beverages (off premise)	94
23	Other food products (off-premise)	87,92,93,101
24	Alcohol purchased for off-premise consumption	97
25	Clothing, women's and children's	104,106
26	Clothing, men's and boy's	105
27	Other clothing	108-109
28	Footwear	110
29	Motor vehicle fuels, lubricants, fluids	112
30	Fuel oil and other fuels	115
31	Pharmaceutical products	120
32	Other medical products	123
33	Games, toys, hobbies, photo supplies	125, 128
34	Pets, flowers seeds and plants	126-127
35	Household supplies	129
36	Personal care products	135
37	Tobacco	139
38	Magazines, newspapers and stationery	140
39	Net expenditures abroad by U.S. residents	145+146-147
40	Rental of tenant-occupied nonfarm housing, group housing	152, 160
41	Owner-occupied housing	156
42	Rental value of farm dwellings	159
43	Water supply and sanitation	162
44	Electricity	166
45	Gas	167

#	PCE Category Title	Unpub09
46	Physicians	170
47	Dentists	171
48	Home health care	173
49	Medical laboratories	174
50	Other professional medical services	175
51	Hospitals	179
52	Nursing Homes	183
53	Motor vehicle maintenance and repair	188
54	Motor vehicle renting and leasing, other services	189
55	Ground transportation	196
56	Air and water transportation	203, 204
57	Clubs, sports centers, parks, theatres and museums	206
58	Cable and satellite TV, video rental	215,219
59	Photographic services, photo and computer repair	216-218
60	Gambling	220
61	Other recreation services	224
62	Eating and drinking places	236-238
63	Alcohol in purchased meals	239
64	School lunches and food for employees	232,240
65	Accomodations	243
66	Financial services	247
67	Life insurance	265
68	Net household insurance	266
69	Net health insurance	269
70	Net motor vehicle and other tranportation insurance	273
71	Telecommunications services	276
72	Postal and delivery services	280
73	Internet access	283
74	Higher education	285
75	Nursery, elementary and secondary schools	288
76	Commercial and vocational schools	291
77	Professional and other services	292
78	Personal care and clothing services	301
79	Social services and religious activities	309
80	Household maintenance	321
81	Americans travel abroad	328
82	Foreigners spending in the US	= -332
83	Final consumption expenditures of nonprofits	336

Appendix C – The Quantria Model

Quantria Strategies has developed, and currently maintains, a number of simulation models to support and inform tax policy analysis. This analysis includes the revenue effects of policy proposals (effect on the deficit), their distributional impacts (by income class or industry segments) and the overall impact on economic activity and growth (job growth and investment).

C.1 Individual Income Tax Simulation Model

Quantria maintains a microsimulation model of the individual federal income tax system. Microsimulation modeling has been a workhorse of tax policy analysis for over forty years. It is a "bottom up" modeling approach. They begin with a sample of individual income tax returns released by the IRS for a particular tax year. (The most recent tax year is 2012.) To this, they overlay a detailed tax calculator that simulates the taxes owed by each individual taxpayer under current law (Plan X). To estimate the change in revenue for a particular tax proposal, current law tax parameters (e.g., rates, brackets, personal exemption amounts) are replaced with parameters specified in an alternative, or counterfactual, scenario (Plan Y). The difference in the tax liability between Plan Y and Plan X is the revenue effect of the proposal for that particular taxpayer. The aggregate change in revenue over all taxpayers (weighted to reflect the population of tax filers in each year) is the revenue estimate.

Quantria also has developed a state-level individual tax model that relies on publicly available income and demographic data collected by the US Census. The focus of this model is how state revenues might change in response to federal tax law changes. For example, many states use federal adjusted gross income (AGI) as the starting point of their tax calculation. If a change in federal tax policy affects AGI, then this will affect state tax revenues.

C.2 Corporate Tax Model

Because of taxpayer confidentiality concerns, the IRS does not release a micro data file of corporations. To fill in this gap, Quantria relies on a number of models that utilize a variety of publicly available sources of corporate activity. These data sources include: detailed tables, by industry and asset size, of the tax computations of US corporations published by the IRS; a micro database of corporate 10-K filings for the S&P 500; and detailed statistics relating to international investment flows compiled by the Bureau of Economic Analysis (BEA).

C.3 Depreciation and Cost of Capital Model

Quantria relies on an integrated model of business investment, depreciation and the user cost of capital for the analysis of tax policies that affect business investment. The starting point for calculating the cost of capital is investment flow data compiled by the Bureau of Economic Analysis (BEA). The data represent investment in non-residential fixed assets in 2015, the last year that data are available. The data is disaggregated into 63 industrial sectors and 96 asset types.

For each industry-asset combination, a depreciation life and depreciation method is assigned based on instructions in IRS Publication 946, How to Depreciate Property. An estimate of economic depreciation for all 96 asset types and for a limited number of industries is also obtained from BEA. This results in three 63x96 matrices: (i) investment, (ii) depreciation method, (iii) depreciation life, and (iv) economic depreciation which form the basis of our model.

The estimates rely on the Hall-Jorgenson (1967) user cost of capital formula:

$$(r-\pi+\delta)\frac{(1-k-\tau z)}{(1-\tau)}. \qquad (1)$$

In this formula:

r is the net-of-tax rate of return a company requires to attract investors;
π is the inflation rate on capital goods;
δ is the rate of economic depreciation;
τ is the statutory corporate tax rate;
k is the investment credit rate; and
z is the present value of depreciation deductions.

We assume a 6 percent rate of return (*r*), an inflation rate (π) of 2.5 percent, a corporate tax rate (τ) of 35 percent and an investment tax credit (*k*) set to zero.

For each of the more than 6,000 industry-asset combinations, we calculate the present value of depreciation deductions based on the asset's depreciation life, depreciation method and rate of inflation. We use the half-year convention as explained in Publication 946. For assets put in place after 1986, there are three types of depreciation method available based on the asset type: 200 percent declining balance (DDB), 150 percent declining balance (1.5DB) and straight-line depreciation (SL).

For each industry-asset pair we calculate the current-law cost of capital based on the Hall-Jorgenson formula. Aggregated figures in the text are weighted by current investment dollars for each category.

In addition to the current-law cost of capital, we calculate the cost of capital under the proposed Framework for tax reform.[10] This involves including (1) temporary (first five years) expensing for certain assets; (2) reduced corporate tax rate to 20 from 35 percent; and (3) limited deductibility of interest expense associated with debt financing of investment.

The limited deductibility of interest expense followed the modeling employed by the Treasury Department's Office of Tax Analysis approach.[11]

In the user cost of capital expression, where r is the firm's nominal discount rate andπ the expected inflation rate, we estimate that:

[10] This analysis assumes that the proposed Senate version of the Administration's Framework is the likely approach for tax reform.
[11] Office of Tax Analysis, U.S. Department of the Treasury, *Effective Tax Rate Model*, July 2014.

$$r - \pi = f\,(i(1-\lambda t) - \pi) + (1- f\,)E. \qquad (2)$$

In this expression, the varaibles are: the fraction of marginal investment financed with debt (*f*), the share of deductible business interest expenses (λ), nominal market interest rate (i), and equity finance (E).

These analyses are closely linked and begin with historical data from BEA on the stock of assets and investment flows across approximately 65 industry sectors and 95 asset classes, see below. For each of the more than 6,000 industry-asset combinations, we model the user cost of capital and the future depreciation deductions flowing from this investment. Our model then compares the revenue effect of the depreciation deductions with those of an alternative scenario (e.g., expensing). Changes in the user cost of capital will affect the level of investment and future depreciation deductions.

C.4 Component of the Cost of Capital – Present Value of Depreciation

For Federal tax purposes, taxpayers may claim an annual depreciation deduction for the cost of tangible physical property used for the production of income. Currently, the modified accelerated cost recovery system (MACRS) determines the annual amount of depreciation that a taxpayer may claim.[12] MACRS assigns to specific asset classes a depreciation method, useful life (recovery period), and a "placed in service" convention.

The taxpayer may apply either the 200-percent or 150-percent declining balance method to determine the annual depreciation amount. MACRS recovery periods range from three to 20 years for most tangible personal property. Generally, tangible property must adopt a mid-year convention that assumes the asset was placed in service midway through the tax year, thus allowing only half of the first-year's depreciation deduction (Refer to Table C-1)

Table C-1 – Recovery Period under MACRS and ADS

MACRS Recovery Period	General Rule-ADS Class Life[13]	Type of Property
3 Years	4 years or less	3-year property
5 Years	More than 4 but less than 10 years	5-year property
7 Years	10 or more but less than 16 years and property without a class life (other than real property)	7-year property
10 Years	16 or more but less than 20 years	10-year property
15 Years	20 or more but less than 25 years	15-year property
20 Years	25 or more years	20-year property
25 Years	50 years	Water utility property
27.5 Years	40 years	Residential rental property

[12] MACRS was part of the Tax Reform Act of 1986, Public Law No. 99-514, section 201(1986)

[13] General Rule-Class life refers to the class lives and recovery periods for ADS described in sections 168(c) and (e).

MACRS Recovery Period	General Rule-ADS Class Life[13]	Type of Property
39 Years	40 years	Nonresidential real property
50 Years	50 years	Any railroad, grading or tunnel bore

Estimating the present-value of depreciation involves modeling the cost recovery percentage allowable under the tax law (current law or proposed in the Framework). In each case, the total deductions may not exceed 100 percent, however the timing of the deduction amount will vary.

The Framework provides for expensing for certain asset classes during the first five years of the budget period. During this time, the total amount available for cost recovery remains unchanged, but the proposed Framework changes merely accelerate the timing of those deductions. This acceleration would increase the present-value of depreciation.

Table C-2 provides an example of this timing difference for an asset that costs $1,000 with a recovery period of 7 years. In this example, the MACRS cost recovery relies on 200-percent declining balance method of depreciation and the half-year convention applies. In this example, the initial reduction in depreciation claimed increases by approximately $893. However, over the life of the asset, subsequent depreciation deductions are reduced compared to what they would have been under MACRS.

Table C-2 – Comparison of the Annual Cost Recovery under MACRS and Expensing

Year:	1	2	3	4	5	6	7	8	Total
MACRS	107.1	255.1	182.2	130.2	93.0	88.5	88.6	55.3	$1,000
Expensing	1000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$1,000
Difference	892.9	-255.1	-182.2	-130.2	-93	-88.5	-88.6	-55.3	0

In the case of the present value of depreciation, this timing difference translates to an increase in the present value, for purposes of the cost of capital. An increase in the present value of depreciation would reduce the cost of capital, holding everything else constant.

Calculating the present value of depreciation involved applying the service lives (shown in Table C-1) to each of the asset classes for equipment, structures, and intellectual property.

Table C-3 – Asset Classes for Cost of Capital and Present Value of Depreciation

Equipment	Structures	Intellectual Property
Mainframes	Office	Prepackaged software
PCs	Hospitals	Custom software
DASDs	Special care	Own account software

Equipment	Structures	Intellectual Property
Printers	Medical buildings	Pharmaceutical and medicine manufacturing
Terminals	Multi-merchandise shopping	Chemical manufacturing, ex. pharma and med
Tape drives	Food and beverage establishments	Semiconductor and other component manufacturing
Storage devices	Warehouses	Computers and peripheral equipment manufacturing
System integrators	Mobile structures	Communications equipment manufacturing
Communications	Other commercial	Navigational and other instruments manufacturing
Nonelectro medical instruments	Manufacturing	Other computer and electronic manufacturing, n.e.c.
Electro medical instruments	Electric	Motor vehicles and parts manufacturing
Nonmedical instruments	Wind and solar	Aerospace products and parts manufacturing
Photocopy and related equipment	Gas	Other manufacturing
Office and accounting equipment	Petroleum pipelines	Scientific research and development services
Nuclear fuel	Communication	Software publishers
Other fabricated metals	Petroleum and natural gas	Financial and real estate services
Steam engines	Mining	Computer systems design and related services
Internal combustion engines	Religious	All other nonmanufacturing, n.e.c.
Metalworking machinery	Educational and vocational	Private universities and colleges
Special industrial machinery	Lodging	Other nonprofit institutions
General industrial equipment	Amusement and recreation	Theatrical movies
Electric transmission and distribution	Air transportation	Long-lived television programs

Equipment	Structures	Intellectual Property
Light trucks (including utility vehicles)	Other transportation	Books
Other trucks, buses and truck trailers	Other railroad	Music
Autos	Track replacement	Other entertainment originals
Aircraft	Local transit structures	
Ships and boats	Other land transportation	
Railroad equipment	Farm	
Household furniture	Water supply	
Other furniture	Sewage and waste disposal	
Other agricultural machinery	Public safety	
Farm tractors	Highway and conservation and development	
Other construction machinery		
Construction tractors		
Mining and oilfield machinery		
Service industry machinery		
Household appliances		
Other electrical		
Other		

This assignment was repeated for each of the industry groups, shown in Table C-4.

Table C-4 – Industry Groups

Farms	Transit and ground passenger transportation
Forestry, fishing, and related activities	Pipeline transportation
Oil and gas extraction	Other transportation and support activities
Mining, except oil and gas	Warehousing and storage

Support activities for mining	Publishing industries (including software)
Utilities	Motion picture and sound recording industries
Construction	Broadcasting and telecommunications
Wood products	Information and data processing services
Nonmetallic mineral products	Federal Reserve banks
Primary metals	Credit intermediation and related activities
Fabricated metal products	Securities, commodity contracts, and investments
Machinery	Insurance carriers and related activities
Computer and electronic products	Funds, trusts, and other financial vehicles
Electrical equipment, appliances, and compon ents	Real estate
Motor vehicles, bodies and trailers, and parts	Rental and leasing services and lessors of intangible assets
Other transportation equipment	Legal services
Furniture and related products	Computer systems design and related services
Miscellaneous manufacturing	Miscellaneous professional, scientific, and technical services
Food, beverage, and tobacco products	Management of companies and enterprises
Textile mills and textile product mills	Administrative and support services
Apparel and leather and allied products	Waste management and remediation services
Paper products	Educational services
Printing and related support activities	Ambulatory health care services
Petroleum and coal products	Hospitals
Chemical products	Nursing and residential care facilities
Plastics and rubber products	Social assistance
Wholesale trade	Performing arts, spectator sports, museums, and related activities

Retail trade	Amusements, gambling, and recreation industries
Air transportation	Accommodation
Railroad transportation	Food services and drinking places
Water transportation	Other services, except government
Truck transportation	