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Corporate Taxation: The Revenue-Maximizing Tax Rate

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SUMMARY

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Corporate Taxation: The Revenue-Maximizing Tax Rate

Economists have long recognized that there are behavioral responses to the corporate tax, and that these responses have implications for the efficiency of the economy and the burden of the tax, as well as how much revenue a tax increase might raise. This report examines the research surrounding the revenue-maximizing corporate tax rate and explores implications for federal tax policy.

The notion that a corporate tax cut could raise revenues (and thus "pay for itself") was part of the debate in 2017, when the corporate tax rate was subsequently cut from 35% to 21%. A decade earlier, this issue played a much more prominent role during the corporate tax debate in 2007. Several studies appeared in 2006 and 2007 that estimated a revenue-maximizing corporate tax rate of around 30%, although one study estimated a higher rate of 56% for a large, less-open economy such as the United States. These studies used a panel of countries to determine corporate revenues as a percentage of GDP as a function of the statutory tax rate.

This report examines two issues with these studies. The first is the incompatibility of the studies' results with theoretical constraints on how low the revenue-maximizing tax rate can be. Because the pretax rate of return falls when the capital stock increases, the corporate tax base is relatively insensitive to tax reductions that increase investment. Under the most generous assumptions, theory suggests the revenue-maximizing tax rate is probably no less than 70%. Effects arising from avoidance and evasion of taxes by corporations are too small to account for a revenue-maximizing rate below the tax rates in effect before the 2017 corporate rate cut (from 35% to 21%).

The second issue is an econometric one. For panel studies comparing trends, including fixed country and time effects is necessary to produce unbiased estimates. When CRS reestimated two of the most prominent studies with these fixed effects included, the results were generally statistically insignificant effects. In cases where estimates were marginally significant, the coefficients indicated no revenue-maximizing tax rate.

A subsequent study addressed another issue with the econometric studies from 2006 and 2007: that the base may be changing at the same time as the tax rate. When controlling for the direction (although not the size), that study found a revenue-maximizing tax rate of 61% in general and a rate around 100% for a large, less-open country.

A related set of literature estimated the elasticity of the corporate tax base with respect to the net-of-tax rate ($1-t$) (where t is the tax rate). This estimate can be used to calculate the implied revenue-maximizing tax rate. These studies used two different methods. The first approach also used a panel. The second examined the degree of clumping of observations below the kinks in the rate structure (where the statutory tax rate increased). The results of these studies largely indicated relatively high revenue-maximizing tax rates.

The implications of theory, of correcting the earlier studies for lack of fixed effects, of accounting for simultaneous base changes, and of the literature on the tax base elasticity are that the revenue-maximizing corporate tax rate is high, and that increases in the corporate tax rate would likely raise close to the static revenue estimate.

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Introduction

Economists have long recognized that there are behavioral responses to the corporate income tax, and that these responses have implications for the efficiency of the economy and the burden of the tax, as well as how much revenue a tax increase might raise. In 1974, when Arthur Laffer allegedly drew a curve on a napkin tracing the relationship between tax revenue and the tax rate in a Washington, DC, restaurant, the term Laffer curve became the popularized expression of the idea behind a revenue-maximizing tax rate.[1] A Laffer curve formalizes the notion that revenue is zero at a zero tax rate and zero at a 100% tax rate (at least with respect to some taxes).[2] In a Laffer curve, the revenue first rises with the tax rate and then falls, and the point at which revenue reaches its zenith is the revenue-maximizing tax rate. If the tax rate is above the revenue-maximizing rate, a tax cut would raise revenue. A body of research into the Laffer curve subsequently developed, largely estimating the response of individual income to the tax rate. However, the issue of a revenue-maximizing corporate tax rate had rarely entered into the discussion of the corporate tax rate until the mid-2000s.

The notion that a corporate tax cut could raise revenues (and thus "pay for itself") was part of the debate in 2017, when the corporate tax rate was cut from 35% to 21% (P.L. 115-97).[3] However, this issue played a much more prominent role during a previous corporate tax debate in 2007, when the Treasury Department sponsored a conference on the corporate tax.[4] At that time, discussions in the popular press referred to several contemporaneous academic studies of the Laffer curve's application to the corporate tax, including references in articles by Glenn Hubbard and Kevin Hassett.[5] In that same year, a major tax reform bill, H.R. 3970, introduced by Representative Charles Rangel, chairman of the House Ways and Means Committee, would have reduced the corporate rate from 35% to 30.5%, among numerous other proposed changes. The bill was not enacted, and attention was diverted to other issues during the great recession that began at the end of 2007.

This report begins with an illustration of the Laffer curve and the revenue-maximizing tax rate. This is followed by an evaluation based on both theory and econometric issues, and a discussion of additional research since 2007. The report also examines the body of literature estimating the tax base elasticity, which can be used to calculate a revenue-maximizing tax rate.

[1] See Alan Blinder, Thoughts on the Laffer Curve, in *The Supply Side Effects of Economic Policy*, ed. Laurence H. Meyer, Boston: Kluwer.Nijhoff Publishing, 1980, https://books.google.com/books?id=YWD_CAAAQBAJ&pg=PA83#v=onepage&q&f=false. Laffer does not recall this specific incidence, although it could have happened. See Arthur Laffer, The Laffer Curve: Past, Present, and Future, June 1, 2004, The Heritage Foundation, https://www.heritage.org/taxes/report/the-laffer-curve-past-present-and-future

[2] Excise taxes can be set at more than 100% and still yield revenue. Taxes on real capital income in excess of 100% can also yield revenues because inflation is an implicit tax on the holding of cash.

[3] Peter Baker, "Arthur Laffer's Theory on Tax Cuts Comes to Life Once More," *New York Times*, April 25, 2017, https://www.nytimes.com/2017/04/25/us/politics/white-house-economic-policy-arthur-laffer.html.

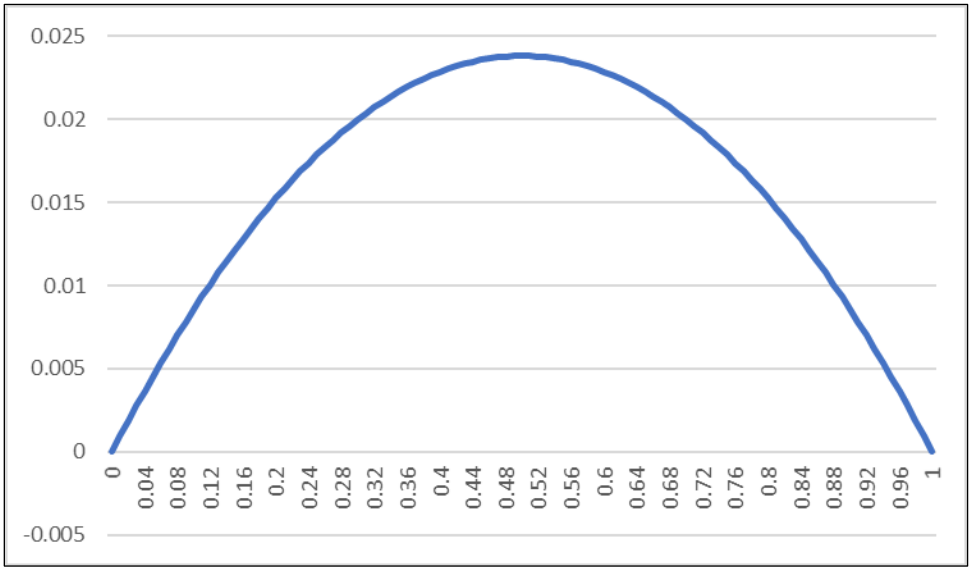
[4] Paul Caron, Treasury Holds Conference Today on Business Taxation and Global Competitiveness, July 26, 2007. https://taxprofblog.aals.org/2007/07/26/treasury-holds/.

[5] R. Glenn Hubbard, "The Corporate Tax Myth," *The Wall Street Journal*, July 26, 2007, and Kevin A. Hassett, "Art Laffer, Righter Than Ever," *National Review*, February 13, 2006, https://www.aei.org/articles/art-laffer-righter-than-ever/.

Illustration of Laffer Curve and the Revenue-Maximizing Tax Rate

Figure 1 presents a hypothetical symmetrical Laffer curve showing revenue as a percentage of GDP as the tax rate changes. With a symmetrical shape, the revenue-maximizing tax rate occurs at the midpoint (50%).[6] It would imply that cutting any tax rate set at less than 50% would lose revenue, since the revenue-maximizing rate is above the federal (and state) corporate tax rates. Cutting any rate set at higher than 50% would increase revenue.

Figure 1. Illustration of a Symmetric Revenue-Maximizing Tax Rate



Source: CRS.

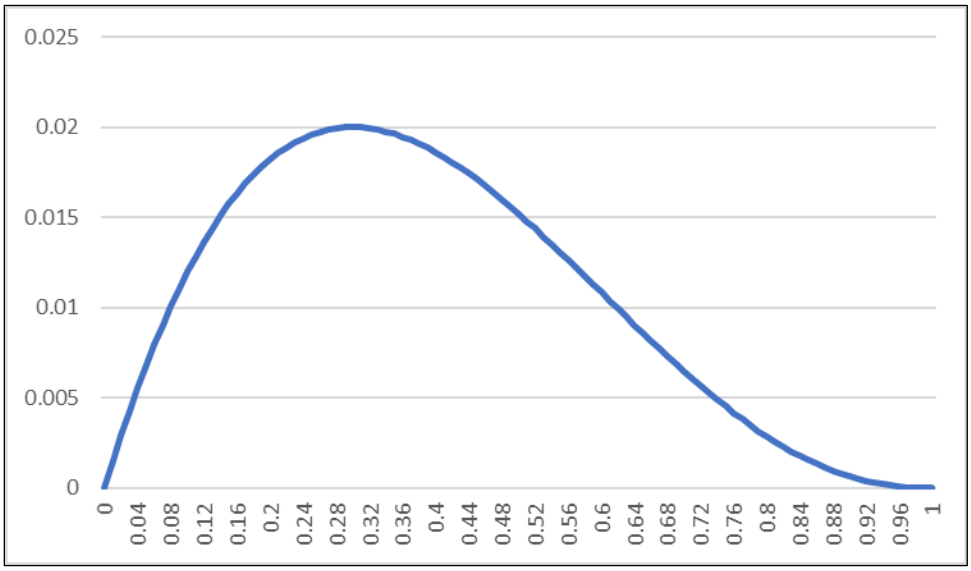
There is no reason why a Laffer curve must be symmetric, and an asymmetric curve can have a revenue-maximizing rate at any point between 0% and 100%. **Figure 2** shows a lower revenue-maximizing tax rate of 30%, which was estimated in some initial econometric studies[7] at a time

[6] These graphs were created using a net-of-tax elasticity formula, as discussed in **Appendix C**. This is a form that creates zero revenue at the 100% tax rate. Some estimating methods are inconsistent with this outcome, including ones that use the tax and the tax rate squared. Revenue is equal to $At(1-t)^e$ where A is a constant, t is the tax rate and e is the net-of-tax elasticity.

[7] Kimberly A. Clausing, "Corporate Tax Revenues in OECD Countries," International Tax and Public Finance, vol. 14 (April 2007), pp. 115-133;. Michael P. Devereux, Developments in the Taxation of Corporate Profit in the OECD Since 1965: Rates, Bases and Revenues, May 2006, presented at a conference of the Alliance for Competitive Taxation and the American Enterprise Institute, June 2, 2006, https://www.researchgate.net/publication/4924248_Developments_in_the_Taxation_of_Corporate_Profit_in_the_OECD_since_1965_Rates_Bases_and_Revenues/link/00b49519df55672802000000/download?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uIn19https://www.researchgate.net/publication/4924248_Developments_in_the_Taxation_of_Corporate_Profit_in_the_OECD_since_1965_Rates_Bases_and_Revenues/link/00b49519df55672802000000/download?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uIn19; Alex Brill and Kevin Hassett, Revenue Maximizing Corporate Income Taxes, American Enterprise Institute, Working Paper no. 137, July 31, 2007, https://www.aei.org/wp-content/uploads/2011/10/20070731_Corplaffer7_31_07.pdf; and Jack M. Mintz, 2007 Tax Competitiveness Report: A Call for comprehensive Tax Reform, C.D. Howe Institute, No. 254, September 2007, https://cdhowe.org/publication/2007-tax-competitiveness-report-call-comprehensive-tax-reform/.

that the corporate tax rate was 35% and when adding state and local taxes brought the total corporate tax rate to around 39%.[8] Estimates from these studies therefore suggested that lowering the corporate tax rate to as low as 30% would raise revenue.

Figure 2. Illustration of a 30% Revenue-Maximizing Tax Rate

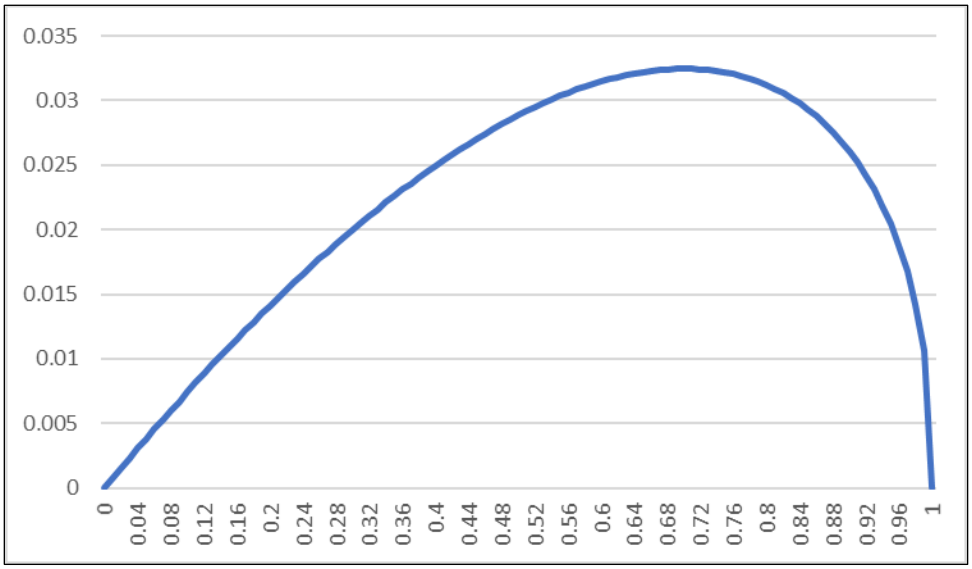


Source: CRS.

Figure 3 shows a relatively high revenue-maximizing tax rate of 70%, more consistent with a corporate model with increases in capital investment income and with subsequent empirical estimates that tended to find high rates. It indicates that cutting the tax rate from 35%, or any rate set at less than 70%, would lose revenue.

[8] The Tax Foundation estimates a combined rate of 38.9% prior to the 2017 tax cut. See Tax Foundation, Corporate Income Tax, https://taxfoundation.org/taxedu/glossary/corporate-income-tax-cit/.

Figure 3. Illustration of a 70% Revenue-Maximizing Tax Rate



Source: CRS.

These alternatives also suggest very different consequences for a tax rate increase. For example, increasing the corporate tax rate from 21% to 28% would result in a static revenue increase of 33.3%. Using **Figure 1**'s symmetric Laffer curve assumption, actual revenue would increase 21.5% (equal to about 65% of the static gain). Using **Figure 2**'s curve with the lower revenue-maximizing tax rate would gain 7.4% (22% of the static gain). Using **Figure 3**'s higher revenue-maximizing rate would gain 28.1% (84% of the static gain).

Revenue-Maximizing Tax Rate Studies in 2006 and 2007

Four prominent revenue-maximizing tax rate studies appeared around the time of the 2007 debate. Hassett referred to a paper by Clausing,[9] and Hubbard referred to a paper by Devereux.[10] In addition, Brill and Hassett prepared a statistical analysis examining the change in the relationship between the corporate tax rate and corporate tax revenues over time.[11] A cross-country study was also prepared by Mintz.[12] Hassett's article quotes Clausing as claiming that the United States was likely to the right of the revenue-maximizing point on the Laffer curve, but this statement, presumably from an earlier draft, is not found in her published article. That article

[9] Kimberly A. Clausing, "Corporate Tax Revenues in OECD Countries," *International Tax and Public Finance*, vol. 14 (April 2007), pp. 115-133.

[10] Michael P. Devereux, *Developments in the Taxation of Corporate Profit in the OECD Since 1965: Rates, Bases and Revenues*, May 2006, presented at a conference of the Alliance for Competitive Taxation and the American Enterprise Institute, June 2, 2006, https://www.researchgate.net/publication/4924248_Developments_in_the_Taxation_of_Corporate_Profit_in_the_OECD_since_1965_Rates_Bases_and_Revenues/link/00b49519df55672802000000/download?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uIn19.

[11] Alex Brill and Kevin Hassett, *Revenue Maximizing Corporate Income Taxes*, American Enterprise Institute, Working Paper no. 137, July 31, 2007, https://www.aei.org/wp-content/uploads/2011/10/20070731_Corplaffer7_31_07.pdf.

[12] Jack M. Mintz, *2007 Tax Competitiveness Report: A Call for comprehensive Tax Reform*, C.D. Howe Institute, No. 254, September 2007, https://cdhowe.org/publication/2007-tax-competitiveness-report-call-comprehensive-tax-reform/.

found a revenue-maximizing tax rate of 33% in her simple specification, but as she added sets of additional variables and accounted for other features, the revenue-maximizing tax rate seemed to rise, as indicated in **Table 1**. Clausing found that large countries and countries that are less open (i.e., countries that have less than the average foreign direct investment), such as the United States, have a revenue-maximizing tax rate of 57%—larger than the combined federal and state rate for U.S. firms of 39%.

Table 1. Revenue-Maximizing Tax Rates and Share of Variance Explained in the Clausing Study

Specification	Tax Rate	R-Squared
(1) Basic	33%	0.13
(2) Additional Variables	39	0.43
(3) Additional Variables	42	0.46
(4) Additional Variables	41	0.23
(5) Additional Variables	37	0.21
(6) Openness	43	0.27
(7) Size	45	0.23
(8) Openness and size	57	0.28

Source: Kimberly A. Clausing, "Corporate Tax Revenues in OECD Countries," *International Tax and Public Finance*, vol. 14 (April 2007).

Note: The R-Squared is a statistical term that measures the share of the variance in the dependent variable explained by the independent variables.

Michael Devereux's paper found a revenue-maximizing rate of 33% under the same specification as Clausing, but he found only weak evidence of a relationship between tax rates and corporate tax revenues as a percentage of GDP. Many of his specifications did not yield statistically significant effects. Brill and Hassett found a rate of around 30%, which has been falling over time. Mintz found a rate of 28%, but his data span only a few years (2001-2005).[13]

While many of the views claiming a corporate tax cut pays for itself may reflect the impressions of this earlier debate, there was little attention paid to the unusual features of the corporate tax that allow important theoretical insights into this rate. Moreover, a number of studies have been published subsequently that indicated much higher revenue-maximizing tax rates.

Are The Results Consistent With Theory?

The Laffer curve had not been a part of the historic debate on corporate taxes because the notion of a revenue-maximizing tax rate other than at very high tax rate is inconsistent with most models of the corporate tax. Traditionally, the main behavioral response associated with the corporate tax was the substitution of noncorporate capital for corporate capital within an economy where the amount of capital was fixed. Imposing a corporate tax (in excess of the noncorporate tax) caused capital to earn a lower return in the corporate sector and to flow out of that sector and into the noncorporate sector, thereby lowering the return in the noncorporate sector and raising the return, before taxes, in the corporate sector. The higher pretax return on capital also caused prices to rise

[13] Hence, most of the variation is across countries, which, as discussed below, is a potentially serious problem.

in the corporate sector and fall in the noncorporate sector, causing a shift toward noncorporate sector total production.

The corporate profits tax base, therefore, had two opposing forces: the amount of capital was falling but the profit rate was rising. Therefore, the taxable base could either increase or decrease as tax rates increased. The direction depended on the substitutability of capital and labor in the corporate sector. The central tendency of most models (with unitary elasticity of substitution between capital and labor) suggested, however, that the tax base was relatively invariant to tax rates, and revenues would always rise with the tax rate. Consequently, under any reasonable set of assumptions there would either be no revenue-maximizing tax rate or an extremely high one.[14]

If behavioral responses caused the total capital in the U.S. economy to contract, the outcome could be different. One such model, the open economy model, appears to be a motivation for the belief in a relatively low revenue-maximizing tax rate. Brill and Hassett discuss elasticity estimates of foreign capital flows to after-tax returns in the range of 1.5 to 3 (they also cite a study with an elasticity of 3.3) in their paper, which finds a revenue-maximizing tax rate of around 30%. They conclude that "[t]hese high elasticities are consistent with the view that reductions in corporate rates could lure a significant enough amount of economic activity to a locality to create a Laffer curve in the corporate tax space."[15]

As shown in **Appendix A**, however, a revenue-maximizing tax rate that low is not achieved even with infinite elasticities and conditions that would lead to lower revenue-maximizing rate levels. In the most extreme case, where: (1) the country is too small to affect worldwide prices and rates of return; (2) capital is perfectly mobile; and (3) products in international trade are perfectly substitutable, the revenue-maximizing tax rate would be the ratio of the labor share of income to the factor substitution elasticity. Assuming fairly common values for a model without depreciation of 75% for labor's share of income and a factor substitution elasticity of 1, the tax rate would be 75%—far above the rates of around 30% reported by Brill and Hassett. This rate could rise as these conditions are relaxed. If the United States is assumed to have 30% of world resources, the rate rises to 81%; if imperfect substitutability between investments across countries and between foreign and domestic products is allowed, it would rise further. It would also rise if the tax system included elements of a residence-based system that taxes earnings from abroad, as the U.S. tax system has always had in some form, reducing the tax advantage of outbound investment.

Although it is possible to have a revenue-maximizing tax rate under 100%, it is probably not possible to find a rate that maximizes revenues as a percentage of GDP, because GDP falls as well as tax revenues. In this case, the same circumstances apply as in the reallocation of capital in the closed economy: with unitary elasticities, the corporate share of income is constant relative to GDP, and with other elasticities, it can rise or fall.

A related circumstance where capital can contract occurs in a model where savings responds so powerfully that the savings supply is infinitely elastic. That is, when a tax is imposed, the capital stock must contract so much, and the pretax rate of return must rise so much, that the after-tax return comes back to its original value. This extreme savings response model yields the same revenue-maximizing tax rate as the extreme open economy, 75%, and likely no revenue-maximizing tax rate for revenues as a percentage of GDP. Moreover, the slowness with which the

[14] An invariant tax base would occur when both production and utility were of the Cobb Douglas form, which is unitary factor substitution elasticities and unitary product substitution elasticities. At a 100% tax rate, a corner solution would presumably be reached where the corporate sector would entirely disappear, but only at that extreme rate would such an effect occur.

[15] Brill and Hassett, *Revenue Maximizing Corporate Income Taxes*, p. 6.

capital stock adjusts means that the revenue would be affected with a long lag. If the revenue-maximizing tax rate also accounted for additional taxes on labor income, it would be about 70%.

The result of this discussion makes it clear that revenue-maximizing tax rates cannot arise from physical reallocations or contractions of capital. Nor are they likely to arise from a substitution between debt and equity, since the debt share has changed very little despite significant changes in the relative tax burden, and estimates of elasticities that do exist are small.[16]

The tax base could also decrease because of avoidance and evasion by corporations. One source of a different outcome is profit shifting, which involves firms maintaining the same activity and shifting the form of operation to unincorporated businesses. Profit shifting could be a possibility (although the point of revenue maximization would be much too low because much of the tax has not disappeared, but rather has shifted). But, at least in the United States, this shift is probably less the result of high corporate tax rates and more the result of increasingly loose restrictions on operating with limited liability outside the corporate form, actions that have not been taken by other countries.[17]

The other profit-shifting issue is the shifting of profits (rather than activity) to foreign countries. Such effects are possible, but it would seem unlikely that tax avoidance could be of this magnitude, given the amount of profits shifted and the behavioral response. Although a small, low-income country, as is characteristic of most tax havens, might not have enough domestic capital that it could afford the loss from lowering its corporate tax rate to attract more capital, such an outcome is much less likely for the United States. Recent estimates of elasticities also suggest that cutting the corporate tax rate would lower revenue much more than enough to offset the tax on profits shifted back into the United States, with an offset as small as 1% and at most 9%.[18] In addition, a study by Dowd et al. found elasticities to be much smaller for changes from a higher tax rate compared to changes in low tax rates.[19] This finding could reflect, in part, the possibility that multinational firms are already engaged in as much profit shifting as is legally feasible, so a change in tax rates in low-tax countries may cause firms to shift location, but a change in the U.S. tax rate might have a negligible effect on overall profit shifting.

In addition, profit shifting can be prevented or limited by revisions in international tax rules. Concerns about this issue led to the imposition of a global intangible low tax income (GILTI) tax in 2017, which implemented a minimum tax on foreign-source intangible income. Early evidence indicated, however, that the share of related company profits reported in tax havens did not change despite the lower tax rate or the global minimum tax.[20] One explanation is that a lower tax

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[16] See Ruud de Mooij, *The Tax Elasticity of Corporate Debt: A Synthesis of Size and Variations*, International Monetary Fund, Working Paper no. WP-11-95, April, 2011, http://www.imf.org/external/pubs/ft/wp/2011/wp1195.pdf.

[17] The Treasury study provides data on the growth over time in unincorporated business forms and suggests that the large share of this income in the United States relative to other countries is due to the ability to avoid the corporate tax and still retain limited liability in the United States. The growth in Subchapter S income (partnerships that can elect to be taxed as corporations) corresponds to increasing limits on the number of permissible shareholders, and the growth in partnership income to the growth in the number of states allowing limited liability companies that do not fall under the corporate tax. Proprietorship income shares have changed very little. In any case, this growth occurred during a period when the corporate tax was constant or falling.

[18] Jane G. Gravelle, "Policy Options to Address Profit Shifting: Carrots or Sticks?" *Tax Notes*, July 4, 2016, pp. 121-134. Even the largest elasticities suggested that a dollar of revenue loss would be offset by only nine cents due to induced profit shifting; the smallest suggested only one cent.

[19] Timothy Dowd et al., *Profit Shifting of U.S. Multinationals*, January 6, 2016, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2711968

[20] See Joint Committee on Taxation, *U.S. International Tax Policy: Overview and Analysis*, JCX-16R-21, April 19, 2021, https://www.jct.gov/CMSPages/GetFile.aspx?guid=aa66e305-74cc-40bc-acad-55bb3e6d5971, which compared (continued...)

rate may not result in much change in the location of profits from intangible assets, which can easily be shifted to zero-tax-rate countries to the extent allowed by law. For instance, even though P.L. 115-97 lowered the U.S. rate from 35% to 21%, both rates are still higher than a zero rate and there is little incentive to shift profits back to the United States. GILTI lowered the global minimum rate to 10.5%, although the cross crediting of foreign taxes means zero rates can persist in some locations. One solution is to tax income from tax havens at the full U.S. rate by raising GILTI rates and imposing a per-country limit on the foreign tax credit so income in tax havens cannot be shielded from U.S. tax by credits from foreign taxes in high-tax countries.

Illegal avoidance of the corporate tax is estimated to be about 10% of corporate tax revenues.[21] However, a similar tax gap was estimated in 2014-2016, before the tax rate was reduced from 35% to 21%, suggesting this evasion of taxes is not very responsive to tax rates.[22]

Revenue Feedback from a General Equilibrium Model to Illustrate Likelihood of a Laffer Curve Near Pre-2017 Rates

A Laffer curve with a revenue-maximizing tax rate implies that there is a point where the tax base contracts so much that no revenue is gained from a tax increase, and, conversely, that cutting tax rates could raise revenue. Revenue offsets that arise from behavioral responses are often referred to as *revenue feedback*. For a tax cut, revenue feedback would be the revenue gain from an expanded base as a percentage of the original revenue loss (for a tax increase, it would be the loss from a contraction in the base as a percentage of the original gain). The revenue-maximizing tax rate is the point where induced changes in the tax rate provide 100% revenue feedback.

One empirically based—although indirect—approach to estimating the revenue-maximizing corporate tax rate involves using a general equilibrium model, which is based on empirical estimates of underlying relationships (such as capital mobility). In 2014, CRS used such a model and concluded that cutting the corporate tax from 35% to 25% in isolation would result in a revenue offset of 5% due to taxes on increased output in the United States.[23] This effect was not due to the increase in corporate taxes on the additional output, which was negligible, but to an increase in both labor and capital income taxes on increased output. Thus, CRS found that the revenue-maximizing tax rate was much higher than the then-current 35% tax rate.

As noted earlier, some have argued that the revenue feedback for the corporate tax arises not from real changes in investment but from artificial profit shifting, where multinationals use a variety of techniques to declare income in low-tax countries. Analysis and evidence, however, do not support this effect.

Finally, for a stand-alone tax cut all of these feedback effects would eventually be swamped by the increase in the debt, which would crowd out capital and reduce output, leading to an

2017 and 2018 tax data; and U.S. Department of the Treasury, *Testimony of Kimberly A. Clausing, Deputy Assistant Secretary, Tax Analysis, Before the Senate Committee on Finance*, March 21, 2021, https://home.treasury.gov/news/press-releases/jy0079, which compared Commerce Department data from 2000 through 2019.

[21] Internal Revenue Service, *Federal Tax Compliance Research: Tax Gap Projections for Tax Year 2022*, https://www.irs.gov/pub/irs-pdf/p5869.pdf.

[22] Internal Revenue Service, *Federal Tax Compliance Research: Tax Gap Estimates for Tax Years 2014-2016*, https://www.irs.gov/pub/irs-pdf/p1415.pdf.

[23] CRS Report R41743, *International Corporate Tax Rate Comparisons and Policy Implications*, by Jane G. Gravelle.

additional loss of revenues of 23% by the 10th year, as estimated by CRS in 2014. This loss of revenues on reduced output is in addition to the direct effect on the budget deficit due to an increase in interest costs of 25% of the revenue loss over the first 10 years.[24]

2007 CRS Reanalysis of Cross-Country Studies: Incorporating Fixed Effects

In the United States, claims that a corporate tax cut could raise revenues generally reference four studies done in 2006 and 2007 using cross-country data. As noted above under "Revenue-Maximizing Tax Rate Studies in 2006 and 2007," two of these studies (by Devereux and Mintz) found inconclusive results or used very short panels. This section considers the other two 2007 studies that found relatively low revenue-maximizing tax rates using cross-country methods—by Brill and Hassett and by Clausing—in more detail.

These studies estimate coefficients for the tax rate and the tax rate squared, with the two coefficients expected to have opposite signs, so as to create the inverse U shape.

In 2007, CRS reanalyzed the Clausing's and Brill and Hassett's studies and concluded that modifying their specifications by including fixed country and time effects led to statistically insignificant results.[25] Fixed effects control for country-specific and time effects on revenues and are required to estimate unbiased results, therefore controlling for factors specific to years and countries not otherwise captured in the economic model.

These longitudinal studies—called *panel studies*—examined changes in revenues to GDP over time across countries. Their method was to estimate an inverse U-shaped curve, where revenue is regressed on the tax rate and the tax rate squared.[26] Using this approach allows the revenue-to-GDP ratio to be determined directly from the tax rate. For this functional form, the revenue-maximizing tax rate is -1/2 of the ratio of the coefficient on the tax rate divided by the coefficient on the square of the tax rate.[27]

CRS obtained the data used for these two studies to replicate and extend the analyses.[28] Both studies and the CRS analysis estimate the effect of the top corporate tax rate (and its square) on corporate tax revenues as a percentage of GDP. Panel data for 29 Organisation for Economic Co-operation and Development (OECD) countries are used for the analysis. This examination suggests why these studies produced results that conflict with theoretical constraints.

[24] Ibid.

[25] This report was coauthored by Jane Gravelle and Thomas Hungerford. The current updated version can be found at CRS Report RL34229, *Corporate Tax Reform: Issues for Congress*, by Jane G. Gravelle.

[26] As noted earlier, this choice of regressors produces an inverse U-shaped tax curve using only the revenue and tax rate measures but it is not consistent with the functional form that produces a Laffer curve, which requires estimating the net-of-tax elasticity of the tax base, and using that elasticity to produce a revenue curve.

[27] The regression (excluding the constant and other terms) is $R = b_1t+b_2t^2$ and the revenue is maximized when the change in revenue with respect to a change in tax rate is zero. Differentiating the regression, this point is reached a $b_1+2b_2t = 0$ or $t = -(b_1/2b_2)$. Since the coefficients are expected of opposite signs, the result is a positive tax rate.

[28] The reanalysis presented here was done by CRS in a prior report on corporate tax reform (see footnote 20).

Brill and Hassett Study

In their study, Brill and Hassett use panel data for the OECD countries from 1981 to 2003.[29] They use regression analysis of ordinary least squares (OLS) to estimate the effects. Brill and Hassett find that the corporate tax rate has a positive effect on corporate tax revenues as a percentage of GDP at first and then a decreasing effect—the effect looks like an inverted U, the shape of the classic Laffer curve. All of their coefficient estimates are statistically significant. However, they do not account for problems often encountered with the use of panel data, and their coefficient estimates appear to be biased and inconsistent, meaning that the estimate is not correct and would not be so regardless of the size of the sample.[30] Specifically, the study did not control for country-specific and time-specific fixed effects.

Table 2 reports the estimation results from CRS's reanalysis of the Brill and Hassett study. The regression includes a tax rate and a tax rate squared to allow for a curve. Panel A of the table displays the results for central government corporate tax data (in the U.S. case, these are federal government tax data). The coefficient estimates for the full time period (1980 to 2003) and the four subperiods defined by Brill and Hassett are reported. In all cases, the coefficient estimates are fairly small and none are statistically significant at conventional confidence levels. Panel B of the table displays the results for total government (i.e., governments at all levels) corporate tax data. Again, the coefficient estimates are fairly small and none are statistically significant. Once appropriate estimation methods are used to correct problems arising with panel data, there appears to be no statistically significant relationship between corporate tax rates and corporate tax revenues as a percentage of GDP.

Table 2. CRS Reanalysis of Coefficient Estimates: Dependent Variable is Corporate Revenues as a Percentage of GDP (Brill and Hassett Model)

	1980-1986	1987-1992	1993-1997	1998-2003	1980-2003
A. Central government corporate tax revenues; federal corporate tax rate					
Tax rate	-0.037 (0.090)	-0.110 (0.081)	0.048 (0.087)	0.049 (0.117)	-0.040 (0.040)
Tax rate squared	0.087 (0.109)	0.122 (0.100)	-0.082 (0.129)	-0.060 (0.178)	0.052 (0.053)
F (joint)	5.15	1.21	0.33	0.21	0.51
Prob>F	0.008	0.303	0.719	0.809	0.603
B. Total government corporate tax revenues; total corporate tax rate					
Tax rate	0.204 (0.195)	-0.042 (0.077)	0.069 (0.076)	0.037 (0.094)	-0.016 (0.038)
Tax rate squared	-0.193 (0.214)	0.044 (0.091)	-0.106 (0.109)	-0.008 (0.123)	0.028 (0.047)
F (joint)	2.25	0.21	0.51	0.74	0.44
Prob>F	0.112	0.811	0.602	0.481	0.612

Source: CRS analysis.

[29] See Alex Brill and Kevin A. Hassett, *Revenue-Maximizing Corporate Income Taxes: The Laffer Curve in OECD Countries*. CRS obtained data from the same sources as Brill and Hassett.

[30] The terms *biased* and *inconsistent* are technical statistical terms. See **Appendix B** for a description and the consequences of these problems, and the statistical definitions for biased and inconsistent.

Notes: Standard errors in parenthesis. Fixed effects linear model with AR(1) disturbance. Other variables include time dummy variables.

Clausing Study

Clausing uses panel data for the OECD countries from 1979 to 2002 to study the effect of corporate tax rates on corporate tax revenue as a percentage of GDP.[31] She includes more explanatory variables than did Brill and Hassett, but her overall research findings and conclusions are essentially the same as theirs—there is a Laffer curve relationship between corporate tax rates and corporate tax revenue as a percentage of GDP. However, her estimation methods also lead to biased and inconsistent coefficient estimates because they do not control for fixed effects.[32]

Table 3 reports the estimation results for five different specifications. The five specifications differ by what explanatory variables are included in the analysis. In all five specifications, the coefficient estimates of the corporate tax rate (and its square) are smaller than those estimated by Clausing and have the opposite signs. Most of the coefficient estimates are not statistically significant at conventional confidence levels, but two are statistically significant at the 10% level only. (In these cases where the coefficients are significant on the tax squared term, they still do not produce the Laffer curve shape but rather indicate rising revenue with a rising tax rate.) Overall, these results suggest that the corporate tax rate has little effect on corporate tax revenues as a percentage of GDP. Consequently, there is little evidence to support the existence of a corporate tax Laffer curve.

Table 3. CRS Reanalysis of Coefficient Estimates: Dependent Variable is Corporate Revenues as a Percentage of GDP (Clausing Model)

	Specification				
	(1)	(2)	(3)	(4)	(5)
Tax rate	-0.055 (0.035)	-0.073 (0.111)	-0.075 (0.046)	-0.048 (0.036)	-0.067 (0.047)
Tax rate squared	0.078* (0.047)	0.118 (0.147)	0.102* (0.061)	0.069 (0.048)	0.093 (0.061)
Profit rate		X			
Corporate share		X			
Unemployment rate			X		X
Per capita GDP growth rate			X		X
Per capita GDP			X		X
Openness				X	X
F (joint)	1.39	0.75	1.45	1.04	1.21
Prob>F	0.251	0.473	0.236	0.354	0.298

Source: CRS analysis.

[31] See Kimberly A. Clausing, "Corporate Tax Revenues in OECD Countries." CRS thanks Kimberly Clausing for providing her data.

[32] Clausing included two variables in her analysis indicating the type of corporate tax system that do not vary over time for a country. The coefficients of these variables are not identified when using the fixed-effect estimation method, which is probably why she estimated the coefficients using OLS. While she obtained coefficient estimates for these two variables, the estimates are biased and inconsistent.

Notes: Standard errors in parenthesis. Fixed effects linear model with AR(1) disturbance. Other variables include the indicated variables and time dummy variables. *significant at 10% level.

The findings in the other studies are also biased and inconsistent, as Mintz only included year-fixed effects, and Devereux, like Clausing and Brill and Hassett, did not include either time or country fixed effects.

Post-2007 Empirical Estimates

After these four studies appeared in 2006 and 2007, there have been relatively few attempts to estimate a corporate revenue-maximizing tax rate using this direct approach, and some of the research has been based on different estimation methods.

Even if an empirical study found a statistically significant relationship that indicated a revenue-maximizing tax rate, such results could not be considered reliable if they did not control for base changes. If the rate is lowered but the base is broadened, the data could show rising tax revenues that would be due to the base changes. For example, when the corporate tax rate was cut from 46% to 34% in the Tax Reform Act of 1986, a number of other changes (most notably a repeal of the investment tax credit) were made with the objective of maintaining revenue neutrality in the corporate tax. In a 2016 paper, Slemrod and Kawano provide estimates for OECD countries, controlling for the direction of changes in the base (although not the magnitude of these changes, a much more daunting task) and find these controls raise the estimated revenue-maximizing tax rate.[33] Their fixed effects model found a revenue-maximizing tax rate of 61% overall; for a large, less-open economy, revenue-maximizing tax rates were around 100%.

Akgun et al. estimated the revenue-maximizing marginal effective tax rate for OECD countries, which captures the major features of the base as well as the statutory rate.[34] They found unstable results when estimating the effect of the statutory rate. Their estimates of the revenue-maximizing effective marginal tax rate were around 25%, although it is not clear how to interpret this number for policymaking. For example, for an asset that is expensed, such as equipment, an increase in the statutory tax rate can actually decrease the marginal effective tax rate due to debt finance. Moreover, the marginal effective tax rate is a forward-looking measure for new investment, whereas the corporate tax revenue is a snapshot in time that largely reflects existing capital.

Two other studies are limited in that they do not include fixed effects. A study by Ridley found a 32% rate, but used a single-year cross section of countries and thus could not control for country-fixed effects, which could have accounted for some or all of the results.[35] A recent study by Balki examined three countries and found a revenue-maximizing tax rate of 43% for the United States.[36] However, his regressions were time series regressions within each country that cannot control for time-varying effects.

[33] Laura Kawano and Joel Slemrod, "How Do Corporate Tax Bases Change When Corporate Tax Rates Change? With Implications for the Tax Rate Elasticity of Corporate Tax Revenues," *International Tax and Public Finance*, vol. 23, no. 3 (June 2016), pp. 401-433.

[34] Oguzhan Akgun et al., *The Capacity Of Governments To Raise Taxes*, OECD Economics Department Working Papers No. 1407, September 2017, https://www.oecd.org/content/dam/oecd/en/publications/reports/2017/09/the-capacity-of-governments-to-raise-taxes_94cdff79/6bee2df9-en.pdf.

[35] Dennis Ridley, "Optimal Tax Rates for Maximal Revenue Generation," *Technium Social Sciences Journal*, vol. 29 (March 2022), pp. 271-284, https://ideas.repec.org/a/tec/journl/v29y2022i1p271-284.html.

[36] Ali Balki, "The Corporate Income Tax Rate Maximizing Tax Revenues and Market Output: Empirical Evidence from the United Kingdom, The United States, and Turkiye," *International Journal of Management Economics and Business*, vol. 21, no. 3 (2025), pp. 1000-1016, https://www.researchgate.net/publication/
(continued...)

Evidence From Taxable Income Elasticity Studies

Some studies have not specifically focused on revenue-maximizing tax rates but rather on taxable income elasticities, that is, how the tax base changes with the tax rate. Once the base becomes a function of the tax rate, a revenue-maximizing tax rate can be estimated. This approach has been used to estimate the revenue-maximizing individual tax rate and capital gains tax rate.[37]

Some of these studies are estimated using a functional form that yields a constant elasticity defined as the percentage change in taxable income divided by percentage change in tax rate. These studies cannot be used to estimate a revenue-maximizing tax rate, which requires an elasticity that increases with the tax rate. At most, these studies may be suggestive because they indicate how far the elasticity is from an elasticity of 1, the elasticity with respect to the tax rate required at the revenue-maximizing tax rate. Instead of or in addition to a constant elasticity with respect to the tax rate (τ), some studies use a constant elasticity with respect to the net-of-tax rate ($1 - \tau$). This elasticity is positive and can yield a revenue-maximizing tax rate, which is 1 divided by ($1 + \varepsilon$), where ε is the elasticity. This result is shown in **Appendix C**.

The next sections discuss studies under two major category headings: (1) panel studies that are similar to the studies above in that they use a longitudinal cross section and (2) studies of kinks in the tax schedule that estimate elasticities based on bunching at the kinks. Most of these studies focus on a particular country.

Cross Section Panel Studies

These studies are similar to the cross-country studies discussed above in that they follow observations over time, but the dependent variable is the tax base and the independent variable the tax rate.

In 2007, Gruber and Rauh estimated the response to the marginal effective corporate rate using financial data on U.S. firms, where the marginal rate varies by industry reflecting different rules on depreciation and other factors.[38] This study uses marginal rather than statutory tax rate and is based on financial data. This study finds a net-of-tax elasticity of 0.2, which implies a revenue-maximizing tax rate of 83%. This rate would maximize the present value of revenue over time. Since the marginal effective tax rate is below the statutory rate, this estimate suggests that both the statutory tax rate and provisions that reduce that effective rate could be used to increase corporate taxes while raising substantial revenues.

A 2012 study by Riedl and Rocha-Akisone used a cross section of OECD countries.[39] That study estimated a constant elasticity with respect to the tax rate, which cannot be used to estimate the revenue-maximizing tax rate (as discussed in **Appendix C**). The study found an elasticity of -0.8, which suggests that overall the OECD countries' tax rates were below the revenue-maximizing tax rate, which is -1. As long as the tax rate is below 50%, the point elasticity would be higher for

398539132_THE_CORPORATE_INCOME_TAX_RATE_MAXIMIZING_TAX_REVENUES_AND_MARKET_OUTPUT_EMPIRICAL_EVIDENCE_FROM_THE_UNITED_KINGDOM_THE_UNITED_STATES_AND_TURKIYE.

[37] See CRS Report R48562, *Boundaries on the Long-Run Realization Response to Changes in Capital Gains Taxes*, by Mark P. Keightley and Jane G. Gravelle.

[38] Jonathan Gruber and Joshua Rauh, "How Elastic is the Corporate Income Tax Base?" in Alan J. Auerbach et al., *Taxing Corporate Income in the 21st Century* (Cambridge University Press, 2007).

[39] Aleksandra Riedl and Silvia Rocha-Akis, "How Elastic Are National Corporate Income Tax Bases In OECD Countries? The Role of Domestic and Foreign Tax Rates," *The Canadian Journal of Economics*, vol. 45, no. 2 (May 2012), pp. 632-671.

an elasticity with respect to the tax rate than the elasticity with respect to the net-of-tax rate. The average tax rate in that study is 30%. If there is both a constant elasticity with respect to the net-of-tax rate and a rising elasticity with respect to the tax rate, the net-of-tax rate elasticity would be t/(1-t) times the constant elasticity at that rate point, which would be 0.34, implying a revenue-maximizing tax rate of 75%.

In 2012, Dwenger and Steiner estimated the elasticity of corporate income to the net-of-tax rate in Germany, using the average tax rate, with an estimate of 0.58 and a revenue-maximizing tax rate of 63%.[40] They used responses to tax reforms in a short panel of tax returns.

In 2020, Krapf and Staubli found a very large elasticity of 3.5 with respect to the net-of-tax rate in Switzerland across cantons, suggesting a revenue-maximizing tax rate of 22%.[41] Their study was based on panel variation across cantons during tax reforms. This methodology is more similar to the methodology of the cross-country studies. This study uses a cross-jurisdiction method similar to that used in 2006 and 2007, but it has the advantage that the tax base is harmonized across the Swiss cantons and only the rates can vary. This elasticity is significantly larger than the other elasticities. That may reflect in part that the observations are across municipalities, rather than countries, and it is likely much easier to shift locations across municipalities that are close by, especially for activities such as pharmaceuticals where earnings largely reflect intangible assets. Thus, these findings may not be applicable to the United States. The authors note that the results may reflect profit shifting.

Studies Based On Kinks In the Rate Schedule

This approach is based on examining observations lying just below a kink in the tax rate schedule, that is when the tax rate changes. If many observations are bunched just below the kink, this is evidence that firms respond to the change in tax rates, and an elasticity can be estimated based on the size of the mass below the kink. A large mass indicates a high elasticity.

One reservation with these studies is that most corporate tax rate schedules have kinks at low or no incomes, so the results might not be generalizable to all firms, particularly large profitable firms that produce most tax revenue.

In 2014, Devereux et al. estimated an elasticity of corporate taxable income with respect to a net-of-tax rate by using bunching at the kink points in the rates, where the rate schedule changes.[42] This study found an elasticity of 0.13 to 0.17 at the highest kink point of £300,000 (approximately $500,000 at that time). These estimates suggest a revenue-maximizing tax rate of 85% to 88%. However, the study also found higher elasticities at much lower kink points.

In 2019, Lediga[43] et al. estimated the elasticity of taxable income with respect to the net-of-tax rate in South Africa by examining kink points. For larger firms, the study found a very low

[40] Nadja Dwenger and Viktor Steiner, "Profit Taxation and the Elasticity of the Corporate Income Tax Base: Evidence From German Corporate Income Tax Data," *National Tax Journal*, vol. 65, no. 1 (March 2012), pp.117-150.

[41] Matthias Krapf and David Staubli, *The Corporate Elasticity of Taxable Income: Event Study Evidence from Switzerland*, Center for Economic Studies and Ifo Institute Working Paper no. 8715-2020, November 2020, https://www.econstor.eu/bitstream/10419/229533/1/cesifo1_wp8715.pdf.

[42] Michael P. Devereux et al., "The Elasticity of Corporate Taxable Income: New Evidence from UK Tax Records," *American Economic Journal, Economic Policy,* vol. 6, no. 2 (2014), pp. 19-53, https://eml.berkeley.edu/~saez/course/devereuxetal13.pdf.

[43] Collen Lediga et al., "The Elasticity of Corporate Taxable Income—Evidence from South Africa," *Economics Letters,* vol. 175 (February 2019), pp. 43-46.

elasticity of 0.1, implying a revenue-maximizing rate of 91%. It found larger effects for small firms.

In a 2022 study focused on private corporations in the United States, Coles et al. estimated a net-of-tax elasticity of 0.91 with respect to the expected tax rate, using bunching at the 0% tax kink (where the tax rate changes from zero to positive).[44] This estimate implies a revenue-maximizing tax rate of 52%.

In 2025, Bukovina et al. found an elasticity for Slovakia of 0.185 for the statutory rate and 0.282 for the marginal effective tax rate, using bunching at the kinks.[45] These estimates translate into revenue-maximizing tax rates of 84% and 78%.

In 2026, Agostini et al. provided estimates around the zero kink point for 16 countries.[46] There was a broad range of results, ranging from an elasticity of 0.075 to 1.19, with an average of 0.792. These elasticities correspond to revenue-maximizing tax rates ranging from 93% to 34%, with an average of 61%.

Summary of Findings

The estimates of elasticities in 2006 and 2007 found relatively low revenue-maximizing tax rates of around 30%. One study, however, found that the elasticity would be much higher, 57%, for a large, less-open country like the United States. Another found weak evidence using different specifications. These results were inconsistent with simple models of the corporate tax, where revenue-maximizing tax rates would be around 70%.

These studies were statistically biased and inconsistent because they did not include country- and time-fixed effects. At that time CRS reestimated the revenue-maximizing tax rates for the two U.S. studies, incorporating fixed effects, and found small, statistically insignificant results.

A principal problem with reduced-form estimates of corporate tax revenues is that they cannot control for other variables that determine corporate revenues. These include not only changes to the base or to credits in the corporate tax, but other factors. For example, the growth in pass-through business income relative to corporate income reflected statutory changes in the number of shareholders allowed by S Corporations that elect to be treated as pass-throughs and changes to state laws that allowed limited liability companies to be treated as partnerships rather than corporations. A study by Kawano and Slemrod that used fixed effects and controlled for direction of changes in the base (although not the quantitative change) found a revenue-maximizing rate of 61% in general and a rate of 100% for large, less-open economies like the United States. Another study found unstable results for the statutory rate and a revenue-maximizing rate of 25% for the marginal effective tax rate on new investment. While the revenue-maximizing tax rate can capture major elements of the tax base, it is not clear what the implications are for the statutory tax rate.

Another body of studies estimated the elasticity of the base to the tax rate, which can be used to find the implied revenue-maximizing rate. These studies generally found larger estimated revenue-maximizing rates, typically above 70%. These findings are generally more consistent with theory.

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[44] J.L. Coles et al., "How Do Firms Respond to Corporate Tax Rates," *Journal of Accounting Research*, vol. 60, no. 3 (2022), pp. 965-1006, https://nathanseegert.com/papers/ColesPatelSeegertSmith_HowDoFirmsRespond.pdf.

[45] Jaroslav Bukovina et al., "Corporate Minimum Tax and the Elasticity of Taxable Income: Evidence from Administrative Tax Records," *American Economic Journal: Economic Policy*, vol. 17, no. 2 (2025), pp. 358-387.

[46] Claudio Agostini et al., *The Elasticity of Corporate Taxable Income Across Countries*, National Bureau of Economic Research, Working Paper no. 34945, March 2026.

While the empirical studies directly estimating the revenue-maximizing tax rate have not yet developed the ability to reliably estimate a revenue-maximizing corporate tax rate, simple theoretical insights indicate that a revenue-maximizing corporate tax rate is much higher than either the current 21% rate or the 35% rate before the 2017 rate cut. Such a rate is probably no less than 70%, a finding consistent with most of the results of the alternative approach of estimating the elasticity of the tax base with respect to the tax rate.

Appendix A. Revenue-Maximizing Tax Rates in an Open Economy

For an exploration of corporate tax revenue, consider a simplified example where there is a U.S. corporate sector and the rest of the world with no tax. The lowest revenue-maximizing rate would apply in a case where there is a small country which is a price-taker (that is, worldwide price and rate of return after tax are fixed because there is perfect capital mobility and perfect product substitutability). To determine the revenue-maximizing tax rate, begin with the equation for corporate tax revenues:

(A1) $Rev = tRK/(1-t)$

where *K*, the corporate capital stock, and *R*, the after-tax rate of return, are potentially functions of the tax rate, *t*. Revenue is maximized when the total differential of equation (A1) with respect to taxes is equal to zero, which is

(A2) $(1-t)(tRdK/dt+tKdR/dt) +RK = 0$

Assuming the rest of the world can be treated as an aggregate and has a zero capital income tax rate, Gravelle and Smetters[47] show that, in a case of a small country with perfect substitutability, *R* does not change and $dK/K = -(\sigma/\mu)\ [dt/(1-t)]$, where μ is the labor share of income and σ is the factor substitution elasticity. Substituting this relationship into (A2) will obtain the revenue-maximizing rate of μ/σ. To use some common values, if μ is 0.75 and σ is 1, the revenue-maximizing rate is 75%.

Because the United States is a large country, the rates would be even higher, because the tax can affect the worldwide interest rate. The Gravelle and Smetters paper provides effects for R and K for a given country share, which can also be substituted into equation (A2). As a result, the revenue-maximizing tax rate is $\mu/(\mu\gamma+ \sigma(1-\gamma)$ where γ is the output share. For example, if the United States has approximately 30% of the total output, the revenue-maximizing tax rate would be 81%. The rates would rise further if capital were not perfectly mobile or products not perfectly substitutable, since these factors would allow R to fall further. At the extreme, it would return to a closed economy solution. Gravelle and Smetters present evidence to suggest that the outcome is more similar to a closed economy than a small open economy solution.

This same outcome, a 75% rate, would also apply for the most extreme case of growth models, the Ramsey model, where the supply of savings is perfectly elastic.

Note that in both of these extreme cases, the after-tax return is fixed and the total burden falls on wage income, so that labor income would fall. One could also calculate a corporate tax rate that maximizes revenue while taking into account the effect on wages and keeping the wage rate constant. Again, relying on the model in Gravelle and Smetters and maximizing,

(A3) $REV = tRK/(1-t) +t_lWL$

Where t_l is the tax rate wages, obtain a revenue-maximizing corporate tax rate of $t = (\mu(1-t_l)/(\sigma-t_l\mu)$. With an approximate 20% tax rate on labor income, the revenue-maximizing corporate tax rate is 70%. This is not the rate that would be found in the cross-section analysis.

[47] Jane G. Gravelle and Kent A. Smetters, "Does the Open Economy Assumption Really Mean That Labor Bears the Burden of a Capital Income Tax?" *Advances in Economic Policy and Analysis*, vol. 6, no. 1 (2006).

Appendix B. Data and Estimation Methods

CRS obtained the data used in the Hassett and Mathur study and the Clausing study from their respective authors.[48] CRS also obtained the data used to replicate the Brill and Hassett study from the original sources cited in the study.[49] CRS replicated the results reported for all studies.

The data are for several countries for a period of several years, and are known as panel data. The model of the relationship between the corporate tax rate (the independent variable) and the various dependent variables takes a linear form:

(B1) $Y_{it} = \alpha + \beta X_{it} + \varepsilon_{it}$

where Y_{it} is the dependent variable, X_{it} is the independent variable (the corporate tax rate in our case), α and β are the regression parameters to be estimated, and ε_{it} is a random error term.[50] The subscripts, *i* and *t*, indicate that information for a particular observation comes from country *i* for year *t* (for example, information for Australia for 1992). The random error term, ε_{it} , is a random variable and captures omitted and unobservable factors or variables that affect the dependent variable. The error term will be discussed in further detail below.

If the following conditions are met:

- the expected value (mean) of the random error term, ε_{it} , is zero;
- the variance of the random error term is constant for all observations;
- the random error term for one observation is uncorrelated with the error term for another observation; and
- the random error terms are uncorrelated with the explanatory variables

then the ordinary least squares (OLS) estimators will yield the best linear unbiased estimators of the parameters (α and β). The β parameter shows the true relationship between the dependent variable and the independent variable, and is the parameter of interest for this report's purposes. Since the estimate of β, it is a random variable drawn from a probability or sampling distribution with an expected value (mean) and variance. This estimator will have the following desirable properties:

- unbiased: the expected value of estimate of β is β;
- efficient: the variance of the estimate of β is smaller than the variance of all other unbiased estimators; and
- consistent: the probability distribution of the estimate of β collapses on β as the number of observations gets arbitrarily large.Estimation problems often arise with panel data because one or more of the conditions listed above are not met, meaning OLS estimator will be biased and inconsistent. Problems arise with panel data, as is demonstrated when equation (B1) is rewritten as:

[48] Authors generously provided their data to CRS. The studies are Kevin A. Hassett and Aparna Mathur, *Taxes and Wages*, American Enterprise Institute, Working Paper, 2006; and Kimberly A. Clausing, "Corporate Tax Revenues in OECD Countries," *International Tax and Public Finance*, vol. 14 (2007), pp. 115-133.

[49] Alex Brill and Kevin A. Hassett, *Revenue-Maximizing Corporate Income Taxes: The Laffer Curve in OECD Countries*, American Enterprise Institute, Working Paper no. 137, July 31, 2007.

[50] For ease of exposition, one independent variable is written in the equation. Generally, several independent variables are included in the linear model. This simplification does not change the following discussion of the model and estimation techniques.

(B2) $Y_{it} = \alpha + \beta X_{it} + \nu_i + \phi_t + \eta_{it}$

The term ν_i is an effect (unobserved heterogeneity) specific to a particular country, capturing differences among countries in (1) the measurement of economic data, (2) economic institutions, (3) laws and regulations applying to business, and (4) attitudes toward business, among other things. The term ϕ_t is a time-specific effect capturing such things as the international business cycle. Since the corporate tax rate is a reflection of the attitudes toward business in a country, X_{it} and ν_i will be correlated. Ignoring the country-specific unobserved heterogeneity means that the OLS estimate of β is biased and inconsistent because the error term in equation (B1) is correlated with the explanatory variable—one of the conditions listed above is violated. Another problem often encountered with data that have a time dimension is that the error terms are correlated from one year to the next year (called *autocorrelation*). Statistical tests indicate that these problems exist with the data CRS obtained from the three studies named above. Consequently, the parameters of the model are estimated using the fixed effect estimation procedure, allowing for an AR(1) error structure.[51]

Identification

Neither Brill and Hassett nor Clausing offer any justification in their studies for using OLS rather than the fixed effects method to estimate the parameters of their models. A well-known drawback of the fixed effects method is that variables that vary across countries, but not across time within a country, cannot be included in the estimation (that is, the parameters associated with these variables are not identified). Devereux (2006) claims "changes in the statutory [corporate tax] rate within a country are comparatively rare. In practice, as found by Clausing (2006), there is not enough variation within country to identify an effect of the statutory rate, conditional on country fixed effects."[52]

To measure the accuracy of this statement and the justification for using OLS, CRS directly examined the variation of the corporate tax rate across countries and over time. **Table B-1** displays the results for the data from the two studies. The first row displays the relevant explanatory corporate tax rate variable used in the study. The second row reports the mean of the variable. The third row reports the standard deviation (a measure of variation of a variable) of the corporate tax rate variable. The last two rows decompose the standard deviation into the between-country component and the within-country component. If there is no variation in the variable over time within a country, then the within component of the standard deviation will be zero. Consequently, the effect of that variable on the dependent variable is not identified conditional on fixed effects (i.e., it cannot be estimated using the fixed effects procedure). As can be seen from the table, there is almost as much variation within countries (the within component) as there is between countries (the between component).

[51] See Christopher F. Baum, *An Introduction to Modern Econometrics Using Stata* (Stata Press, 2006) for a description of this technique. The overall results and conclusions are not changed when using the random effects estimation procedure allowing for an AR(1) error structure.

[52] Michael P. Devereux, *Developments in the Taxation of Corporate Profit in the OECD Since 1965: Rates, Bases and Revenues*, University of Warwick, Working Paper, May 2006, p. 20.

Table B-1. Standard Deviation of Corporate Tax Rate Variables in the Three Data Sets

	Brill and Hassett Data	Clausing Data
Variable	Corporate tax rate	Corporate tax rate
Mean	0.362	0.354
Overall Standard Deviation	0.092	0.101
Between Component	0.065	0.078
Within Component	0.064	0.063

Source: Author's analysis of data.

In addition, all OECD countries changed their corporate tax rate at least once between 1979 and 2002. Four countries (Ireland, Norway, Spain, and Switzerland) changed their corporate tax rate once during this period. In contrast, Luxembourg changed its corporate rate 12 times over this period. On average, OECD countries changed their corporate tax rates once every five years. Therefore, this evidence refutes the argument that the effect of the corporate tax rate on corporate tax revenues is not identified conditional on fixed effects.

Appendix C. Obtaining Revenue-Maximizing Tax Rates From Tax Base Elasticity Estimates

Two functional forms are used in the studies of tax base elasticities. The constant elasticity with respect to change in tax rate, where B is the tax base, τ is the tax rate, ε is the elasticity (expected to be negative) and A is a constant, is:

(1) $B = A\ \tau^{\varepsilon}$

An alternative is estimating an elasticity (expected to be positive) of the base to the net-of-tax share or $(1- \tau)$ and is:

(2) $B = A(1- \tau)^{\varepsilon}$

A revenue-maximizing tax rate appears when a change in tax results in no change in revenue or when:

(3) $\delta(\tau\ B) = 0$ or

(4) $\delta\tau\ B + \tau\ \delta B = 0$

By taking logs and differentiating equations (1) and (2) CRS finds respective expressions for δB.

(5) $\delta B = BE\ \delta\tau/\ \tau$

and

(6) $\delta B = -BE\ \delta\tau/(1-\tau)$

If the value for δB is substituted from (5) into (4) the tax rate τ disappears. However, if the value of δB from (6) is substituted into (4), the revenue-maximizing rate is:

(7) $\tau = 1/\ (1+e)$

For example, if the elasticity if 0.5, the revenue-maximizing tax rate is 1/1.5 or 66.7%.

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