Contextualizing Elasticities for Policymaking:

Capital Gains and Revenue-Maximizing Tax Rates

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Abstract: Capital gains revenue estimates rely on a long history of research empirically estimating the tax elasticity of capital gains realizations. These elasticity estimates have varied from zero to well over 3 in absolute value depending on numerous factors, such as the time frame studied, the type of capital asset, and the estimation strategy employed. Often, the headline elasticity from a study of this nature is used to calculate the implied revenue-maximizing capital gains tax rate. Unfortunately, this last, policy-relevant step has received insufficient scrutiny. The standard approach fails to sufficiently acknowledge that the estimates of the revenue-maximizing rate are a product of the estimation procedure used and the context of the tax system from which the data were generated. Such an approach yields a single capital gains tax rate which applies to all realized gains and mechanically overstates the resulting revenue-maximizing rate.

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I. Introduction

The debate over the revenue-maximizing tax rate for income taxes has a long history. In discussing the individual income tax reductions proposed to be included in the Revenue Act of 1921, which reduced ordinary income tax rates and eventually included a 12.5 percent rate for capital gains on assets held for two years,[1] Secretary of the Treasury Andrew Mellon stated that "I am confident that in a short time the Treasury would actually collect more under the lower rates than under the higher rates if continued."[2] Secretary Mellon was arguing that the prevailing tax rates were so high that they actually were reducing the amount of revenue that could be collected. This occurs under scenarios in which the elasticity of taxable income is greater than one (i.e. a one percent reduction in tax rates will result in a greater than one percent increase in taxable income); or more succinctly, the tax rates exceed those at which tax revenue is maximized.

Due to its direct relevance to public policy, economists have long studied the relationship between individual income and marginal tax rates. As marginal tax rates directly affect after-tax income, taxpayers are incentivized to change their behavior in response to changes in tax rates. These behavioral responses may be in forms that alter levels of real economic activity, such as the number and intensity of hours worked or the amount of savings and investment. Or they may be in the form of shifting or otherwise recharacterizing economic activity where income is reclassified to exploit differences in tax rates across types of income; compensation through taxable wages versus non-taxable benefits on an individual level or the organizational choice of incorporation versus utilizing a pass-through structure at the business entity level, for example. In addition to contemporaneous changes in behavior, marginal tax rates may also affect the

[1] The Revenue Act of 1921 also repealed the war excess profits tax and increased in the corporate rate by 50 percent to 12.5 percent. The effective tax rate, including the excess profits tax, in 1921 was 16.21 percent (United States Internal Revenue, Department of Treasury 1923), and fell to 11.26 percent in 1923 (United States Internal Revenue, Department of Treasury 1925). For a description of the excess profits tax see Blakey and Blakey (1919).

[2] "Higher Taxes Sure without Big Savings Mellon Declares," *New York Times,* August 5, 1921.

timing of income in an effort to minimize the present value of after-tax income across multiple periods. Another potential response that is particularly relevant to government budgetary analysis is taxpayers simply misreporting their income for tax purposes, separate from or in conjunction with other responses.

Secretary Mellon wasn't the last to argue that reducing tax rates could result in increased revenues. This possibility has often been pointed to by proponents of supply-side policies as an example of how tax rate reductions can result in increased revenues. During the 1980s, proponents of lowering income tax rates generally, and capital gains tax rates specifically, pointed to large econometric estimates of the elasticity of taxable income, which implied low revenue-maximizing rates. However, as revenue-maximizing rates are derived mechanically from the elasticity and empirical estimates thereof vary a great deal, care must be taken to understand the nuances that underpin the various estimates and it must be acknowledged that they are a result of the context in which they were estimated. Thus, caution should be exercised when using these estimates to directly influence public policy, particularly in attempting to set a single revenue-maximizing tax rate on capital gains income.

Consider tax policy during Mellon's tenure. Top marginal tax rates in the early 1920s were high, but a series of changes reduced them dramatically. Between 1920 and 1926, the top statutory individual tax rate declined from 73 percent to 25 percent.[3] And though the largest reductions in the rates were at the top of the income distribution, rates were lowered across all income levels.[4] During this period, Federal personal tax receipts declined and only in 1928 were

[3] The Revenue Act of 1921 reduced the top statutory rate to 58 percent, and the Revenue Act of 1924 further reduced the rate to 25 percent (Statistics of Income, Internal Revenue Service 2020); (Smiley and Keehn 1995). The effective rate of tax fell for those with reported net income in excess of $1 million from 64 percent in 1920 (United States Internal Revenue, Department of Treasury 1922) to 16.6 percent in 1926 (United States Internal Revenue, Department of Treasury 1928).

[4] For example, tax rates dropped by over 43 percent for taxpayers with net income between $40,000 and $45,000 from 26 percent to 15 percent, and by over 50 percent at the bottom of the distribution from 11 percent to 5 percent for taxpayers with $10,000 of net income.

they higher than receipts in 1920 in nominal dollars, while they remained below 1920 in real terms (Statistics of Income, Internal Revenue Service 2008).

A naïve inflation-adjusted income elasticity for this 1920-1928 period would be -0.23. However, this simple estimate fails to account for heterogeneity and other nuances that may be relevant to policymaking. For example, the elasticity does not appear to be constant across the income distribution or types of income. Restricting the analysis to those with income below $150,000 results in an elasticity of taxable income of -0.2 whereas the same calculation for those above $150,000 results in an elasticity of -2.0.[5] Furthermore, the calculated elasticity is highly dependent on the structure of the rest of the tax code and very sensitive to concurrent changes to other provisions. A relevant example in this case is the increased exemption amount enacted in 1925, which directly reduced the number of taxpayers and the amount of reported income, confounding estimated behavioral elasticities. Moreover, some of the tax avoidance mechanisms available to high income taxpayers during these nascent years of the US Federal income tax system are no longer available in today's system, reducing the applicability of these estimates to today's taxpayers. Smiley and Keehn (1995) conclude that much of the benefit of the reduced taxes in the 1920s and any increase in revenues associated with it was the result of reduced tax avoidance through these avenues.

It should be clear that applying a simple elasticity calculated on taxpayer behaviors almost 100 years ago to today would provide inadequate guidance for modeling contemporary policy. As time passes, evolution in policy and the economy reduces the practical usefulness of older data and empirical estimates that rely on them. Fortunately, there continues to be a well-developed and active literature that attempts to estimate the overall elasticity of taxable income. In a review of recent empirical estimates of the elasticity of taxable income, Saez, Slemrod, and

[5] These elasticities are simple calculations based on aggregate cross-sectional tax return data as reported by the Department of the Treasury and are for illustrative purposes only. They are obviously ignoring population and economic growth effects and any other secular changes in the generation of income that may have contributed to economic growth. Further, for these elasticities to be properly identified, those effects would need to be uncorrelated with the tax rate changes.

Giertz (2012) suggest that it is somewhere between -0.12 and -0.4 and that, like the responses in the 1920s, varies by income.

But as the preceding thought experiment illustrates, properly understanding any calculated elasticity of taxpayer responses to tax rate changes requires an understanding and accounting for not only the explicit changes to tax rates themselves but the broader context of the tax system in which the changes occurred. This is especially true when extrapolating these estimates to analyze the effects of proposed legislation, which may occur outside of the tax environment used to estimate the elasticity. These considerations are particularly important in the case of capital gains, where the debate over the revenue-maximizing rate generates significant interest. This paper seeks to highlight some of the issues in using empirical estimates of the tax elasticity of capital gains realizations to evaluate policy changes, especially with respect to identifying and implementing a revenue-maximizing rate.

Broadly, there are three considerations one must take into account when thinking about estimated elasticities and their policy implications. First is whether it is appropriate to apply a given estimate to the specific policy under consideration, which we refer to as external validity. For instance, the naïve elasticity calculated above from a policy change enacted almost 100 years ago would not be externally valid for use today given vastly differing circumstances. Second, is the estimated elasticity methodology internally valid; or is the estimation strategy and methodology driving the policy implications? Third, do the simplifications used for estimation purposes cast doubt on the use of the estimated elasticity for a specific policy prescription? For example, the naïve elasticities calculated above are based on aggregate cross section data and do not include the effects of other changes like the increased exemption enacted at that time. These three prongs – external validity, internal validity, and simplification bias – provide a framework to contextualize elasticities for use in policy analysis to better account for anticipated behavioral responses.

The remainder of the paper is organized as follows. Section II describes the general tax treatment of capital gains under current U.S. Federal and state law as well as a brief history of tax rates. Section III details the debate and the numerous academic papers on the tax elasticity of capital gains, with a focus on methodology choices that drive the estimates and their

implications. Section IV discusses the mechanics of calculating the implied revenue-maximizing rate from an estimated elasticity and discusses our three-pronged framework in detail, identifying various issues in determining a revenue-maximizing rate. Section V highlights a practical problem with implementing a top marginal rate on capital gains designed to maximize revenues by documenting the distribution of long-term capital gains income in the U.S. Section VI concludes.

II. Capital Gains Taxes in the United States

The first modern income tax, implemented by The Revenue Act of 1913, included realized capital gains in net income and were taxed at the same rates as other income, which ranged from 1 percent to 7 percent. Large rate increases followed shortly; the top rate in 1918 was 77 percent. Within a decade of the enactment of the income tax, capital gains were given preferential treatment. The Revenue Act of 1921 lowered rates generally, but particularly for capital gains, affording taxpayers the ability to have gains from assets held for at least two years taxed at the lesser of their normal rate or 12.5 percent, beginning in 1922. Rates on gains held for less than two years remained taxed at the applicable ordinary rate, which then ranged from 4 to 58 percent, where it had ranged from 4 to 73 percent in 1921. Consequently, this meant that only those with substantial incomes benefited from the election to use the preferential rate.[6]

Throughout the middle half of the 20th century, the tax treatment of capital gains varied substantially, with preferential treatment typically taking the form of a partial exclusion of long-term gains. Throughout those decades, the exclusion ranged from 50 to 70 percent. After factoring in changes in the underlying ordinary rates, this led to maximum effective marginal rates on long-term gains of roughly 25 percent for most of the period prior to 1968. In the years that followed, a series of rate increases culminated in a maximum rate of 39.9 percent between 1976 and 1978.[7]

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[6] The benefit of the election for long-term gains only accrued when ordinary marginal rates exceeded 12.5%, which applied to net income above $16,000 and applied to fewer than 3 percent of returns.

[7] See Treasury (1985).

The Tax Reform Act of 1986 briefly conformed the treatment of capital gains to that of ordinary income beginning in 1988 with a maximum tax rate of 28 percent.[8] The Omnibus Budget Reconciliation Act of 1990 decoupled them, with rates on long-term gains maintaining the maximum 28 percent rate while the top ordinary rate rose to 31 percent.

There was considerable debate leading up to the enactment of the 1990 act regarding the revenue-maximizing rate for capital gains. A number of studies came to differing conclusions regarding the revenue-maximizing rate, varying from lows in the teens of 15 percent (Department of Treasury 1989) and 16 percent (Lindsey 1987), while others urged caution in expecting increased revenues with a reduction in the rate from 28 percent (Auerbach 1989).

Since 1990, there have continued to be frequent changes in the tax rates on capital gains. The Taxpayer Relief Act of 1997 reduced the maximum tax rate on long-term capital gains to 20 percent.[9] The top rate was further reduced in 2003 to 15 percent, on a temporary basis, under the Jobs and Growth Tax Relief Reconciliation Act of 2003.[10] The 20 percent maximum rate returned in 2013, though at higher income thresholds, under the American Taxpayer Relief Act of 2012. In addition, a 3.8 percent surtax enacted under the 2010 Patient Protection and Affordable Care Act came into effect in 2013 and applies to the net investment income of high-income taxpayers, including long-term capital gains.[11]

Under current Federal tax law, realized long-term capital gains on assets held for one year and a day are taxed at preferential rates below the tax rates applicable to ordinary income.[12]

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[8] See JCT (1987).

[9] See JCT (1997).

[10] See JCT (2005).

[11] The Net Investment Income Tax generally applies to interest, dividends, rents, royalties, certain annuities, and both long- and short-term capital gains.

[12] Between 1922 and 1978, a variety of holding periods applied to the preferential treatment of long-term capital gains. The number of holding periods varied from as many as five to as few as one, each with a corresponding tax

Table 1 shows the income thresholds and tax rates for ordinary and long-term capital gains for tax year 2017. The top statutory rate on ordinary income was 39.6 percent and 20 percent on long-term capital gains plus the 3.8 percent net investment income tax, if applicable.[13] As a result, the top applicable combined Federal statutory rate of tax on long-term capital gains in 2017 was 23.8 percent.

Table 1. Federal Statutory Tax Rates on Ordinary and Long-Term Capital Gains, 2017

Taxable Income (Dollars)				Tax Rates	
Single Filers		Joint Filers		Ordinary	Long-Term Gains
At least	But Less Than	At least	But Less		
0	9,325	0	18,650	10%	0%
9,325	37,950	18,650	75,900	15%	0%
37,950	91,900	75,900	153,100	25%	15%
91,900	191,650	153,100	233,350	28%	15/18.8%*
191,650	416,700	233,350	416,700	33%	15/18.8%*
416,700	418,400	416,700	470,700	35%	18.8%*
418,400+		470,700+		39.6%	23.8%*

* The 3.8% net investment income tax applies to single and joint filers with modified adjusted gross incomes of $200,000 and $250,000, respectively. As this table displays taxable income, taxpayers in these brackets may or may not be subject to the NIIT.

In addition to Federal income tax, capital gains are often subject to state income taxes, which can vary a great deal. While some states do not have an income tax, most tax long-term capital gains at ordinary rates, currently reaching as high as 13.3%. However, many states do give broad preferential treatment to capital gains through exclusions, deductions or credits. Also,

rate. The last change in this respect occurred with the Tax Reform Act of 1976, which increased the longest holding period from 6 months to one year, beginning in 1978 (Department of the Treasury 1985).

[13] Public law 115-97, enacted in December of 2017, generally reduced ordinary income tax rates, setting a maximum rate of 37 percent for tax years 2018-2025, but did not change the preferential rates for long-term capital gains.

states may give tax preference to gains on particular types of assets but not others. This variation in state policy combined with graduated Federal tax rates means that taxpayers with long-term capital gains face significantly different marginal rates according to their income, asset holdings and states of residence.

Capital gains income is more highly sensitive to marginal tax rates than most forms of income, in part because taxpayers can choose when to realize a capital gain. A classic example of taxpayer responsiveness to capital gains taxes occurred with respect to the enactment of the Tax Reform Act of 1986, which was enacted in October of 1986 after months of hearings. Among many other changes, it increased the top statutory rate on long-term gains for those realized after December 31, 1986. This made the tax rate for 1986 temporarily low relative to future rates, providing a strong incentive to realize gains prior to the end of the year. Taxpayers with significant accrued unrealized gains, anticipating the increase in tax rates, increased their realizations in 1986 compared to 1985 by 90 percent. Part of this increase can be attributed to an acceleration of gains that would have otherwise occurred later, thereby reducing realizations in subsequent years. A similar, though smaller, effect occurred around the anticipated rate increases scheduled to occur in 2013, resulting in a 60 percent increase in realizations in 2012 relative to 2011 (Auten, Splinter and Nelson (2016) and Saez (2017)). These two examples highlight temporary short-term responses in which taxpayers time the realization of gains to take advantage of low present rates rather than face future higher rates and may have no effect on aggregate gains across multiple periods.

While these transitory effects are important behaviors for policy makers to consider and can drive a substantial part of revenue estimates of changes in the capital gains tax rate, other behavioral responses are perhaps more important. In addition to taxpayers simply changing the timing of their realizations across tax rate regimes, there are other mechanisms by which changing tax rates might provoke liability-minimizing responses over longer horizons that permanently change the level of realization, such as individual taxpayers altering the mix of assets they hold or by recharacterizing certain types of income as capital gains (e.g. carried interest). Corporations may also respond to shareholder-level tax rates by changing their levels of retained earnings and/or dividends, which affects asset prices and therefore accrued gains

(Chetty and Saez 2005). Responses of this sort may differ in magnitude from transitory responses and so are often estimated separately. The range in estimates for this so-called "permanent" elasticity is substantial across studies; from as low, in absolute terms, as -0.18 (Burman and Randolph 1994) to as high as -1.72 (Auerbach and Siegel 2000). However, as shown in detail by Dowd, McClelland, and Muthitacharoen (2015), estimates for both the transitory and permanent elasticities can vary substantially *within the same study* depending on the econometric specification used for estimation, with transitory elasticity estimates varying from -1.2 to -2.7 and permanent elasticities varying from -0.56 to -1.1, even when all other aspects of the analysis remain unchanged.

III. Empirical Work on the Tax Elasticity of Capital Gains

Many researchers have studied the responsiveness of capital gains realizations to the capital gains tax rate. Each of the resulting studies relied on a particular combination of methodology and set of assumptions applied to specific data. Each of those steps and assumptions should be carefully considered when applying the estimated elasticity for policy making. As highlighted above, one should consider the external validity, internal validity, and simplification consequences embedded in each elasticity. As the goal of this paper is to provide a framework with which to contextualize behavioral elasticities, it is important to keep these details in the forefront when looking to the existing literature for guidance for contemporary policy analysis.

In an early empirical paper using 1973 Federal tax returns Feldstein, Slemrod, and Yitzhaki (1980) reported that taxpayers were very sensitive to the tax rate: "An important implication of this high coefficient is that a reduction in the tax rate on capital gains would actually increase the total revenue collected." These results were highlighted during a hearing of the Senate Finance Committee in 1978 and were instrumental in the debate to lower the capital gains tax rate in the Revenue Act of 1978.[14] Yet, their results were controversial and spawned a flurry of research. The authors highlighted two significant caveats regarding their results. First,

[14] See Auten and Cordes (1991) and Joint Committee on Taxation (1979).

taxpayers may realize more gains when their tax rate is temporarily low, thereby biasing the estimated elasticity upwards in absolute value. Second, estate tax rules in 1973 allowed for a full step up of basis of assets transferred at death, which increases the value of holding assets longer and would increase estimates of the elasticity. In a replication study, Minarik (1984) showed that the Feldstein, Slemrod, and Yitzhaki study did not account for the sampling weights in the underlying data. When those weights are used, he found the elasticity to be much smaller; in his preferred specification the elasticity was as low -0.49.

Generally, there were two strands of empirical papers that emerged to analyze the tax responsiveness of realized capital gains during the 1980s and early 1990s: those that used time series of aggregate data and those that used cross-section or panel data on individual taxpayers. Auten and Cordes (1991) point out that the time-series data largely found smaller elasticities that tended to be less than one in absolute value and the micro data analyses tended to find large elasticities in excess of one. The staff of the Joint Committee on Taxation argued that the time series analysis provided a better forecast of taxpayer responses to policy changes because the tax rates in time series analysis varied only due to legislation (Joint Committee on Taxation 1990). Others argued that time series estimates understated the elasticity because they aggregated across individuals, masking the true responsiveness of taxpayers. Further, Auerbach (1988) argued that time series estimation suffered from specification problems as the results were extremely sensitive to the chosen time frame of the analysis. This precludes analysts from using them to effectively determine the responsiveness of taxpayers to a policy change, thereby concluding that "its revenue implications cannot be determined."[15]

In response to many of these criticisms, Burman and Randolph (1994) used panel data to estimate both the transitory and the permanent effects, finding a very large transitory elasticity that exceeded -6 and a small and insignificant permanent effect of -0.18. Following up on that research, Auerbach and Siegel (2000) re-estimated the Burman and Randolph model paying particular attention to the wealthy and "sophisticated" taxpayers. Using the current year and

[15] P. 612, Auerbach (1988).

expected future tax rates, they find a transitory elasticity of -4.4 and a permanent elasticity of -1.7. On the time series front, Bogart and Gentry (1995) used aggregate data at the state level and state tax rate variation to estimate an overall elasticity of -0.67.

Several recent papers follow up on the Bogart and Gentry work and use aggregate state-level data leveraging the variation in tax rates at the state level to generate estimates of the elasticity. Bakija and Gentry (2014) find an overall elasticity of -0.66, but the time series nature of their estimates makes it difficult to tease out separate transitory and permanent elasticities. Their estimate should be thought of as a combination elasticity, although a separate specification for two different time periods of 1957-1979 and 1990-2007 might reasonably be considered capturing a more permanent effect. New work by Agersnap and Zidar (2020) find an overall elasticity of between -0.3 and -0.5. They also use aggregate state time series data to estimate an overall elasticity. However, they argue that many lags of the tax rate changes should be included to capture the true effect of the tax on realizations and include them in their specification in an effort to capture permanent effects. Crucially, their estimated elasticities are statistically different from -1.0. However, their estimates are generally imprecisely estimated and can't reject that the elasticity is -0.7.[16] The results of these recent studies fall solidly in the established pattern of time series estimates being smaller in absolute value than those derived from panel data.

In other recent research, Dowd, McClelland, and Muthitacharoen (2015) use a panel of individual income tax returns to estimate a transitory elasticity of -1.2 and a permanent elasticity of -0.72 over the period 1999 to 2008. They also estimate the capital gains tax elasticity for several different types of assets, finding mutual fund realizations are relatively inelastic with

[16] As pointed out by McClelland (2020), the imprecision of these estimated elasticities implies significant ranges for their estimate of the revenue-maximizing tax rate.

respect to the preferential capital gains tax rate while gains associated with partnerships and S-corps are relatively elastic.[17]

A comparison of Agersnap and Zidar (2020) and Dowd, McClelland and Multhitacharoen (2015) highlights a vexing methodological conundrum for estimating the tax elasticity of capital gains. The Agersnap and Zidar research uses aggregate data and includes many lags because they have decades of aggregate time series. However, like the critiques offered in the late 1980s, the specific time periods included are likely to play an important role in their estimates, and one wonders to what extent taxpayer behavior today is influenced by tax rate changes and behaviors from decades ago. In contrast, the large micro panel estimates do not have many years included in their samples. The Dowd, McClelland and Muthitacharoen (2015) paper used ten years of taxpayer data. Their preferred specification used the current year tax rate to estimate the transitory rate and a combination of the prior year, the current year, and the next year's tax rates to estimate the permanent response.[18] However, one might question the validity of a permanent response estimated over a relatively short period. Finally, due to data limitations most of the time-series aggregate research use net capital gains including both short-term gains and long-term gains. In contrast, the cross-section panel data research typically use positive net long-term capital gains. These differences in dependent variables make comparison across the different methodologies and data sources problematic.

In both strands of the literature, the driving force for the estimates is tax rate changes at the state level. Most of those state changes are small in magnitude, suggesting that applying the results to large tax reforms may lead to biased out-of-sample predictions. This is directly

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[17] A new working paper studying the repeal of the lifetime capital gains exemption in Canada also finds similar short run elasticities of between -0.9 to -1.09 depending on the amount of prior usage of the lifetime exemption (Lavecchia and Tazhitdinova 2020).

[18] Burman and Randolph (1994) use the current year and prior year tax rates while Auerbach and Siegel (2000) use the current year and the expected next year tax rates. Both of these papers as well as the Dowd, McClelland, and Muthitacharoen (2015) paper are careful to control for endogeneity of the tax variables by using plausibly exogenous instruments.

addressed in the work of Saez and Stantcheva (2018) on optimal taxation, in which they argue that an estimated revenue-maximizing tax rate is only relevant for small changes. Large tax reforms would be outside of the sample used to estimate their elasticities upon which their analysis depends:

> "Our approach is valid for evaluating small reforms using local elasticities. Evaluating large tax reforms (or finding the optimum far from the status quo at which elasticities are estimated) requires estimating structural elasticities."[19]

Their observation is applicable to many other estimated elasticities in that they are often estimated with small changes in tax rates and can't reasonably be expected to hold for much larger changes.

In a departure from prior research using longitudinal data or aggregate state data, Dowd and McClelland (2019) estimate a non-parametric model using the notch in tax rates that occurs after holding a capital asset for one year and a day. Assets held for longer than a year are subject to the lower preferential tax rate while short-term capital gains are taxed at ordinary tax rates. Observing that this notch will induce taxpayers to hold assets longer than otherwise, they are able to estimate a short-run transitory elasticity and a quasi-permanent elasticity by examining the mass of sales for assets held for 12 months and a day. Using transaction-level data on positive gains, they find a short-run elasticity of -0.47 an overall quasi-permanent elasticity of -0.79, both of which vary across taxpayers. For example, taxpayers with adjusted gross income in excess of $1 million are found to have elasticities of -0.73 and -0.89 for the short-run and permanent responses, respectively, while taxpayers with a net capital loss greater than $3,000 are found to have elasticities of -0.33 and -0.26. Dowd, McClelland and Mortenson (2019) also use a non-parametric method to investigate the effect of the business cycle on the estimated short-run elasticity. They find that the short-run elasticity was largest during the depths of the Great Recession, with elasticities in excess of 3 in absolute value. This contrasts with an estimate of -1.0 for the subsequent year.

[19] P. 123, Saez and Stantcheva (2018).

There are at least four distinct advantages to these non-parametric estimates of the transitory and permanent elasticity. First, for the most part, investors have full knowledge of where the notch in tax rates occur and the implications for tax liability to delaying realizations. As a result, estimates from the bunching of realizations just after the one-year holding period are not likely to be spurious. Second, in an ideal world we would estimate these elasticities relative to the pool of potential realizations available to taxpayers. Due to data limitations regarding the unobserved magnitude of accrued unrealized gains, that is not possible. Prior estimates of the transitory elasticity around tax reforms include realizations of accrued gains that might otherwise not have been realized for many years into the future and are compared to a base of normal realizations. As a result, they inflate the estimates when compared to prior realizations. Third, because of the relatively steep change in tax at the notch, these estimated elasticities are more likely to be valid estimates of taxpayer responses for large tax reforms. Fourth, because these estimates are non-parametric, the researcher does not need to impose a structure on the decision-making process of taxpayers, and so specification error is much less of a concern.

However, caution should also be exercised in using these bunching elasticities. First, the Dowd and McClelland (2019) elasticities are calculated for individuals that one might reasonably suspect are anticipating only holding the asset for a brief period - perhaps not what one would normally think of as a permanent response. Second, Blomquist and Whitney (2018) show that for bunching estimators to represent the true elasticity response of taxpayers, we need to assume restrictions on the heterogeneity of preferences across those taxpayers.

IV. Revenue-Maximizing Tax Rate for Capital Gains

The research on the responsiveness of capital gains realizations to changes in the tax rate can inform policymakers about the revenue implications from changing the capital gains tax rate. Because realizations have been shown to be relatively elastic, particularly when the rate change is anticipated, policymakers have often been concerned about raising the rate to a level at which aggregate tax revenues decline. Several recent papers have argued that the tax rate on long-term gains can be increased significantly above current levels and generate additional revenue (Gravelle (2020) and Agersnap and Zidar (2020)).

There are three important considerations when applying these empirical findings to policy discussions of a revenue-maximizing tax rate for capital gains.

1.) External validity. Does either the time period or broader tax system underlying the estimates reasonably reflect current conditions? Moreover, is the suggested policy inside or outside of the range of policy parameters considered in the estimation analysis?
2.) Internal validity. Does the choice of the estimation equation or methodology directly drive the resulting revenue-maximizing rate implied by the behavioral elasticity?
3.) Simplification Bias. Does the complexity of the Federal and state systems for the taxation of long-term capital gains realizations introduce biases in using the top statutory rate for revenue-maximizing tax rate discussions?

Taking this one-by-one, first, we must acknowledge that every elasticity estimate is dependent on the tax system and economic conditions that existed during the timeframe of the analysis. As Dowd, McClelland, and Mortenson (2019) show, the state of the economy affects the estimated short-run elasticity, with estimates of the elasticity with respect to the maximum tax rate varying from -0.65 during the peak of the business cycle in 2007 to -1.7 during the trough in 2009.[20] This also implies that the time period studied can have important impacts on estimated elasticities. Indeed, Dowd, McClelland and Muthitacharoen (2015) found that their estimates were sensitive to the years included in the sample.

Large departures from that tax system or economic environment are likely to result in different estimates of the tax elasticity complicating any attempt to calculate a revenue-maximizing tax rate. For instance, elasticities estimated prior to the 2004 preferential rate treatment on qualifying dividends might very well be different than those estimated afterwards. Corporations may treat retained earnings differently due to another tax-preferred method to distribute earnings to shareholders and investors now have another tax-favored way to access

[20] For additional discussion of the effects of the business cycle on estimated elasticities, see Joint Committee on Taxation (2019).

investment returns. Similarly, since 1986 much more business activity is conducted by pass-through entities relative to corporations. Thus, estimates relying on time periods when pass-through activity was not nearly as robust as today are likely to be misleading. Additionally, estate tax treatment for assets held until death will have profound effects on the realization behavior of individuals. In consideration of this, researchers should be careful about using time periods that include tax year 2010 when the estate tax was briefly repealed.

The second consideration in revenue-maximizing analysis is discussed in detail by the staff of the Joint Committee on Taxation (JCT (1990)). They highlighted that the revenue-maximizing rate is a construct of the assumed specification used for estimation. The base specification for parametric estimates of the effect of marginal tax rates on capital gains realizations is an ad hoc log-linear equation of the following form:

1.) $\ln(\mathrm{g}) = a + b_1\mathrm{X} + b_2\tau + \mu$

The dependent variable is the natural log of realized capital gains (g), X is a set of independent variables, and τ is the marginal tax rate on long-term capital gains.[21] The parameter of interest in this equation is b_2. The linear tax formulation allows for easy interpretation of the coefficient on the marginal tax rate. In this specification, the estimated tax elasticity of capital gains — the percent change in capital gains realizations given a percentage point change in the tax rate — is calculated according to equation 2:

2.) $\varepsilon = \hat{b}_2\tau$

[21] Researchers use this (or a similar specification with the log of gains) as gains realizations are highly skewed; such a transformation more closely approximates a normal distribution. And depending on the particular analysis, researchers may use any number of tax rates for τ, choosing any combination of statutory or effective rates, average or marginal rates, state, Federal or combined rates, etc. Further, some specifications use the net of tax rate, $(1-\tau)$, instead of the tax rate.

Due to the semi-log specification, the elasticity is a function of the coefficient multiplied by the tax rate.[22] The semi-log specification from equation 1 implies that the underlying equation for the level of gains is of the form in equation 3 below, where the other independent variables have been eliminated for simplicity:

3.) $g = Ae^{\hat{b}_2 \tau}$

Here, gains realizations are a function solely of a constant, A, and the exponential of the estimated behavioral coefficient b_2 multiplied by the statutory tax rate.[23] Tax revenue is the product of the tax rate and realizations:

4.) $R = g * \tau$

The revenue-maximizing tax rate is derived by differentiating this equation with respect to τ and satisfying the condition:

5.) $R' = (\tau * \hat{b}_2 + 1) * g = 0$

Rearranging the terms implies that the revenue-maximizing rate is:

6.) $\tau^* = -1/\hat{b}_2$

As a result, the revenue-maximizing rate depends solely on the value of b_2 and is inversely related. Yet, this is simply a construct of the specification used for the estimation. There are many reasonable specifications that could be used to estimate the elasticity, and each would yield a different result for the revenue-maximizing tax rate. Indeed, some specifications may not even yield a maximum rate by virtue of its structure. For example, a log-log specification generates a tax elasticity that is independent of the tax rate. In this case, if the elasticity is less than one, the implication is that you can raise the rate indefinitely and continue to generate additional tax revenue. In contrast, if the elasticity is above one, then there isn't any

[22] The derivative of g with respect to τ is $\hat{b}_2$*g. Multiplying this by $\frac{\tau}{g}$ results in the elasticity as shown in equation 2. In contrast to this specification, a log-log specification would result in an elasticity that is simply $\hat{b}_2$ and is independent of the tax rate.

[23] For ease of notation, the constant A is $e^{a+\hat{b}_1 X}$, where the covariates X are evaluated at their means.

tax rate that generates revenue. Empirical estimates derived from such a specification may still provide useful information about how we would expect taxpayers to respond to small perturbations in the tax rate. However, they would not be useful in identifying the revenue-maximizing rate.

Like the log-log specification, non-parametric estimation is unable to generate a revenue-maximizing result as it remains agnostic on the functional form of the realization equation. Rather, it estimates taxpayer responses given the conditions and tax system that exist in the underlying data. For example, a non-parametrically estimated elasticity of -0.7 simply suggests that a one percent perturbation around the prevailing tax rate will result in a -0.7 percent change in capital gains realizations. It says nothing about a revenue-maximizing rate.

The third consideration of using empirical estimates of elasticities to determine a single policy-relevant revenue maximizing-rate is that the US tax system is not as simple as the model described above with one marginal tax rate applied to all realized capital gains. Tax rates on other sources of income or tiered rates that apply to different amounts of capital gain can confound the application of an estimate to policy. Researchers use varying tax rates for their analysis. Some studies employ a micro-simulation approach and use estimated effective marginal tax rates for each individual taxpayer while others use maximum statutory tax rates. The micro-simulated marginal tax rates capture the complexity of the tax system with phase-outs and other interactions but may or may not be relevant when considering a specific tax change. Studies using only the top statutory tax rate miss out on this complexity.

Related to the choice of the tax rate used for the empirical research is a mechanical problem that arises due to a graduated rate schedule, which presently exists at both the Federal level as well as in many states. Consider two graduated rates for long-term capital gains; the equation for revenues is modified in the following manner:

$$7.)\ R = \begin{cases} g * \tau_u & , \text{ if } y \geq L \\ (g - (L - y)) * \tau_u + (L - y) * \tau_L & , \text{ if } y < L \text{ and } g + y > L \\ g * \tau_L & , \text{ if } g + y \leq L \end{cases}$$

Where τ_u is the upper tax rate, τ_L is the lower tax rate applicable to capital gains up to the lower threshold of *L*, and *y* is all other non-gains income. We need to modify equation 1 to

consider the different marginal rates that may apply. In this case, the marginal tax rate faced by an individual is a function of τ_u, τ_L, total income and the tax rate thresholds as follows:

$$8.)\ \tau = M(y, g, \tau_u, \tau_L, L) = \begin{cases} \tau_u, & \text{if } g + y > L \\ \tau_L, & \text{if } g + y \leq L \end{cases}$$

where y is other income sources, g is the amount of gains realized, and τ_u, τ_L, and L are the parameters of the tax system. Equation 8 highlights that the marginal tax rate includes the amount of gains realized, making it endogenous. In the empirical literature, there are several solutions to resolve this endogeneity. As is common in the panel estimation literature, Dowd, McClelland, and Muthitacharoen (2015) use the first-dollar tax rate excluding endogenous income items as well as the maximum Federal and state tax rate as instruments for the marginal tax rate. Given that the observed marginal tax rate varies between τ_L and τ_u, the predicted marginal tax rate from the first stage regression with these instruments will be less than or equal to τ_u. Alternatively, as in Bakija and Gentry (2014) and Agersnap and Zidar (2020), researchers using aggregate time series data often simply use the maximum Federal and state tax rates and therefore the assumed value of τ is τ_u.

Substituting Equation 8 into the log linear version of Equation 1, differentiating R with respect to the upper tax rate τ_u produces the following equation for the revenue-maximizing tax rate:

$$9.)\ R' = \begin{cases} g + \tau_u * \widehat{b_2} * g & , \text{ if } y \geq L \\ (g - L) + \tau_u * \widehat{b_2} * g & , \text{ if } y < L \text{ and } g + y > L \\ \tau_L * \widehat{b_2} * g & , \text{ if } g + y \leq L \end{cases}$$

Setting this equation equal to zero and rearranging terms, the revenue-maximizing rate collapses to equation 6 above in the first instance where other income is greater than the threshold for taxation at the upper rate. In the second instance, where gains are taxed at both the upper and the lower rate, we get:

10.) $\tau_u^* = -((g - L)/g) * 1/\widehat{b_2}$

Equation 10 highlights that while the estimated elasticity is with respect to all gains, the revenue response is only with respect to the gains that are taxed at the upper tax rate. If we set L to zero, we can recover the standard revenue-maximizing rate as calculated in equation 4. However, if the lower threshold, L, is 50% of g, then the maximizing rate would be half of the results above. Moreover, since L is net of ordinary income, the revenue-maximizing capital gains tax rate depends on the amount of other income and is specific to the individual. In other words, assuming the log-linear specification is correct — a big if — and that the estimates produced using a vintage of past data under past tax systems produced valid predictions for the current tax system — also a big if — the revenue-maximizing rate still mechanically varies for each individual. What then does it mean to calculate a revenue-maximizing tax rate? In the next section, we compare the first dollar of tax on capital gains and the last dollar of tax and show that these rates vary considerably across the income distribution and more importantly a significant portion of realized capital gains are taxed below the top capital gains rate.

V. Variation in Statutory Tax Rates Applied to Capital Gains

As shown earlier in Table 1, Federal long-term capital gains tax rates are progressive. For tax year 2017, long-term capital gains that otherwise would have been taxed under ordinary income tax rates at either 10 or 15 percent rate were taxed at a zero percent rate. Long-term gains income that otherwise would have been taxed at rates between 25 percent and 35 percent were taxed at 15 percent. Long-term gains that otherwise would have been taxed at 39.6 percent are taxed at 20 percent. In addition, to the statutory rates on long-term capital gains, there is also the net investment income tax of 3.8 percent on investment income including long-term capital gains realizations, for taxpayers with modified adjusted gross income in excess of $250,000 in the case of a joint tax return and $200,000 otherwise. Recall, the ordinary income brackets and the tax rates for single and joint filers as shown in Table 1. That rate structure results in considerable variation in marginal tax rates on capital gains income for taxpayers. Table 2 below shows the

average marginal tax rate on the first dollar of capital gains realized for those with capital gains as well as the average marginal tax rate on the last dollar of realized capital gains.[24]

Table 2. Long-Term Capital Gains Realizations and Average Marginal Tax Rates, 2017[25]

Adjusted Gross Income Thresholds (Dollars)			Average Marginal Tax Rate		Positive Long-Term Capital Gains (Millions $)		
			First Dollar	Last Dollar	Total	Taxed at Top Rate	Percent Taxed at Top Rate
Negative	-	0	0.1	6.0	20,011	286	1.4
0	-	10,000	1.1	4.1	2,190	50	2.3
10,000	-	20,000	2.8	15.0	3,322	80	2.4
20,000	-	30,000	2.7	3.9	3,642	43	1.2
30,000	-	40,000	4.7	7.1	4,148	83	2.0
40,000	-	50,000	5.1	6.4	4,777	68	1.4
50,000	-	75,000	6.5	13.2	14,527	70	0.5
75,000	-	100,000	7.4	9.3	19,598	122	0.6
100,000	-	200,000	10.7	15.4	68,534	55	0.1
200,000	-	500,000	15.8	22.9	109,323	745	0.7
500,000	-	1,000,000	20.1	23.7	77,490	26,471	34.2
1,000,000	+		18.0	24.0	525,327	441,883	84.1
Total			16.7	22.5	852,889	469,958	55.1

Source: Authors calculations using tax year 2017 individual tax returns, and Joint Committee on Taxation Individual Tax Model.[26] First-dollar and last-dollar marginal tax rates are calculated by giving each tax return with positive long-term capital gains an additional ten percent of their long-term gains.

[24] The first-dollar and last-dollar tax rates are calculated by giving each return with positive long-term capital gains an additional ten percent of their long-term gains. The first-dollar is calculated after eliminating any realized capital gains and then giving those taxpayers a 10 percent of their long-term capital gains. The tax rate is calculated as the change in taxes owed divided by the change in capital gains income.

[25] We use 2017 because the current version of the Joint Committee on Taxation individual tax model is based on 2017 data. Inspection of the more recent 2018 data indicates that a similar percentage of capital gains is taxed at the top statutory rate.

[26] For more information, see Joint Committee on Taxation (2015)

Scanning down the estimated tax rates columns there are many rates above zero and below the statutory 15 percent applicable to taxpayers with incomes below the 15 percent threshold.[27] These are due to taxpayers phasing out of credits and deductions as well as the kiddie tax that applies the parent's tax rate on passive investment income of their children. The 15 percent last dollar marginal tax rate for taxpayers in the $10,000-$20,000 range is almost entirely due to an interaction with the Earned Income Tax Credit, in which that credit is disallowed for those with investment income above $3,450. In other words, small increases in capital gains income for some taxpayers can cause a large loss of tax credits, leading to marginal tax rates in excess of 100 percent.

Moving across the table, we report the total amount of long-term capital gains realizations for 2017 and the amount in each bracket that is taxed at the top rate. Focusing on the last two columns, we see that the capital gains of taxpayers with incomes below $500,000 are largely not taxed at the top rate. By and large, the top rate only affects taxpayers with adjusted gross income in excess of $500,000, though for these taxpayers, on average, the first dollar tax rate is below the maximum. The final column reports the percentage of capital gains that is taxed at the top rate. For taxpayers with between $500,000 and $1 million of AGI, 34 percent of their capital gains realizations are taxed at the top rate, while taxpayers with over $1 million in AGI had 84 percent of their realizations taxed at the top rate. Combined, these two groups had 78 percent of their realizations taxed at the top rate. In comparison, for all taxpayers with capital gains in 2017, only 55 percent was taxed at the top rate. Hence, increasing the top statutory marginal rate on long-term capital gains will only apply to approximately 55 percent of realized capital gains. This mechanically dampens any calculated maximum capital gains rate.

[27] As shown in Table 1 for 2017, the 15 percent long-term rate bracket starts at $37,950 for single taxpayers and $75,900 for joint returns, and the 20 percent bracket starts at $418,400 and $470,700 for single and joint returns, respectively.

VI. Conclusion

For over a century, there has been a lively debate about revenue-maximizing tax rates for various sources of income. That debate has sparked an active empirical literature exploring the responsiveness of taxable income generally and capital gains realizations specifically to taxation. However, the empirical research on capital gains realizations has shown that estimated elasticities can and do vary substantially. Not only are estimates based on time-series sensitive to the sample years included in the analysis, but cross-section and panel analysis are also sensitive to the sample years and the business cycle. Additionally, estimated elasticities have been shown to vary along many cross-sectional dimensions, including the type of asset being sold, the taxpayer's characteristics, and the income and loss position of the taxpayer. This variation suggests that there is not a single elasticity or revenue-maximizing tax rate that is applicable to all taxpayers and across all asset types.

Moreover, most empirical estimates using U.S. data are derived from variation in state tax rates. Using these relatively small changes, which may not be particularly salient to taxpayers, to model expected taxpayer responses to large Federal reforms is problematic. For instance, one should use caution in extrapolating from single-digit state-based tax reforms to large-scale reforms such as replacing the preferential rate with ordinary tax treatment that would entail significantly larger rate increases.

Finally, modeling choices and simplifying assumptions used for estimation purposes have direct impacts on the derivation of a revenue-maximizing tax rate. There are a multitude of estimation equations that could be used and not all of them will result in a tractable revenue-maximizing tax rate. Moreover, we show that there are also mechanical reasons associated with a graduated preferential rate system that undermine the ability to make simplifying assumptions about revenue-maximizing rates.

References

Agersnap, Ole, and Owen Zidar. 2020. "The Tax Elasticity of Capital Gains and Revenue-Maximizing Rates." *National Bureau of Economic Research Working Paper* 27705.

Auerbach, Alan J. 1989. "Capital Gains Taxation and Tax Reform." *National Tax Journal* 42 (3): 391-401.

Auerbach, Alan J. 1988. "Capital Gains Taxation in the United States: Realizations, Revenue, and Rhetoric." *Brookings Papers on Economic Activity* 595-637.

Auerbach, Alan J., and Jonathan M. Siegel. 2000. "Capital Gains Realizations of the Rich and Sophisticated." *American Econmic Review* 90 (2): 276-282.

Auten, Gerald E., and Joseph J. Cordes. 1991. "Policy Watch: Cutting Capital Gains Taxes." *Journal of Economic Perspectives* 5 (1): 181-192.

Auten, Gerald, David Splinter, and Susan Nelson. 2016. "Reactions of High-Income Taxpayers to Major Tax Legislation." *National Tax Journal* 69 (4): 935-964.

Bakija, Jon M., and William M. Gentry. 2014. "Capital Gains Taxes and Realizations: Evidence from a Long Panel of State-Level Data." *Unpublished Manuscript.* https://web.williams.edu/Economics/wp/BakijaGentryCapitalGainsStatePanel.pdf.

Blakey, Roy G., and Gladys C. Blakey. 1919. "The Revenue Act of 1918." *The American Economic Review* (American Economic Association) 9 (2): 214-243.

Blomquist, Nils Soren, and K Whitney. 2018. "The Kink and notch bunching estimator cannot identify the taxable income elasticity." *Working Paper* (Department of Economics, Uppsala University) 2018 (4).

Bogart, William T., and William M. Gentry. 1995. "Capital Gains Taxes and Realizations: Evidence from Interstate Comparisons." *Review of Economics and Statistics* 77 (2): 267-282.

Burman, Leonard E., and C. William Randolph. 1994. "Measuring Permanent Responses to Capital-Gains Tax Changes in Panel Data." *American Economic Review* 84 (4): 794-809.

Chetty, Raj, and Emmanuel Saez. 2005. "Dividend Taxes and Corporate Behavior: Evidence from the 2003 Dividend Tax Cut." *Quarterly Journal of Economics* 120 (3): 791-833. doi:https://doi.org/10.1093/qje/120.3.791.

Department of the Treasury. 1985. *Report to Congress on the Capital Gains Reductions of 1978.* Washington, DC: Government Printing Office. https://www.treasury.gov/resource-center/tax-policy/Documents/Report-Capial-Gains-Reduction-1978.pdf.

Department of Treasury. 1989. *General Explanation of the President's Budget Proposals Affecting Receipts.* Washington, DC: Department of Treasury, US Government.

Dowd, Tim, and Robert McClelland. 2019. "The Bunching of Capital Gains Realizations." *National Tax Journal* 72 (2): 323-358.

Dowd, Tim, Robert McClelland, and Athiphat Muthitacharoen. 2015. "New Evidence on the Tax Elasticity of Capital Gains." *National Tax Journal* 68 (3): 511-544. doi:http://dx.doi.org/10.17310/ntj.2015.3.02.

Dowd, Tim, Robert McClelland, and Jacob A. Mortenson. 2019. *Investor Responsiveness to Capital Gains Taxes During the Great Recession.* Tax Policy Center, Urban Institute and Brookings Institution, Washington, DC: Tax Policy Center. https://www.taxpolicycenter.org/publications/investor-responsiveness-capital-gains-taxes-during-great-recession.

Feldstein, Martin, Joel Slemrod, and Shlomo Yitzhaki. 1980. "The Effects of Taxation on the Selling of Corporate Stock and the Realization of Capital Gains." *Quarterly Journal of Economics* 94 (4): 777-791.

Gravelle, Jane G. 2020. *Capital Gains Tax Options: Behavioral Responses and Revenues.* Congressional Research Service.

Joint Committee on Taxation. 2015. *Estimating Changes In The Federal Individual Income Tax: Description Of The Individual Tax Model.* Washington, DC: U.S. Government Printing Office. https://www.jct.gov/publications/2015/jcx-75-15/.

Joint Committee on Taxation. 2019. *Estimating Taxpayer Bunching Responses To The Preferential Capital Gains Tax Rate Threshold.* Washington, DC: U.S. Government Printing Office. https://www.jct.gov/publications/2019/jcx-42-19/.

Joint Committee on Taxation. 1990. *Explanation of the Methodology Used to Estimate Proposals Affecting the Taxation of Income From Capital Gains.* Washington, DC: U.S. Government Printing Office.

Joint Committee on Taxation. 1979. *General Explanation of the Revenue Act of 1978 (H.R. 13511, 95th COngress, Public Law 95-600).* Washington, DC: United States Government Printing Office.

Joint Committee on Taxation. 1987. *General Explanation of the Tax Reform Act of 1986.* Washington, DC: Government Printing Office. https://www.jct.gov/publications.html.

Joint Committeee on Taxation. 2005. *General Explanation of Tax Legislation Enacted in the 108th Congress.* Washington, DC: U.S. Government Printing Office. https://www.jct.gov/publications.html.

Joint Committtee on Taxation. 1997. *General Explanation of the Tax Legislation Enacted in 1997.* Washington, DC: U.S. Government Printing Office. https://www.jct.gov/publications.html.

Lavecchia, Adam M., and Alisa Tazhitdinova. 2020. "Permanent and Transitory Responses to Capital Gans Taxes: Evidence from a Lifetime Exemption in Canada." *Unpublished Working Paper.*

Lindsey, Lawrence B. 1987. "Rates, Realizations, Revenues of Capital Gains." In *Taxes and Capital Formation*, by Martin Feldstein, 17-26. Chicago: National Bureau of Economic Research.

McClelland, Robert. 2020. "New Study Suggest Congress Could Raise Money By Increasing Capital Gains Tax Rates To 47 Percent. But There Is A Catch." *TaxVox: Indivdual Taxes.* September 16. https://www.taxpolicycenter.org/taxvox/new-study-suggests-congress-could-raise-money-increasing-capital-gains-tax-rates-47-percent.

Minarik, Joseph J. 1984. "The Effects of Taxation on the Selling of Corporate Stock and the Realization of Capital Gains: Comment." *Quarterly Journal of Economics* 99 (1): 93-110.

Saez, Emmanuel. 2017. "Taxing the Rich More: Preliminary Evidence from the 2013 Tax Increase." *Tax Policy and the Economy* 31: 71-120.

Saez, Emmanuel, and Stefanie Stantcheva. 2018. "A simpler theory of optimal capital taxation." *Journal of Public Economics* 162: 120-142. doi:https://doi.org/10.1016/j.jpubeco.2017.10.004.

Saez, Emmanuel, Joel Slemrod, and Seth Giertz. 2012. "The Elasticity of Taxable Income with Respect to Marginal Tax Rates: A Critical Review." *Journal of Economic Literature* 50 (1): 3-50.

Smiley, Gene, and Richard H. Keehn. 1995. "Federal Personal Income Tax Policy in the 1920s." *The Journal of Economic History* (Cambridge University Press) 55 (2): 285-303. http://www.jstor.com/stable/2123554.

Statistics of Income, Internal Revenue Service. 2020. "SOI Tax Stats - Historical Table 23." *IRS.GOV*. https://www.irs.gov/statistics/soi-tax-stats-historical-table-23.

—. 2008. "SOI Tax Stats - Individual Time Series Statistical Tables." *www.irs.gov*. March. https://www.irs.gov/statistics/soi-tax-stats-individual-time-series-statistical-tables.

United States Internal Revenue, Department of Treasury. 1922. *Statistics of Income From Returns of Net Income for 1920*. Washington, DC: Government Printing Office.

United States Internal Revenue, Department of Treasury. 1923. *Statistics of Income From Returns of Net Income for 1921*. Washington, DC: Government Printing Office .

United States Internal Revenue, Department of Treasury. 1925. *Statistics of Income From Returns of Net Income for 1923*. Washington, DC: Government Printing Office.

United States Internal Revenue, Department of Treasury. 1928. *Statistics of Income from Returns of Net Income for 1926*. Washington, DC: Government Printing Office.

United States Internal Revenue, Treasury Department. 1925. *Statistics of Income from Returns of Net Income for 1922*. Washington: Government Printing Office.