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Capital Gains Tax Options: Behavioral Responses and Revenues

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Summary

Compared with most other tax provisions, the potential revenue gain scored for an increase in capital gains taxes is strongly affected by behavioral responses assumed by the Joint Committee on Taxation (JCT) and the Department of the Treasury. As an illustration, the Obama Administration estimated in February 2010 that allowing the Bush tax cuts for capital gains to expire would have raised $16 billion of revenue in FY2019. Yet, based on Congressional Budget Office (CBO) projections in January 2010, the current effective capital gains tax was 13.3% in 2008 and would have increased to 17.9% in 2019; applying the differential in these rates to the realizations in 2019 would have produced a revenue difference of $40 billion. Although some of this differential could arise from different forecasts, assumptions about behavioral responses are the main reason for the reduction in projected revenues.

Because these behavioral responses limit the potential revenue scored from a tax increase on capital gains and because of concerns that most income of very high-income individuals is in the form of capital gains (whether accrued or realized), proposals have been advanced to tax capital gains currently (as accrued) by marking to market publicly traded securities and imposing a look-back tax on difficult-to-value assets. Such a change faces a number of difficulties; thus it is important to understand the evidence of the behavioral responses. The analysis in this study suggests that the Administration's projections and those of the JCT, absent a change in their realizations response, may understate revenue gains from increasing capital gains tax rates.

Realizations responses in revenue projections by the revenue-estimating agencies (Joint Committee on Taxation and the Treasury) were publicly discussed at the end of the 1980s, in the midst of a contentious debate. The larger the absolute value of the elasticity (the percentage change in realizations divided by the percentage change in taxes), the smaller the revenue gain; with elasticities larger than one in absolute value, a loss would occur. Estimated elasticities in the literature prior to 1990 ranged from 0.3 to almost 3.8, leaving limited guidance for revenue-estimating agencies. JCT used an elasticity of 0.76, whereas Treasury used an elasticity of one.

Concerns were raised at that time that there were serious problems with this evidence. Perhaps the most significant concern was that the larger results from studies of individuals reflected a timing or transitory response (high-income taxpayers with variable income chose to realize gains when tax rates were temporarily low). This transitory response is not appropriate for assessing a permanent change.

Evidence and studies since that time suggest that the permanent elasticity is considerably lower than what appeared to be the case in 1990. The surge in realizations in 1986 as a capital gains tax rate increase was preannounced provided compelling evidence of the importance of a transitory response. A study of the limits of realizations (which cannot exceed accruals in the long run) suggested the elasticity (percentage change in realizations divided by the percentage change in the tax rate) could be no more than 0.5 in absolute value (evaluated at a 22% tax rate), and a midpoint of 0.25. A number of new econometric studies, using new techniques to isolate the permanent response, suggested elasticities of around 0.5 or less. Other recent studies suggested larger responses. The JCT appears to maintain its original assumption, while the Treasury response has been reduced to be similar to JCT's; both appear to exceed the realizations limit.

Simulations indicate that an increase in capital gains tax rates of five percentage points would raise slightly more than $40 billion on a static basis for 2019, about $30 billion using the 0.25 elasticity and $18 billion using the 0.5 elasticity. The JCT estimates would likely be around $10 billion, reflecting a 0.68 elasticity. Taxing gains on an accrual basis would eliminate this response in the long run and gain additional revenues on currently unrealized gains.

Contents

Introduction 1
Realizations Responses and Revenue 2
The 1990 Debate 4
Developments Since 1990 6

Tables

Table 1. Realizations Elasticities, Post-1980s Studies 6
Table 2. Revenue Gain from Increasing Capital Gains Tax Rates by Five Percentage Points, Estimates for FY2019 Based on Alternative Realizations Responses 10

Table B-1. Elasticities from Studies of the 1980s 14

Appendixes

Appendix A. Technical Appendix 12
Appendix B. Econometric Studies 14
Appendix C. Citations to Studies 20

Contacts

Author Information 21

Introduction

The Bush tax cuts, enacted in 2001 and 2003, were scheduled to expire at the end of 2010. Among the expiring tax provisions was a lower 15% rate for long-term capital gains and dividends, with a 0% tax rate on capital gains and dividends for taxpayers subject to ordinary rates of 15% or less. Absent legislative action, capital gains tax rates would have reverted to pre-2003 rates of 20% and 10% (18% and 8% for assets held for five years or more), and dividends would be taxed at ordinary rates. The highest ordinary tax rate is currently 35% but, absent change, will rise to 39.6%.

President Obama proposed in both his budget outlines (FY2010 and FY2011) to retain the 15% and 0% rates for lower- and middle-income taxpayers, but to tax both dividends and capital gains at 20% for married couples with income of $250,000 or more and single taxpayers with income of $200,000 or more. The tax rates were temporarily extended through the end of 2012 by the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010 (P.L. 111-312).

The final resolution at the beginning of 2013 (American Taxpayer Relief Act of 2012, P.L. 112-240) was to tax capital gains for higher-income individuals at the higher rate, but at incomes of $480,050 for married couples and $453,350 for singles in 2018, considerably higher than those proposed by President Obama.

Compared with most other tax provisions, the potential revenue gain scored for an increase in capital gains taxes is strongly affected by behavioral responses assumed by the Joint Committee on Taxation (JCT) and the Department of the Treasury. As an illustration, the Obama Administration estimated in February 2010 that allowing the Bush tax cuts for capital gains to expire would have raised $16 billion of revenue in FY2019.[1] Yet, based on Congressional Budget Office (CBO) projections in January 2010, the current effective capital gains tax was 13.3% in 2008 and would have increased to 17.9% in 2019; applying the differential in these rates to the realizations in 2019 would have produced a revenue difference of $40 billion.[2] Although some of this differential could arise from different forecasts, assumptions about behavioral responses are the main reason for the reduction in projected revenues.

To address these potential behavioral responses, some supporters of increasing taxes on capital gains (given that such gains comprise a significant part of the income of high-income individuals)[3] have proposed applying mark-to-market rules to tax capital gains as accrued, which would eliminate the realization response for affected assets.[4] Assets that are less easily valued could be subject to look-back treatment, which would increase the tax to achieve the same after-

[1] FY2019 is used as an example of a long-run effect; the first few years may differ as a result of assumed short-term responses. In addition, later years may reflect more normal times as asset values are more likely to have rebounded fully from the recession. For the Treasury estimates, see *General Explanation of the Administration's FY2011 Revenue Proposals*, February 2010, p. 153, at http://www.treas.gov/offices/tax-policy/library/greenbk10.pdf.

[2] This calculation is based on an average tax rate of 13.3% in 2008 and 17.9% in 2019 (supplied by CBO), with the differential applied to projected realizations in 2019, in Congressional Budget Office, *The Budget and Economic Outlook: Fiscal Years 2010 to 2020*, p. 85, at http://www.cbo.gov/ftpdocs/108xx/doc10871/01-26-Outlook.pdf.

[3] According to the Congressional Budget Office, capital gains are 24% of the income of individuals with income of $1 million or more and 1% or less of the income of individuals with income of $200,000 or less. See *The Distribution of Asset Holdings and Capital Gains*, August 4, 2016, https://www.cbo.gov/publication/51831.

[4] Such a proposal has been made by Senator Wyden, ranking Democrat on the Senate Finance Committee. See Laura Davison and Lynnley Browning, "Key Democrat Revises Plan to make Capital Gains Tax Due Annually," *Bloomberg*, April 2, 2019, https://www.bloomberg.com/news/articles/2019-04-02/top-senate-democrat-touts-annual-capital-gains-tax-ahead-of-2020.

tax earnings that would have occurred if the tax were imposed on an accrual basis.[5] Such an approach has a number of complexities, and to the extent that these changes aim to address the behavioral response, it is important to understand the limits this behavioral assumption imposes on options for increasing taxes on realized capital gains and the empirical basis for these estimated effects.

Realizations responses in revenue projections by the revenue-estimating agencies (JCT and Treasury) were publicly discussed at the end of the 1980s, in the midst of a contentious debate. This report explains how these responses affect revenues, discusses the debate that occurred in the late 1980s, reviews research since that time, and analyzes the implications for revenue effects.[6] The analysis in this report suggests that the Obama Administration's projections and those of the JCT, absent a change in their realizations response, may likely understate revenue gains from allowing lower capital gains tax rates to expire.

Realizations Responses and Revenue

Because taxpayers can choose to realize capital gains, economists and policymakers have been concerned about a reduction in the potential revenue from capital gains taxes because those taxes reduce realizations. It is possible for a tax increase to lose revenue if the response is large enough. If realizations are postponed until death, the gains escape tax entirely.[7] Thus, there is an incentive to delay and perhaps ultimately avoid the tax by not selling assets.

Capital gains realizations responses are typically expressed in the form of an elasticity, which is the percentage change in realizations divided by the percentage change in taxes. These elasticities are expected to be negative but are often reported without the minus sign (and will be in this report). If realizations increase by 5% when the tax rate falls by 10%, the elasticity is 0.5; if realizations increase by 10% when the tax rate falls by 10%, the elasticity is one; if realizations rise by 20% while the tax rate falls by 10%, the elasticity is two.

The higher the value of the elasticity, the smaller the revenue gain or loss from a capital gains tax increase or decrease. If the elasticity is less than one, a tax increase gains revenue; if the elasticity is greater than one, the tax increase loses revenue. For a small increase in tax rates, the ratio of revenue gain projected to the gain realized with no behavioral response (static gain) is one minus the elasticity. Thus, if the elasticity is 0.25, 75% of the static revenue gain will be realized (that is (1-0.25) times the static gain). If the elasticity is 1.25, the tax increase will *lose* 25% of the static gain (i.e., (1-1.25) equals minus 0.25).[8]

Three types of elasticities are relevant to capital gains realizations and revenues and are discussed in the economics literature. The first is the permanent elasticity, which is most relevant for permanent tax law changes: it measures the longer-run (after a year or two) realizations response to a permanent change in tax rate. The second is the short-run elasticity, which measures the short-term response to a permanent change. The third is the transitory elasticity, which measures

[5] In a look-back treatment, the ratio of sales price to acquisition, along with holding period, could be used to determine the average rate of gain, with net proceeds recalculated to assume that gain was taxed on an accrual basis, leading to a smaller appreciation. An additional tax would be collected by reducing the basis to make the proceeds equal to that net of tax gain.

[6] Numerous other issues are relevant to evaluation of capital gains taxes including economic effects and distributional concerns. See CRS Report 96-769, *Capital Gains Taxes: An Overview*, by Jane G. Gravelle.

[7] This treatment is called step-up in basis and means that when the heir sells an asset, the basis, or amount deducted from the sales price to determine taxable gain, will be the value at the time of death rather than the original acquisition cost of the decedent.

[8] This rule is not strictly applicable for large changes because the elasticity may change as the tax rate changes.

the response to a temporary tax increase or decrease. This transitory effect might occur because the incomes of wealthy individuals (and the associated taxes due) may vary from year to year, and they time realizations in years when their tax rates are low. It may also occur in the aggregate when a tax change is pre-announced. For example, if taxpayers learn that the tax is increasing next year, they may shift realizations into the current year to take advantage of this year's lower tax rate.

Although this discussion will focus on the magnitude and effects of permanent elasticities, these short-term and transitory effects constitute both a challenge in estimation and affect shorter-term responses to changes. Thus a brief discussion is in order.

The short-term realizations elasticity has most often been discussed (as it was in the late 1980s) in the context of a capital gains tax cut. The idea behind such as response is that taxpayers have a large stock of accrued gains that they would have already realized if the tax rate were lower and thus there will be a larger increase in realizations in the first year or two.

Applying such an effect has two caveats. The first is that the short-term response may be muted if there has been a recent increase in realizations. For example, unbeknownst to revenue estimators in the late 1980s (because the data were not available), there had been a surge in realizations in 1986 because of the pre-announced increase in capital gains taxes for 1987 and later years as part of the Tax Reform Act of 1986. With so many of these accrued gains exhausted, it was unlikely that there would have been a very large short-run response had a tax cut been enacted in 1990.

Second, and more important for the current issue, there is no reason to expect that short-run responses apply to a tax increase that is not pre-announced, because, although a cut in taxes may unleash significant short-term realizations from the existing stock of gains, an increase should not cause a similar contraction. The stock of gains that has not been realized because of taxes will simply remain unrealized, with no effect on realizations.[9]

The transitory response is sometimes used interchangeably with the short-term response, but transitory responses can be thought of as occurring because of a temporary lower or higher rate. As noted above, a large aggregate transitory response occurred in 1986 because of the passage of legislation that raised future tax rates significantly. A large increase also occurred in 2012 for the same reason. However, because the higher-income taxpayers who realize most capital gains can have significant fluctuations in income and taxes, transitory responses occur among individuals even in years when the law does not change. This possibility of a transitory response was more pronounced in the period (prior to 1987) when capital gains were subject to graduated rates (because the tax benefit was an exclusion rather than a fixed rate).

Statistical estimates of realizations responses can be based on a variety of functional forms, but one of the most common functions causes the elasticity (percentage change in gains divided by a percentage change in tax rates) to rise proportionally with the tax rate. Therefore elasticities should be reported with reference to the assumed tax rate. For much of the discussion in the 1990 debate, the relevant tax rate was the one associated with the tax change under consideration, the 22% rate midway between the current and new rate. Many elasticities discussed at that time reflect that rate. Capital gains realizations elasticities are expected to be negative but the elasticities in this report will be stated and referred to in absolute value (without the minus sign).

[9] Gains could fall a little more initially because the gains not realized today would be available in the future, and also because of sticker shock. But this phenomenon is very different from the large responses in gains that are from the current stock of gains with a tax cut. It is also a timing effect, but evidence suggests that, in the steady state, virtually all of the accrued gains not realized are never realized, but held until death. See Jane Gravelle, "Limits to Capital Gains Feedback Effects," *Tax Notes* 51, April 22, 1991, pp. 363-371.

This formulation also leads to a revenue-maximizing tax rate, which is the tax rate at which the most capital gains tax revenue will be realized. The underlying equations are presented in **Appendix A**.

For considering the effects of allowing tax increases, the 22% rate appears appropriate as a starting point (although the effect would roughly reflect the midpoint between the old and new tax rates). Under current law, in addition to the rates of 0%, 15%, and 20%, there is also the 3.8% net investment income tax enacted by the 2010 health care law for taxpayers with incomes above $250,000 for couples and $200,000 for singles. The Congressional Budget Office estimates an overall marginal tax rate of 21.2% for long-term capital gains, and the Department of the Treasury estimates a similar rate of 21.3%.[10]

Note that these issues surrounding capital gains taxes and realizations are not applicable to taxes on dividends, which are estimated by CBO to be taxed at a slightly lower marginal rate of 18.4%.[11]

The 1990 Debate

In 1990, the George H. W. Bush Administration proposed to reduce the capital gains tax rate that had been adopted in 1986. That legislation increased the top rate on capital gains from 20% to 28% by taxing capital gains as ordinary income. During the late 1980s, the revenue-estimating agencies (the Joint Committee on Taxation and the Department of the Treasury's Office of Tax Analysis) had begun to investigate and add behavioral responses in the form of realizations elasticities. The Congressional Budget Office also began to include tax variables in their regressions used to forecast baseline capital gains revenues.

Because of the strict budget constraints applying at that time, the issue of revenue cost was a crucial one in 1990.[12] The Administration chose an elasticity (at a 22% rate) of 0.98. The JTC used an elasticity of 0.76.[13]

Two types of data were used to estimate the realizations response. The first was aggregate time series, which related total realizations in different years to the tax rate in that year. The second was micro-data studies, which examined individual taxpayers' realizations in comparison to their tax rates. These studies included cross-section studies (which compare taxpayers in a single year), pooled cross-section time-series (which compare taxpayers and include many years but do not follow individual taxpayers over time) and panel studies (which compare taxpayers over time, tracking each taxpayer).

As shown in **Table B-1** in **Appendix B**, estimates of the realizations response varied dramatically, from 0.3 to almost 4. To make the revenue implications clear, an elasticity of 0.3

[10] Congressional Budget Office, *Taxing Capital Income: Effective Marginal Tax Rates Under 2014 Law and Selected Policy Options*, December 18, 2014, https://www.cbo.gov/publication/49817, p. 34; U.S. Department of Treasury, Office of Tax Analysis, *Marginal Income Tax Rates by Income Source*, 2016, prepared August 2015, https://home.treasury.gov/policy-issues/tax-policy/office-of-tax-analysis.

[11] Ibid.

[12] During that time, tax changes were constrained by deficit targets under legislation popularly known as Gramm-Rudman. See CRS Report RL30009, *Tax-Cut Legislation: Applicable Budget Enforcement Procedures*, by Robert Keith.

[13] Sources for these data are in an archived CRS report that was published in *Tax Notes*, Jane Gravelle, "Can a Capital Gains Tax Cut Pay for Itself?" *Tax Notes* 48, July 9, 1990, pp. 209-219. These elasticities are reported before adjustments for portfolio responses and are larger than the elasticities actually used for revenue estimating, which were 0.7 and approximately 0.9.

would imply, for a small increase in the tax rate, that the revenue gained would be 70% of the revenue projected if there were no realizations response. An elasticity of 4 implies a *loss* of three times the projected revenue gained if there were no behavioral response. Estimates based on aggregate time series were generally lower, ranging from 0.3 to 0.9 (70% to 10% of revenue gained). Estimates based on individual taxpayer data ranged from 0.55 to 3.8.

The range of estimated responses and their implications for revenue implied serious problems with the estimation methods. The range was particularly broad for estimates based on individual data. The JCT took the position that the time series results were more reliable, and they estimated their own elasticity using this methodology. The Treasury never actually provided a specific methodology for their number, but rather reported it as a conservative choice given the realizations estimates.

Researchers trying to estimate the realizations response faced many problems, which are discussed in more detail in **Appendix B**. In general, individual data are preferred for estimation, because aggregation can produce a bias and loses information. In addition, it is very difficult to control for other factors that change over time.

More important, for using individual data, was the problem of distinguishing between permanent and transitory responses. Because income, especially of high-income individuals who realize most gains, can fluctuate over time, tax rates also vary over time. Individuals would be expected to time realizations to coincide with periods of low rates. Individuals might also need to cash in assets when income (and therefore taxes) is unusually low. This concern basically precluded relying on simple cross-section results for permanent responses. Thus, no revenue-estimating entity relied on the larger elasticities (close to 4) produced by some of these micro-data studies.

Arguments were made at the time that panel data, which followed individuals over several years, could be used to separate these elasticities, because in these data individual tax rates could be examined over several years. These studies used the average of the current, previous, and future tax rate as a permanent rate. These studies reported smaller elasticities, but ones that still were well above one in some cases.

Because of an incorrectly reported elasticity, the three panel studies available at that time appeared to produce a much narrower range of results. These panel results probably influenced the Treasury to choose a larger elasticity than those suggested by the aggregate time series data. However, as noted in the following section, the last panel study also had a very large elasticity.[14] Thus, although attempts were made to address the problem of transitory effects with panel studies, this procedure may not correct for the transitory effect, perhaps because periods of lower income or higher income can continue for several years.

Although panel studies offered some possibility of controlling for transitory effects, the panels available were for only a few years. If the higher-income individuals who realize most gains experienced prolonged spells of higher or lower than normal income, panel studies might reduce the transitory element, but estimates could still reflect some transitory response elements. Thus

[14] The three panel studies, whose results are reported along with other studies in **Appendix B**, originally reported elasticities of 0.55, 1.29 and 1.65. This range was still wide, but the upper limit was much lower than the high estimates in cross-section studies. Moreover, the 0.55 may have been low because of the low tax rate in that study. As discussed in the next section, however, the elasticity for the latest panel study (Gerald E. Auten, Leonard E. Burman, and William C. Randolph, "Estimation and Interpretation of Capital Gains Realization Behavior: Evidence from Panel Data." *National Tax Journal*, September 1989, pp. 353-374) was reported as 1.65, but should have been reported as 3.2. This estimate was similar to the estimates from single year cross sections. Thus the short-panel approach did not appear to address the transitory issue. The other micro-data approach, pooled cross-section times series, with a 1.18 elasticity, also likely reflects a mix of permanent and transitory effects.

panel estimates could still be too large, whereas the biases in time-series estimates remained uncertain. Neither approach was without flaws.

Ultimately the proposed tax cuts were not enacted at that time (although they were eventually reduced in 1997 and again in 2003).

Developments Since 1990

The range of realizations elasticities, even if confined to time series estimates, is very broad for revenue-estimating purposes or otherwise evaluating capital gains taxes. Researchers turned their attention to methods to produce more precise and reliable estimates.

One important event that influenced thinking about these elasticities was the sharp spike in realizations that occurred in 1986. Between 1985 and 1986, realizations rose from $170.6 billion to $324.4 billion, falling to $144.2 billion in 1987.[15] A study of this phenomenon using taxpayer data showed that these gains occurred in December, and were seven times the gains in December of the previous year.[16] This increase, which took place when a tax increase was passed for the following years, was evidence of the magnitude of transitory realizations responses and contributed further to concerns about the reflection of transitory responses in the econometric studies.

Eleven additional academic econometric studies of the realizations response have been identified beginning in 1990, and nine of those studies are reported in **Table 1**.[17] The table also includes estimates of practices by CBO, JCT, and Treasury.[18] CBO cautions that its realizations estimate is not for the purpose of estimating revenues. Rather, the tax rate is included as part of an overall statistical study which includes many variables used to project capital gains realizations for the baseline.[19]

The second column of **Table 1** reports the coefficient which, multiplied by the tax rate, will produce the elasticity. The studies are arrayed by elasticity, from smallest to largest.

Table 1. Realizations Elasticities, Post-1980s Studies

Sources of Data	Coefficient	Realizations Elasticity at 22%
No Change in Behavior	0.0	0.00
Burman and Randolph Panel Study (1994)	1.0	0.22

[15] These data are reported in Robert Gillingham and John S. Greenlees, "The Effect of Marginal Tax Rates on Capital Gains Revenue: Another Look at the Evidence," *National Tax Journal*, vol. 45, June 1992, p. 176.

[16] See Leonard E. Burman, Kimberly A. Clausing, and John F. O'Hare, "Tax Reform and Realizations of Capital Gains in 1986," *National Tax Journal*, vol. 47, March 1994, pp. 1-18.

[17] All of these studies are summarized in **Appendix B**, but two are excluded because they basically repeat the now discredited methodologies of cross-section and short-panel studies.

[18] Coefficients currently used were provided by these agencies.

[19] For that reason, CBO does not focus as heavily on specification with respect to the tax rate as researchers concentrating on the realizations response might. For example, the CBO regression does not use instrumental variables. CBO also notes that the estimated realizations response is sensitive to other variables included. For other specifications, CBO finds a realization coefficient as large as 2.9.

Sources of Data	Coefficient	Realizations Elasticity at 22%
Auerbach and Siegel Panel Study (2000)	1.126	0.25
Gravelle Limit Study Midpoint (1991)	1.136	0.25
CBO Time Series (2010)	1.76	0.39
Minas, Lim, and Evans Time Series (Australia, 2018)	2.15	0.47
Gravelle Limit Study Upper Limit (1991)	2.27	0.5
Eichner and Sinai Time Series (2000)	2.28	0.5
Bogart and Gentry State Panel Study (2000)	2.5	0.55
Bakija and Gentry State Panel Study (2014)	2.91	0.64
JCT (Current)	3.1	0.68
Treasury (current)	3.25	0.72
Gillingham and Greenlees Time Series (1992)	3.4	0.75
Auten and Joulfaian Panel Study (2004)	3.6	0.79
Dowd, McClelland and Muthitacharoen Panel (2015)	4.1	0.90

Source: See **Appendix B** for summaries of studies and **Appendix C** for citations.

Notes: The coefficient is the fixed estimate from a semi-log function that, multiplied by the tax rate, yields the elasticity. That is, if the regression is of the form: log gain = a + bt + other regressors, and t is the tax rate, the coefficient is b. It is expected to be negative but is reported as an absolute value.

Table 1 also includes the results of a study by Gravelle, which was not an econometric study.[20] Some analysts had observed that large estimated elasticities from cross-section and panel studies implied large realizations that were far outside the scope of historical experience.[21] Gravelle's study noted that there was a limit to the realizations response in that, for a permanent elasticity, realizations could not exceed accruals (the change in the market value of assets). If every asset were sold every year, realizations would equal accruals, but they could be no larger. The study provided data on the ratio of realizations to accruals, along with tax rates, over a long period of time, and used the average values to estimate the upper limit of the realizations elasticity. The study found that limit to be 0.5, below the estimates of all existing cross-section and panel studies, and below most of the time series studies. Moreover, the 0.5 limit is an upper limit and implies that in the absence of taxes and transactions costs individuals would sell every asset every year. Because some assets are unlikely to be sold even in those circumstances, because investors

[20] This study is an archived CRS report, which was published by Tax Notes. See Jane Gravelle, "Limits to Capital Gains Feedback Effects," *Tax Notes* 51, April 22, 1991, pp. 363-371.

[21] See, for example, Alan J. Auerbach, "Capital Gains Taxation and Tax Reform," *National Tax Journal*, September 1989, pp. 391-401.

are satisfied with their investments, the elasticity is likely to be considerably lower. (For example, individuals and families holding controlling shares of corporations are unlikely to sell their assets, as are individuals with investments in family businesses and real estate, or simply those whose portfolios are satisfactory.) **Table 1**, therefore, reports both the upper limit and the midpoint of this study.

This study was prepared in 1991, and covered the data from 1954 to 1989. In the study, the realizations to accruals level was estimated at 46% and the tax rate was estimated at 18.4%. More recent evidence covering the period 1989-2013 finds a similar ratio, 48%, and a similar tax rate of 17.3%.[22] These findings support the limits to realizations elasticities found in the initial Gravelle study.

As an illustration, the Dowd, McClelland, and Muthitacharoen panel study that produced the highest coefficient implies that if all income taxes and transactions taxes and costs were eliminated, realizations would 4.25 times their current value, when the level of accruals suggests they could be no more than twice as large.[23]

That same study also corrected the elasticity for the most recent panel study of the 1980s, indicating an elasticity of 3.2, similar to the cross-section results.[24] This correction reinforced the observation that the panel studies could not necessarily address the transitory issues that plagued cross-section studies.

Four of the nine studies are panel studies, three are times series, and two are cross-state aggregate panel studies. The Burman and Randolph study was an early innovative econometric study because it used variation in state tax rates to estimate the permanent elasticity. That study found a very small elasticity that was statistically insignificant and a very large (in excess of 6) transitory elasticity. Because state tax rates are exogenous and presumed permanent, their evidence suggested a very small response. Auerbach and Siegel replicated their approach with different years and found similar results. The findings in these studies were consistent with the Gravelle estimate of limits in that they fell below the upper limit of elasticities. Most subsequent studies have incorporated state tax rates.

The Auten and Joulfaian study and the Dowd, McClelland, and Muthitacharoen study are individual panel studies and had the highest elasticities of any of the studies. Two aspects were likely to lower their elasticities compared with earlier panel studies: they added state tax rates and they had a longer panel, so that time series effects probably became more important. Both studies, however, continued the approach used by earlier panel studies that used adjacent years to capture permanent tax rates. This period may be too short, and for that reason their estimates probably continue to reflect transitory, timing responses. These timing responses are not appropriate for

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[22] Accruals were taken from Jeff Larrimore et al., *Recent Trends in U.S. Top Income Shares in Tax Record Data using More Comprehensive Measures of Income Including Accrued Capital Gains*, NBER Working Paper 2300, June 2017; data on realizations and tax rates from U.S. Department of Treasury, Office of Tax Analysis, *Taxes Paid on Long Term Gains: 1977-2014* and *Taxes on Capital Gains for Returns with Positive Net Capital Gains: 1954-2014*, both prepared December 2016, https://home.treasury.gov/policy-issues/tax-policy/office-of-tax-analysis.

[23] Using the semi-log elasticity outlined in **Appendix A**, eliminating all taxes would cause the new realizations compared to the old to be e^{bt}, where b is the coefficient and t is the tax rate. Their value of b is 4.1. Considering the federal tax rate of 21.3% alone, the ratio is 2.39. If state and local taxes are 2.4% as reported by the Bakija and Gentry study, the tax rate would be 23.7% and the ratio would be 2.64. The 1991 Gravelle study estimated transactions costs to be 11.6% of realizations. These costs include a small transactions cost for stocks but more significant ones for real estate and property, where sales commissions, legal costs of sales, and transfer taxes are larger. All of these costs are applied to sales price and are larger relative to realizations. Adding these amounts to taxes increases the rate to 35.3% and the ratio of new to old realizations to 4.25.

[24] The study reported the elasticity of shares, rather than realizations. This point is discussed further in Jane Gravelle, "Limits to Capital Gains Feedback Effects," *Tax Notes* 51, April 22, 1991, pp. 363-371.

measuring a permanent response. The Dowd, McClelland, and Muthitacharoen study also provided sensitivity analysis, producing a wide range of estimates reflecting different specifications, inclusion of different variables, and different time periods. For example, considering different time subperiods, the coefficient ranged from 1.8 to 8.0, although the latter estimate would seem questionable because it also produced a large transitory elasticity of the wrong sign.

Three of the studies (along with CBO's estimate) used aggregate time series data. The Gillingham and Greenlees study was the earliest and added a few years of data to some earlier studies, whereas the other time series studies (Eichner and Sinai) added many more years. Both studies control for 1986, which was an unusual year. It appears that more years added to time series data lead to lower elasticities; however, all of the time series results fall within the range of the eight time series studies from the 1980s. One time series study falls below the upper limit estimated by Gravelle, one is about at the upper limit, and one is considerably larger. The third time series study was based on Australian data (one of the rare studies undertaken on data outside of the United States).

The two state studies, by Bogart and Gentry and by Bakija and Gentry, used aggregate data over time grouped by state. Because they include time controls, they also relied on cross-state variation to identify a permanent response. Their results were slightly above the Gravelle study's upper limit. Bakija and Gentry also show that the control for state fixed effects is important; coefficients rise from 2.91 to 3.88 without state fixed effects.

The elasticities in **Table 1** are closer together and lower than those in the studies of the 1980s. JCT's current coefficient appears to be similar to the estimate used during the 1990 debate (although the elasticity was slightly higher in 1990, that appears to be due to the exclusion of small portfolio effects;[25] without those, it would probably be around 0.76). The Treasury estimate has been reduced and is now of the same rough magnitude as the JCT assumption.

Given the evidence from panel studies that use state variation to identify permanent effects and studies of the reasonableness of elasticities given realizations responses, both JCT and Treasury estimates appear high, so that they likely understate the revenue to be gained from increasing the tax rate.

Table 2 uses the elasticities from **Table 1** and the CBO projections to compare these revenue estimates for raising the tax rate on capital gains by five percentage points, for 2019, based on those results. (The method for calculating the revenue is in **Appendix A**.) The estimates are based on CBO's estimates of revenue for 2019 of $199 billion, and their average marginal tax rate of

[25] Portfolio effects adjusted revenue effects from a capital gains tax to account for shifting investments out of capital gains producing assets taxed at a lower rate to other assets whose income would be taxed at higher rates.

21.2%.[26] The $199 billion is adjusted down to $180 billion to reflect the share of gains that are short-term gains taxed at ordinary rates, as reported by the Department of the Treasury.[27]

Table 2. Revenue Gain from Increasing Capital Gains Tax Rates by Five Percentage Points, Estimates for FY2019 Based on Alternative Realizations Responses

Sources of Data	Revenue Gain 2019 ($billions)	Ratio of Revenue Gain to Static Gain
No Response	42.3	1.00
Burman and Randolph Panel Study (1994)	31.4	0.74
Auerbach and Siegel Panel Study (2000)	30.1	0.71
Gravelle Limit Study Midpoint (1991)	30.0	0.71
CBO Time Series (2010)	23.5	0.56
Minas, Lim and Evans Time Series (Australia, 2018)	19.6	0.46
Gravelle Limit Study Upper Limit (1991)	18.4	0.44
Eichner and Sinai Time Series (2000)	18.3	0.43
Bogart and Gentry Cross-State (2000)	16.1	0.38
Bakija and Gentry Cross-State (2014)	12.2	0.29
JCT (Current)	10.3	0.24
Treasury (2010)	8.9	0.21
Gillingham and Greenlees Time Series (1992)	7.5	0.18
Auten and Joulfaian Panel Study (2004)	5.6	0.13
Dowd, McClelland, and Muthitacharoen Panel Study (2015)	1.0	0.03

Source: Estimates in **Table 1** and Applications of Formulas in **Appendix A**.

As shown in **Table 2**, the revenue gain as a percentage of static gain ranges from a reduction of 26% to a reduction of 97%. The revenue gain for the five-percentage-point tax rate increase ranges, from the lowest to the highest elasticity, from $31.4 billion per year to $1 billion, a range of $30.4 billion.

These results also illuminate the interest in adopting measures such as an accrual-based taxation that could also include a look-back method. (See **Appendix A** for an explanation of calculating

[26] Projection of gains from CBO, Revenue Projections, by Category, January 2019, at https://www.cbo.gov/about/products/budget-economic-data#1. CBO's marginal effective tax rate, which is almost identical to Treasury's rate, is from Congressional Budget Office, *Taxing Capital Income: Effective Marginal Tax Rates Under 2014 Law and Selected Policy Options*, December 18, 2014, https://www.cbo.gov/publication/49817, p. 34. Treasury's tax rate of 21.3% is from U.S. Department of Treasury, Office of Tax Analysis, *Marginal Income Tax Rates by Income Source, 2016*, prepared August 2015, https://home.treasury.gov/policy-issues/tax-policy/office-of-tax-analysis. The Urban-Brookings Tax Policy Center projects a lower capital gains marginal tax rate of 19.9%. See Table T18-0106, August 23, 2018, at https://www.taxpolicycenter.org/model-estimates/baseline-effective-marginal-tax-rates-august-2018/t18-0106-effective-marginal-tax. This estimate was made later than the Treasury and CBO estimate, but based on the public use file rather than actual tax data.

[27] U.S. Department of Treasury, Office of Tax Analysis, *Taxes Paid on Long Term Gains: 1977-2014* and *Taxes on Capital Gains for Returns with Positive Net Capital Gains: 1954-2014*, both prepared December 2016, https://home.treasury.gov/policy-issues/tax-policy/office-of-tax-analysis.

taxes under the look-back method.) Such a method would not only eliminate the realizations response, increasing capital gains revenues for the five-percentage-point increase from $10.3 billion to $43.2 billion, but by taxing unrealized gains it would collect $222 billion on unrealized gains in a steady state ($180 billion at the old rates and $222 billion at the new rate).

Which results are most reliable? The Auten and Joulfaian panel study, judging by problems with short panels in the 1980s, probably retains some transitory elasticity effects because it applied the same methodology. Although it also reflects time series elements, the estimate is probably an overstatement of the permanent elasticity. It also substantially exceeds the upper limit estimated by Gravelle. The Dowd, McClellan, and Muthitacharoen study produced the largest elasticity and also uses adjacent periods to measure the transitory elasticity. It also indicates dramatically differing estimates from different subperiods, implying some fragility in the estimates.

Turning to time series, the Eichner and Sinai results include many more years than Gillingham and Greenlees, suggesting that this time series result should be preferred. CBO includes even more years. Given the findings of the remaining studies and of Gravelle's limit calculations, the elasticity is likely below 0.5.

These findings suggest that revenue-estimating assumptions retained from the 1990 debate may understate the revenue gain. In all cases, evidence from both post-1980s econometric studies and the limits study indicates that there will be revenue gains from increasing the tax rate by five percentage points, although these gains are negligible relative to the static gain for the highest elasticity. Assuming the lower elasticities (and consistent with the Gravelle constraints), revenue gained would be three times the amount likely to be projected by the JCT. Using the Gravelle upper limit, revenues would be 45% larger. Thus, the JCT's projections, absent a change in their realizations response, may likely understate revenue gains from increasing capital gains tax rates.

Appendix A. Technical Appendix

This appendix shows in the first section the standard realization of revenues from a coefficient derived from a semi-log function. The second shows the method of calculating taxes under the look-back method.

Modeling Realizations and Revenues

The elasticity of realizations with respect to taxes can be estimated with a variety of functional forms, but one of the most common, and the one on which the estimates in **Table 2** are based is a semi-log function of the form (excluding the constant and other regressors, such as stock market values and GDP):

(1) $\log G = bt$

where G is gains, t is the tax rate, and b is the tax rate coefficient to be estimated. If equation (1) is differentiated, and b is restated in absolute value, the result is:

(2) $dG/G = -b\ dt$

Multiplying the right hand side top and bottom by t results in an elasticity (dG/G divided by dt/t) of bt. Because the relationship is normally negative, but it is convenient to restate b in absolute value, a minus sign is added to b.

If equation (1) is restated in its originally, nonlogged form (again ignoring other explanatory variables and stating b in absolute value), it is:

(3) $G = A\ e^{-bt}$

Since revenues are tG, the revenue equation is written:

(4) $R = tAe^{-bt}$

Note that if equation (4) is logged and differentiated, the result is $dR/r = dt/t\ (1-bt)$. Thus, if the absolute value of the elasticity bt, is 1, there is no revenue gain.

To estimate revenues, denoting new values with an *, divide new revenues by old to achieve:

(5) $R^* = R^*\ (t^*/t)e^{-b(t^*-t)}$

The revenue maximizing tax rate is where dR/R=0, or where (1-bt) equals zero. This rate is equal to 1/b. Thus, if the coefficient of b is two, the revenue maximizing tax rate is 50% and if b equals 5 the revenue maximizing tax rate is 20%.

Calculating Taxes under the Look-Back Method

A look-back method decreases basis (i.e., increases taxable gain) in order to achieve the same net on a sale as if the tax had been paid on an accrual basis. In these calculations, g = growth rate, T= holding period, S = sales price, B = basis, t = tax rate, and B* = new basis.

To determine the growth rate g:

(1) $B(1+g)^T = S$

And solving for g:

(1) $g = (S/B)^{(1/T)} -1$

To find a value of B* that will give you the same return as accrual taxation:

The gain on realization with the new basis is $S-t(S-B^*)$

The gain on accrual is $B(1+g(1-t))^T$

Equating them and substituting in for the value of g:

(3) $B(1+((S/B)^{1/T}-1)(1-t))^T = S-t(S-B^*)$

Solving for B*

(4) $B^* = [B(1+((S/B)^{1/T}-1)(1-t))^T - S(1-t)]/t$

Appendix B. Econometric Studies

Elasticities in Studies of the 1980s

Table B-1 reports the elasticities found in a series of estimates of the realizations elasticity in the 1980s, the information available to influence a choice of realizations response at the time of the 1990 debate. These studies are discussed in general terms earlier, and in more specific terms in the following subsection. Where possible elasticities are reported at a 22% tax rate. The studies are divided into categories based on the fundamental approach used. Citations to all studies in this report are in **Appendix C**.

Table B-1. Elasticities from Studies of the 1980s

Study	Elasticity
Aggregate Time Series	
Auten (1982)	0.80
Treasury (1985)	0.84
CBO (1986)	0.27
Darby, Gillingham, and Greenlees (1988)	0.58
CBO (1988)	0.76
CBO Alternative (1988)	0.45
Auerbach (1989)	0.54
Jones (1989)	0.89
Micro-Data: Panel	
Auten and Clotfelter (1982)	0.55
Treasury (1985)	1.29
Auten, Burman, and Randolph (1989)	3.20
Micro-Data: Cross-Section	
Feldstein, Slemrod, and Yitzhaki (1980)	3.75
Minarik (1981)	0.62
Gillingham, Greenless, and Zeischang (1989)	3.80
Micro-Data: Pooled Cross-Section Time-Series	
Lindsey (1987)	1.18
Treasury Elasticity, 1989	0.98
Joint Committee on Taxation Elasticity, 1989	0.76

Source: Table Reproduced from Table 2 in Jane Gravelle "Can a Capital Gains Tax Cut Pay for Itself?" *Tax Notes* 48, July 9, 1990, pp. 209-219. The elasticity for the Auten, Burman, Randolph panel study was revised from 1.65 to 3.2 reflecting the discussion in Jane Gravelle, "Limits to Capital Gains Feedback Effects," *Tax Notes* 51, April 22, 1991, pp. 363-371.

General Issues

Statistical (or econometric) studies relating capital gains realizations to tax rates face many challenges, and some of the debate over the evidence reflects the concerns about these challenges. The debate also concerned which type of data should be used: aggregate time series (which examines total economy-wide realizations over time compared with the economy-wide tax rates) versus individual taxpayer data (which related individual realizations to individual tax rates). As can be seen in **Table B-1**, aggregate time series results were generally smaller and more consistent, falling within a range of 0.3 to 0.9. Estimates based on micro data (individual observations) varied from 0.55 to almost 4.[28] The estimate for the pooled time-series, cross-section regression probably reflects a mix of times series and cross-section results.

Other things equal, it is more desirable to use individual data, because aggregate data cause a loss of information (i.e., individual variability is lost when individual responses are aggregated) and can bias the results. In addition, it is difficult to control for all of the changes over time that can affect realizations. Two of these, changes in transactions costs and a disconnect between changes in asset prices and changes in accruals, could cause estimates to be overstated.[29] Nor is it clear that the times series estimates are capturing only permanent effects. Other effects, however, could work in the opposite direction.

Yet the problems associated with studies based on individual data sets were so severe that many researchers believed that aggregate time series results were more reliable.

As an initial problem and point of contention, the effective capital gains tax rate, which would be used as a predetermined (exogenous) variable to explain realizations in a regression, is actually an endogenous variable which is influenced by the amount of realizations itself. Different techniques could, in theory, be used to address this very serious econometric problem, including using the first dollar tax rate (the tax that would appear on the first dollar of capital gains), using maximum statutory rates, using a rate based on predicted gains (where predicted gains are based on other attributes), or using instrumental variables methods.[30] In general, these problems of endogeneity of the explanatory variable are much more severe in the case of individual cross-section data, where much of the variation is due to individual circumstances, and less important in aggregate time series data where the major source of variation is changes in the law.

As noted earlier, another important issue, for using individual data, was the problem of distinguishing between permanent and transitory responses. Because income, especially of high-income individuals who realize most gains, can fluctuate over time, tax rates also vary over time. Individuals would be expected to time realizations to coincide with periods of low rates. Individuals might also need to cash in assets when income (and therefore taxes) is unusually low. Although attempts were made to address this problem with panel studies by averaging the previous year, current year, and next year tax rates to create a permanent rate, this procedure may

[28] It was not possible in most cases to adjust the results for a consistent tax rate and the 0.55 panel estimate may reflect an unusually low tax rate. The 0.62 cross-section estimate may be affected by treatment of the truncation of gains at zero.

[29] These issues are discussed in Jane Gravelle "Can a Capital Gains Tax Cut Pay for Itself?" *Tax Notes* 48, July 9, 1990, pp. 209-219.

[30] With instrumental variables (which is done by a two-stage least squares method), a preliminary regression treats the tax rate as the dependent variable (endogenous) and estimates it using other predetermined instruments. For example, one approach is to regress the actual tax rate on first dollar rate, predicted rate, maximum rate, etc. and use the fitted values in the final regression, where the dependent variable is realizations. Using the maximum tax rate alone cannot be used in a single cross-section regression and it is problematic in time series studies that cover periods when the relationship between the maximum and average rate changed over time due to changes in the law.

not correct for the transitory effect, perhaps because periods of lower income can continue for several years.

Studies Since the 1980s

The following discussion reviews the realizations studies published since the 1980s. In some cases, studies used many specifications, and this section explains why specific results were reported in **Table 1**, and why results from two studies were not included. References to these studies are in **Appendix C**. They are discussed in order of publication.

Slemrod and Shobe (1990)

This study uses a six-year small panel to replicate the Feldstein, Slemrod, and Yitzhaki and the Auten and Clotfelter studies. The authors found varying, but quite large, elasticities (in excess of 1, and in excess of 5 in some cases). Their study appears to confirm potential problems with these studies, and also suggests short panels have significant problems as well (as the elasticity for their full sample was 5.84). These large elasticities are similar to those from cross-section and some panel studies in the 1980s, although some were not statistically significant and results varied significantly over time periods. Slemrod and Shobe also estimated a regression that related the difference between current year realizations and average realizations to the difference between current year and average tax rates. They also obtain large, but statistically insignificant results. They acknowledge that their results may capture transitory effects. Because this study continues a methodology that has largely been rejected, the results are excluded from **Table 1**.

Gillingham and Greenlees (1992)

This study extends a previous times series analysis covering 1954-1985 for a short period (through 1989) and makes some changes in approaches used by CBO to replicate the results. The CBO study referenced used tax rates based on predicted gains in a standard regression. The authors consider three changes. The first is to use an instrumental variables technique that uses taxes on predicted gains as an instrument (that is, first regress actual effective tax rates on predicted tax rates and use the fitted values in the regression on realizations). This provision increased the coefficient from 2.9 to 4.2 and increased the elasticity at a 22% tax rate, from 0.64 to 0.92. Second, they suggested use of the maximum tax rate as an instrument rather than the predicted tax rate, which increased the coefficient to 5.8 and the elasticity to 1.28. They also argued that the data should be differenced (a change in realizations related to a change in rates); differencing produced higher elasticities (1.39 for the instrument with predicted gains and 1.429 for the instrument with the maximum rate) but these elasticities were not statistically significant at conventional levels. Differencing may also capture short-term or transitory effects. Finally they extended the time period through 1989, with and without excluding 1986. Excluding 1986, they found an estimate of 3.4 rather than 4.2 using the predicted gains instrument and 3.5 when the data were differenced (corresponding to elasticities of 0.75 and 0.77 at a 22% rate). For the maximum rate, the values were 5.4 and 5.3 (with and without differencing), corresponding to elasticities of 1.18 and 1.16. Confining the elasticities under consideration to those in the extended sample but excluding 1986, the crucial issue is whether to use the predicted gains rate or the maximum rate as an instrument. It is difficult to know what conclusion to draw from this study, because the principal conclusion of the authors is that micro-data approaches are superior.

Problems exist with using the maximum rate as an instrument for this time-series regression, because the law itself changed substantially over the time period in a way that altered the relationship between the maximum rate and the average rate. Over this time period, there were episodes where the maximum rate affected a large fraction of taxpayers and other periods where it

affected only a small fraction of taxpayers. Given these reservations about using the maximum rate, the coefficient of 3.4 is reported in **Table 1**.

Burman and Randolph (1994)

The Burman and Randolph study is perhaps the most innovative study done since the 1980s. It separated permanent and transitory effects in a short panel (1979-1983) using variations in state tax rates to identify permanent effects. For the transitory rate, the authors included in their instruments the first dollar current tax rate, which introduced a transitory element. Thus taxpayers with unusually low current income, excluding capital gains (and low current first dollar rates) would have transitory rates below their permanent rates, whereas those with high income would have higher rates. The permanent rates would vary across taxpayers in different states due to state tax rates. The authors estimated an elasticity of 0.18 at an 18% tax rate, which implies a coefficient of one, and an elasticity of 0.22 at a 22% tax rate. This estimated effect was not statistically significant, probably because there was not very much variation in tax rates.[31] They estimated a transitory elasticity of 6.45. Several subsequent studies use across-state variations or incorporate state tax rates into the analysis.

Bogart and Gentry (1995)

This study also relied on differentials across states to identify permanent responses, but used aggregate state level gains from 1979 to 1990. The study also uses year dummies to control for fixed-year effects, so that the basic identification is due largely to the differential in tax rates across states. The authors report an elasticity of 0.65, which at their reported tax rate reflects a coefficient of 2.5. For a 22% rate, this coefficient leads to an elasticity of 0.55. The techniques used in the study should identify a permanent elasticity.

Auerbach and Siegel (2000)

Auerbach and Siegel used panel data from 1985 to 1994 to replicate the Burman and Randolph results for a different time period. They report an elasticity of 0.33 at the mean of the tax rate. Unfortunately, they do not report the tax rate. Based on evidence from other sources (Eichner and Sinai), the tax rate is probably around 25%. Using that tax rate, the coefficient is 1.126 and suggests an elasticity at a 22% rate of 0.25, very close to the Burman and Randolph results. They find a transitory elasticity of 4.9 (4.1% at a 22% rate).

Auerbach and Siegel also report an alternative specification in which they add several instruments to the permanent tax rate including the first dollar tax rate for the current year and the year ahead maximum statutory rate to a regression on the next year's tax rate. The permanent elasticity is much higher, 1.75 rather than 0.33. This magnitude of elasticity is similar to that found in panel and cross-section studies in the 1980s. The problem with their approach is that this addition of the current first dollar rate likely adds a transitory element to the permanent tax rate, which explains their significantly larger elasticity. Thus, the 1.126 coefficient is reported in **Table 1**.

Auerbach and Siegel also provide a separate regression for the very wealthy and for "sophisticated" taxpayers (who report sales of more complicated financial products such as derivatives or report short sales). Their findings using the Burman and Randolph methodology indicate that there is essentially no response for these taxpayers.

[31] When a small coefficient is statistically insignificant, the data may be reliable but the confidence interval includes zero because it is a small effect. It may be reasonable to conclude that the effect is quite small, and perhaps nonexistent. When a large coefficient is not statistically significant, it suggests that there is a lot of uncertainty in the relationship and the result is not reliable.

Eichner and Sinai (2000)

This study extends time series analysis through 1997, but finds that it is important to exclude 1986 from the estimates. When 1986 is excluded the coefficient is 2.28, for an elasticity of 0.5. There is also a case for excluding 1997, although it is not as important. When both are excluded, the coefficient in a semi-log specification is 2.18, which implies, at a 22% tax rate, an elasticity of 0.48. As in the case of Gillingham and Greenlees, many specifications are tried. One approach used an instrumental variables method relying on the top marginal tax rate. This approach led to an estimate of 3.8, for an elasticity of 0.84. Curiously, the coefficient changes quite substantially when 1997 was also excluded, to 5.13 and an elasticity of 1.13. One of the problems of using the top marginal tax rate is that there are differences between that tax rate and the average tax rate in the years before 1986 when the tax benefit was an exclusion and rates where more steeply graduated. The authors also tried some specifications with changes in tax rates. These tended to lead to elasticities ranging from 0.83 to 1.46. However, in most of these cases some or most of the tax rate coefficients were not statistically significant. Moreover, it is more likely that this approach reflects more transitory elements. Given the problems with using marginal rates and the instability of specifications with tax rate changes, the 2.28 coefficient is reported in **Table 1**.

Auten and Joulfaian (2004)

This analysis uses a longer micro-data panel (over 17 years) to estimate permanent and transitory effects. Although they include state tax rates, they do not use the state tax variation to identify permanent effects. Their approach is similar to the panel studies of the 1980s in that it uses adjacent years to separate permanent and transitory effects. Their estimate is lower than most estimates of short panels from the 1980s, although this lower elasticity may reflect time series elements. It is likely, however, that the permanent estimate contains transitory elements. They find an elasticity of 0.72 at an apparent 20% tax rate, which indicates a coefficient of 3.6 and an elasticity of 0.79 at a 22% tax rate.

Evans (2009)

The Evans study is a basic cross-section regression, relying on the public use file, with a number of different specifications, leading to elasticities typically between 2 and 5. Although there are some issues associated with the public use file data, because tax returns are blended for high-income taxpayers to protect confidentiality, the main reservation about this study is that it reflects the fundamental, and now widely recognized, shortcomings of cross-section studies, and the findings cannot be interpreted as reflecting permanent realizations elasticities. These results are not reflected in **Table 1**.

Bakija and Gentry (2014)

This study uses a 50-year panel of state data reflecting changes in combined federal and state tax rates. The data are aggregated by state, including state- and time-fixed effects. The identification for the effects comes from changes in effective state marginal tax rates, which are largely exogenous. The state-fixed effects mean that unobserved differences across states are controlled for. The authors provide a number of tests of the effects of changing specification, in particular showing that omitting state-fixed effects and year-fixed effects, separately and together, has significant effects in raising the elasticities.

Dowd, McClelland and Muthitacharoen (2015)

This study uses standard panel methods using a 10-year panel, although its estimates of transitory elasticities rely, as with other studies, on adjacent years, which may not be sufficient to eliminate transitory effects. However, it does have year-fixed effects, which should help control for

transitory effects from law changes (as opposed to income changes). It also provides considerable sensitivity analysis with different specifications and time subperiods.

Minas, Lim, and Evans (2018)

This study is an aggregate time series study done with Australian data from 1988 to 2015 and spans a period which included an exclusion for part of capital gains as well as changes in marginal tax rates. It includes controls similar to those in U.S. studies for GDP, inflation, and the stock market index.

Appendix C. Citations to Studies

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