Estimating the Effects of Business Tax Reform on Output

November 29, 2017; Version 1.0

Jason DeBacker*

Bio: Jason DeBacker is an assistant professor of economics at the University of South Carolina, an economist with the Open Source Policy Center, and was formerly a financial economist in the Treasury's Office of Tax Analysis. Jason is a core maintainer of the open source models B-Tax and OG-USA, which model business taxes and macroeconomic effects of tax policy, respectively. His research focuses on tax policy and firm dynamics.

Abstract: *Tax policy can have strong effects on the incentives to invest. This note describes a simple approach to approximate the effects of tax policy on investment and output using open source data and models.*

Taxes on the returns to capital investments affect the incentives to invest. Because investments increase the the stock of productive capital, they affect output and income. Models to analyze the the effects of tax policy on macroeconomic outcomes are sophisticated, but tend to be expensive to run and subject to many opaque assumptions. In this *Quantitative Note*, I describe an investment elasticities approach for evaluating the potential output effects of tax policy changes.

1. Investment Elasticities Approach

In this section, I describe the steps for using an investment elasticities approach for estimating the effect of business tax reform on aggregate output. This approach will proceed as follows:

1. Determine the effects of the policy change on the user cost of capital.
2. Use this change in the cost of capital together with measures of the responsiveness of investment to the cost of capital to find the change in the rate of investment.
3. Use this change in investment to determine the change in the stock of productive capital.
4. Multiply the percentage change in the stock of capital by the share of output attributable to capital to find the percentage change in output.

This investment elasticities approach is a quantitative exercise in which the researcher must determine the values of the key parameters at each step.

1.1 Changes in the Cost of Capital

The first step requires the researcher to determine how the cost of capital changes as a result of the tax reform. This can be a difficult computation, requiring one to model the tax code in order to determine it's affects on the after-tax return to an investment.

To determine changes in the cost of capital, I use the Cost of Capital Calculator web application that is built on the B-Tax open source microsimulation of investment model. This web application allows one to change tax policy and reports the effects of these changes on the cost of capital and marginal effective tax rates on investment.[1] Through this application, one can find the percentage change in the cost of capital under a wide variety of tax reforms. The Cost of Capital Calculator does not currently return the user cost of capital, but we can determine this by adding the rate of economic depreciation to the cost of capital numbers reported. For corporate businesses, the weighted (by asset value) economic depreciation rate across all asset types is 0.062.

1.2 The Sensitivity of Investment to the Cost of Capital

The second step of this calculation requires a measure of the sensitivity of investment to the cost of capital. Economists summarize the degree of responsiveness with a measure called an "elasticity". Elasticities measure the percentage change in a behavioral variable given a percentage change in something that is not determined within the economic model. The

Quantitative Notes is published by Open Research Group, Inc., a public benefit corporation. For more *QNs* or to arrange meetings with an expert, please contact experts@openrg.com. The author(s) did not receive funding from any source for the production of this *Quantitative Note*.

[1] More flexibility in the tax policy parameters and experiments is available by directly using the B-Tax model on which the Cost of Capital Calculator web application is built.

relevant elasticity for our purposes here is the elasticity of investment with respect to the cost of capital, called the "user cost elasticity". This measure gives us the percentage change in investment for a one percentage point change in the cost of capital.

A number of researchers have measured this elasticity. These researchers take a wide variety of approaches, using sharp variation in the cost of capital due to the tax code (Zwick and Mahon, 2017), variation across firms in tax status and financial constraints (Edgerton, 2010), variation within firms over time ((Dwenger, 2014) and (Chirinko et al., 1999) and (Cummins and Hassett, 1992)), and changes in investment behavior following tax reforms ((**?**)CHH1994). Across these various approaches, the empirical estimates of the elasticity of investment with respect to the cost of capital are often around -1.0. In their survey of the literature, Hassett and Hubbard (2002) put the central tendency of estimates in the range of -0.5 to -1.0.

1.3 Investment Rates

With the responsiveness of investment to the cost of capital in hand, we need to know how much the capital stock will change as a result of the changes in investment. To do this, we need to know the amount of investment and the size of the capital stock. The Bureau of Economic Analysis (BEA) computes both of these. From the BEA's NIPA Table 5.1 we find that in the second quarter of 2017, investment (in annual terms) was $3.795 trillion. NIPA Table 5.10 shows that the stock of produced assets in 2016 was $56.981 trillion. Thus, the investment rate is approximately $\$3.795/\$56.981 = 0.067$ or 6.7%.

In addition, it is useful to know the share of investment and capital that are subject to the corporate income tax system if the tax policy differential impacts on corporate and non-corporate entities. B-Tax provides these calculations, finding that about 54.5% of capital is held by businesses subject to the corporate income tax system.

1.4 Capital's Share of Output

In the final step of the calculation described above, we multiply the percentage change in the capital stock by capital's share of output to determine the percentage change in output that results from the investment response to the tax policy change. Elsby et al. (2013) document capital's share of income in the United States and how it has changed over time. They estimate capital's share of output to be about 42%. The average in the post-war period is closer to 33%, thus their findings suggest a sharp rise in capital's share of output in the last two decades.

2. A Stylized Example

As an example, I use this methodology to compute the changes in investment and output that result from a reduction in the top corporate income tax rate from 35% to 20%.[2] Simulating this reform in the the Cost of Capital Calculator yields a cost of capital of 0.062 when the corporate income tax rate is 35% and 0.057 when the corporate income tax rate is 20%. These estimates imply user cost of capital of 0.124 and 0.119, respectively. The the lower corporate rate results in a -4% change in the user cost of capital for corporate entities (and no change for non-corporate entities). With an elasticity of -1.0, this translates in an increase in the investment rate of 4% for corporate entities.

This increase in investment increases the long run corporate capital stock by an additional 4%. If capital accounts for 42% of output, this translates into an additional $4\% \times 0.42\% = 1.7\%$ increase in corporate output. To determine the change in *total* economic output, we need to understand the share of economic output attributable to corporations. If we assume that the investment rate of non-corporate entities remains the same after the corporate rate cut, then the increase in the corporate capital stock of 4% means that in the long-run, corporations will own 55.5% of the capital stock and thus (with some assumptions on symmetry between production functions between the corporate and non-corporate sector). This means total economic output would increase by $1.7\% \times 0.555\% = 0.9\%$.

Of course, these ranges vary depending on the user cost elasticity parameter used. If one were to use the more modest elasticity of -0.25 estimated by Chirinko et al. (1999), then the corporate investment rate would increase by 1%. This would result in an increase in the corporate capital stock of 1% and corporations holding 54.5% of capital on the long run (again, assuming no changes in the investment rate of non-corporate entities). The 5.26% larger corporate capital stock in this case would result in a $1\% \times 0.545 \times 0.42 = 0.2\%$ increase in total economic output.

3. Caveats and Complicating Factors

This methodology is intuitive and simple. However, this approximation necessarily abstracts away from factors that might be important.

One must consider that the elasticities used here might be more appropriate for small policy changes rather than large changes. Also, time horizons are important. For example, if a tax cut is temporary, businesses may accelerate investments into the reform period in order to gain from lower rates and responses could be larger.

[2] As explained in more detail the next section, it is assumed that interest rates are unaffected by this tax cut.

The cost of capital framework is relevant for investments that just break even. It is these "marginal" investments that are affected by tax policy. Investments making above market returns are going to be made regardless. Thus the results present above, which assumes that all investments earning the market rate of return, would tend to overstate the investment (and thus output response) to changes in tax policy. Power and Frerick (2016) estimate that only about 25% of corporate income tax base attributable to investments earning the market rate of return. If it is only these investments that respond to the cost of capital, the investment effects of tax policy might be only 25% of the size illustrated in the stylized example.

Zwick and Mahon (2017) and others find heterogeneity in the response of investment to the change in the cost of capital, with substantial differences between large and small businesses. In addition, one might expect differential responses across industry or asset type. The calculations above apply an overall elasticity to all investments, but the composition of investment and how the different businesses respond to changes in the cost of capital might be important.

Edgerton (2010) finds that firms with positive taxable income respond differently that those with losses. Thus business cycles, or even the distribution losses across businesses, may be relevant considerations.

General equilibrium effects can also be significant. For example, as demand for investment increases, interest rates would tend to increase as well, dampening the effects of the change in tax policy on investment responses. Relatedly, if the tax policy is financed by increases in government debt, this too will tend to push up interest rates and attenuate the investment response to the tax change.

Finally, these calculations do not include international competitiveness effects. For example, a lower corporate statutory rate would not only provide incentives to increase domestic investment, but also for multinationals to locate new investment inside the United States that they would otherwise have made overseas. To understand these effects, one needs to look beyond the changes in the cost of capital to changes in average effective tax rates (AETRs) (see Devereux and Griffith (1998)). In general, including these locational decisions will increase the response of investment to changes in corporate tax rates.

Modeling Notes

B-Tax

The Cost of Capital Calculator is a web application that allows users to interact with the B-Tax model. B-Tax is an open source model that computes marginal effective tax rates by asset type or industry under different financings regimes. The model can be used to calculate the effects of federal tax policy on business' incentives to invest in new structures, equipment, land, or intellectual property. B-Tax version 0.1.8 was used for this article. As an open source model, B-Tax is under constant development and improvement. Therefore, the results reported in this paper will change as improvements are made. The model relies on 2013 data from the IRS Statistics of Income and the Bureau of Economic Analysis.

Modeling Assumptions

The calculations from B-Tax represent the incentive effects on investments which earn the economic rate of return as decisions to make investments earning above market rates of return will not be affected by changes in the corporate income tax. Results assume that investments are financed by the historical mix of debt and equity financing used by C-corporations, 32% debt, 68% equity. Furthermore, rates of inflation, nominal interest rates and the pre-tax nominal rates of return to equity investments are assumed to be constant across the tax policies considered (with values of 2.4%, 6.8%, and 8.2%, respectively).

References

Chirinko, Robert S., Steven M. Fazzari, and Andrew P. Meyer, "How responsive is business capital formation to its user cost?: An exploration with micro data," *Journal of Public Economics*, October 1999, *74* (1), 53–80.

Cummins, Jason G. and Kevin A. Hassett, "The Effects of Taxation on Investment: New Evidence From Firm Level Panel Data," *National Tax Journal*, September 1992, *45* (3), 243–251.

Devereux, Michael and Rachel Griffith, "The taxation of discrete investment choices," IFS Working Papers W98/16, Institute for Fiscal Studies December 1998.

Dwenger, Nadja, "User Cost Elasticity of Capital Revisited," *Economica*, 01 2014, *81* (321), 161–186.

Edgerton, Jesse, "Investment incentives and corporate tax asymmetries," *Journal of Public Economics*, December 2010, *94* (11-12), 936–952.

Elsby, Michael, Bart Hobijn, and Ayseful Sahin, "The Decline of the U.S. Labor Share," *Brookings Papers on Economic Activity*, 2013, *44* (2 (Fall)), 1–63.

Hassett, Kevin A. and R. Glenn Hubbard, "Tax policy and business investment," in A. J. Auerbach and M. Feldstein, eds., *Handbook of Public Economics*, Vol. 3 of *Handbook of Public Economics*, Elsevier, 2002, chapter 20, pp. 1293–1343.

Power, Laura and Austin Frerick, "Have Excess Returns to Corporations Been Increasing Over Time?," *National Tax Journal*, December 2016, *69* (4), 831–846.

Zwick, Eric and James Mahon, "Tax Policy and Heterogeneous Investment Behavior," *American Economic Review*, January 2017, *107* (1), 217–248.