The Growth Effects of Corporate Tax Reform and Implications for Wages

The Council of Economic Advisers

October 2017

Executive Summary

October 2017

The recent disconnect between America's real wages and America's corporate profits is an aberration that reflects the disappointing state of capital accumulation. The pace of capital services growth in the United States slowed substantially during the current business cycle expansion through 2016, with the centered 5-year moving average contribution of capital deepening to labor productivity dropping below zero in 2012 for the first time in modern history. Workers have not seen real wage increases because firms have been discouraged from investing in America by outdated tax policy and heavy regulation.

This is the second in a series of papers from the Council of Economic Advisers that explores the impact of two key elements of business tax reform in the Unified Framework for Fixing Our Broken Tax Code[1] (hereafter, the "Unified Framework") – a reduction in the statutory Federal corporate tax rate from 35 to 20 percent and the introduction of immediate full expensing of non-structure investments – on American workers. In the first paper we explored the impact on wages through application of the findings in a literature that directly connects these corporate tax policies to wage growth. In this paper, we review literatures linking the tax changes to capital formation and to economic growth. While a full estimate of the growth impact of the Unified Framework must await the details of the complete plan, we demonstrate below that the corporate tax side alone will have substantial effects on gross domestic product (GDP) growth.

Our findings indicate that the business side of the Unified Framework would increase GDP by between 3 and 5 percent over the baseline long-run projection. The GDP effects we estimate are growth impacts from corporate tax reform alone. The literature and models vary as to the timeframe over which these benefits could be realized; some have the effects as soon as 3 to 5 years, others find it could take at least double that time. There will be additional GDP effects from reforms to individual income and pass-through business taxes, which we have not modeled, as well as growth from regulatory reform (see CEA paper of October 2, 2017: The Growth Potential of Deregulation) and an infrastructure package.

These estimated boosts to GDP from corporate rate reductions are consistent with estimates from other studies. An evaluation of the Unified Framework by Benzell, Kotlikoff, and Lagarda (2017) similarly estimates a long-run boost to GDP of 3 to 5 percent. Estimates from the Tax

[1] https://www.treasury.gov/press-center/press-releases/Documents/Tax-Framework.pdf

Foundation imply a long-run GDP boost of 3.1 percent from corporate rate reductions alone, 3.0 percent from full expensing, and 4.5 percent from both reforms implemented jointly (Tax Foundation, 2017).[2] Previous proposals to reduce the corporate tax rate, such as the "Growth and Investment Tax Plan," were estimated to increase long-run output by 4.8 percent (The President's Advisory Panel on Federal Tax Reform, 2005).

We also study the impact of this growth on average household income and again find that the average household would, conservatively, realize an increase in wage and salary income of $4,000. Additional elements of the Unified Framework, including changes to individual income tax rates, may deliver further increases to household income, combatting a longer-term stagnation.

1. Introduction

A substantial academic literature measures the effects of corporate tax policy on economic growth. This paper summarizes the literature and uses the estimates to calculate the predicted effects on growth of changes in corporate tax policy proposed under the Unified Framework (U.S. Treasury, 2017). This is not an attempt to estimate the growth effects of the overall plan, given that some details of the plan outside of the corporate reforms are yet to be resolved. But there is considerable academic consensus that reductions in effective corporate tax rates have substantial, positive short- and long-run effects on output. Further, the primary mechanism by which changes in corporate tax liabilities affect output is their first-order effect on the user cost of capital, the expected real cost of renting capital services. A decrease in the tax rate on corporate profits, along with expensing of investment, decreases the before-tax rate of return used to assess the profitability of an investment project, thereby increasing firms' investment, desired capital stock, and potential output. Likewise, by lowering the user cost of capital and making more investments profitable, multinational corporations and foreign capital can be attracted to invest in the U.S. economy.

It is important to point out that if corporate tax rate reductions (which lower the user cost of capital) occur simultaneously with other measures that raise the user cost of capital, the net effect may not induce additional investment or output. For example, the United Kingdom lowered the statutory corporate tax rate by 2 percentage points between 2008 and 2011, but capital allowances for both industrial buildings and machinery were reduced during the same period, increasing the user cost of capital (Centre for Business Taxation, 2017; Bilicka and Devereux, 2012). This higher user cost from the expensing change actually led to a net increase in the effective marginal tax rate (EMTR) despite the statutory rate reduction, undermining the

[2] In the Tax Foundation's modelling, full expensing is permanent, applies only to C-corporations, and applies to both equipment and structures.

growth effects of the corporate tax rate decrease. Thus, even when statutory corporate tax rates decrease, other components of the user cost can limit the dynamic effects on an economy.

The Unified Framework, however, calls for a reduction in the corporate tax rate and a move toward immediate full expensing for capital investments excluding structures. These factors both move to reduce the tax on capital and stimulate capital formation.

Given the parameters in the cost of capital literature discussed below, our calculations imply that a reduction in the statutory Federal corporate income tax rate from 35 percent to 20 percent, coupled with the introduction of full expensing of all non-structure capital investment, lowers the user cost of capital by an average of approximately 15 percent. These changes, in turn, generate an expected additional long-run increase in GDP of 4.2 percent over the baseline Congressional Budget Office (CBO) forecast. Limiting the full expensing provision to five years would reduce the long-run steady state growth effect to 3.1 percent. The economy would achieve the higher growth path if firms expect the full expensing elements of the Unified Framework to be continued.

Much of this boost to U.S. output may be apparent in the near term. Estimates from the empirical literature on exogenous tax shocks discussed below suggest that corporate tax reform elements of the Unified Framework would generate an increase in GDP of 2.4 to 3.2 percent relative to the baseline GDP estimate over three to five years.

The remainder of this paper is as follows. Section 2 reviews the empirical literature on the effects of exogenous tax changes on output growth. Section 3 reviews the empirical evidence on the effects of changes in corporate tax policy on the user cost of capital and subsequent investment. Section 4 reports the results of applying estimates from these literatures to the proposed changes in the Unified Framework, relying on results from sections 2 and 3 to inform the estimates. In section 5, we provide estimates of the worker wage effects implied by the GDP growth and investment estimates. Section 6 provides an expansive literature review on taxes and worker wages, and sections 7 and 8 give additional guidance on worker income considerations from the Unified Framework. Section 9 concludes.

2. Evidence on Taxes and Growth

A fundamental challenge to estimating the effects of changes in income tax rates on economic growth is that the timing of the tax changes are not random. Historically, legislators have tended to lower tax rates during periods of economic contraction and raise taxes during periods of expansion. This high correlation of tax changes with economic conditions can negatively bias estimates of the effect of tax rate reductions on investment and output.

Estimated effects of tax changes may also be biased by the correlation of those changes with unobserved factors.

Recent empirical studies have employed two techniques to address these challenges. One is the structural vector autoregression (SVAR) approach, following Blanchard and Perotti (2002), in which identification of causal effects relies on institutional information about tax and transfer systems and the timing of tax collections to construct automatic fiscal policy responses to economic activity. In their original study, Blanchard and Perotti (2002) find an initial tax multiplier of 0.7 on impact, with a peak impact of 1.33 after seven quarters. In contrast, using sign restrictions to identify tax shocks, Mountford and Uhlig (2009) find a peak-to-impact multiplier that is substantially larger.

A second approach, originating with Romer and Romer (2010), uses narrative history from Presidential speeches and Congressional reports to identify exogenous tax changes with political or philosophical, as opposed to economic, motivations. These changes are unlikely to be correlated with other factors affecting output. Tax cuts unrelated to the business cycle can be used as a quasi-natural experiment to estimate the effect on economic output; this matters because if tax cuts are a response to deteriorating economic conditions, the data will show a spurious negative correlation between taxes and growth. Romer and Romer estimate that a 1 percentage point reduction in the total tax share of GDP increases GDP by 1 percent in the first year and up to 3 percent by the third year after reform. They further find that a 1 percentage point reduction in the total tax share of GDP raises investment by 1.5 percent in the first year and up to 11.2 percent by the third year after reform.

Using the Romer and Romer (2010) series as an external instrument for changes in average individual marginal tax rates, Barro and Redlick (2011) similarly find that a permanent 1 percentage point reduction in the average marginal tax rate raises real GDP per capita by 0.5 percent in the subsequent year, corresponding to a conventional tax multiplier of 1.1. Applying the narrative approach to U.K. data, Cloyne (2013) finds that a 1 percentage point reduction in the total tax share of GDP increases GDP by 0.6 percent on impact and by 2.5 percent over three years, and raises investment by 1.2 percent immediately and 4.6 percent by the third year. Hayo and Uhl (2014) estimate a maximum response to a 1 percentage point drop in total tax liability (as a percent of GDP) of 2.4 percent using German output data. Applying a similar approach to fiscal consolidations (tax revenue increases) across OECD countries, Leigh, Pescatori, and Guajardo (2011) find a tax-based fiscal consolidation of 1 percentage point of GDP reduces GDP by 1.29 percent.

Mertens and Ravn (2013) develop a hybrid approach that combines both methods. Because narratively identified shocks may be prone to measurement error, and identification in a SVAR framework can require questionable parameter restrictions, Mertens and Ravn develop an

estimation strategy that utilizes Romer and Romer's (2010) narrative tax shock series as an external instrument to identify structural tax shocks, avoiding the need to impose parameter restrictions. Utilizing this hybrid approach to analyze U.S. data, they estimate that a 1 percentage point reduction in the average personal income tax rate raises real GDP per capita by 1.4 percent in the first quarter, and by up to 1.8 percent after one year. They further find that a 1 percentage point cut in the average corporate income tax rate raises real GDP per capita by 0.4 percent in the first quarter and by 0.6 percent after a full year, with the effect persisting through 20 quarters. Mertens and Ravn additionally estimate that a 1 percentage point cut in the average corporate income tax rate generates an increase in non-residential investment of 0.5 percent on impact, with a peak increase of 2.3 percent after six quarters. Also employing a hybrid approach, Mertens and Olea (2017) find that in the first two years following a tax decrease of 1 percentage point, real GDP is expected to be higher by about 1 percentage point.

Though the estimated coefficients of these studies are not directly comparable, the sign, size, and statistical significance of the estimates, combined with their replication across time and geography, provide strong evidence of a positive effect of tax cuts on economic growth. Although some of this literature relies on changes in overall tax liabilities, the most recent literature allows us to simulate the impact of corporate tax changes specifically. Moreover, dynamic stochastic general equilibrium (DSGE) models of newer vintage, for example Lizarazo Ruiz, Peralta-Alva, and Puy (2017), are now generating growth effects from changes in income tax rates that are in the range of Mertens and Ravn (2013) and Barro and Redlick (2011), suggesting increasing convergence of estimates by alternative modeling frameworks. This development is important, as some critics of the macroeconometric literature have asserted that the results are too large to be theoretically plausible.

3. Empirical Evidence on Effects of Corporate Tax Changes

A. Effects on investment activity and economic growth

A primary mechanism by which changes in corporate tax rates affect business investment is through the effect on the user cost of capital. The user cost of a capital investment can be thought of as the rental price of capital, and is the minimum return required to cover taxes, depreciation and the opportunity costs of investing in capital accumulation versus financial alternatives. A decrease in the user cost increases the desired capital stock and thereby induces gross investment.

By increasing the after-tax return on capital assets, a decrease in the rate of tax on corporate profits decreases the before-tax rate of return required for the marginal product of new physical assets to exceed the cost of producing and using those assets, increasing firms' desired capital stock. Conversely, by decreasing the after-tax return on physical assets, a

decrease in the net present value of tax deductions for investment expenses increases the before-tax rate of return required.

Several factors may tend to bias empirical estimates of the user-cost elasticity of investment, and early studies (e.g. Eisner and Nadiri, 1968) tended to find estimates considerably smaller than the unit elasticity of demand for capital predicted by the neoclassical production function, as derived by Jorgenson (1963) and Hall and Jorgenson (1967). First, a reliance on aggregate data potentially biases elasticity estimates downward due to simultaneity between the user cost of capital and investment shocks. These aggregate data also suffer from limited variation and unobserved firm heterogeneity, as demonstrated by Goolsbee (1998, 2004). Second, as Goolsbee (2000a) and Cummins, Hassett, and Oliner (2006) demonstrate, *q*-based empirical evaluations of neoclassical models will tend to suffer attenuation bias when the fundamentals that drive investment are mismeasured. Third, as noted above, estimates of the effects of changes in corporate taxes on economic output can be biased by the timing of tax reform. Historically, legislators have tended to lower corporate tax rates and raise investment tax incentives during periods of economic contraction and raise corporate taxes (and withdraw investment credits and other incentives) during periods of economic expansion. Insofar as investment is correlated with general economic conditions as in standard accelerator models (in which the change in the growth of output drives investment), estimates of the user-cost elasticity of investment will therefore be biased toward zero. Studies that properly address these biases therefore tend to exploit large tax events that differentially affect different types of firms or asset classes; in these instances, the variation in tax "treatment" is plausibly uncorrelated with underlying economic conditions.

Exploiting instances of major corporate tax reforms, Cummins and Hassett (1992) estimate user-cost elasticities of investment of roughly -1.1 for equipment and -1.2 for structures. Auerbach and Hassett (1992) and Cummins, Hassett, and Hubbard (1994, 1996) exploit differences in the composition of investment across industries to identify user-cost elasticities, finding an estimated long-run elasticity of the capital stock of -0.67. Djankov, Ganser, McLiesh, Ramalho, and Shleifer (2010) find an elasticity of -0.835 at the mean based on their own database of corporate income tax rates for 85 countries in 2004.

Using cointegration and plant-level microeconomic data, Caballero, Engel, and Haltiwanger (1995) report estimated long-run user-cost elasticities of investment by Standard Industrial Classification two-digit industry codes ranging from -0.01 for transportation to -2.0 for textiles and -1.0 on average. These results imply a generally high long-run responsiveness of investment to changes in the user cost of capital. Schaller (2006) also uses cointegration techniques to estimate long-run user-cost elasticity. Assuming that user costs will largely be exogenous in a small, open economy, Schaller estimates a user-cost elasticity of -1.6 from quarterly Canadian aggregate data spanning 1962 through 1999. Using Bundesbank data to

specifically estimate user-cost elasticities with respect to the German tax system, and employing GMM techniques to instrument for potentially endogenous investment decisions, Harhoff and Ramb (2001) find a smaller user-cost elasticity of -0.42.

More recently, Dwenger (2014) uses German panel data and a distributed lag model based on Chirinko, Fazzari, and Meyer (1999). Dwenger's baseline estimates are about twice as large as the elasticity of -0.25 estimated by Chirinko et al. However, after properly accounting for the equilibrium relationship in the error correlation model, Dwenger (2014) finds point estimates of the user-cost elasticity of investment to be -0.9, and a two-sided chi-squared suggests the elasticity is not statistically different from the neoclassical benchmark of -1.0.

Approaching the question from a somewhat different angle, Giroud and Rauh (2017) employ Romer and Romer's narrative approach to estimate the impact of U.S. State-level corporate taxes on establishment counts, employment, and capital. They find short-run statutory corporate tax elasticities of both employment and of establishment counts of approximately -0.5 (-1.2 over a 10-year horizon), and short-run statutory corporate tax elasticities of capital of -0.24 to -0.25.

Exploiting quasi-experimental variation created by the Domestic Production Activities Deduction (DPAD), which allowed firms to deduct a percentage of "Qualified Production Activities Income" from taxable income, Ohrn (2017) finds that a 1 percentage point reduction in the corporate tax rate increases investment by 4.7 percent of installed capital and decreases debt by 5.3 percent of total assets.

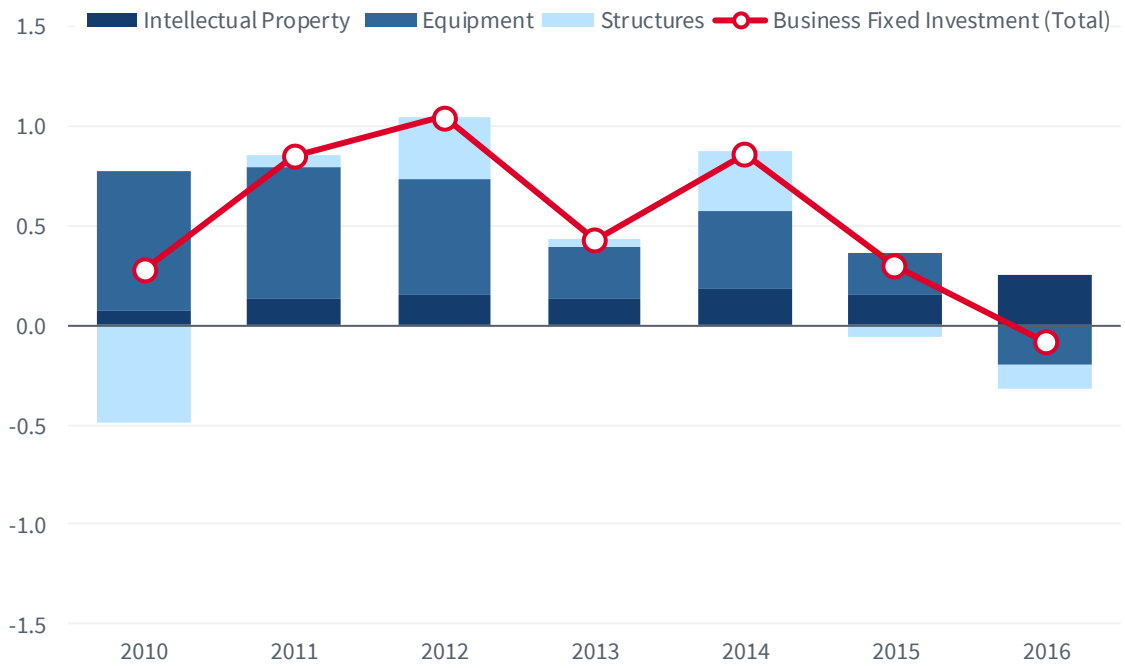
In contrast, the effect of dividend taxation on investment is unclear. In a recent paper, Yagan (2015) found that the 2003 U.S. dividend tax cut had no effect on C-corporation investment or employee compensation relative to S-corporations. Specifically, he uses data on U.S. corporate income tax returns from 1996 to 2008 to compare C- and S-corporations' responses to the dividend tax cut. Agreeing with the "new view" of dividend taxation where investments are funded out of retained earnings and riskless debt, these results imply either that the dividend tax cut in particular had no effect on firms' cost of capital or that investment responds less to the cost of capital than other literature suggests. One factor may be that the user cost impact of dividend taxation may be different than in the canonical model, perhaps because shareholders do not "pierce the corporate veil" and rationally discount dividend policy. Desai and Goolsbee (2004) similarly find that the dividend tax cut had a minimal impact on marginal investment decisions, and that partial expensing provisions introduced in 2002 and 2003 were not sufficiently large to counterweigh contemporaneous declines in other macroeconomic aggregates. Auerbach and Hassett (2006), however, find that the effect of the dividend tax cut on the user cost of capital may have differentially affected firms that pay dividends and rarely

issue new shares relative to those that have yet to pay dividends and those likely to issue shares.

Thus, if the Unified Framework had targeted dividend policy, there would be significant uncertainty regarding the likely impact of the tax change on the user cost of capital. But for corporate tax changes and depreciation, there is a generally emerging consensus within the academic literature, as summarized in Hassett and Hubbard (2002), that places the estimated user-cost elasticity of investment at approximately -1.0, as predicted by standard neoclassical models in the mold of Jorgenson (1963). These estimates imply that a tax change that lowers the user cost of capital by 10 percent would raise demand for capital by up to 10 percent. The tax rate or deduction change required to affect a 10 percent reduction in the user cost of capital varies with the values of other relevant user cost parameters, which we discuss below in section 4.

Figure 1. Contribution of Business Investment to Real GDP Growth

(Percentage Points, Annual Rate)



Note: Business fixed investment contribution shows the net contribution of private non-residential structures, equipment, and intellectual property investments to real GDP growth.
Source: Bureau of Economic Analysis – Private Fixed Investment by Type

As evidence of the need for increased capital investment in the United States, Figure 1 shows that business equipment investment has weakened substantially since 2014. The figure shows the contribution to GDP growth from each of three business investment categories: equipment,

structures, and intellectual property. Investment in equipment and structures, and their resulting contribution to real GDP growth, slowed in recent years and was negative in 2016. In contrast, growth in intellectual property investment remained positive in 2016. Reductions in the user cost of capital that spur equipment investment could reverse these trends and boost GDP growth.

B. Effects on net capital outflows

One component of investment is foreign direct investment (FDI), and numerous empirical studies, discussed below, have observed that FDI is highly responsive to cross-border differences in tax rates. Further, this responsiveness may have increased in recent years. These predictions are relevant to GDP estimates as, for a given level of domestic savings (*S*), any increase in inward foreign investment constitutes a decline in net capital outflows (*NCO*) and a corresponding decline in net exports (*NX*), in accordance with the national income accounting identity $S = I + NX = I + NCO$. Intuitively, a decline in the user cost of capital attracts capital inflows (both foreign firms investing more in U.S. capital stock formation and U.S. firms choosing domestic capital stock formation over foreign), leading to an exchange rate appreciation that lowers exports and raises imports, resulting in a decline in net exports. As a capital inflow, however, FDI is an important funding source for increased investment, since $I = S - NCO$.

De Mooij and Ederveen (2003, 2005, 2008) provide extensive literature reviews on the impact of tax rates on FDI. As most papers utilize different data and empirical specifications to isolate this impact, these literature reviews transform the coefficients in each study into a uniform semi-elasticity of FDI with respect to the corporate tax rate. In their 2003 paper, de Mooij and Ederveen average across 351 elasticity estimates, finding a mean elasticity value of -0.7 corresponding to a mean semi-elasticity (with respect to a percentage point on the tax rate) of -3.3. In their 2005 paper, they extend the 2003 result by considering alternative classifications of literature and including new studies. Instead of averaging across all studies, they estimate average semi-elasticities by study type: time series, cross-sectional, discrete choice, and panel. They find an average semi-elasticity of -2.61 across time series studies, -7.16 across cross-sectional studies, -3.43 across discrete choice models, and -2.73 across panel data studies. Across all 427 estimates, they find an average semi-elasticity of -3.72. In their most recent paper (2008), they predict semi-elasticities based on study characteristics. For studies that use financial data such as FDI or property, plant, and equipment, they predict an effective marginal tax rate semi-elasticity of -4.0, an effective average tax rate semi-elasticity of -5.9, and a country statutory tax rate semi-elasticity of -2.4. For count data such as the number of new plants and/or plant expansions, they find an effective marginal tax rate semi-elasticity of -1.3, an effective average tax rate semi-elasticity of -3.2, and a country statutory tax rate semi-elasticity

of 0.3. Summarizing their work, Table 1 contains semi-elasticities based on the coefficients within the described studies.

Table 1: Summary Statistics of FDI Semi-elasticities

	Number of elasticities	Mean	Median	Max	Min	S.D.
Hartman, 1984	6	−2.6	−3.5	2.0	−4.0	2.3
Bartik, 1985	3	−6.9	−6.6	−5.7	−8.5	1.4
Boskin and Gale, 1987	12	−5.8	−2.7	0.3	−21.2	7.6
Newlon, 1987	2	−0.4	−0.4	3.5	−4.3	5.5
Young, 1988	12	−1.1	−2.1	5.3	−9.2	4.2
Murthy, 1989	4	−0.6	−0.7	0.5	−1.6	1.0
Slemrod, 1990	58	−5.5	−3.5	17.8	−84.5	14.4
Grubert and Mutti, 1991	6	−1.7	−1.6	−0.6	−3.3	1.2
Papke, 1991	2	−4.9	−4.9	−0.9	−8.8	5.6
Hines and Rice, 1994	4	−10.7	−5.0	−1.2	−31.7	14.1
Jun, 1994	10	−0.5	−1.3	5.9	−5.4	3.2
Swenson, 1994	10	1.3	2.7	5.1	−8.1	4.3
Devereux and Freeman, 1995	4	−1.6	−1.6	−1.4	−1.7	0.1
Hines, 1996	46	−10.9	−10.2	−1.1	−36.7	8.2
Pain and Young, 1996	6	−1.5	−1.4	−0.4	−2.8	1.2
Cassou, 1997	17	−7.5	−2.8	3.1	−44.7	13.5
Shang-Jin, 1997	5	−5.2	−5.0	−4.7	−6.2	0.6
Devereux and Griffith, 1998	10	−0.8	−0.9	0.0	−1.2	0.4
Billington, 1999	2	−0.1	−0.1	−0.1	−0.1	0.0
Broekman and van Vliet, 2000	3	−3.3	−3.5	−2.5	−4.0	0.8
Gorter and Parikh, 2000	15	−4.5	−4.3	4.2	−14.3	4.2
Grubert and Mutti, 2000	15	−4.0	−4.2	−1.7	−5.8	1.2
Altshuler, Grubert and Newton, 2001	20	−2.7	−2.6	−1.4	−4.0	0.8
Benassy-Quere et al., 2001	4	−5.0	−5.0	−2.2	−7.9	3.0
Swenson, 2001	95	−3.9	−3.2	8.0	−29.9	8.4
Buttner, 2002*	23	−1.52	−1.59			0.58
Benassy-Quere et al., 2003 *	19	−5.37	−4.22			3.21
Stöwhase, 2003*	5	−7.36	−6.82			1.12
Buttner and Ruf, 2004*	15	−0.42	−0.39			0.35
Desai, Foley and Hines, 2004*	2	−0.64	−0.64			0.02
Stöwhase, 2005*	14	−5.26	−4.30			2.71

Source: de Mooij and Ederveen (2003). * indicates update from de Mooij and Ederveen (2005)

In the first study on taxation and FDI, Hartman (1984) examined aggregate inflows into the U.S. between 1965 and 1979 as a ratio of GNP, leading to a mean elasticity of -2.6 as calculated by de Mooij and Ederveen (2003). Several papers then extend Hartman's analysis by using a longer time-series and slightly adapting Hartman's model (Boskin and Gale, 1987; Young, 1988; Murthy, 1989), suggesting mean semi-elasticities of -5.8, -1.1, and -0.6 (de Mooij and Ederveen,

2003). Newlon (1987) criticized the data on the rate of return for FDI used by Hartman and similar studies and highlighted spurious correlation in the data, but found a similar semi-elasticity of -0.4 (de Mooij and Ederveen, 2003). Slemrod (1990) also criticized Hartman's use of FDI flows, raising concerns about using aggregate FDI flows to analyze the relationship between FDI and tax rates. Auerbach and Hassett (1992) then showed that different components of FDI respond differently to tax rates, moving researchers to use data on property, plant, and equipment (PPE) instead.

Grubert and Mutti (1991) analyzed the distribution of plant and equipment in manufacturing affiliates in 33 countries, leading to a mean semi-elasticity of investment of -1.7 with respect to foreign effective tax rates (de Mooij and Ederveen, 2003). Hines and Rice (1994) consider the distribution of PPE in all affiliates in 73 countries and estimate a much larger semi-elasticity of PPE ownership with respect to tax rates of -10.7 though the mean significant semi-elasticity is -5.0 (de Mooij and Ederveen, 2003).[3] Altshuler, Grubert and Newlon (2001) similarly compared the tax sensitivity of PPE and inventories in 58 countries between 1984 and 1992, finding that the elasticity of both to changes in after-tax returns increased between 1984 and 1992, leading to an estimated average semi-elasticity of -2.7 across both years (de Mooij and Ederveen, 2003).

Another set of studies analyzes the impact of a host country's tax rates on firms' location choices using discrete choice models. For example, Bartik (1985) estimates the probability that a multinational chooses a given State for the location of new plants as a function of State statutory corporate income tax rates. De Mooij and Ederveen (2003) estimate that Bartik's mean semi-elasticity is -6.9. Using the same concept, Papke (1991) also finds a negative relationship between State corporate income tax rates and location decisions, with a mean semi-elasticity of -4.9 (de Mooij and Ederveen, 2003). Devereux and Griffith (1998) expand the discrete choice model outside of the U.S, by looking at U.S. firms' decisions to locate in France, Germany, or the UK. De Mooij and Ederveen (2003) show that Devereux and Griffith's logit model implies an average semi-elasticity of -0.8. Buettner and Ruf (2004) and Stöwhase (2003) look at the location choices of German multinationals within the European Union. Buettner and Ruf find mixed results, while Stöwhase find that firms respond to effective tax rates but not statutory tax rates. The average semi-elasticity from Buettner and Ruf is -0.42 compared to -7.36 in Stöwhase (de Mooij and Ederveen, 2005).

Since de Mooij and Ederveen's (2008) meta-analysis, several notable studies have been published. Using a novel dataset on corporate tax rates across 85 countries in 2004, Djankov et al. (2010) find large effects of corporate tax rates on FDI where raising the effective tax rate by 10 percentage points reduces FDI by 2.3 percentage points after one year. Looking at affiliates

[3] De Mooij and Ederveen estimate the mean significant semi-elasticities in their earlier working paper: "Taxation and Foreign Direct Investment: A Synthesis of Empirical Research," CESifo Working Paper 588, 2001.

in low-tax jurisdictions, Dischinger and Riedel (2011) find a significant inverse relationship between the average tax differential to other group affiliates and a subsidiary's intangible (intellectual) property investment, with estimates suggesting a semi-elasticity of around -1.1. Karkinsky and Riedel (2012), meanwhile, examine whether patent applications are more likely to be made by lower-tax affiliates, and find a semi-elasticity evaluated at the sample mean of -2.3, meaning a 1 percentage point increase in the corporate tax rate differential reduces the number of patent applications by 2.3 percent.

An additional margin along which changes in corporate tax rates are likely to affect growth is through profit shifting by U.S. firms to foreign subsidiaries, typically by mispricing sales of intangible capital and intangible capital services between affiliates in high and low-tax jurisdictions.[4] Guvenen, Mataloni, Rassier, and Ruhl (2017) argue that profit-shifting by U.S. multinational firms leads to some economic activity being credited to their foreign affiliates, resulting in an understatement of U.S. GDP. This profit-shifting has increased substantially since the 1990s. The authors correct for this mismeasurement by "reweighting" the amount of consolidated firm profits that should be attributed to the United States by apportioning profits according to the locations of labor compensation and sales to unaffiliated parties.

Applying these new weights to all U.S. multinational firms and aggregating to the national level, the authors calculate that in 2012 about $280 billion of so-called foreign profits could be reattributed to the United States. Given that the trade deficit was equal to approximately $540 billion, this reattribution would have reduced the trade deficit by over half in that year. Extrapolating the 2012 findings to subsequent years shows that transfer pricing continued to account for at least half of the trade deficit between 2013 and 2016. Crucially, firms' tendency to engage in profit shifting is highly responsive to tax rate differentials. Hines and Rice (1994), using aggregate country-level data from the Bureau of Economic Analysis, estimate a tax semi-elasticity of profit shifting of -2.25, indicating that a 1 percentage point decrease in a country's corporate tax rate is associated with an increase of 2.25 percent in reported corporate income.

Estimated tax elasticities and semi-elasticities of cross-border investment and profit shifting are relevant to an analysis of the effects of a reduction in the user cost of capital on investment because they have a direct bearing on investment financing. Elasticities from this literature suggest that reducing the U.S. corporate tax rate will have two effects. First, U.S. net capital outflows (*NCO*) would decline. This is both because foreign firms would invest more in U.S. capital and because U.S. firms would invest less in capital abroad. Second, U.S. firms would be less incentivized to shift profits abroad. The former effect will tend to result in a dollar

[4] Profit shifting, otherwise referred to as BEPS (base erosion and profit shifting) refers to tax avoidance strategies that exploit gaps and mismatches in tax rules to artificially shift profits to low or no-tax locations. This is different from the legitimate earning of profits abroad from investment.

appreciation, which will reduce net exports (*NX*). The latter effect will tend to raise net exports. Provisions of the Unified Framework to reduce abuse of a territorial tax system would be critical to the realization of these gains.

4. Effects of a 20 Percent Corporate Tax Rate and Full Expensing[5]

A. GDP Estimates

Employing the estimates from the empirical literature on tax changes and growth to estimate the effects of the changes outlined in the Unified Framework presents several challenges. These challenges include, but are not limited to, the choice of model, determining reasonable values of relevant parameters, and translating proposed changes into the independent variables on which coefficients have been previously estimated. As always, richer, more dynamic, structural models yield richer, more dynamic results, but require enhanced judgment. Reduced-form models may attenuate errors in judgment but may omit important general equilibrium effects and generate point estimates of questionable validity out of sample.

The particular challenge in translating the Mertens and Ravn (2013) estimates into growth forecasts is that their estimated coefficients are based on an explanatory variable equal to Federal tax receipts on corporate income relative to corporate profits. Applying these estimates to a reduction in the statutory corporate income tax rate from 35 to 20 percent and the simultaneous introduction of full expensing for non-structure investment requires calculating the effect these changes would have on Federal tax liabilities. As such, it is not valid to simply treat changes in average effective tax rates as changes in the relevant independent variable of the Mertens and Ravn model. Corporate profits in 2016 and preliminary estimates of the combined static revenue effect suggest a roughly 6.5 percentage point decline in the ratio of Federal corporate tax liabilities to corporate profits in the first year of implementation.[6] Mertens and Ravn's estimates suggest this could raise GDP per capita by approximately 3.2 percent over five years. Their estimates further suggest that the proposed reduction in the average corporate tax rate would generate a peak increase in non-residential investment of 15 percent.

Converting the expected immediate static revenue effect into a change in the total tax liability share of GDP of 0.8 percent, Barro and Redlick's (2011) and Romer and Romer's (2010) estimates suggest reducing the statutory Federal rate to 20 percent and allowing full expensing

[5] In all elasticity calculations we use the percent change in the total statutory rate (Federal + average State), i.e. 39.6 to 24.6 percent.

[6] Bureau of Economic Analysis, Table 6.17D, "Corporate Profits Before Tax by Industry."

would raise GDP by 0.4 and 0.8 percent, respectively, in year one, and by a cumulative 2.4 percent over three years. Romer and Romer's estimates also imply an increase in investment of approximately 9 percent by year three.[7]

Approaching the question from a more structural angle, a primary mechanism by which changes in corporate tax rates affect business investment is through their effect on the user cost of capital. As discussed previously, by increasing the after-tax return on capital assets, a decrease in the rate of tax on corporate profits decreases the before-tax rate of return required for the marginal product of new capital assets to exceed the cost of producing and using those assets, thereby increasing firms' desired capital stock. By raising firms' desired capital stock relative to current stock, decreases in the user cost of capital thereby require positive net investment to counteract depreciation, implying an increase in gross investment.

The user cost modeling is simple if expensing is permanent, but the current plan calls for it to expire after five years. In a forward-looking, rational expectations model, firms would look ahead to the expiration of the provision and respond less to the tax change because their long-run target capital stock would be lower than for a permanent change in policy.

Accordingly, estimating the impact of an expiring provision necessitates estimating the impact of permanent expensing and the impact of the expiring expensing. The correct growth effect would then be between the two, depending on the extent to which firms expect the provision to be renewed in subsequent legislation.

We begin with the effect of permanent expensing. The emerging consensus in the academic literature places the user-cost elasticity of investment at -1.0, which implies that a tax change that lowers the user cost of capital by 10 percent would raise demand for capital by 10 percent. Computing the effect on the average user cost of capital of reducing the statutory corporate tax rate to 20 percent and introducing immediate full expensing of non-structure capital investment depends on the values of the relevant parameters. Calculations of these parameters, following Devereux, Griffith, and Klemm (2002) and Bilicka and Devereux (2012), yield an estimated decline in the average user cost of capital of approximately 15 percent, though the percentage change in the user cost varies across asset types. Assuming a consensus user-cost elasticity of investment of -1.0, a 15 percent decline in the average user cost of capital would induce a 15 percent increase in the demand for capital. Following Jensen, Mathur, and Kallen (2017), it is then possible to use the Multifactor Productivity Tables from the Bureau of Labor Statistics in a simple growth accounting framework to increment the Congressional

[7] Bureau of Economic Analysis, Table 1.17.5, "Gross Domestic Product, Gross Domestic Income, and Other Major NIPA Aggregates."

Budget Office's 10-year GDP growth projections by the additional contribution to output from a larger capital stock, assuming constant capital income shares, until we attain a new steady state.[8, 9]

Based upon user-cost elasticity estimates, our calculations show that a reduction in the statutory Federal corporate tax rate to 20 percent combined with permanent full expensing of capital investment would raise long-run GDP by between 3 and 5 percent. Our estimates indicate a 0.5 percent increase over the baseline CBO forecast in year one and a 4.2 percent increase in the long-run steady state. Eliminating full expensing of non-structure assets in year five, however, would reduce the long-run steady state increase in GDP to 3.1 percent. The economy would achieve the higher growth path if firms expect the policy to be continued.[10]

Comparing our calculations to growth projections generated by fully dynamic, general equilibrium models reveals significant model confirmation. Benzell et al. (2017) use the Global Gaidar Model (GGM) to analyze the effects of the business tax reforms proposed under the Unified Framework. The GGM is a 90-period overlapping-generations (OLG), life-cycle model with agents in 17 regions calibrated to United Nations demographic and International Monetary Fund fiscal data. By explicitly modeling global capital markets, the GGM is thus particularly suited to modeling corporate tax changes with first-order effects on capital inflows. The authors find that the reduction in the effective corporate tax rate as a result the Unified Framework would raise the U.S. capital stock by between 12 and 19 percent and GDP by between 3 and 5 percent in the long-run.

By comparison, Evans (2017) uses a closed-economy OLG model to simulate the effects of a reduction in the statutory Federal corporate tax rate from 35 to 20 percent, with no change in expensing provisions. In the closed-economy context, consumption initially falls and investment is eventually partially crowded out by government borrowing. In long-run steady state, assuming the corporate rate cut is followed by moderate cuts in government spending

[8] Congressional Budget Office. 2017. "An Update to the Budget and Economic Outlook: 2017 to 2027."

[9] Multifactor Productivity Tables, Bureau of Labor Statistics:
Capital and Related Measures from the Three-Digit Database, 1987-2015, Private Business Sector, (NAICS 11-81), Productive capital stock (direct aggregate-billions of 2009 dollars); Capital and Related Measures from the Three-Digit Database, 1987-2015, Private Business Sector, (NAICS 11-81), Gross investment (billions of 2009 dollars); Total Economy Production Account and Costs, 1987 to 2015, Total Economy, Basic Measures.

[10] Devereux and Griffith (1998) have argued that marginal analysis like this may be less relevant for high-value, discrete projects that should be more responsive to average tax rates over time. They develop a measure of the effective average tax rate, EATR, and show that capital spending is highly responsive to it. Mathur et al. (2017) calculate the impact of moving toward full expensing and dropping the statutory corporate tax rate to 20 percent, finding that the EATR declines by approximately 11 percentage points. They estimate that, under the assumption that the move to full expensing remains permanent, corporate investment would increase as a result by up to 34 percent in certain asset classes, thereby raising GDP by 4.7 percent over 10 years and by 8.4 percent in the long run.

to counteract subsequent growth in government debt, the capital stock is still 7.7 percent higher, and GDP is 2.0 percent higher. Again, these values do not include any effects of full expensing.

Previous estimates of similar tax reform proposals yielded similar results. A 2005 report released by The President's Advisory Panel on Federal Tax Reform evaluated a "Growth and Investment Tax Plan" that implemented a business cash flow tax, allowed for the immediate expensing of capital investment, and set a flat corporate tax rate of 30 percent. Analysis of this plan by the U.S. Treasury Department found that these reforms would have generated an increase in the capital stock by 20.4 percent over the long run, raising output by 4.8 percent over the same period (The President's Advisory Panel on Federal Tax Reform, 2005).

Moreover, a 2017 analysis by the Tax Foundation finds that reducing the corporate tax rate (applicable to both S and C corporations) to 20 percent increases long-run GDP by 3.1 percent. When also adding full expensing of all capital investment for C corporations, they estimate a long-run GDP increase of 4.5 percent. These reforms are also estimated to raise the capital stock by 13 percent and wages by an average of 3.8 percent and average after-tax income by 5.2 percent.

Given the estimates from our own user cost calculations, calculations based on reduced-form estimates from the exogenous tax shocks literature, and simulations by general equilibrium models such as the GGM, we expect the long-run growth effects of the corporate tax reforms in the Unified Framework to be a 3 to 5 percent increase in GDP over the baseline forecast.

Financing of the additional investment implied by the reduction in the user cost of capital would depend, as noted above in section 3, partly on repatriation of previous profits and decreased profits attributed to foreign subsidiaries, and partly on changes in savings and capital flows. Our preliminary calculations suggest that funding the estimated increase in gross investment could potentially be achieved almost entirely by increased capital inflows by both US and foreign multinational firms. Given that in 2016 private non-residential fixed investment totaled $2.3 trillion, a 15 percent change would constitute an approximately $347 billion increase in investment.[11] The mean estimate of the tax semi-elasticity of FDI of -3.3 reported in de Mooij and Ederveen (2003), corresponding to a user-cost elasticity of 2.8,[12] suggests that a 15 point reduction in the statutory Federal corporate tax rate along with the introduction of full expensing would raise FDI in the U.S. by $201 billion and reduce U.S. direct investment (DI) abroad by $131 billion, for a combined reduction in net capital outflows of $332 billion.[13] As

[11] Bureau of Economic Analysis, Table 5.3.5, "Private Fixed Investment by Type."
[12] Since $\Delta\log(I) = \alpha\log(\varkappa) = [\alpha / (1 - EMTR)]\,\Delta EMTR$.
[13] Bureau of Economic Analysis, Table 1.1, "U.S. International Transactions."

noted above, increased capital inflows would result in an appreciation of the dollar, thereby reducing net export demand in tandem with the increase in net capital inflows.

Moreover, our calculations also indicate a positive contribution to growth from reduced profit shifting by U.S. firms to foreign affiliates. Applying Hines and Rice's (1994) estimate of the tax semi-elasticity of profit reporting to a statutory corporate rate reduction of 15 percentage points suggests that reduced profit shifting could add up to $142 billion to GDP (0.7 percent), based on 2016 numbers.[14] These transfer pricing effects could well be additive to the GDP effects just discussed.

5. The Wage Effects from Capital Investment and Economic Growth Following Corporate Tax Reform

As discussed in the previous CEA white paper on the effects of tax reform on wages, workers are likely to see their wages grow due to the growth effects of the corporate side of the Unified Framework. We expand on that discussion here, relying on GDP growth estimates to corroborate our interpretation of the conclusions from the corporate tax incidence literature.

There are at least two channels by which corporate tax reform translates into increases in worker wages. First, the "direct" channel is the rent-sharing that may emerge from worker bargaining over the increased profits of the firm (Arulampalam, Devereux, and Maffini, 2012). As Krueger and Summers (1987) noted in the early literature on inter-industry wage differentials for seemingly similar workers, "[m]ore profitable industries tend to use some of their rents to hire better quality labor, and share some of their rents with their workers." A more recent literature on intra-industry wage differentials confirms that rent-sharing remains a feature of the U.S. labor market (Barth, Bryson, Davis, and Freeman, 2016; Card, Cardoso, Heining, and Kline, 2016; Song, Price, Guvenen, Bloom, and von Wachter, 2015), and the literature on the wage effects of corporate tax reductions in developed countries confirms the effects empirically.

A second, indirect, channel implies that corporate tax rate reductions will result in higher worker wages as a result of changes in worker productivity that result from increased capital investment. In this indirect channel, changes in the corporate tax rate affect the investment decisions of firms; lower tax rates encourage investment and produce a higher ratio of capital to labor. The higher ratio of capital to labor then generates productivity increases for workers and raises their wage. The fact that capital can move relatively easily across borders while labor cannot serves to intensify the burden of the corporate tax on workers; surpluses from profits earned elsewhere and capital located elsewhere cannot as easily be captured by domestic

[14] Bureau of Economic Analysis, Table 4.1, "U.S. International Transactions in Primary Income."

workers. These two channels also have different implications for the timing of worker wage increases. An increase in profits from lower corporate taxes may be bargained over immediately, whereas increased wages resulting from productivity effects of capital deepening will be slower to develop.

Estimates of GDP growth due to the corporate side of the Unified Framework have implications for worker wages arising through the indirect channel. A back-of-the-envelope calculation helps gauge the magnitude of the possible effects. As discussed above, the long-run GDP effects of the corporate tax reform of the Unified Framework are 3 to 5 percent.

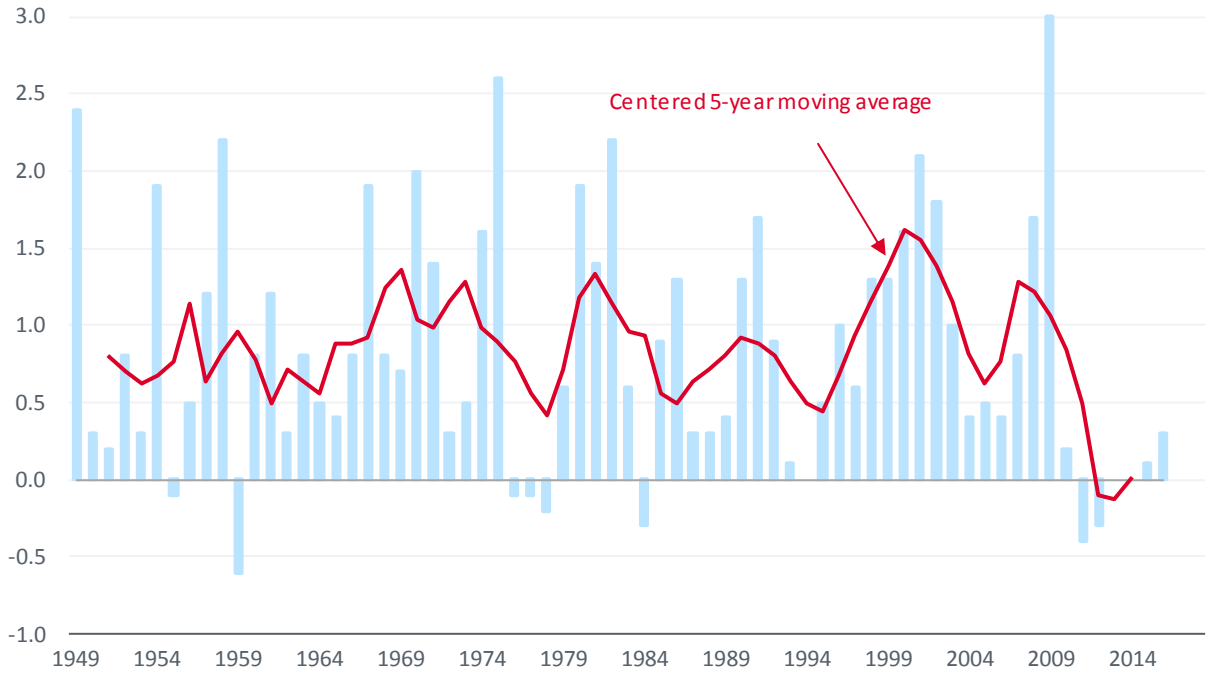
What do these estimates imply for worker wages? CBO estimates of future values of real GDP extend to 2027. Using the most recent CBO estimates, baseline real GDP in 2027 would be $22.7 trillion, measured in 2016 dollars, without tax reform.[15] If the GDP effects of tax reform were felt in their entirety by that year, a 3 to 5 percent increase in GDP would represent an additional $0.7 trillion and $1.2 trillion in output, respectively, measured in 2016 dollars. Workers stand to gain some, but not all, of this additional output. For a lower bound on how much workers gain, we use the labor share of GDP from 2016: $10.0 trillion in labor compensation out of $18.6 trillion in nominal U.S. GDP, or 53.6 percent.[16,17] For an upper bound, we use the standard Cobb-Douglas assumption that labor receives 70 percent of income. Applying these estimates to the increased output implied by a 3 to 5 percent GDP boost by 2027 implies each of the 126.2 million households in the U.S. would earn $2,900 (3 percent growth and applying the labor share of GDP) to $6,400 (5 percent growth and Cobb-Douglas assumptions) in additional wage and salary income alone.[18] Adjusting for anticipated growth in the number of households (approximated using population growth forecasts) gives household income increases of $2,700 to $5,900.[19] Household income gains would be larger in subsequent years as baseline real GDP continues to expand and the growth effects of corporate tax reform continue to play out. If the tax incidence literature is correct, and labor bears a disproportionate share of the corporate tax burden, then we would expect the labor share of GDP to rise, which would tend to favor the higher end of this range.

The wage effects of corporate rate reductions are also apparent from data on capital deepening. The blue bars in Figure 2 show the contribution of capital deepening to labor productivity growth (measured as the growth rate of capital services per worker hour

[15] Congressional Budget Office. 2017. "An Update to the Budget and Economic Outlook: 2017 to 2027."
[16] Bureau of Economic Analysis, Table 6.2D, "Compensation of Employees by Industry."
[17] Bureau of Economic Analysis, Table 1.17.5, "Gross Domestic Product, Gross Domestic Income, and Other Major NIPA Aggregates."
[18] Bureau of Labor Statistics, Table H-1, "Income Limits for Each Fifth and Top 5 Percent of All Households: 1967 to 2016."
[19] Congressional Budget Office. 2017. "An Update to the Budget and Economic Outlook: 2017 to 2027."

multiplied by the capital share, which has averaged about one-third of total costs, historically). The results pertain to the nonfarm business sector of the U.S. economy, which captures 75 percent of total economic activity. This measure has clear cyclical components, but a centered 5-year moving average has hovered near zero since 2011, indicating that weak capital investment has held down labor productivity growth. The latter effect is well-documented, with Ollivaud, Guillemette, and Turner (2016) finding that weaker growth in capital per worker explains much of the slowdown in productivity growth since the financial crisis. A return to the historic, long-run level of capital deepening in the United States would boost worker productivity by 0.8 percent per year. If these productivity gains are translated to worker wages, the business sector would experience an increase in real wage income of $4,000 by year 8.

Figure 2. Contribution of Capital Deepening to Labor Productivity Growth
(Percent change from a year earlier)



Note: Capital deepening is the contribution to labor productivity growth of more capital per worker hour. Labor productivity growth is in the private non-farm business sector.
Source: Bureau of Labor Statistics - Contribution of Capital Intensity

6. Additional Evidence on Wage Effects

These back-of-the-envelope estimates of the effects of corporate rate reductions on worker wages are consistent with the income effect estimates found in a large empirical literature on corporate tax rates and worker wages, a body of work we refer to as the “taxes-and-wages”

literature. This literature asks: "What can we learn from the wage history of workers in countries and sub-country regions with different levels of corporate income taxation?"

Before proceeding, it is important to clarify the relationship between the empirical results we discuss below and theoretical models of the labor incidence of the tax burden measured elsewhere in the tax literature, in part because the public discussion of our first paper revealed that there is a significant amount of confusion on these issues, even among economists. These models typically estimate the corporate tax burden borne by workers at between 21 and 75 percent, with higher figures generally representing more recent studies that assume freer movement of capital across borders. These incidence estimates can be interpreted as the share of the total burden of taxation born by workers, where the total burden is the surplus eliminated from the private market by corporate taxation. The burden includes any losses in government revenue, but also includes the deadweight loss from the corporate tax wedge. As a result, using these incidence estimates as a multiplier on the static change in government revenue from corporate rate reductions is the lower bound on the additional surplus accruing to workers under the rate changes.

Estimated changes in household income based on the taxes-and-wages literature provide a direct link from decreases in corporate tax rates to increases in worker wages, eliminating the need to estimate the deadweight loss from the corporate tax wedge in order to apply the incidence estimates. When comparing predicted changes in wages from changes in corporate tax rates, it is important to be aware of any potential confounding events. Corporate rate reductions generally occur without other changes to the corporate tax code, but this is not always true. For example, changes in the corporate rate in the United Kingdom after 2007 were accompanied by changes to expensing rules. The combined effect was to increase the user cost of capital and, therefore, to eliminate the indirect channel for wage growth from corporate rate reductions. Indeed, the increases in the user cost of capital following the British reforms may have had a negative impact on worker wages.

The taxes-and-wages literature uses a variety of methods to estimate the impact of corporate taxes on worker wages. In our previous white paper "Corporate Tax Reform and Wages: Theory and Evidence" we focused on a subset of the academic literature using data on the United States that we viewed as representing the broad consensus of the findings. In order to make clear how sweeping the results are, we here document a more extensive range of the applicable literature.

Country-based studies use changes in differential corporate tax rates from within a country, for example across states or provinces, to estimate the wage effects of corporate tax changes. These studies benefit from the ability to compare similar firms across regions that are subject to different tax rates. However, results from this type of study are difficult to apply across

countries because labor can typically move between regions of a country more easily than it can move between countries. Thus, these estimates may understate the impact on wages from Federal corporate tax changes. At the same time, local corporate rate changes may be more effective at attracting capital investment than nationwide changes. These criticisms apply to studies measuring the wage effects of corporate income taxes using the differential corporate tax rates among U.S. States.

Felix (2009) estimates an elasticity of worker wages with respect to corporate income tax rates based on variation in the marginal tax rate across U.S. States. In these estimates, a 1 percentage point increase in the top marginal State corporate rate reduces gross wages by 0.14 to 0.36 percent over the entire period (1977-2005), but the dampening effects of corporate tax rates on wages is growing over time. A 1 percentage point State corporate tax increase reduces wages by 0.45 percent for the most recent period in her data (2002-2005). The estimates in Felix (2009) imply an elasticity for the U.S. statutory corporate tax rate of roughly -0.1 to -0.2. A research report issued by the Tax Foundation in 2009 corroborates the results from Felix (Carroll, 2009). Again using data on changes in the corporate tax rate across states, Carroll (2009) estimates coefficients consistent with an elasticity of worker wages with respect to the U.S. statutory corporate tax rate of -0.1 to -0.2.

In a paper forthcoming in the *American Economic Review*, Fuest, Peichl, and Siegloch (2017) exploit nearly 6,800 tax changes in German municipalities between 1993 and 2012 to identify the wage effects of municipal corporate rate changes. The point estimates in the paper imply a wage elasticity with respect to the local business tax of -0.14. An additional contribution of the Fuest et al. (2017) study is their analysis of the distributional consequences of the corporate taxation burden which shows that lower and medium-skilled workers are differentially disadvantaged by higher tax rates. They estimate that these effects are large enough to significantly affect estimates of tax progressivity and suggest that including these effects would decrease the progressivity estimates of the overall U.S. tax system by 25 to 40 percent.

Other country-based studies, like those assessing the effects of corporate income tax rate changes in Canada, may be more applicable to the United States. Still, union membership is higher in Canada, suggesting there may be some limits to applying these estimates to the U.S. case. Using corporate rate changes across and within Canadian provinces between 1998 and 2013, Ebrahimi and Vaillancourt (2016) estimate the effects on worker wages, analogous to the Felix (2009) and Carroll (2009) analyses for U.S. States. The study finds that a one percent increase in the statutory corporate tax rate is associated with a reduction in worker hourly wages of 0.15 to 0.24 percent. These results control for observable worker characteristics, including union membership, and the paper's main results hold for both public and private workers. In a new working paper, McKenzie and Ferede (2017) also use changes in corporate tax rates within Canada to develop an estimate of the impact on worker wages. The baseline

elasticity estimate is -0.11 with alternative estimates giving values as large (in absolute value) as -0.15. Dwenger, Rattenhuber, and Steiner (2013) estimate the worker wage effects of corporate tax rate changes in Germany. Their results imply a semi-elasticity of wages with respect to the average tax rate ranging from -1.24 without accounting for employment effects and -2.36 when employment effects are included.

A third type of study that compares changes in tax rates across time within developed countries may be more likely to capture the average effect. However, as with single-country studies, it is important to include a long enough time lag for the effects of corporate tax reform to take effect. For example, if corporate tax reform takes several years to change labor productivity, measuring post-tax reform differences in wages too early will lead to underestimation of the effects (Auerbach 2006). It will take time for firms to increase their level of investment to reflect the new, lower tax rate and labor markets to adjust to new, higher productivity.

A cross-country study by Hassett and Mathur (2015) based on 65 countries and 25 years of data finds that the elasticity of worker wages in manufacturing after five years with respect to the highest marginal tax rate in a country is -0.5 in the baseline case, which includes the addition of spatial tax variables. Expanded analysis by Felix (2007) follows the Hassett and Mathur strategy, but incorporates additional control variables, including worker education levels and the openness of countries. Her estimates imply a semi-elasticity of between -0.7 and -1.23. When she replicates the Hassett and Mathur specification, the semi-elasticity is -0.43.

A set of recent papers also seeks to measure the rent-sharing, or "bargaining", channel directly, including Liu and Altshuler (2013), and Arulampalam et al. (2012). Liu and Altshuler measure an elasticity of U.S. worker wages with respect to effective marginal tax rates of between -0.03 and -0.04, elasticities representing the profit-sharing of U.S. workers with respect to the tax liabilities of their employers. Work by Desai, Foley, and Hines (2007) also relies on wage data for U.S. multinationals to assess the relative share of the corporate tax burden born by labor, measuring the labor share at between 45 and 75 percent, near the higher end of theoretical predictions. Neither of these papers assess economy-wide effects of corporate tax reform and are, therefore, excluded from the summary figure below.

Results from Azémar and Hubbard (2015) also utilize cross-country changes in the corporate tax rates of OECD countries to measure the effects of corporate tax rate changes for worker wages. The paper measures changes in worker wages with and without controls for changes in value-added. The results imply a semi-elasticity of worker wages with respect to the corporate tax rate of -0.43 (an elasticity of -0.17 in the U.S. case), of which approximately three-fourths is related to the indirect channel and one-fourth to the direct channel. Azémar and Hubbard note that the estimates without value-added (those corresponding to the combination of both direct and indirect channels) may be over-estimates given the correlation between value-

added and corporate tax rates. We include them in Figure 3 below, but note this caution on interpretation.[20]

Applying the results in each paper to the proposed rate reductions in the Unified Framework, Figure 3 gives a summary of the estimated changes in U.S. household wages implied by each paper. For results where semi-elasticities are reported, we multiply the semi-elasticity by the change in the statutory rate implied by the Unified Framework, a 15 percentage point change. This is the percentage change in wages implied by the point estimates. These changes are then applied to the average value of household income reported by the U.S. Census in 2016, $83,143, and multiplied by the share of average household income that is wage-and-salary income (78 percent).[21,22] For results where elasticities are reported, we calculate the percent change in the tax rate in the U.S. as 0.15 divided by 0.396 (the U.S. statutory rate including State taxes), or 37.8 percent.[23]

The income changes indicated in Figure 3 are based on a percentage change applied to average household income. The empirical literature on whether households at all income levels would experience a similar change is much thinner than the set of papers contained in Figure 3. Theoretically, the capital-skill complementary hypothesis maintains that the burden of corporate taxation should fall more on high-skilled labor because corporate taxation leads to a decrease in the capital stock, and high-skilled workers are more complementary to capital than low-skilled workers. On the other hand, high-skilled labor also tends to be more mobile (like capital itself) than low-skilled labor and, therefore, more capable of avoiding the tax burden, implying that low-skilled labor may bear most of the cost. These findings have important implications for how we view the progressivity of the corporate tax. Among the few papers that analyze the impact of the corporate tax by skill level, both Felix (2007) and Fuest et al (2017) find that low-skilled labor bears a larger burden of the corporate tax, implying a relatively larger income boost from corporate rate reductions for low-skilled relative to high-

[20] An additional contribution to the literature, Clausing (2016), also uses corporate tax rates from OECD countries alongside worker wage growth and employs a two-step process linking the capital/labor ratio to the corporate tax rate and then worker wages. She finds a significant impact of corporate tax rates on the capital to labor ratio, but no statistically significant follow-on effect for worker wages. Traditionally, capital deepening has been a strong contributor to worker productivity growth in the U.S., as discussed above. In VAR results linking worker wages to corporate rates directly, Clausing rarely finds statistically significant effects. But the published results do not include point estimates for all tax variables even in regressions with statistically significant coefficients for some of these variables. As a result, the total effect for worker wages from these results cannot be calculated.

[21] Bureau of Labor and Statistics, Table A-1, "Households by Total Money Income, Race, and Hispanic Origin of Householder: 1967 to 2016."

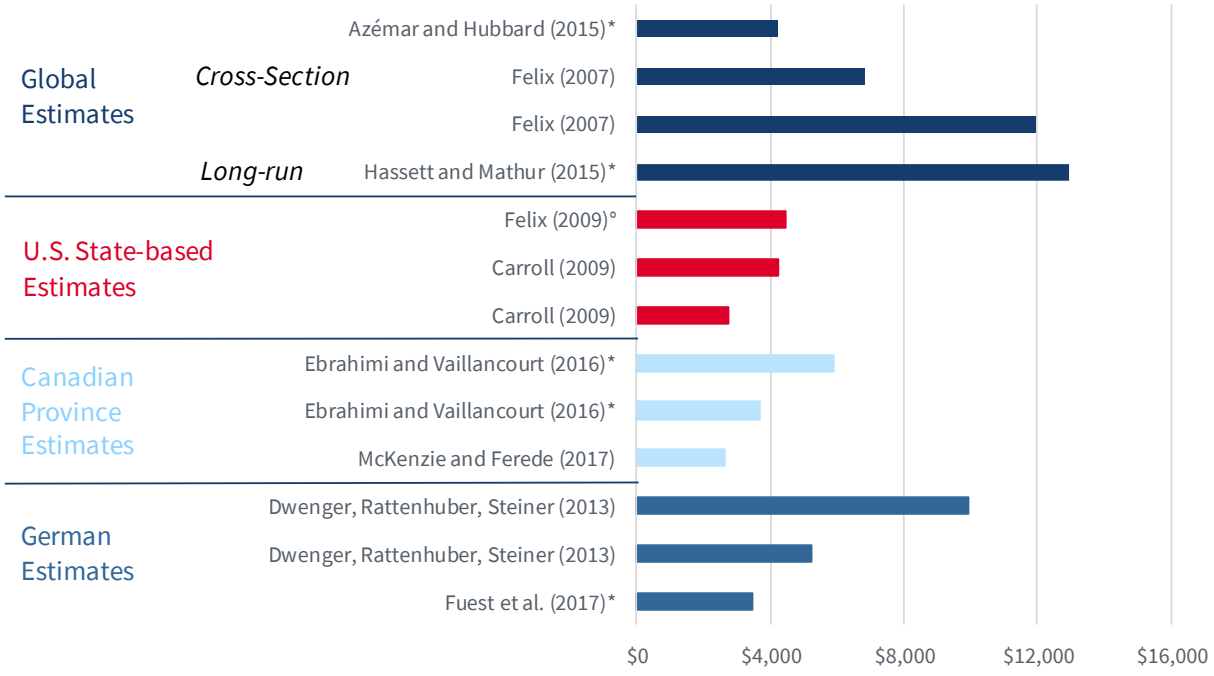
[22] Bureau of Labor Statistics. 2017. "Wages and salaries were 92 percent of income before taxes for consumers ages 25 to 34 in 2014." *TED: The Economic Daily*.

[23] Estimated reductions in the Effective Marginal Tax Rate (EMTR) and the Average Tax Rate (ATR) resulting from the Unified Framework are larger than 37.8 percent.

skilled workers. Felix (2009), on the other hand, finds that high-skilled workers bear more of the burden. Differences by skill level are statistically significant in the Fuest et al result; neither paper by Felix reports the statistical significance of skill-level differences.

What do these empirical results imply for the likely effects of corporate tax reform in the United States? Within each of the four estimation strategies shown in Figure 3, there is a range of estimated worker wage effects. Overall, the estimated impact of the 15-point reduction in the U.S. corporate tax rate varies from $2,600 (based on the cross-Canadian province results from McKenzie and Ferede, 2017) to over $12,000 based on the longer-run effects of corporate tax rate changes observed in the Hassett and Mathur data. The average result is $6,000. Removing the two lowest and two highest estimates gives a range of $3,400 to $9,900.

Figure 3. Average Income Increases for U.S. Households from Corporate Rate Reduction Implied by Literature Wage Elasticities[24]



Note: * indicates paper was published in a peer-reviewed journal. ° indicates paper was published in the Economic Review of the Federal Reserve Board.
Source: See reference list and discussion in text.

[24] Estimates correspond to Azémar and Hubbard (2015): Table 4, column 2; Felix (2007): Table 5, columns (I) and (III), evaluated at the mean of openness; Hassett and Mathur (2015): Table 4, column (2); Felix (2009): Table A2, column corresponding to 2001-2005; Carroll (2009): Table 3, rows (4) and (5); Ebrahimi and Vaillancourt (2016): Table 4, Models 1 and 2; McKenzie and Ferede (2017): Table 3, column (3); Dwenger et al (2013): Table 2; Fuest et al (2017): Section 5.2.

First, it is worth noting that the estimated coefficients from the Canadian reform result in a range of household income estimates of $2,600 to $5,900 for the proposed Unified Framework reductions. These studies control for some of the institutional differences between the U.S. and Canada, though not the interactions between those differences and corporate rate reductions. In addition, the Canadian values are within-country differences. The implications of changes in the corporate rate across States or sub-country regions are likely to be different from country-wide changes for two reasons. First, these estimates may underestimate the effects of corporate tax rates on workers, given the higher rate of worker geographic mobility across provinces compared to worker mobility across country borders. But, on the other hand, corporate rate reductions may be a more effective weapon in tax competition within a country than it would be across countries. Estimates from U.S. States in Felix (2009) and Carroll (2009) imply wage effects between $2,700 and $4,500; again these results are subject to the competing biases apparent in the Canadian results.

Cross-country estimates from Felix (2007) and from Hassett and Mathur (2006, 2015) imply far larger effects on wages from corporate reforms, ranging from $5,000 to $15,000 in the Hassett and Mathur (2015) estimates which take into account the spatial correlation of corporate rate changes. Estimates from Azémar and Hubbard (2015) are closer to $4,000, although the authors caution the estimates may suffer from omitted variable bias and be too high. For Hassett and Mathur, the larger estimates may partially reflect the intentional measure of longer-term wage outcomes; both Azémar and Hubbard (2015) and Felix (2007) measure cross-country differences in the cross-section. This larger range of estimates is also consistent with estimates from Dwenger et al. (2013) on the wage effects of German corporate tax reforms, but the differing nature of wage bargaining across countries is an important limit on transferring these results.

In all cases, corporate tax rate changes used for identification are smaller than the 15 percentage point reduction proposed under the Unified Framework. If the effects of corporate taxes on wages are not linear, then the outcome for U.S. workers may be different from the estimates in Figure 3. One final consideration relates to changes in employment, which these wage estimates do not incorporate. If the effect of corporate tax reform is to raise wages of U.S. workers primarily through wage bargaining rather than through enhanced productivity, employers may reduce their demand for labor as a result. This seems far less likely to be the case in the U.S. than in countries with centralized wage-setting and stronger labor bargaining power. See Dwenger et al. (2013) for a discussion in the German case.

As a whole, we view these estimates as indicating a U.S. Federal corporate rate reduction from 35 to 20 is likely to result in wage increases for U.S. households of $4,000 or more.

7. Additional Income Effects from Corporate Tax Reform

As discussed in the previous white paper on this topic, "Corporate Tax Reform and Wages: Theory and Evidence", the tendency of U.S. firms to hold corporate profits overseas reduces wages for U.S. workers. Firms' tendency to engage in profit shifting is highly responsive to tax rate differentials, as discussed above, and corporate rate reductions are therefore likely to affect the share of profits repatriated. Under the assumption that U.S. workers would retain 30 percent of the 2016 profits of U.S. firms earned abroad and not currently repatriated, U.S. households could earn a raise of up to 1 percent, depending on the share of profits repatriated. (See Kline, Petkova, Williams, and Zidar, 2017, for an example of workers capturing 29 percent of firm operating surplus.) The trajectory of foreign profits indicates the value to U.S. workers of these profit shifts would increase in the future. Household income boosts from this channel may be additive to the estimated $4,000 in household income discussed in Section 6, as the empirical literature in Section 6 is largely based on countries and time periods with less foreign profit activity, and less existing capital parked overseas as taxes changed.

In general, profits earned abroad evidence the willingness of U.S. firms to invest in production and business operations overseas, at the expense of domestic investment. Reductions in the corporate rate create an opportunity for U.S. firms to increase domestic investment instead. Further, these multinationals are among the class of high-paying employers in the United States. The rent-sharing literature discussed above implies incentivizing these high-paying firms to perform more of their operations in the U.S. is again constructive for U.S. wage growth.

8. Income Effects from Individual Tax Reform

While a full analysis of the individual side of the Unified Framework is premature at this time, a final factor to consider when thinking about the impact of tax reform on the welfare of our citizens is the likely impact of marginal personal income tax rate changes on pre-tax incomes. In this section, we sketch this additional factor using general economic principles frequently covered in the literature. Changes in personal income tax rates can affect both pre-tax and post-tax income. The simplest intuition for these pre-tax income changes is that individuals must make decisions regarding how much labor to supply based on the income, which might be earned from that labor compared to the opportunity cost of working. A reduction in the marginal tax rate on earned income provides a bigger incentive to work. This is the substitution effect of labor taxation. On the other hand, rate reductions on individual income will reduce tax payments and increase net income. This increase in household net income may trigger the so-called "income effects" of lower tax rates because households will likely want more leisure time as their income rises, all else equal. The empirical literature has come to the general conclusion that labor supply elasticities for prime age males are near zero. However, other

segments of the population—in particular married women—are more responsive to changes in marginal tax rates; for women, the substitution effect outweighs the income effect.

Still, labor supply is but one margin by which households can respond to changes in tax rates. Charitable giving, for example, has been shown to be responsive to tax rates (Peloza and Steel, 2005), as have capital gains (Auerbach, 1988). A summary statistic that captures all responses to taxation, be they changes in labor supply, capital gains realizations, increased efforts to minimize taxes, income shifting, evasion, etc., is net taxable income. Changes in taxable income can better capture the efficiency cost to taxation that may not be as evident when analyzing specific margins of response. Still, the elasticity of taxable income (ETI)—the percentage change in taxable income for a one percent change in marginal personal income tax rates—should be interpreted with some caution. Some elements of response represent a change in income that reflects a change in the welfare of households, but the statistic on its own may not accurately capture household welfare effects.[25]

A simple empirical model for assessing the impact of individual income tax rates on taxable income (denoted y_{it}) is a regression of pre-tax income on the net-of-tax rate, expressed as $1 - \tau_{it}$ in the equation below:

$$\ln(y_{it}) = \alpha + e * \ln(1 - \tau_{it}) + \varepsilon_{it}$$

Here, e measures the ETI and captures a set of behavioral responses to income taxation including, but not limited to, labor supply effects.

Table 2 provides a summary literature review on the range of estimates for ETI covering a range of tax rate adjustments, both permanent and temporary, and a range of time periods. Generalities are difficult to draw from the table, but the average elasticity over these studies is approximately 0.77, with estimates ranging from 0.2 in a sample of high income earners to over 3.0 from Feldstein's 1995 results.

Using a representative ETI of -0.3 from Table 2 above implies sizable changes in taxable income from the proposed personal income tax rate reductions in the Unified Framework. For a filing unit experiencing a three percentage point decrease in its statutory marginal tax rate (going from 15 to 12 percent), our rough estimate is that taxable income would increase by about $2,800; higher values of the ETI (in absolute value) imply larger taxable income changes. Similarly, we estimate that taxable income for a filing unit going from the 28 to 25 percent bracket would increase by $6,200 (and, again, more when using a larger ETI.) Thus, when the

[25] ETI may also not be an effective measure of overall welfare. Saez, Slemrod, and Giertz (2012) show, if households engage in activities that have positive externalities, then ETI is not sufficient to make welfare judgments.

complete plan is available, CEA anticipates substantially increasing its estimate of the income effects of the Unified Framework from the very conservative level of $4,000.

Table 2: Summary Statistics of Estimated Taxable Income Elasticities

Paper	Focus	Best Estimate	Tax Change (Years)	Permanent v. Transitory
Auten & Carroll (1995)	All income groups	0.46 to 3.04	TRA 86 (1985, 1989)	Permanent
Auten & Carroll (1999)	Joint > $21k Single> $15.6k	0.45 to 1.13 0.57 best estimate	TRA 86 (1985, 1989)	Permanent
Carroll (1998)	> $50k	0.4	OBRA 90 & 93 (1989-1995)	Permanent
Feldstein (1995)	All income groups	1.04 to 3.05	TRA 86 (1985, 1988)	Permanent
Giertz (2007)	Oversample of high income earners	0.40 to 0.26	Year over year changes in income and tax rates from 1979-2001	Both
Goolsbee (2000b)	Upper Income	0 to 0.40	OBRA 93 (1991-1995)	Both
Gruber & Saez (2002)	All income groups	0.4	ERTA & TRA 86 (1979-1990)	Permanent
Kopczuk (2003)	All income groups	0.21 to 0.57 w/o tax base effect, 0.53 overall	ERTA & TRA 86 (1979-1990)	Permanent
Lindsey (1987)	All income groups	1.6 to 1.8	ERTA (1979)	Not clear
Long (1999)	$0k to $200k	0.193 to 0.819	State variation (1991)	More transitory
Looney & Signhal (2006)	Middle-income families ($35,000 and $85,000)	0.75 to 0.71	Year over year changes in income and tax rates from 1979 to 1990.	Both
Moffitt & Wilhelm (2000)	All income groups	0 to 1.83	TRA 86 (1983, 1989)	Permanent
Saez (2003)	All income groups	0.311	Bracket creep (1979-1981)	Transitory
Saez (2004)	All income groups	0 to 1.7 (pairs of years) 0.62 for top 1%	1960-2000	Permanent
Sammartino & Weiner (1997)	Top 1%	large transitory small permanent	OBRA 90 & 93 (1989-1994)	Both

Source: Giertz (2004) and Saez, Slemrod, and Giertz (2012)

9. Conclusion

In the foregoing analysis, we have cited a wide range of academic studies demonstrating that reductions in corporate tax liabilities have significant positive short- and long-run effects on GDP growth and wages, in particular by lowering the user cost of capital and thereby inducing higher investment in capital formation, financed principally by increased capital inflows. On the basis of these studies, we have calculated that a reduction in the statutory Federal

corporate income tax rate from 35 percent to 20 percent simultaneously with the introduction of immediate full expensing of capital investment would generate an increase in GDP of between 3 and 5 percent in the long run. Studying the impact of this growth on the typical household, we again find that the average household would, conservatively, realize an increase in wage and salary income of $4,000.

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ABOUT THE COUNCIL OF ECONOMIC ADVISERS

The Council of Economic Advisers, an agency within the Executive Office of the President, is charged with offering the President objective economic advice on the formulation of both domestic and international economic policy. The Council bases its recommendations and analysis on economic research and empirical evidence, using the best data available to support the President in setting our nation's economic policy.

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October 2017