The Aggregate Effects of Targeted Tax Cuts

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Abstract

This paper analyzes how different types of tax changes can have different economic impacts. Using Congressional records, I decompose the plausibly exogenous legislative provisions identified in Romer and Romer (2010) into one of five categories: business marginal rate provisions, business investment incentives, other business provisions, individual marginal rate provisions, and other individual provisions. I find that the effects differ crucially depending on which types of taxes are being cut and that the most stimulative effects come from marginal rates for both individuals and businesses and investment incentives. This is consistent with the findings in Mertens and Montiel Olea (2018) and suggests that substitution effects, rather than income or demand-driven effects, are the primary driver of tax multipliers. I use my results to analyze the effects of the Tax Cuts and Jobs Act of 2017, which was mostly comprised of reductions to individual and corporate marginal tax rates. I estimate the Act will boost GDP growth by an average of between 1.4-2.3 percentage points per year from 2018 through 2020. This is significantly higher than most existing estimates of the near-term effects, which usually range between 0.5-1.0pp per year. While the combination of the Act's relative permanence and its distributional considerations suggest that these numbers should be thought of as an upper bound, they also support the idea that other estimates are understating the stimulative effects of the Act by not fully accounting for its composition.

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1 Introduction

Estimating the effects of tax changes on economic activity poses a significant empirical challenge because observed tax changes are rare, discrete events whose motivations are often correlated with other drivers of short-term economic activity. To deal with these issues, Romer and Romer (2010) (henceforth RR) use a narrative approach based on a wide variety of historical documents. The fundamental idea behind this strategy is that tax changes motivated by a desire to boost long-run growth, rather than countercyclical policies designed to return growth to its normal level, are less likely to be subject to omitted variable bias and thus can more plausibly be used as exogenous regressors or instruments. They estimate large fiscal multipliers using these shocks; a tax cut equal to 1% of GDP is expected to increase real GDP growth by up to 3pp in the three years following the policy's implementation.

In practice not all tax policies are created equal, however. Because different types of taxes apply to different agents (individuals vs. corporations) and have different incentive effects (tax credits vs. marginal rates), there are good reasons to think the macroeconomic effects of a tax policy will depend not only on its size but also its composition. For this reason, many authors in recent years have developed a variety of creative identification strategies based on the underlying exogeneity of the tax events identified in RR to examine the effects of fiscal policy in more detail. Mertens and Ravn (2012) examine how the effects of narrative tax shocks depend on the delay between announcement and implementation. Mertens and Ravn (2013) uses the narrative tax changes as instruments in a structural vector autoregression (SVAR) to show how the effects of corporate and individual tax cuts differ. Barro and Redlick (2011) uses the narrative shocks as instruments to marginal tax rates and compare the fiscal multipliers on taxes and spending. Most recently, Mertens and Montiel Olea (2018) and Zidar (2018) use the narrative shocks to analyze the effects that changes to marginal tax rates have on different parts of the income distribution.

This paper expands this literature by decomposing the provisions identified in RR into one of five categories: business marginal rate provisions, business investment incentives, other business provisions, individual marginal rate provisions, and other individual provisions. To my knowledge, this is the first paper which isolates the revenue components of exogenous tax changes attributable to investment-specific provisions. This distinction is important; I show that investment-specific measures are the most effective at stimulating not just investment, but also total output.

These findings are consistent with Mertens (2018), who show that the stimulative effects of individual income tax cuts are driven entirely by provisions which affect *marginal* rates; provisions such as tax credits which reduce *average* rates without affecting incentives on the margin are

shown to have virtually no effect. They interpret these findings as suggesting that the stimulative effects of fiscal policy are driven by substitution effects- that is, changes in incentives- rather than income or aggregate demand effects. This supports my findings that the most stimulative policies are those which incentivize working and investing.

These results are important becuase they suggest that the effects of a tax change depend crucially on what types of taxes are changing. As an illustrative example, I apply my estimates to analyze the Tax Cuts and Jobs Act of 2017 (TCJA), which was estimated to have a total effect on tax liabilities of about 1% of GDP. Statements from lawmakers suggest that the primary motivations behind the act were to stimulate long-run economic growth, and thus it would be classified as plausibly exogenous under the RR narrative framework.

Overall I estimate that the TCJA will boost real GDP growth by an average of 1.4-2.3pp per year between 2018-2020, a number which is significantly larger than most existing estimates of between 0.5-1.0pp per year. This disparity comes from the fact that the Act included significant reductions in marginal rates for both businesses and individuals as well as an extension/expansion of bonus depreciation; my results suggest that these incentive-based provisions are more stimulative relative to an average tax change. While the Act's permanence, its distributional considerations, and its unprecedented repatriation provisions provide several important reasons to think that these results should be interpreted as an optimistic upper bound, they also suggest that existing forecasts which do not take into account the Act's particular provisions may be conservative.

The paper proceeds as follows. Section 2 describes the identificaction strategy and discusses some properties of the shock series I use. Section 3 shows the estimated effects of each type of tax cut and how they compare to aggregate estimates. Section 4 uses my empirical estimates to analyze the macroeconomic effects of the Tax Cuts and Jobs Act of 2017 and compares the findings to existing studies. Finally, Section 5 concludes.

2 Tax Shock Identification

2.1 Background and Narrative Approach

This section outlines the methodology behind the series of tax shocks I use in my empirical specification. The tax shocks I use are derived using the narrative approach first developed in RR, who begin by compiling a detailed record of all major US tax changes starting in 1947. From this set of tax legislation, they examine historical records such as presidential speeches and reports from Congressional committees to get a sense of the motivation behind each one. The authors

note that there is generally a single, clear motivation expressed for each piece of legislation and that these motivations are generally extremely consistent across sources.

After identifying the motivation for each piece of legislation, they classify a particular change as "endogenous" if its motivation was based on circumstances which would cause growth to differ from normal. The example that they use is a tax cut passed in anticipation of an upcoming recession; in this case, factors unrelated to tax policy would be projected to affect output growth, and the goal of the tax policy would be to counteract them. Another example would be policymakers' desire to raise taxes to counteract increases in government spending. Including such tax changes as regressors would therefore lead to omitted variable bias because they would be correlated with other factors which influence economic outcomes.

Those tax changes which are not motivated by factors which cause growth to deviate from its normal pattern are considered to be exogenous. RR note that the motivation for these types of provisions tends to fall in one of two categories. The first is the desire to reduce an inherited budget deficit and the second is a desire to promote long-run growth. Because these motivations should not in principle be correlated with factors that cause growth to deviate from its normal trend, they should be relatively free of the omitted variable bias contained in the endogenous tax provisions. RR, as well as Mertens and Ravn (2012) and Mertens and Montiel Olea (2018), provide a variety of robustness checks to justify the use of shocks classified as exogenous regressors, including showing that the exogenous tax changes are not Granger caused by output growth, that they cannot be predicted using lagged macroeconomic variables, and that they do not show any serial correlation, which justify their use as a starting point for my decomposition.

2.2 Decomposition of Tax Changes and Shock Construction

To construct my shock series I begin by taking the list of exogenous tax changes identified as being exogenous based on the criteria in the previous section that do not include retroactive components.[1] The series starts in 1947 and ends in 2005.

Wherever possible, I use the revenue numbers from Romer and Romer (2010) or Mertens and Ravn (2013) to obtain the revenue breakdown by different types of provision. In cases for which the detailed revenue breakdowns are not available, I go back to the source documents and calculate

[1] An example of an exogenous tax change that included a retroactive component was the Revenue Act of 1948, which went into effect in the second quarter of 1948 and which retroactively changed taxes for the first half of the year in addition to affecting revenues in the second half. In this case I assign the entire change in tax liabilities to the second quarter of 1948 and do not include any entries for the first half. I exclude retroactive components because they generally don't allow for behavioral responses and thus should not be expected to have the same effects as other types of tax changes.

them myself based on reports from the Joint Committee on Taxation (JCT), the Presidents' Budgets, Congressional Budget Office (CBO) estimates, and other government documents.[2] For illustration, the revenue decomposition for the Economic Recovery Tax Act of 1981 from the Presidents' Budget for 1983 is shown below. This leads to a total of 45 quarters that have at least one type of exogenous tax change between 1948 and 2005.

	Calendar year liabilities				
	1981	1982	1983	1984	1985
Individual income tax provisions	−3.7	−40.9	−82.3	−110.6	−137.6
Capital cost recovery provisions:					
Individual income taxes	−0.9	−2.4	−3.9	−5.3	−7.4
Corporation income taxes	−4.5	−9.5	−18.1	−25.2	−37.2
Subtotal, capital cost recovery provisions	−5.4	−11.8	−22.0	−30.5	−44.6
Windfall profit tax and other energy provisions:					
Individual income taxes	−0.4	0.5	0.5	0.4	0.5
Corporation income taxes		*	0.2	0.3	0.4
Excise taxes	−0.1	−1.3	−1.9	−2.0	−2.4
Subtotal, windfall profit tax and other energy provisions	−0.5	−0.8	−1.2	−1.2	−1.5
Corporation income tax rate reductions		−0.2	−0.4	−0.5	−0.5
Saving incentive provisions	−*	−0.8	−4.6	−2.0	−5.6
Estate and gift tax provisions		−2.3	−3.6	−4.6	−6.2
Tax straddles:					
Individual income taxes	1.3	0.8	0.8	0.8	1.0
Corporation income taxes	0.1	0.1	0.1	0.1	0.1
Subtotal, tax straddles	1.4	0.8	0.9	0.9	1.1

Figure 1: Example Revenue Decomposition for Economic Recovery Tax Act of 1981

The result is a detailed revenue decomposition for each tax change into one of five categories:

1. Individual marginal rate provisions (including social insurance taxes)
2. All other individual provisions (including estate taxes)
3. Business marginal tax rates
4. Corporate investment provisions (including investment tax credits and changes to depreciation allowances)

[2]In some rare cases the total effects of the revenue estimates I use do not exactly match the aggregate numbers used in Romer and Romer (2010) and Mertens and Ravn (2013) due to differences in sources of the revenue estimates, but these differences are extremely small and entirely inconsequential when comparing the results using my aggregate series and theirs. The detailed breakdowns and their sources are available by request.

5. All other business provisions (including non-investment tax credits and excise provisions)

Table 1 below shows this breakdown for each type of shock as well as some summary statistics. The summary statistics are written as the ratio of the change in tax liabilities to the previous quarter's nominal GDP and are calculated based only on nonzero observations for each type. Across all provisions, the average tax change amounts to a reduction in liabilities amounting to -0.14% of GDP, with the largest increase being 0.71% in 1981 Q1 (a combination of the Social Security Amendments of 1977 and the Crude Oil Windfall Profit Tax Act of 1980) and the largest cut being 1.81% in 1948 Q2 (the Revenue Act of 1948).

Type of Provision	**Observations**	**Mean**	**St. Dev.**	**Max**	**Min**
Individual marginal rates	28	-0.10%	0.5%	0.58%	-1.22%
Other individual provisions	14	-0.16%	0.26%	0.09%	-0.90%
Business marginal rates	10	-0.14%	0.16%	0.04%	-0.42%
Investment incentives	14	-0.07%	0.26%	0.54%	-0.28%
Other business provisions	20	0.06%	0.20%	0.64%	-0.24%
Total	**45**	**-0.14%**	**0.54%**	**0.71%**	**-1.81%**

Table 1: Shock Summary Statistics

The time series of shocks is illustrated in Figure 2. Several patterns emerge from looking at the raw series. Overall, individual provisions (especially individual marginal provisions) are the most common type of tax change; shocks related to business and excise taxes are less frequent. The tax changes with the largest magnitudes for both cuts and hikes occurred in the early 1980s, with the most impactful piece of legislation- the Economic Recovery Tax Act of 1981- leading to large changes in liabilities from 1982-1984. It is also notable that while different tax changes in the same quarter generally had the same sign, there were cases in which different provisions pushed in different directions. Sometimes this occurred over multiple years as part of the same piece of legislation; the Jobs Growth and Tax Relief Reconciliation Act of 2003, for example, led to a decrease in revenues in 2003 Q3 when bonus depreciation measures went into effect and an increase in revenues in 2005 Q1 when they expired. In other cases different types of provisions went into effect in the same quarter and offset each other. This occurred in 1954 Q1 when the Social Security Amendments of 1950 led to an increase in revenue that kicked in at the same time as the expiration of the Excess Profits Tax and other temporary income tax increases that had been in effect since 1951.

Using only aggregate changes in liabilities implicitly assumes that all types of tax changes have the same effect. As a result this observed heterogeneity in the size and frequency of observed

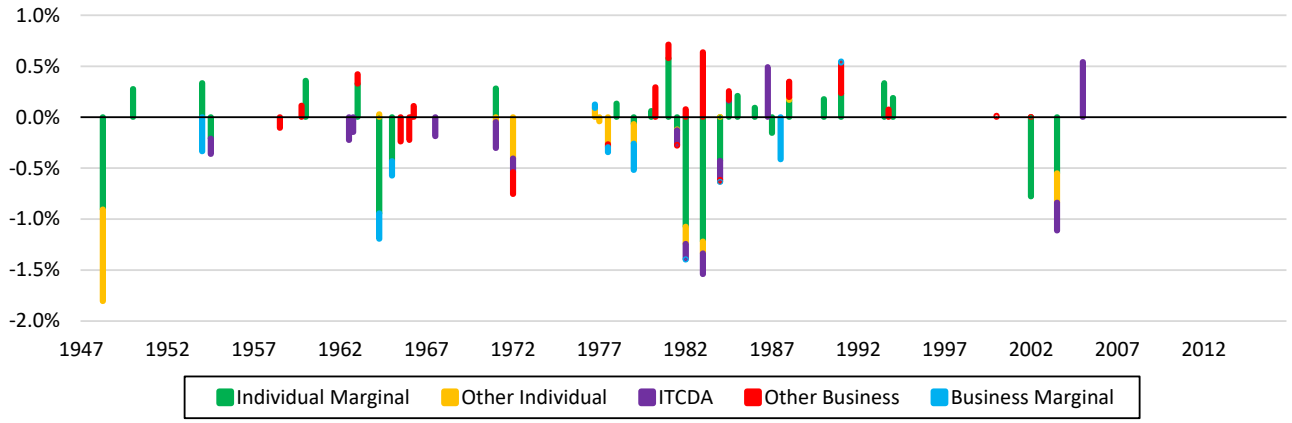

Figure 2: Time Series of Shocks

tax changes has important implications. In cases such as in 1954 and 1982, there were large tax changes of different types that pushed revenues in opposite directions; to the extent that these different types of tax changes can have different macroeconomic effects, aggregating changes of liabilities together will not correctly estimate their effects. In the next section, I provide evidence that the effects of different types of tax changes are meaningfully different for different types of provisions.

3 Empirical Evidence

This section outlines the main empirical results. First, I show the estimates of when I aggregate all of the tax shocks into a single series. This allows for direct comparison to past work and acts as a baseline to which to compare the shock series for each type of provision. Overall I find output multipliers have an average of about 1 over the three years following the shock and a peak of around 2 that occurs between two to three years after the shock. In addition to boosting overall output, I find that tax cuts are stimulative for consumption expenditure (particularly for durable goods) and investment. These results are similar to those found in Romer and Romer (2010), Mertens and Ravn (2012), and Mertens and Ravn (2014).

Next, I examine the effects of the other tax provisions to see which are driving the aggregate results. Tax shocks that target individual marginal rates or corporate marginal rates have average multipliers of about 1.7. Investment provisions have even larger average output multipliers (3.3) in addition to having the largest effects on equipment investment.

3.1 Baseline Specification and Aggregate Results

To test the effects of each shock, I use the following local projection specification as my baseline.

$$y_{t,t+h} = c_h + \sum_{j=1}^{J} \beta_j y_{t-j} + \sum_{k=1}^{K} \sigma_k GDP_{t-k} + \gamma_h^{Total} s_t^{Total} + \epsilon_{t,h} \tag{1}$$

Here s_t^{Total} is the aggregate tax shock for each quarter described in the previous section and $y_{t,t+h}$ represents the the log of the variable of interest h periods after the shock. In this specification, the coefficient γ_h^{Total} can be interpreted as the percent increase in outcome variable y that occurs h periods after an unanticipated tax shock that lowers government revenue by 1% of GDP relative to a counterfactual economy in which tax policy did not change. I estimate the effects on each variable up to three years after each shock occurs. I use data from 1947-2005; I omit later observations to avoid issues related to the zero lower bound on interest rates and the Great Recession. As controls I include a constant, $J = 4$ autoregressive lags of the variable of interest, and $K = 4$ lags of the log of real GDP to control for contemporaneous economic conditions. Following Jordà (2005), I use Newey-West standard errors to account for serial autocorrelation of the residuals.

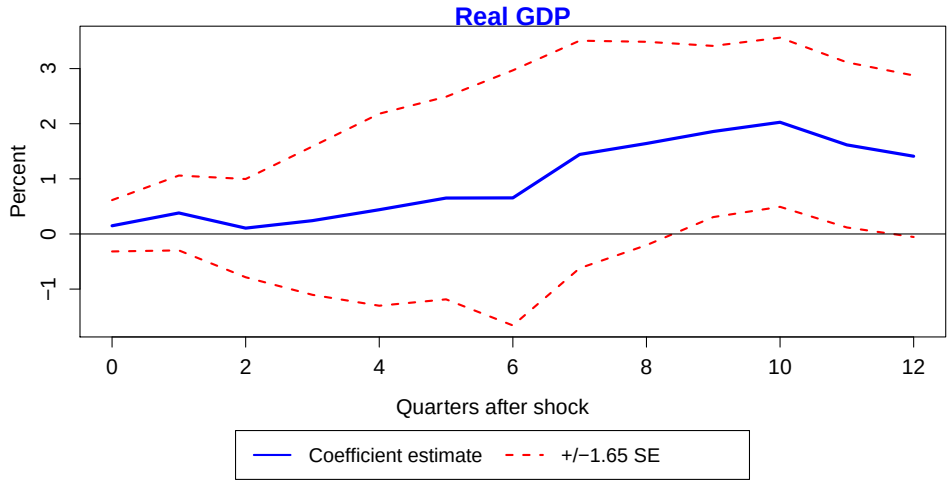

Figure 3: Baseline Responses to Exogenous Tax Cut (90% CI)

The results for GDP are shown in Figure 3 with 90% confidence intervals. The estimated effects are small during the first year, averaging about 0.2%. The second and third years show an increase to 0.8% and 1.8%, respectively. In addition to showing the largest effects, the third year also shows the most statistical significance. These results are broadly in line with past estimates

and reinforce two key points: tax cuts have strong output effects that tend to peak around two to three years after being implemented.

To help understand these results, I also consider the responses of several other economic outcomes. Equipment investment, shown in the left panel of Figure 4, increases by up to 7% in response to the shock. This is mirrored by a similar increase in consumer durable expenditures shown in the middle panel. The right panel shows that the response of nondurable consumption is far more muted, however, with a peak effect of about 1.7% that aligns closely with the peak effects on total output.

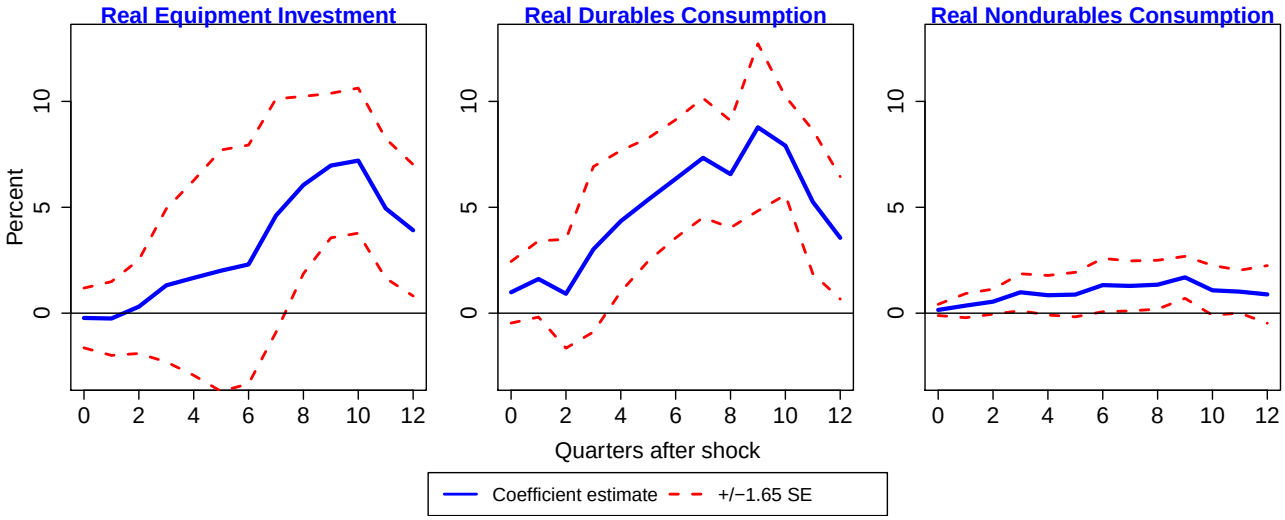

Figure 4: Baseline Responses to Exogenous Tax Cut (90% CI)

Figure 5 shows that these stimulative effects are not a free lunch, however. Real individual tax receipts tend to fall by about 5% in the two years following the shock before trending back to their pre-shock level in year three. While corporate tax receipts also show a decline, it is smaller and not statistically significant, and is followed by a larger increase in the third year. This is due in part to the fact that these estimates are taking the average effect across all types of tax changes, the majority (and largest) of which have targeted individuals.

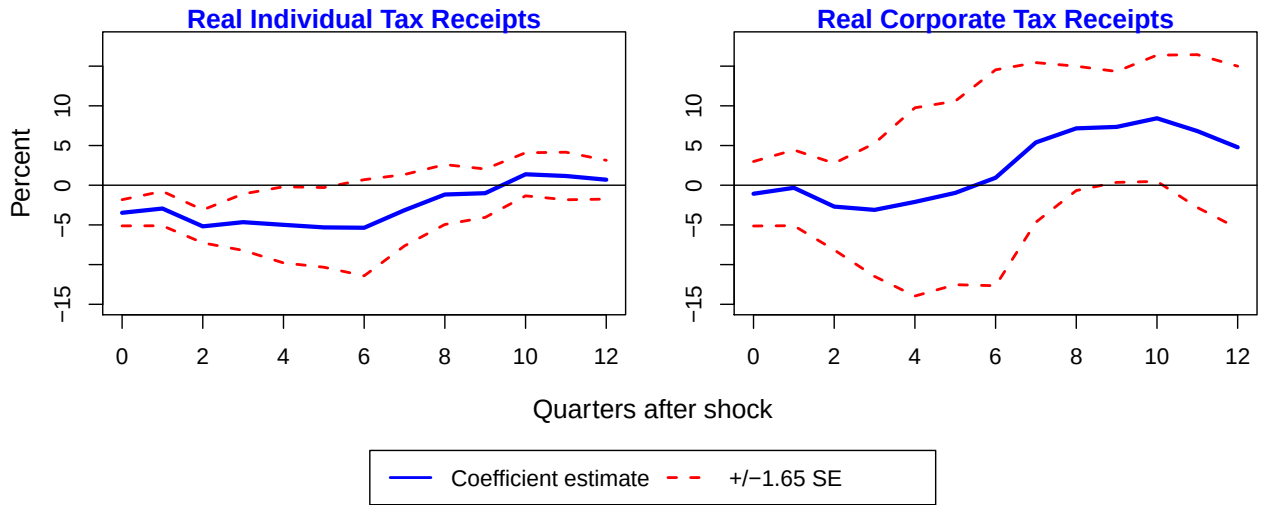

Figure 5: Baseline Responses to Exogenous Tax Cut (90% CI)

3.2 Results by Type of Tax Change

In this section, I examine the heterogeneity of the effects across a variety of different types of tax shocks. To do so, I use the following local projection specification:

$$y_{t,t+h} = c_h + \sum_{j=1}^{J} \beta_j y_{t-j} + \sum_{k=1}^{K} \sigma_k GDP_{t-k} + \sum_i \gamma_h^i s_t^i + \epsilon_{t,h} \tag{2}$$

The object of interest to be estimated is the set of γ_h^i for each type of tax shock i. This specification can be thought of as a more generalized version of the one used in the previous section; estimating the effect of aggregate tax shocks is equivalent to imposing $\gamma_h^i = \gamma_h \; \forall \; i$ in Equation 1. As before, the impulse response to a specific type of tax shock s_t^i at horizon h is simply γ_h^i, the partial derivative of Equation 2 with respect to the shock. Crucially, this specification controls for the effects of other contemporaneous shocks. Most exogenous provisions affect more than one type of revenue, so it is important that I control for the effects of the other shocks when estimating their effects.

The output multipliers for each of the five types of shocks are shown in Figure 6, and the peak and average output multipliers for each type are shown in Table 2. The estimated multipliers for individual marginal rates, business marginal rates, investment provisions, and other business provisions are all larger than the estimated aggregate multiplier. While business marginal rates have a higher peak multiplier, the effects are only visible for the first two years before fading.

Cuts to individual marginal rates, on the other hand, appear stimulative even at the end of the estimated response horizon. Investment provisions have the largest multipliers both in terms of peak and average, and the effects appear to be more persistent than business marginal rate cuts. While other business provisions are estimated to have similar multipliers to marginal rate and investment incentives, this is driven almost entirely by excise taxes. Excise taxes, which include taxes on items such as gasoline, cigarettes, and alcohol, differ from other business provisions in that they operate through both income and substitution channels instead of simply through income channels (like tax credits). To the extent that it is the substitution effects of excise tax cuts which promote economic activity, this is consistent with the responses of the other incentive-based provisions.

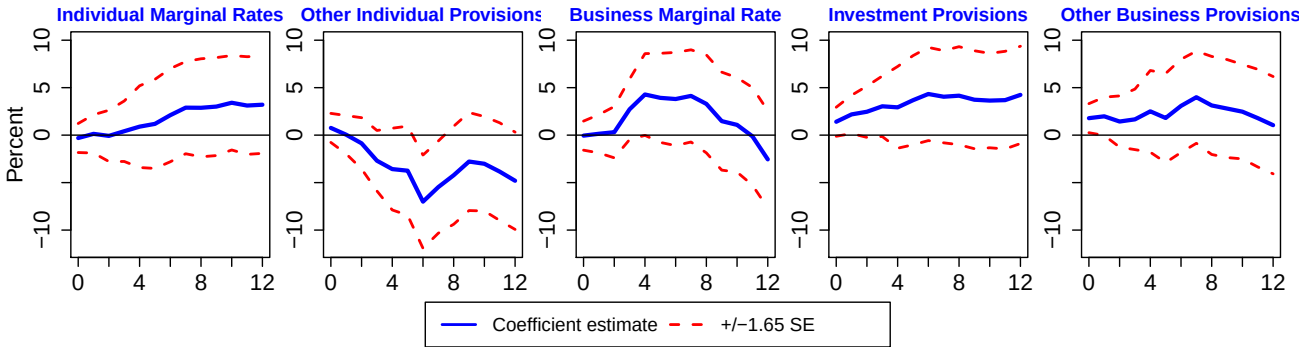

Figure 6: GDP Responses to Exogenous Tax Cut (90% CI)

Type of Provision	Average Multiplier	Peak Multiplier
Individual marginal rates	1.75	3.41
Other individual provisions	-3.17	-7.00
Business marginal rates	1.75	4.28
Investment incentives	3.34	4.33
Other business provisions	2.27	3.99
Total	**0.97**	**2.02**

Table 2: Average and Peak Output Multipliers

That the multipliers on other individual provisions is so negative is somewhat puzzling, especially given that it is such an outlier relative to the other types of tax cuts. One possible explanation is that tax credits reduce labor supply through income effects. To test this I examine how labor responds to tax shocks. In Figure 7, I show the impulse responses of the average manufacturing workweek for production and nonsupervisory employees to a tax shock of each

type. I focus on average hours instead of aggregate because the former reflects adjustments on the intensive margin that would be expected to reflect labor supply effects. I use manufacturing hours instead of hours for all employees because to my knowledge it is the most general series representing hours worked that extends across my entire shock sample.

I estimate statistically significant declines of about 2-3% in the average manufacturing workweek in response to a tax cut that affects average individual tax rates but has no impact on marginal rates. In contrast, none of the other provisions show meaningful declines in the average workweek; there are virtually no effects on hours worked from individual marginal rate or investment provisions, and modestly positive effects for business marginal rates and other business provisions. These findings are consistent with a story in which wealth effects reduce labor supply. To the extent that other individual provisions act like lump-sum transfers, a standard model of labor supply would predict that they will respond by increasing both consumption and leisure in response to a tax credit whereas a reduction in marginal rates would lead workers to substitute time away from leisure and increase their hours worked.

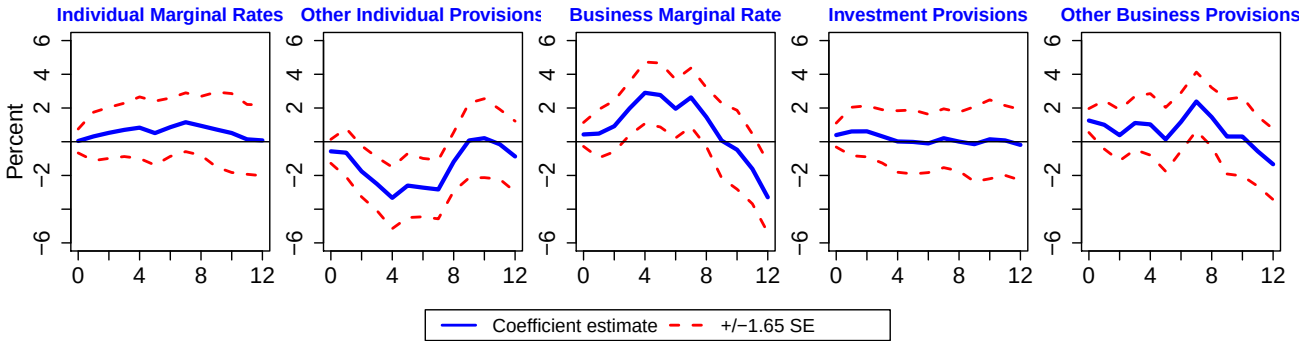

Figure 7: Average Manufacturing Weekly Hours Responses to Exogenous Tax Cut (90% CI)

An important contribution of this paper is to look at the effects of investment incentives. The previous section showed that investment-specific provisions had the largest growth multipliers both in terms of average and peak effects. An obvious question is what effect these provisions have on investment. The impulse responses to real equipment investment[3] are shown in Figure 8 and the peak and average multipliers are shown in Table 3.

The first panel shows that individual marginal tax rates have similar effects on investment as the results using aggregate tax cuts, though the point estimates are noisier. Other individual

[3]I use equipment investment instead of total nonresidential fixed investment (which also includes structures and intellectual property products) because bonus depreciation and investment tax credits have historically applied almost exclusively to equipment.

provisions (shown in the second panel) do not appear to have any meaningful impact; the point estimates oscillate between positive and negative and are insignificant throughout the response horizon. Business provisions, especially investment-specific provisions, have much more stimulative effects on investment. It is also worth pointing out that, unlike most of the other coefficients, the estimated effects of investment provisions become more significant if the response horizon is extended beyond three years.

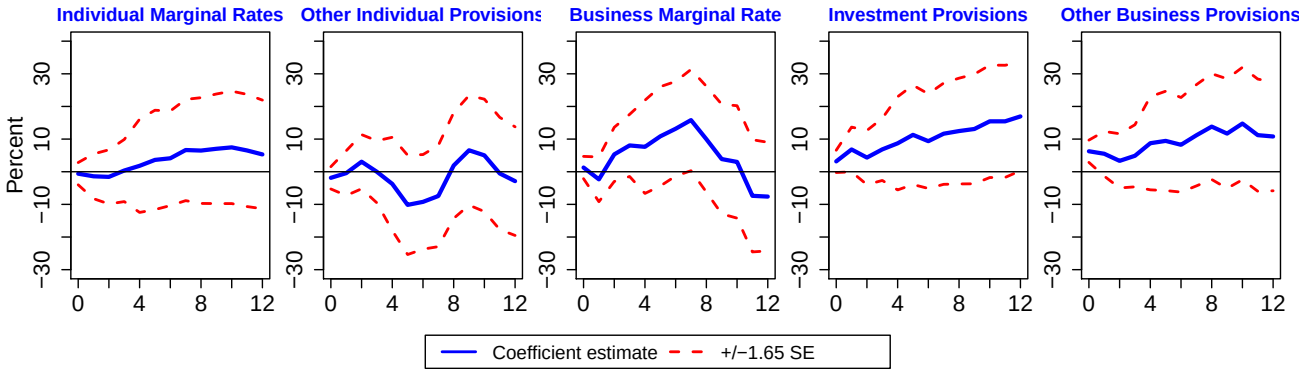

Figure 8: Real Equipment Investment Responses to Exogenous Tax Cut (90% CI)

Type of Provision	Average Multiplier	Peak Multiplier
Individual marginal rates	3.52	7.45
Other individual provisions	-1.52	-10.14
Business marginal rates	4.74	15.82
Investment incentives	10.42	16.95
Other business provisions	9.22	14.76
Total	**3.55**	**7.82**

Table 3: Average and Peak Investment Multipliers

To summarize, this section showed that my approach generates aggregate results that are consistent with other estimates from the literature but that these aggregate estimates belie significant heterogeneity across different types of taxes. I show that tax cuts to individual provisions which do not affect marginal rates are estimated to lead to contractions in output, and show that this is consistent with a story in which wealth effects lead to reductions in labor supply. In addition, I find that investment-specific provisions are the most stimulative in terms of both output and investment.

3.3 Robustness and Alternative Specifications

This section outlines a variety of robustness checks. While most of the numerical and graphical results are omitted from this draft in the interest of space, they are available upon request.

The first set of robustness checks that has been explored extensively in the literature concerns the shocks themselves. A large body of past work which has used the shocks including Romer and Romer (2010), Mertens and Ravn (2012), Mertens and Ravn (2014), and Mertens and Montiel Olea (2018) have all shown that the shock series has many desirable statistical properties as part of their robustness checks. More specifically, they have shown that the shocks do not seem to be autocorrelated and that they cannot be predicted by lagged measures of activity.

I also analyze how my results are sensitive to the specification that I use. I find that changing the number of lags (both of the dependent variable or of real GDP), including additional controls such as lagged tax revenue or government spending, including a linear or quadratic time trend. Given the limited number of observations, it is important to check the degree to which single observations are driving the results. To check this I find the five quarters with the largest total shocks and iteratively set all shocks within that quarter to zero and re-estimate my results dropping one at a time.[4] While dropping observations from an already-small sample leads to generally wider standard errors, the point estimates remain very similar to my baseline results. If I restrict my sample to post-1981, I find that all of the estimates become larger and more significant but that their relative sizes remain consistent; this matches the findings in Romer and Romer (2010).

There may also be concern that the shocks could be correlated with political factors; to the extent that Republicans are more likely to cut taxes, for example, the shocks could be capturing the general effects of a business-friendly climate as opposed to the tax change itself. To check this, I include a dummy variable indicating whether the president was a Republican and find that the results are virtually identical.

3.4 Comparison of Results

Mertens and Ravn (2012) further refine the series used by Romer and Romer (2010) by separating exogenous provisions which were "anticipated" in the sense of having a delay of more than 90 days between announcement and implementation. Using this exogenous series in a vector autoregression, they find that unanticipated expansionary tax shocks increase output, consumption, and investment, with a peak effect occurring around 2.5 years after the shock.

The authors build on this work in Mertens and Ravn (2013) by separating the exogenous series

[4]The quarters I check are 1948Q2, 1982Q2, 1981Q1, 1964Q2, and 2003Q3.

they developed in their earlier paper into provisions relating to corporate taxes and individual provisions and using these series as instruments for the structural shocks in a VAR. They find that a 1% personal tax cut boosts output by around 1.5% on impact and leads to a decline in government revenue that returns back to its baseline over approximately three years. A 1% cut in the corporate tax rate, on the other hand, leads to a smaller (0.5%) increase in output that is more persistent.

In Mertens and Montiel Olea (2018), the series developed in Mertens and Ravn (2012) is further refined to distinguish between tax measures which affect individual marginal rates and other individual measures (such as tax credits). The authors estimate a short-run elasticity of taxable income of around 1.2 in response to tax changes that occurred between 1946 and 2012 and finds that elasticities are much larger in the top 1% of the income distribution. Tax cuts which target the top 1% of individual earners are estimated to boost economic activity and incomes outside the top income bracket, but increase the inequality in pre-tax incomes. I build on this work by calculating separately the provisions associated with investment incentives and showing that they have effects that are meaningfully different from other types of tax changes.

One important difference between this paper and the past work of Mertens is that his work focuses on the subset of tax changes which have less than one quarter of implementation lag whereas I include provisions whose revenue effects occur more than 90 days after they were signed into law. This extra explanatory power is useful given that I am splitting the set of shocks, which is already relatively small, into sub-components. Nonetheless it is useful to see how this approach, which cuts the total number of quarters with nonzero observations from 45 down to 28, affects my results.

Overall I find more modest and noisier aggregate output multipliers than in my baseline results. Figure 9 shows this breakdown by type of tax in the same manner as before. The most notable result is the extreme volatility of business marginal rate provisions. This is due in large part to sample concerns; there were only 10 examples of changes to business marginal rates in my baseline specification and removing the provisions with implementation lag reduces the number to 5. For the other measures, however, the results appear mostly reasonable and consistent with my previous findings. I still find that the output multipliers are positive for individual marginal rate provisions and negative for other individual provisions, and that investment provisions are more stimulative than other types of business tax changes. Given that the samples become significantly smaller when this approach is taken, however, it would be worthwhile to explore alternative classifications for the business marginal rate provisions to avoid the small-sample issues.

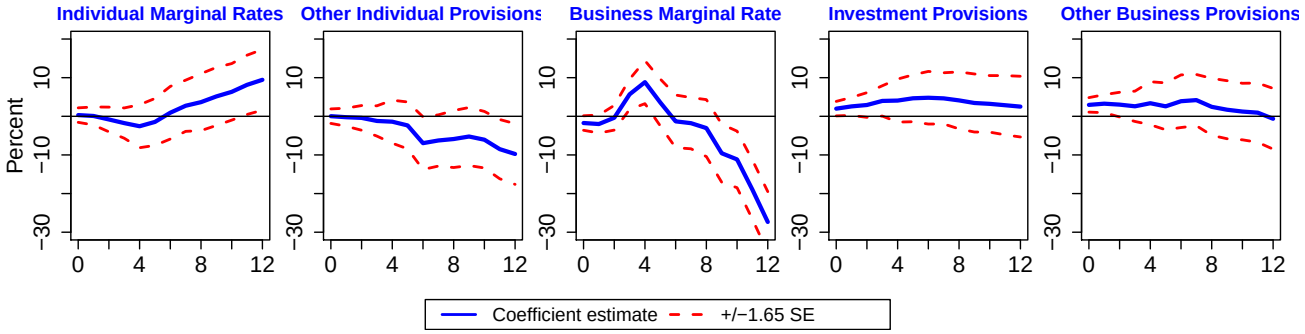

Figure 9: Output Responses to Exogenous Tax Cut with No Implementation Lag (90% CI)

Finally, when I consider the effects of different tax shocks on real investment, I find that the role of investment tax credits becomes even more pronounced when I focus on measures of tax shocks which exclude provisions with delayed implementation. This reinforces my earlier findings and suggests an important role for investment tax incentives beyond that of other types of tax changes.

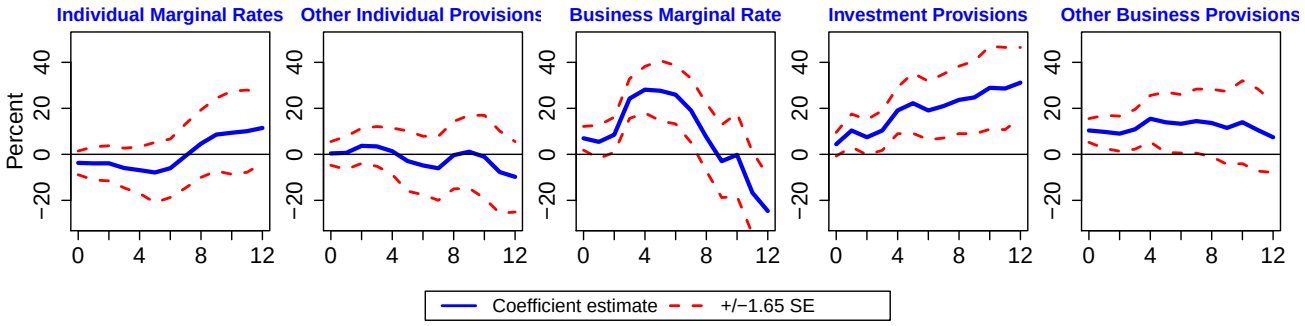

Figure 10: Equipment Responses to Exogenous Tax Cut with No Implementation Lag (90% CI)

4 The Effects of the Tax Cuts and Jobs Act of 2017

In this section I apply my estimates of the exogenous tax changes to the Tax Cuts and Jobs Act of 2017[5] (TCJA) to estimate their effects. First, I provide background information about the tax bill and argue that its motivations are very much in line with the definition of exogeneity used

[5]This was the original name of the legislation, which was ultimately changed to "An Act to provide for reconciliation pursuant to titles II and V of the concurrent resolution on the budget for fiscal year 2018" before it was officially signed into law. Lawmakers and the media continued to refer to the act by its informal title after it was passed, however, and for simplicity I will too.

by Romer and Romer (2010). Next, I use budget impact estimates from the JCT to show the estimated effects broken down by component to generate a set of shocks constructed in the same manner as those used in my estimation. By combining this new shock with the estimated effects obtained in the previous section, I am able to generate a counterfactual prediction for the effects of the Act.

My estimates suggest a boost to GDP growth of about between 1.4-2.3pp per year on average between 2018-2010, with even stronger surges in equipment investment. These estimates are extremely large and approximately twice the size of most past attempts to quantify the Act's effects. This is driven by the fact that it consists entirely of incentive-based provisions- that is, corporate and individual marginal rates and investment incentives- that I find to be most stimulative types of tax cut. These estimates, which are based on the average economic responses to similar tax changes in the past, come with three important caveats. The first is that the Act appears to be relatively more permanent than past tax changes. The second is that it has different distributional consequences than past tax changes. Lastly, there are two provisions- the special repatriation rates for corporations and the simplification of the tax code- which were touted as important pieces of the TCJA but which have few historical precedents. These issues suggest that my results should be thought of as an optimistic upper bound; nonetheless, they do suggest that existing estimates may be understating the Act's effects by not fully taking the specifics of its provisions into consideration.

4.1 Background and Composition

The Tax Cuts and Jobs Act of 2017 had several major effects on the US tax code. The largest component was an across-the-board reduction in individual marginal tax rates. In addition to the marginal rate changes, the standard deduction for individuals was increased and many personal deductions were phased out. There were also significant changes to corporate taxation, including a reduction in corporate tax rates from 35% to 21%, an extension of bonus depreciation provisions for investment, and a shift to a territorial tax system. The Act was signed into law on December 22, 2017, with most of the provisions going into effect at the start of 2018. Table 4 shows the revenue estimates for 2018 from the Joint Committee on Taxation, with estimates for CY 2018 calculated as the sum of the effects from FY 2018 plus one-quarter of the effects of FY 2019. I classify the revenue raised from the temporary repatriation incentives as falling under business marginal rates.

The stated motivations for the Act were to increase economic growth above its long-run level

Type of Provision	CY 2018 Revenue Effects	Share of GDP
Individual marginal rates	-$128bil	-0.65%
Other individual provisions	$5bil	0.03%
Investment incentives	-$42bil	-0.21%
Business marginal rates	-$42bil	-0.21%
Total	**$136bil**	**-1.04%**

Table 4: JCT Revenue Estimates for Tax Cuts and Jobs Act of 2017

and simplify the tax code. These motivations were consistently expressed in speeches and written statements by Republican lawmakers throughout the second half of 2017. For example, in a statement released by President Trump in November 2017, he said that the goal of the tax plan was to "...deliver historic tax cuts and reforms — the rocket fuel our economy needs to soar higher than ever before".[6] Similar sentiments were echoed by Senate Majority Leader Mitch McConnell, who noted that the goal of the Act was to "...provide the American people with a robust economy that reaches for its full potential"[7], and Speaker of the House Paul Ryan, who said "Today is about how much better things can be: More jobs, fairer taxes, and bigger paychecks. Faster growth and real upward mobility."[8] These statements suggest that the TCJA falls under RR's classification of being an exogenous shock.

4.2 Effects and Comparison with Other Estimates

There are several studies which attempt to analyze the budgetary impact of the TCJA. This section compares my estimated output multipliers to those using alternate methods. These estimates are summarized in Table 5.

Using baseline estimates from Romer and Romer (2010) would suggest a peak increase in GDP of 3% between 2019-2020. These are supported by estimates from Mertens and Ravn (2014), who find peak multipliers of around 3. Another approach Mertens (2018) is similar to this paper in that it estimates the effect of past tax changes which Romer and Romer (2010) classify as exogenous and applies those estimates to the revenue effects calculated by the JCT. Using both single equation and structural vector autoregression (SVAR) models using an aggregate tax multiplier- that is, treating all types of exogenous taxes the same- he estimates that real GDP will change by roughly +1.3% in 2018, +0.4% in 2019, and -0.3% in 2020.

Using the instrumental variables approach of Mertens and Ravn (2013) allows the tax changes

[6] https://www.whitehouse.gov/briefings-statements/statement-president-tax-cuts-jobs-act/
[7] https://www.republicanleader.senate.gov/newsroom/press-releases/mcconnell-statement-on-the-tax-cuts-a
[8] https://www.speaker.gov/press-release/speaker-ryans-floor-remarks-tax-cuts-and-jobs-act

My Estimates	Peak Annual Effect	Annual Average Effect
Aggregate, all provisions	1.9	1.0
Aggregate, no delayed provisions	0.7	0.2
Decomposed, all provisions	**3.2**	**2.3**
Decomposed, no delayed provisions	**2.4**	**1.4**
CBO Estimates	0.8	0.6
Alternatives shown in Mertens (2018)		
Average of aggregate estimates	1.2	0.4
Mertens and Montiel Olea (2018)	1.6	1.3
Zidar (2018)	1.7	0.8

Note: This table shows the effects on GDP growth (in pp) relative to a counterfactual in which the TCJA was not passed. "Aggregate" estimates combine all shocks into a single series while "Decomposed" estimates are those which account for the five separate types of provisions. Estimates outside of my own come from Mertens (2018) and use only the provisions which have no implementation lag. The column "Peak Annual Effect" shows the largest full-year effect under each specification.

Table 5: Summary of Estimated TCJA Output Effects, 2018-2020

to be decomposed by their corporate, individual, and international provisions; Mertens shows that these estimates result in a larger jump in 2018 (+1.8%) followed by declines in 2019 and 2020 (-0.2%) for similar cumulative effects. He finds that the corporate provisions are the largest driver of growth in 2018, contributing +2.0%, with a smaller positive contribution from the individual provisions (+0.9%) and an ofsetting effect of the international provisions (-1.0%). Using estimates based on changes to marginal tax rates (as in Mertens and Montiel Olea (2018)) or allowing for income dependence (as in Zidar (2018)) lead to cumulative estimates from 2018-2020 of roughly 1.5-3.0% with the effects more evenly distributed across the three-year response horizon.

A more structural approach is taken by Barro and Furman (2018), who analyze the long-run implications of the various aspects of the TCJA through the lens of a neoclassical Ramsey model. They estimate that real GDP growth will be about 0.9 percentage points higher both 2018 and 2019. This short-run boost is driven by reductions in individual marginal rates. After 10 years, they estimate that GDP will rise by 0.4% under the current letter of the law and 1.2% of the provisions are made permanent. These long-run effects are mostly driven by changes in investment expensing, however, and the authors note that simply making the investment provisions (which are currently set to phase out by 2026) permanent would lead to a long-run increase of 0.3% in real GDP at one-sixth the cost. The authors make the interesting point that most of the long-run

effects are likely to be driven by the provisions affecting investment. This matches closely with my findings, which show that investment tax credits have stimulative effects which are far more persistent than most other types of tax changes.

Compared to these results, my aggregate estimates align most closely with the findings of Romer and Romer (2010) and Mertens and Ravn (2014), with an estimated aggregate tax multiplier of just under 2 occurring about two years after the shock. I find that most of the expansionary aggregate effect is driven by incentive-based provisions, however, including marginal rates for both individual and corporate income and investment incentives. In contrast, I find that other types of provisions have virtually no expansionary effect on output. Given that the TCJA consists almost entirely of these highly expansionary provisions, it is perhaps unsurprising that I estimate its stimulative effects to be larger than existing work. All told, my results which consider the effectiveness of individual provisions suggest an annual effect of between 1.4pp (using a shock measure which excludes provisions with delayed implementation) and 2.3pp (using a shock measure which includes these delayed provisions) per year.

There are several important caveats to keep in mind when interpreting my results, however. The first is that they are estimated under the assumption of average behavior of fiscal and tax policy following past shocks; given the TCJA has a more permanent nature than many past reforms, the estimated effects on the debt and deficit are likely to be significantly conservative. The second is that my results do not take any distributional considerations into account, which both Zidar (2018) and Mertens and Montiel Olea (2018) showed are important. In particular, the responses of economic activity I estimate correspond closely in terms of both magnitude and timing to the experiment of a 1% tax cut for the bottom 99% of the income distribution in Mertens (2018). To the extent that the distributional consequences of the TCJA accrue more to the top of the income distribution than past changes, this suggests that the response of output will be smaller.

Finally, it is important to note that there are several important aspects of the Act that do not have clear historical counterparts and thus are not taken into account when estimating the effects of past tax changes. One is the increase in tax revenue occurring as a result of the temporary repatriation tax, which allowed foreign subsidiaries of US multinationals to bring money to the US at temporarily low rates (8% for illiquid assets and 15.5% for liquid assets). As Mertens (2018) notes, while these provisions raised revenue in the short run, they ensured that these assets would not be taxed at their usual (and higher) statutory rates in the future. As a result, it is not clear that this provision should be considered a tax increase. Another important example is the simplification of the tax code. While it is inherently difficult to quantify, Romer and Romer (2014)

provide suggestive evidence from the US interwar era (between 1919-1941) that a simplified tax code can limit the responsiveness of the taxable incomes for the wealthiest taxpayers.

5 Conclusion and Discussion

This paper examines how economic activity responds to different types of tax shocks. Starting from the plausibly exogenous tax events identified from narrative records in Romer and Romer (2010), I manually analyze Congressional tax records and other government documents to isolate the revenue breakdowns for each provision into one of five categories: individual marginal rates, other individual measures, business marginal rates, business investment incentives, and other business provisions. When all of the shocks are combined into a single aggregate series, I estimate peak output multipliers of around 2 that occur between two and three years after the shock. These aggregate effects are consistent with past findings in terms of both size and timing. When the taxes are broken up into sub-categories, however, I find substantial heterogeneity across the different types of tax changes.

Compared to my aggregate estimates, I find output multipliers which are similar in their timing but significantly larger in magnitude for provisions which affect marginal tax rates for businesses and individuals as well as those which incentivize investment. While existing work has estimated the effects of shocks to individual and corporate tax rates, the decomposition of narrative shocks into components related to investment is new to the literature. I show that this decomposition is important because shocks to investment tax incentives are the most effective at stimulating not only equipment investment, but also total output. These results are consistent with recent work showing that empirical estimates of the tax multiplier are driven by substitution effects rather than income or demand-driven effects.

I apply these estimates to the revenue provisions of the Tax Cuts and Jobs Act of 2017, whose long-run growth motivations would classify it as an exogenous change based on RR's narrative framework. Because the changes consisted of the most stimulative types of tax provisions, I estimate that the act will boost real GDP growth by between 1.4-2.3pp per year from 2018-2020. These estimates are significantly higher than most existing estimates of the Act's effects. Given the limited historical precedent of the TCJA's permanence and distributional effects, these should be interpreted as upper bounds; nonetheless, they suggest that existing estimates which do not take the composition of the tax changes into account may be understating its effects.

There are several promising avenues for further research, particularly with regards to the investment provisions developed in this paper. One fundamental issue with the series is the limited

number of observations. One way to address this is to find a series for which the separate tax shocks can act as instruments. Leveraging heterogeneity in the exposure of different states, individuals, or businesses to aggregate tax shocks (such as in Mertens and Montiel Olea (2018) or Zidar (2018)) could provide additional variation to help identify the effects of these provisions. In addition, past work (such as Auerbach and Gorodnichenko (2012)) suggests that the effects of tax shocks could be are asymmetric, non-linear, or state-dependent; this is particularly important given that past work such as Winberry (2016) has shown that accounting for nonlinear and state-dependent responses to shocks is extremely important for explaining aggregate investment patterns. Ultimately, building these insights into a comprehensive macroeconomic model could help inform fiscal policy analysis and theories of optimal taxation.

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