The Macroeconomic Effects of Corporate Tax Reforms

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[latest version here; replication package here]

Abstract

This paper extends a standard general equilibrium framework with a corporate tax code featuring two key elements: tax depreciation policy and the distinction between c-corporations and pass-through businesses. In the model, the stimulative effect of a tax rate cut on c-corporations is smaller when tax depreciation policy is accelerated, and is further diluted in the aggregate by the presence of pass-through entities. Because of a highly accelerated tax depreciation policy and a large share of pass-through activity in 2017, the theory predicts small stimulus, large payouts to shareholders, and a dramatic loss of corporate tax revenues following the Tax Cuts and Jobs Act (TCJA-17). At the same time, because of less accelerated tax depreciation and a lower pass-through share in the early 1960s, the theory predicts sizable stimulus in response to the Kennedy's corporate tax cuts. The model-implied corporate tax multiplier for Kennedy's tax cuts is four times higher than for Trump's. These predictions are consistent with novel micro- and macro-level evidence from professional forecasters and publicly available tax returns.

JEL Codes: E06, H02, H06

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1 Introduction

This paper presents a model of the macroeconomic effects of corporate tax reforms and uses it to analyze the Trump's Tax Cuts and Jobs Act of 2017 and the Kennedy's corporate tax cuts of the early 1960s. The theoretical framework consists of a standard macroeconomic environment augmented with two key elements: tax depreciation policy and the distinction between c-corporations and pass-through businesses. For each reform, novel empirical evidence is collected and used to validate the predictions of the theory.

The first key ingredient of the analysis is tax depreciation policy, which defines the set of rules that businesses are required to follow to deduct investment from their tax base. As I document in Furno (2021), the vast majority of corporate tax codes around the world do permit businesses to fully recover the cost of investment from their tax base, but only over time according to a tax depreciation schedule. As a result, differences in tax depreciation policies across space and time boil down to how fast investment can be deducted. When investment is allowed to be deducted over a short period of time, the tax depreciation schedule is said to be 'accelerated', and recent empirical contributions from the public finance literature have documented the ability of accelerated tax depreciation policy to stimulate firms' investment.[1]

Pass-through businesses are the second key ingredient. In the US, only c-corporations are subject to corporate income taxation. All other forms of organization (s-corporations, partnerships, and sole-proprietorships) are 'pass-through', in the sense that their earnings are not subject to firm-level taxation and are 'passed through' to their owners. I document that roughly 40% of economic activity took place in the pass-through sector in 2017, compared to 25% in the early 1960s.[2]

In the model, corporate tax changes affect the economy primarily through the investment decision of c-corporations, which is affected not only by the tax rate but also by tax depreciation policy. Specifically, the possibility to deduct investment from the tax base (partially) counteracts the distortion introduced by the tax rate: the faster investment is deducted from the tax base, the higher the present value of the investment deductions, the smaller the distortion to the rate of return on investment (RoI) caused by the tax rate. As a result, when tax depreciation policy is very accelerated - like it was in 2017 - the

[1]For example, see Zwick and Mahon (2017), Ohrn (2018), and Ohrn (2019). From a theoretical perspective, the importance of tax depreciation policy is known at least since Smith (1963) and Hall and Jorgenson (1967).

[2]Several recent contributions have documented some of the implications and issues arising from this pass-through status. For example, see Cooper et al. (2016), Clarke and Kopczuk (2017), Chen et al. (2018), Smith et al. (2019), Barro and Wheaton (2020), Kopczuk and Zwick (2020), Bhandari and McGrattan (2021), Smith et al. (2021).

RoI is almost unaffected by the corporate tax rate, and a rate reduction is not particularly expansionary. This interaction between the tax rate and tax depreciation is the same as what is described in Hall and Jorgenson (1967).[3]

On top of this, a corporate tax rate cut entails a transfer of resources from the government to c-corporations in the form of reduced corporate tax liabilities. How these tax savings are used by c-corporations depends on how much the RoI increases in response to the cut. When pre-reform tax depreciation policy is very accelerated, the increase in the RoI is small and a large share of the tax-savings is distributed to the shareholders (either as dividends or as share repurchases). When pre-reform tax depreciation policy is not accelerated, instead, the increase in the RoI is sizable and the tax savings are primarily used for investment.

While this mechanism accounts for the response of the c-corporate sector, it is necessary to consider the pass-through sector to understand what happens in the aggregate. Since a change to the corporate tax rate affects directly only c-corporations, the aggregate effect is diluted by the presence of pass-through businesses. To a rough approximation, if the pass-through share of economic activity is 50%, the aggregate effect of a corporate cut will be 50% smaller than the effect in the c-corporate sector. More precisely, pass-through entities are not only excluded from the tax cut, but they are also put at a competitive disadvantage. This happens because they compete with c-corporations in the production of (imperfectly) substitutable goods, which further amplifies the shift of economic activity from pass-through businesses to c-corporations and may reduce the aggregate effect even more.[4]

To test my theory, I first collect empirical evidence on the recent TCJA-17. In particular, I compare pre-reform professional forecasts with actual outcomes for both macroeconomic aggregates and c-corporations' aggregates constructed from firm-level data. I also use publicly available tax returns from the IRS to compare the response of c-corporations and pass-through businesses. When simulating the TCJA-17, my model predicts small stimulus, large payouts to shareholders, and a dramatic loss of corporate tax revenues - in line with the empirical evidence. This is due to highly accelerated tax depreciation policy and a large share of pass-through businesses in 2017.

At the same time, when used to analyze the corporate provisions of the Kennedy's

[3] I replicate Zwick and Mahon (2017) on Compustat data for the recent TCJA-17 to provide additional empirical evidence in favor of this mechanism.

[4] C-corporations and pass-through businesses compete even in narrowly-defined industries of the US economy. As an illustrative example, IRS data from 2012 shows that 52.3% of economic activity in the "Apparel Manufacturing" industry (NAICS 315) took place in c-corporations, and the remaining 47.7% in pass-through businesses. Hence the assumption of imperfect substitutability between goods produced by the two sectors.

tax cuts, the model predicts sizable stimulus to GDP and investment, and a small increase in payouts to shareholders - in line with time-series descriptive evidence. This is due to less-accelerated tax depreciation policy and to a smaller share of pass-through activity in the early 1960s.

I then compute model-implied corporate tax multipliers for each tax reform and find that, for every dollar of lost corporate tax revenues, the Kennedy's tax cuts stimulated output roughly four times more than the Tax Cuts and Jobs Act. A large part of this difference can be attributed to differences in pre-reform tax depreciation policy.

To better understand how corporate taxes work in my model, I offer some analytic insights. I first provide a formal mapping between my corporate tax and the familiar concept of a "capital tax", and show that corporate taxes can be thought of as capital taxes accompanied by investment subsidies. I then prove that the government can allow full-expensing of investment and still collect tax revenues in the steady-state. Finally, I derive the analytic steady-state and use it to characterize the distortions introduced by US corporate tax policy over the last few decades. This last exercise shows that US policy-makers have by now removed most of the distortions introduced by corporate taxes, but this also implies that they are running out of ammunition: further reductions of corporate tax rates are unlikely to provide strong stimulus to the economy.

1.1 Contributions to the Literature

The main contribution of this paper is to document a duality of responses of the US economy to two major corporate tax reductions, and to propose a unified framework able to rationalize the joint response of a wide set of variables across these two episodes.[5] This is achieved by explicitly analyzing tax depreciation policy and pass-through businesses while keeping the economic environment as simple as possible, in order to illustrate the mechanisms at play transparently and to showcase the explanatory power of these two elements of the tax code.

Relative to the existing macroeconomic literature, the main contribution of this paper is to illustrate the qualitative and quantitative implications of considering both pass-through businesses and tax depreciation policy when studying the effects of a corporate tax reform. For example, when studying the recent TCJA-17, failing to explicitly consider the pass-through business sector would overestimate the response of aggregate business investment by a factor of two, and restricting tax depreciation policy to be equal to eco-

[5]There are several policy papers that provide forecasts for the effect of major corporate tax reforms, but they are usually limited to the response of output and corporate tax revenues and do not quantify the importance of tax depreciation policy and pass-through businesses in shaping the effect of each reform.

nomic depreciation - as common in macroeconomics - would overestimate the response of aggregate business investment by roughly a factor of five. As a result, failing to consider both tax depreciation policy and pass-through businesses would prevent a standard macroeconomic framework to rationalize the proposed empirical evidence on the recent TCJA-17.

The intuition that the effect of a corporate tax rate cut on corporate investment depends on tax depreciation policy has been theorized by the public finance literature at least since Hall and Jorgenson (1967), and the recent work by Zwick and Mahon (2017) has provided solid empirical evidence in support of this claim. Moreover, recent empirical work has documented the economic importance of the pass-through sector - see for instance Cooper et al. (2016). Unfortunately, these insights in isolation are not sufficient to pin down the macroeconomic response of the economy to a corporate tax reform. As a result, the main contribution of this paper to the public finance literature is to illustrate the qualitative and quantitative importance of tax depreciation and pass-through businesses in shaping the joint response of investment, payouts to shareholders, and corporate tax revenues in response to a corporate tax reform. This is easily achieved thanks to a general equilibrium modeling approach, which naturally provides restrictions on the comovement of a large set of variables of interest.

The paper also provides some novel empirical results. Following the TCJA-17, this paper documents a small impact on aggregate variables by extending and complementing Kopp et al. (2019), who focus on investment. It is the first to show a larger response in the c-corporate sector by aggregating firm-level data, and to document a shift of economic activity from pass-through businesses to c-corporations using publicly available IRS data - some of which have been manually digitalized and made available in the replication package.

Finally, this paper provides two analytic results directly related to the optimal capital taxation literature in macroeconomics which stems from the seminal contributions of Chamley (1986) and Judd (1985). The first result is a mapping between corporate taxes and capital taxes which shows that thinking of corporate taxes as a form of taxation on the income produce by the factor of production 'capital' - as suggested for example in Lucas (1990), Atkeson et al. (1999), Mankiw et al. (2009) - ignores the key role of deducting investment from the tax base. This mapping is established in an economic environment isomorphic to the one in Chamley (1986), and relies on the definition of the corporate tax base rather than on alterations of the economic environment. This result clarifies how the small stimulus to capital accumulation after the recent TCJA-17 is consistent with a large body of macroeconomics research that attributes large distortions to capital taxation.

The second result is that - in a frictionless environment - the corporate tax can efficiently collect positive tax revenues in the long-run. It is an extreme result, yet useful to show that the collection of corporate tax revenues can be (at least partially) decoupled from the distortions caused to capital accumulation.[6] This insight is key to explain the sizable loss of corporate tax revenues in spite of the small stimulus to the economy after the TCJA-17, something that a capital tax in a standard macroeconomic environment would not be able to reproduce.

[6] Abel (2007) makes the very same point suggesting that it is possible to collect tax revenues efficiently by subsidizing capital producers, and this paper simply highlights that a corporate tax with full-expensing can be precisely thought of as a capital tax accompanied by a subsidy to investment at the same rate.

2 Empirical Evidence on the TCJA-17

This section presents evidence on the effects of the Tax Cuts and Jobs Act of 2017. I first examine aggregate and c-corporate variables by comparing their actual paths with pre-reform forecasts. I then look at the response of both c-corporations and pass-through businesses using tax returns.

A distinctive feature of the analysis is that it explicitly distinguishes between c-corporations - that pay corporate taxes - and pass-through businesses - that do not. Usually, data collection and analysis is organized around the distinction between corporations (c-corporations and s-corporations) and non-corporations (partnerships and sole-proprietorships). When studying corporate tax reforms, however, this categorization is problematic because c-corporations and s-corporations are aggregated together, but the latter do not pay corporate income taxes.

At the aggregate level, the evidence suggests small stimulus and a sharp reduction in corporate tax revenues. The response is larger at the c-corporate level, but the percentage increase in payouts to shareholders outweighs the percentage increase in investment, suggesting that a sizable portion of the tax-savings from the reform were distributed to shareholders. Finally, tax returns shows a shift of economic activity from pass-through businesses to c-corporations.

This section proceeds as follows. The various tax changes introduced by the TCJA-17 are summarized in subsection 2.1, while the empirical evidence is presented and discussed in subsection 2.2 and subsection 2.3.

2.1 The TCJA-17: Corporate Provisions

It is common for recent major US tax reforms to include provisions affecting a variety of tax instruments, and the Tax Cuts and Jobs Act of 2017 is no exception. For example, the reform included changes to individual income taxation, to the estate tax exemption, to the individual mandate penalty, to international tax rules, and introduced a deduction for pass-through income.[7] Since corporate taxation is the main focus of this paper, I summarize the corporate provisions of the TCJA-17 in Table 1.

[7] For real-time assessments of the Tax Cuts and Jobs Act see Tax Foundation (2017), Barro and Furman (2018), Mertens (2018), Gale et al. (2018), Kopp et al. (2019).

Table 1: Corporate Tax Provisions in the TCJA-17

Provision	Static Revenue Change ($bln) 2018-2020
Corporate Tax Rate from 35% to 21%	−357.1
Bonus Depreciation Allowance from 50% to 100%	−93.6
Interest-Deduction Cap	+45.8
Small Business Reform (e.g. Section 179)	−34.6
Additional Changes to Deductions	+35.9
Changes to Loss Treatment	+27.5
AMT Repeal	−20.3
Changes for Insurances, Banks and Fin Instruments	+16.7
Changes to Business Credits	+2.1
Changes Accounting Methods	+5.6

Source: JCT Conference Report for H.R.1.

The two main corporate provisions introduced by the TCJA-17 are a permanent cut to the statutory corporate tax rate from 35% to 21% and a temporary five-year increase in bonus depreciation for assets with an estimated life less than 20 years - basically any fixed capital asset except buildings.[8] These two provisions constitute the focus of the theoretical analysis carried out later in the paper. Another important provision reduces the ability of businesses to deduct interest payments on debt from their tax base, while the remaining provisions are aimed at re-organizing the tax code in an overall revenue-neutral fashion.[9]

The Tax Cuts and Jobs Act was signed into law on December 22 2017, and the vast majority of its provisions became effective in January 2018.

2.2 Aggregate and C-Corporate Response

To assess the response of the US economy to the TCJA-17, I compare actual realizations of macroeconomic and c-corporate variables with pre-reform professional forecasts, and interpret the difference as the estimated effect of the reform.[10]

One issue with this approach is that the TCJA-17 is not the only shock hitting the

[8]Bonus depreciation will gradually phase out starting in 2023.

[9]Bonus depreciation, together with the newly-introduced pass-through income deduction for the individual income tax, affect pass-through businesses as well. Goodman et al. (2021) document almost no response of pass-through businesses to the pass-through income deduction, and pass-through businesses tend to be less capital-intensive then c-corporations. Thus, I abstract from these two pass-through provisions in my main theoretical analysis.

[10]The idea behind this exercise is the same as in Kopp et al. (2019) whose focus is on aggregate business investment.

US economy in 2018. To assess the potential impact of unforeseen shocks, I compute historical forecast errors and use them to construct confidence intervals for the forecasts. These intervals are directly informative about the errors made by forecasters in the past and, to the extent that these errors reflect unanticipated shocks, the intervals do as well.

Another important concern is that pre-reform forecasts might incorporate expectations of an imminent reform, thereby biasing the estimated effect. To assess the extent of anticipation effects in pre-reform forecasts, I first look at the probability of an imminent reform from betting markets data. Panel (a) of Figure 1 reports the probability of a corporate tax cut from the election of former President Trump to the passage of the TCJA-17.

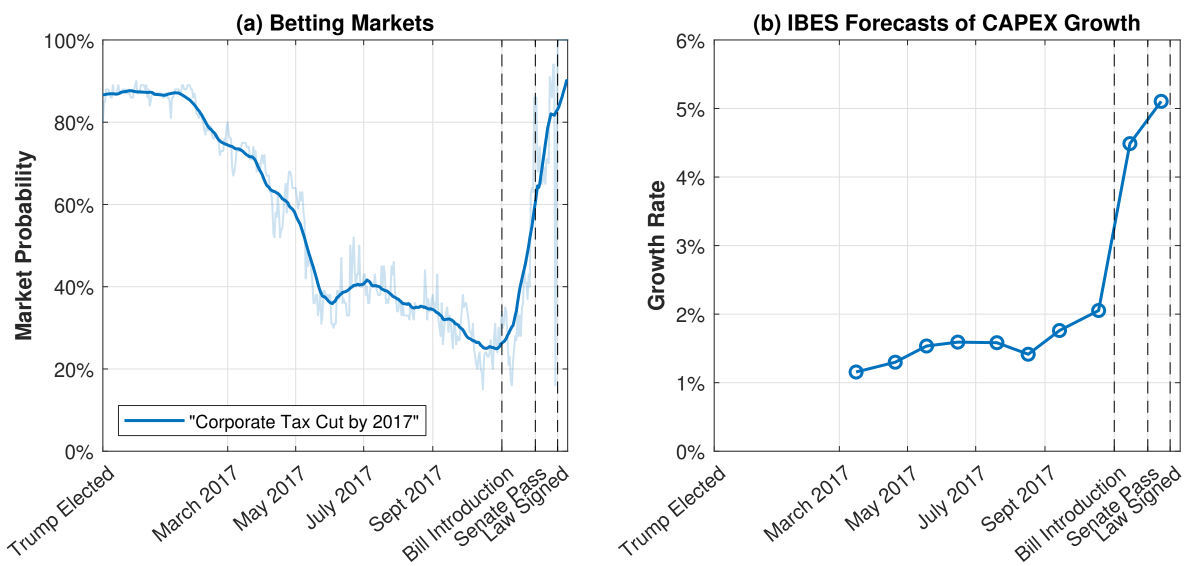

Figure 1: Perceptions of a Corporate Tax Reform before the TCJA-17
Source: IBES, PredictIt.

A corporate tax cut was perceived as almost certain in the first few months after the election, arguably as a reflection of electoral campaign promises. However, as months went by without any legislative action, the perceived probability decreased to around 30% in the summer of 2017. It then picked up once the first draft of the TCJA-17 reform bill was introduced into Congress in the fall of 2017, and increased quickly as the bill passed congressional vote and eventually became law in December 2017.

Based on the probability from betting markets, it appears that forecasts made in the summer of 2017 are the least likely to incorporate anticipation effects. It is possible, however, that betting market participants' beliefs differ systematically from those of professional forecasters. To mitigate this concern, I examine the dynamic evolution of professional forecasts from IBES in Panel (b) of Figure 1. The plot reports the evolution over time of forecasts of capital expenditure growth for 2018. The series exhibits a strong correlation with betting market probabilities, which suggest a similar evolution of beliefs between betting market participants and professional forecasters.

While it is not possible to completely rule out anticipation effects in pre-reform forecasts, it is important to realize that there was no detailed draft of the reform before the fall of 2017, and thus no clear indication of the magnitude and composition of a possible policy intervention. This consideration further mitigates concerns of anticipation effects.

2.2.1 Results for Macroeconomic Aggregates

Forecasts for macroeconomic aggregates come from the Survey of Professional Forecasters (SPF) and are compared to their NIPA counterparts - except for corporate tax revenues where both actuals and forecasts come from the Update to the Budget and Economic Outlook produced by the Congressional Budget Office (CBO). The results are reported in Figure 2.

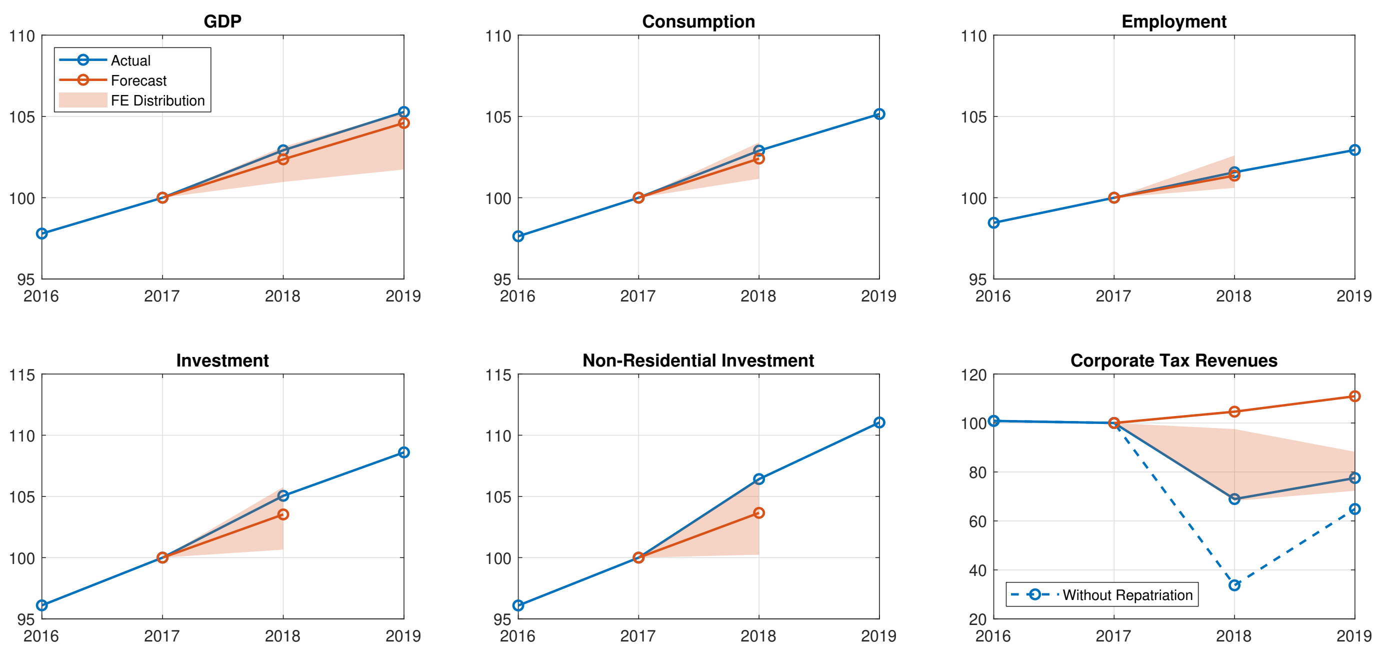

Figure 2: Response of Macroeconomic Aggregates to the TCJA-17
Notes: "Forecast" refers to the median forecast in the SPF, and the point forecast made by the CBO. "FE Distribution" adds to the median forecast the 90% central mass of the forecast error distribution, computed by fitting a kernel density over the forecast errors over the period 2011-2018. Corporate tax revenues are adjusted by subtracting an estimate for tax collection on repatriated profit. Repatriation is measured from the BEA Balance of Payment, and the tax revenue adjustment is computed using a 15% tax rate. All values are normalized to 100 in 2017.

The figure shows small stimulus - a couple of percentage points at best - to output, consumption, employment, and investment. Interestingly, the response of non-residential investment appears larger than that of investment, which is consistent with the idea that the macroeconomic response is driven by the investment decision of the productive sector.

The loss of corporate tax revenues, instead, is dramatic - especially when they are adjusted to filter out the effect of profit repatriation by multinational companies.[11] Since the theoretical framework in this paper features a closed-economy and abstracts from cross-border operations, it is important to have an empirical counterpart that can be used to assess the predictive power of the theory.

2.2.2 Results for C-Corporations

Unfortunately, actuals and forecasts for the c-corporate sector are not readily available. The proposed solution is to aggregate firm-level data from IBES and Compustat and construct measures of economic activity in the c-corporate sector from the micro data. The IBES database contains professional forecasts for large c-corporations. Similarly, Compustat contains detailed information for a large sample of c-corporations.

Figure 3: Response of C-Corporations Aggregates to the TCJA-17

Notes: Perfectly-balanced panel of ≈ 800 firms accounting for ≈ 25% of non-residential investment and ≈ 15% of employment. Forecasts for employment and buyback component of payout are extrapolated using the 2-year growth rate. "FE Distribution" adds to the median forecast the 90% central mass of the forecast error distribution, computed by fitting a kernel density over the forecast errors over the period 2011-2017.

Since Compustat contains information on a large number of c-corporations but not forecasts, my strategy is to first compare actuals with pre-reform forecasts using the IBES dataset, and then compare actuals between IBES and Compustat to assess the representativeness of the former. Figure 3 reports the results for the IBES sample.

[11]To construct repatriated profit I follow Smolyansky et al. (2019) and use a 15% tax repatriation rate to perform the adjustment.

The stimulus to output, investment and employment is larger for the c-corporate sector than for the aggregate economy. In particular, the response of investment in 2018 exceeds pre-reform forecasts by more than 10%, which is consistent with the idea that the investment decision of c-corporations plays a key role.

It is also useful to compare the response of pre-tax income, measured by EBITDA, and after-tax income, measured by net income. While pre-tax income in 2018 is in line with forecasts, after-tax income exceeds forecasts because of the reduction in tax-liabilities due to the TCJA-17. Furthermore, the large response of payouts to shareholders - measured as the sum of dividends and share buybacks - suggests that a big share of those tax-savings were transferred to owners of c-corporations.

Since the IBES sample is skewed towards large c-corporations, I then compare it to a larger sample from Compustat, and the results are reported in Figure 4.

Figure 4: Response of C-Corporations Aggregates to the TCJA-17: IBES vs Compustat
Notes: Perfectly-balanced panel of ≈ 800 firms accounting for ≈ 25% of non-residential investment and ≈ 15% of employment. Forecasts for employment and buyback component of payout are extrapolated using the 2-year growth rate. "FE Distribution" adds to the median forecast the 90% central mass of the forecast error distribution, computed by fitting a kernel density over the forecast errors over the period 2011-2017. Compustat aggregate comprises a perfectly-balanced panel of ≈ 5000 firms accounting for ≈ 50% of non-residential investment and ≈ 30% of employment.

The response of c-corporations in the Compustat sample is similar to the IBES sample. One notable exception is after-tax income, but this is probably due to accounting differences between the two samples. Overall, the IBES sample covers 25% of aggregate business investment and 15% of aggregate employment, while the Compustat sample covers 50% and 30%, respectively. In the rest of the paper, I consider the IBES sample representative of the population of c-corporations.

2.3 C-Corporations vs Pass-Through Businesses

Businesses in the US can choose to operate under one of four major legal forms of organization: sole-proprietorship, partnership, s-corporation and c-corporation. There are several differences between them, but what matters for this paper is how each legal form is taxed. The first three forms of organization are pass-through for tax purposes: the business is not taxed directly, but its income is passed through to the owners who are taxed at the individual income level. C-corporations, instead, are taxed directly with the corporate income tax.[12]

2.3.1 The Size of the Pass-Through Sector

Panel (a) of Figure 5 offers a decomposition of US economic activity in 2017 by legal form of organization.

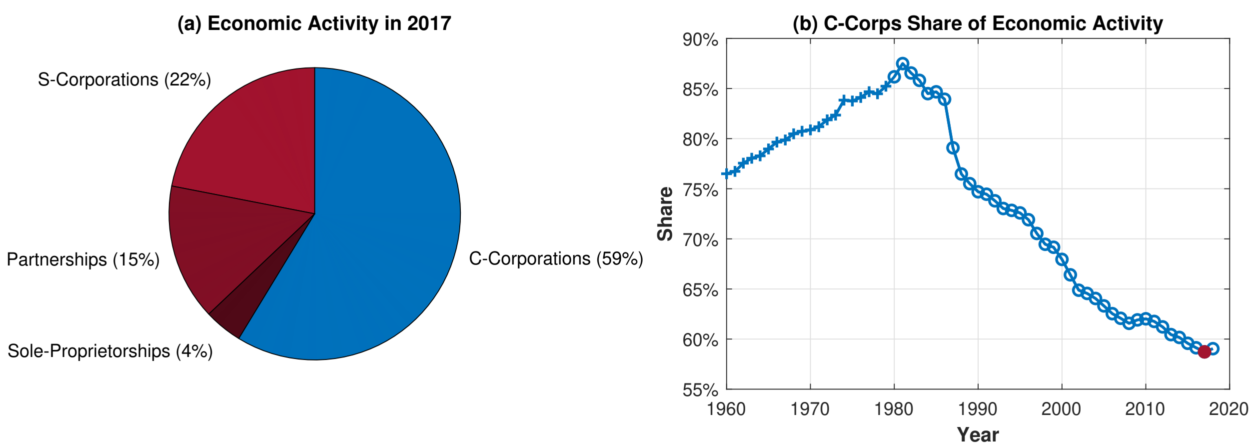

Figure 5: The Size of the Pass-Through Sector in the US Economy
Notes: Economic activity is measured by "Business Receipts" from publicly available aggregated tax returns from IRS SOI. Data before 1980 have been manually collected from scanned version of SOI's Business Income Tax Return Reports and Corporation Income Tax Return Reports.

In 2017, approximately 40% of US economic activity was carried out by pass-through businesses and was not subject to corporate income taxation. Similarly, one fourth of economic activity in the corporate sector was not subject to corporate taxation. These magnitudes highlight the importance of considering explicitly the pass-through sector when analyzing corporate tax reforms.

Panel (b) of Figure 5 shows the evolution of the share of economic activity that is subject

[12] Owners of c-corporations are also taxed through the dividend tax once corporate income is distributed, and through the capital-gains tax if they realize a capital gain thanks thanks to a share price increase.

to corporate income taxation since the early 1960s. There are two clear trends. The first one is the steady increase in pass-through economic activity since the tax reforms of the 1980s. The second one is the rise of c-corporations in the two decades before.
While the dynamic evolution of the pass-through sector reflects intriguing technological, legal and tax considerations, a satisfactory analysis of this phenomenon is beyond the scope of the analysis. What this paper emphasizes is that, at any point in time, the aggregate impact of a corporate tax reform depends on the share of economic activity taking place in the pass-through sector, and this shares has experienced large fluctuations over the last decades.

2.3.2 The Shift of Activity from Pass-Through Businesses to C-Corporations

I turn to publicly available business tax returns from the IRS to assess the response of c-corporations and pass-through businesses to the TCJA-17. The results are displayed in Figure 6.

Figure 6: The Shift of Economic Activity from Pass-Through Businesses to C-Corporations
Notes: All values are computed from the publicly available IRS SOI aggregated tax returns. "Output" is measured by "Business Receipts". "Investment", which is not available for sole-proprietorships, is measured by capital expenditure and is computed as "Depreciable Assets" in year t minus year $t-1$ plus "Depreciation" in year t. "Income Reported by Individuals" defined as the sum of "Ordinary Dividends" and "Qualified Dividends" for c-corporations, and as the sum of "Business or Profession Net Income" and "Partnership and S-Corporation Net Income" for pass-through businesses.

The top row compares the response of output, investment and income reported by individuals for c-corporations and pass-through businesses, while the bottom row reports the share of c-corporate activity for each of these variables. Tax returns suggest an expansion of the c-corporate sector relative to the pass-through sector in response to the TCJA-17, and this is especially clear when one looks at the share of activity happening in the c-corporate sector. The decline in the years before the reform is consistent with the 'secular rise' of pass-through businesses, but the trend is reversed in 2018 after the TCJA-17.

3 Theoretical Framework

This section introduces the theoretical framework and documents its ability to explain the empirical evidence presented in section 2. To illustrate the main mechanism, I introduce a frictionless "baseline model", which is essentially a two-sector neoclassical growth model augmented with tax policy. Despite its simplicity, the model can rationalize the qualitative response of macroeconomic and c-corporate variables to the TCJA-17.

I then enrich the baseline model to improve its quantitative fit, and use this "extended model" to assess the relative importance of the TCJA-17's two main corporate tax provisions: the tax rate cut and bonus depreciation.

3.1 Baseline Model

The model economy is deterministic and populated by a productive sector, a representative household, and a government. The productive sector is further divided into a representative c-corporate sector and a representative pass-through sector. The former is subject to corporate income taxation and distributes its after-tax cash-flows to its shareholders. The latter is not directly subject to taxation, and its cash-flows are 'passed-through' to its shareholders. In the rest of the paper, variables relating to the pass-through sector will be denoted with a tilde.

The representative household solves the following optimization problem:

$$\max \quad \sum_{t=0}^{+\infty} \beta^t \frac{\hat{c}_t^{1-\sigma}}{1-\sigma}$$

$$s.t. \quad \hat{c}_t = c_t^{\gamma} \cdot \tilde{c}_t^{1-\gamma}$$

$$c_t + p_t \tilde{c}_t + \Delta S_{t+1} P_t + \Delta \tilde{S}_{t+1} \tilde{P}_t = (1 - \tau^{II}) \cdot \left[w_t l_t + \tilde{w}_t \tilde{l}_t + S_t d_t + \tilde{S}_t \tilde{d}_t \right] + \text{Transfer}_t$$

$$l_t + \tilde{l}_t = 1, \quad l_t = l, \quad \tilde{l}_t = \tilde{l}$$

$$\Lambda_{t+j,t} \equiv \beta^j \cdot \frac{u'(\hat{c}_{t+j})}{u'(\hat{c}_t)}$$

where c_t is consumption of goods from c-corporations, $\tilde{c}_t$ is consumption of goods from pass-through businesses, and $\hat{c}_t$ is a consumption bundle constructed using a Cobb-Douglas aggregator. The good produced by the c-corporate sector is the numeraire, and p_t is the (relative) price of the good produced by pass-through businesses. The household supplies labor inelastically to each sector, and receives wages equal to w_t and $\tilde{w}_t$ each period. She also invests in shares of each sector, that trade at prices P_t and $\tilde{P}_t$.[13] Owner-

[13]In equilibrium, the supply of each type of shares will be fixed and normalized to one.

ship of the productive sector entitles the household to dividends d_t from c-corporations, and pass-through income $\tilde{d}_t$ from pass-through businesses. Finally, the household pays individual income taxes and receives transfers from the government. For simplicity, I assume that there is a uniform individual income tax rate τ^{II} on labor income, dividends and pass-through income.[14] Finally, the household's intertemporal marginal rate of substitution $\Lambda_{t,t+j}$ will be used by the productive sector when making intertemporal decisions.

To better understand how corporate tax reforms affect the economy, I impose as much symmetry as possible between c-corporations and pass-through businesses. Each sector accumulates its own capital stock through investment, hires labor competitively, and produces a final good using a constant return-to-scale technology. However, only c-corporations pay corporate income taxes.

C-Corporations

$$\begin{aligned}
\max \quad & \sum_{t=0}^{+\infty} \Lambda_{0,t} d_t \\
s.t. \quad d_t &= \pi_t - T_t^{\pi} \\
\pi_t &= Y_t - w_t l_t - i_t \\
k_{t+1} &= (1-\delta) k_t + i_t \\
Y_t &= k_t^{\alpha} \cdot l_t^{1-\alpha} \\
T_t^{\pi} &= \tau^{\pi} \cdot TB_t^{\pi} \\
TB_t^{\pi} &= Y_t - w_t l_t - ID_t^{\pi}
\end{aligned}$$

Pass-Through Businesses

$$\begin{aligned}
\max \quad & \sum_{t=0}^{+\infty} \Lambda_{0,t} \tilde{d}_t \\
s.t. \quad \tilde{d}_t &= \tilde{\pi}_t \\
\tilde{\pi}_t &= p_t \cdot \tilde{Y}_t - \tilde{w}_t \tilde{l}_t - p_t \cdot \tilde{i}_t \\
\tilde{k}_{t+1} &= (1-\tilde{\delta}) \tilde{k}_t + \tilde{i}_t \\
\tilde{Y}_t &= \tilde{k}_t^{\tilde{\alpha}} \cdot l_t^{1-\tilde{\alpha}}
\end{aligned}$$

Corporate income taxes T_t^{π} are computed by multiplying the corporate income tax base TB_t^{π} by the statutory corporate income tax rate τ^{π}. The corporate income tax base differs from corporate cash-flows because investment is usually not treated as an expense, but is deducted according to a tax depreciation schedule.[15] As a result, a fraction of present and past investment is deducted from the tax base each period, and this represents the investment deduction ID_t^{π} allowed by the tax code.

[14] In practice, dividends are taxed at a preferential rate, there are numerous deductions and exemptions, and there are tax brackets. Since my main theoretical experiments will involve changing the corporate tax rate while leaving the individual income tax rate unchanged, a uniform individual income tax rate will preserve my main conclusions.

[15] In reality, firms use a mix of capital assets to produce their final goods, and each asset category is potentially subject to a different tax depreciation schedule. Therefore, the capital stock in the model should be interpreted as a representative business capital, and the tax depreciation schedule as a representative tax depreciation schedule for business capital.

In general, the investment deduction for a generic period t is given by:

$$ID_t^\pi = \sum_{j=0}^{+\infty} \delta_j^\pi \cdot i_{t-j}$$

where the policy parameters $\{\delta_j^\pi\}_{j=0}^{+\infty}$ represent the percentage of investment from j periods ago that can be deducted from the tax base. Investment is eventually deducted from the tax base in full, so that the policy parameters sum up to one. To improve tractability and build intuition, I approximate the tax depreciation schedule using a declining-balance tax depreciation schedule, which permits the aggregation of all non-depreciated past investment into an auxiliary variable k_t^π.[16] The investment deduction can then be rewritten as

$$\begin{aligned} ID_t^\pi &= \delta^\pi \cdot (i_t + k_t^\pi) \\ \text{where} \quad k_{t+1}^\pi &= (1 - \delta^\pi) \cdot (i_t + k_t^\pi) \end{aligned}$$

The auxiliary variable k_t^π represents the stock of past investment that has not been depreciated for tax purposes yet, and δ^π is now the only policy parameter summarizing the tax depreciation schedule.[17] In this way, the corporate tax code is fully summarized by the pair (τ^π, δ^π).

To close the model, I introduce a government that collects tax revenues that can go into wasteful spending or into transfers to the representative household:

$$\begin{aligned} T_t &= T_t^\pi + T_t^{II} \\ G_t &= \theta \cdot T_t \\ \text{Transfer}_t &= (1 - \theta) \cdot T_t \end{aligned}$$

where T_t^{II} are individual income tax revenues, T_t are total tax revenues, and G_t is wasteful spending. The parameter $\theta \in [0, 1]$ determines the share of tax revenues that go into wasteful spending. When $\theta = 0$, all tax revenues are distributed back to the representative household.

[16] Winberry (2021) adopts the same approximation. In Furno (2021), I show that the error due to this approximation is negligible in standard economic environments.

[17] Notice that $\delta_j^\pi = \delta^\pi \cdot (1 - \delta^\pi)^j$.

3.2 The Investment Decision and the Tax Bill of C-Corporations

In the baseline model, the investment decision of the c-corporate sector is driven by the following Euler Equation:

$$1 = \Lambda_{t,t+1} \left[\underbrace{\frac{1-\lambda^{\pi}_{t+1}\tau^{\pi}}{1-\lambda^{\pi}_{t}\tau^{\pi}}}_{\approx 1} \cdot (1-\delta) + \underbrace{\frac{1-\tau^{\pi}}{1-\lambda^{\pi}_{t}\tau^{\pi}}}_{\text{"Corporate Tax Wedge"}} \cdot MPK_{t+1} \right]$$

$$\text{where} \quad \lambda^{\pi}_{t} = \underbrace{\sum_{j=0}^{+\infty} \Lambda_{t,t+j} \cdot \left[(1-\delta^{\pi})^{j} \cdot \delta^{\pi} \right]}_{\text{PDV of tax depreciation schedule}}$$

The distortion to the investment decision introduced by the corporate tax code shows up in the form of a wedge, that I label as the "corporate tax wedge". This wedge is jointly determined by the statutory tax rate and the present discounted value of the tax depreciation schedule. This result mirrors Hall and Jorgenson (1967), and can be thought of as an extension to general equilibrium thereof.[18]

A higher value of δ^{π} reflects a more accelerated tax depreciation policy, which in turn implies that both λ^{π}_{t} and the corporate tax wedge are closer to one. As a result, even when the statutory tax rate is high, the distortions to the investment decision can be small if tax depreciation policy is highly accelerated.

The tax rate and tax depreciation policy also determine the tax bill of c-corporations:

$$T^{\pi}_{t} = \tau^{\pi} \cdot \left[Y_t - w_t l_t - \sum_{j=0}^{+\infty} \delta^{\pi} \cdot (1-\delta^{\pi})^{j} \cdot i_{t-j} \right]$$

However, changes to the corporate tax code do not affect the investment decision and the tax bill in the same way. It is possible - and this is key to understand the TCJA-17 - to conceive a corporate tax reform that leaves the corporate tax wedge almost unchanged, while producing a big change to the corporate tax bill.

3.3 Calibration to the US Economy before the TCJA-17

I calibrate the model to the US economy in 2017, just before the TCJA-17. Several parameters - such as the discount rate, the household's IES, economic depreciation and the labor

[18] This happens because the baseline model is a neoclassical model. In general, when the economic environment is enriched with frictions, it is not possible to summarize the distortions to the investment decision in such a clear-cut way.

share - are standard. I calibrate labor supply and the exponents of the Cobb-Douglas consumption aggregator to match the relative size of the c-corporate and pass-through sectors.

Table 2: Calibration of the Baseline Model

Parameter	Value	Notes
β	0.94	Rate of time preferences
σ	1	IES
$\delta = \tilde{\delta}$	0.10	Physical depreciation rate
$\alpha = \tilde{\alpha}$	0.35	Labor share (= 0.65)
l	0.575	C-Corps share of salaries and wages
γ	0.575	C-Corps share of business receipts
τ^{π}	0.35	Statutory Corporate Tax Rate
δ^{π}	0.4823	Tax Depreciation Rate
τ^{II}	0.135	Average effective tax rate
θ	0	Mimic a debt-financed tax cut

The tax code is calibrated as follows. The corporate tax rate is set equal to the statutory corporate tax rate. The tax depreciation rate δ^{π} is set in such a way that it matches the present discounted value of a representative tax depreciation schedule computed using the same methodology proposed in Zwick and Mahon (2017). This present discounted value averages tax depreciation schedules for different types of capital assets, and includes the 50% bonus depreciation that was in place in 2017 - see subsection A.1 for the details. The individual income tax rate is set equal to the average effective tax rate computed from publicly available individual income tax returns from the IRS. Finally, in order to mimic a debt-financed tax cut, I assume that all tax revenues are transferred back to the representative household by setting $\theta = 0$.

Table 3 shows that the calibrated model's deterministic steady-state is able to reproduce four important empirical moments: corporate profits, dividends, corporate tax revenues and individual income tax revenues as a share of GDP. These moments are not explicitly targeted by the calibration, but the model can match them well because the way the variables are defined in the model is a good approximation of what happens in practice.

Table 3: Fit of Key Untargeted Moments

Moment	Model (SS)	Data
π/Y	0.08	0.10
d/Y	0.05	0.05
T^{π}/Y	0.03	0.02
T^{II}/Y	0.10	0.08

Notes: Model (SS) refers to the deterministic steady-state of the model. Data comes from NIPA and span the period 2012-2017. Corporate profit and dividends in the NIPA refer to both c-corporations and s-corporations, thus slightly over-estimating the value for c-corporations alone.

Matching these four untargeted moments ensures that the size of the corporate sector and of the government's tax collection in the model is representative of the US economy before the TCJA-17.

3.4 The TCJA-17: Model vs Data

The Tax Cuts and Jobs Act of 2017 is simulated by starting from the calibration in Table 2 and introducing an unanticipated permanent change to the following policy parameters:

- A permanent reduction in the corporate tax rate τ^{π} from 35% to 21%.
- A permanent increase in the tax depreciation rate δ^{π} from 0.4823 to 0.8305.

The change to the tax depreciation rate increases the present discounted value of the representative tax depreciation schedule in steady-state from $\approx$ 0.94 to $\approx$ 0.99.[19] While the TCJA-17 increased bonus depreciation only temporarily, US policy-makers have repeatedly extended expiring bonus depreciation over the last couple of decades. It is not unreasonable to believe that bonus depreciation will be extended upon expiration, which justifies the assumption of a permanent change. Importantly, since the increase in bonus depreciation only applies to new investment, I introduce auxiliary variables to distinguish between old and new investment for tax purposes - see subsection A.2 for details.

The results from the model are presented and compared to the empirical evidence in Figure 7. The first column describes the response estimated in the data, and the second column the response from the model. The first row focuses on macroeconomic aggregates, and the second on c-corporate ones.

[19] I allow for 90% bonus depreciation, instead of 100%, to take into account the fact that the TCJA-17 placed some restrictions on asset eligibility. See subsection A.1 for the details.

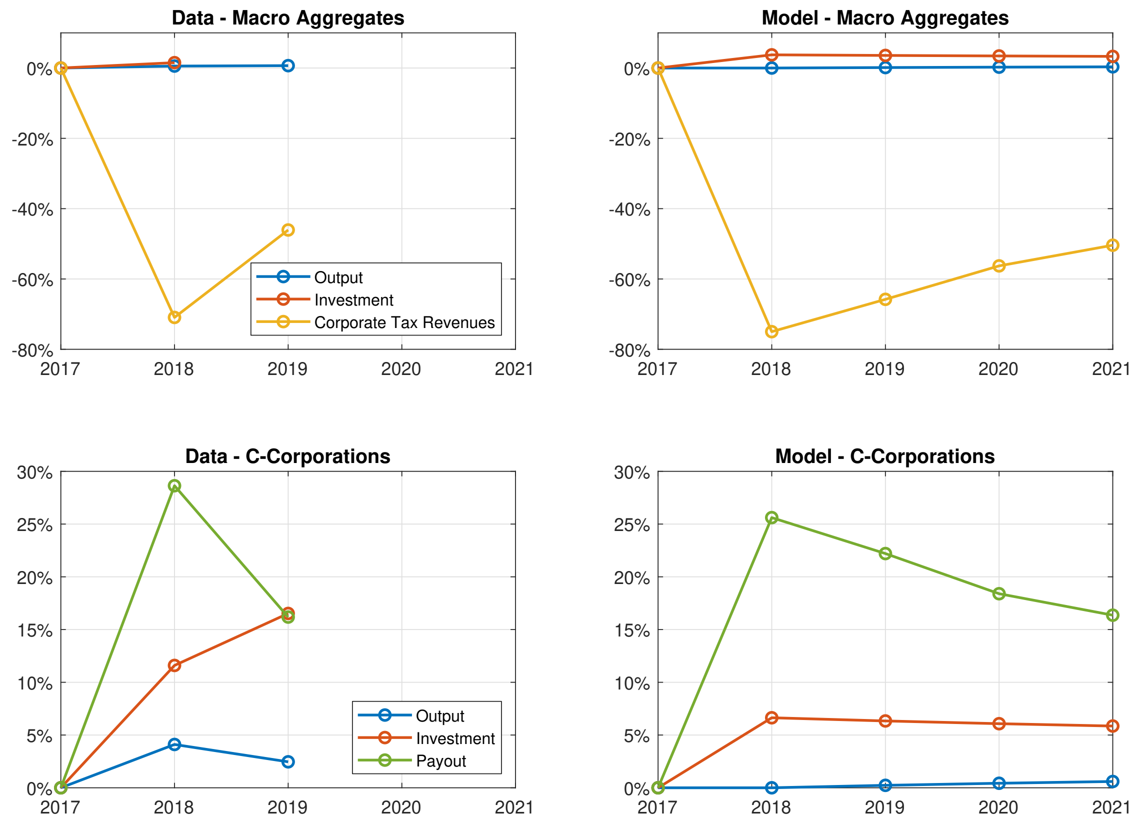

Figure 7: The TCJA-17: Model vs Data
Notes: Empirical moments are computed as the difference between the actual realizations and the pre-reform forecasts from section 2. The empirical response of corporate tax revenues is adjusted to eliminate the effect of profit repatriation.

The model successfully reproduces the relative responses of aggregate and c-corporate variables estimated in the data. At the aggregate level, the model predicts a small response of output and investment, and a large fall in corporate tax revenues. Moreover, the response of investment is larger than that of output. At the c-corporate level, the model predicts an increase in payouts to shareholders larger than investment - in line with the data. Again, the response of investment is larger than that of output.

The intuition behind what happens can be broken down into two pieces. The first piece clarifies the response of c-corporations. Because of highly accelerated tax depreciation policy before the TCJA-17, the pre-reform corporate tax wedge was close to one (≈ 0.97 under the proposed calibration). As a result, the ability of the reform to further remove distortions was very limited in the first place, and ended up providing little stimulus to c-corporate investment. At the same time, the tax-savings due to the reform were large, and c-corporations found themselves with a sizable amount of additional cash. Given their limited desire to increase investment, they distributed a big share of this extra cash to their shareholders.

The second piece of intuition helps understand the even smaller response at the aggregate level. On the one hand, given a large share of pass-through businesses, the corporate provisions in the TCJA-17 applied to only 60% of the productive sector (measured in terms of economic activity). On the other hand, the remaining 40% was not only not stimulated, but was in fact put at a competitive disadvantage relative to prior the reform, which produced a shift of economic activity from pass-through businesses to c-corporations. Overall, this resulted in further dilution of the aggregate stimulus.

3.4.1 Improving Fit: An Extended Model

The baseline model can reproduce the overall pattern of macroeconomic and c-corporate responses, but is not able to offer a good quantitative fit for the response of some of the variables. In particular, Figure 8 shows that the response of output and investment for c-corporations is smaller than in the data. This is partly due to the assumption of exogenous labor supply, which reduces the ability of c-corporations to respond to the stimulus by hiring more workers.

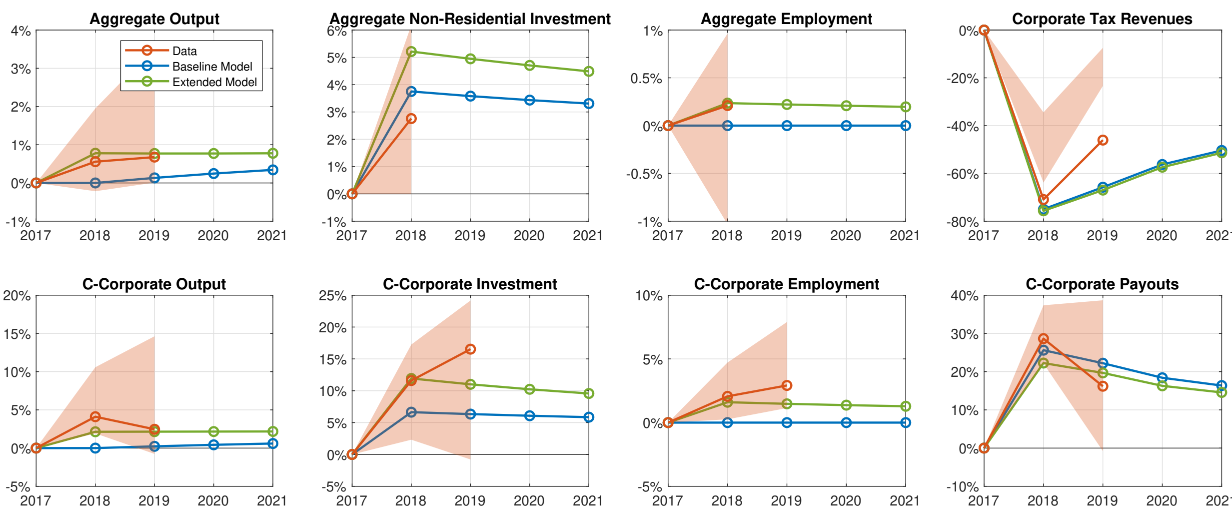

Figure 8: Quantitative Fit of the Baseline and Extended Model

To improve the quantitative fit, I alter the baseline model in three ways. First, I endogenize labor supply and assume it is mobile across the two sectors. Second, I assume a more general CES consumption aggregator for the representative household. Third, I assume variable capital utilization. The additional parameters are calibrated in a standard way and the details can be found in subsection A.3. The "extended model" response is given by the green lines in Figure 8.

Endogenous labor supply that can move across the two sectors facilitates re-allocation of economic activity across sectors. Similarly, a CES consumption bundle allows household's spending to shift towards the goods produced by c-corporations - which are now relatively cheaper. Finally, variable capital utilization amplifies the response of c-corporate output as it gives an additional margin of adjustment to the c-corporate sector.

3.4.2 Decomposing the TCJA-17: Tax Rate Cut vs Bonus Depreciation

I use the "extended model" to perform a counterfactual assessment of the importance of each of the two main corporate provisions in the TCJA-17, and the results for c-corporate investment and corporate tax revenues are reported in Figure 9.

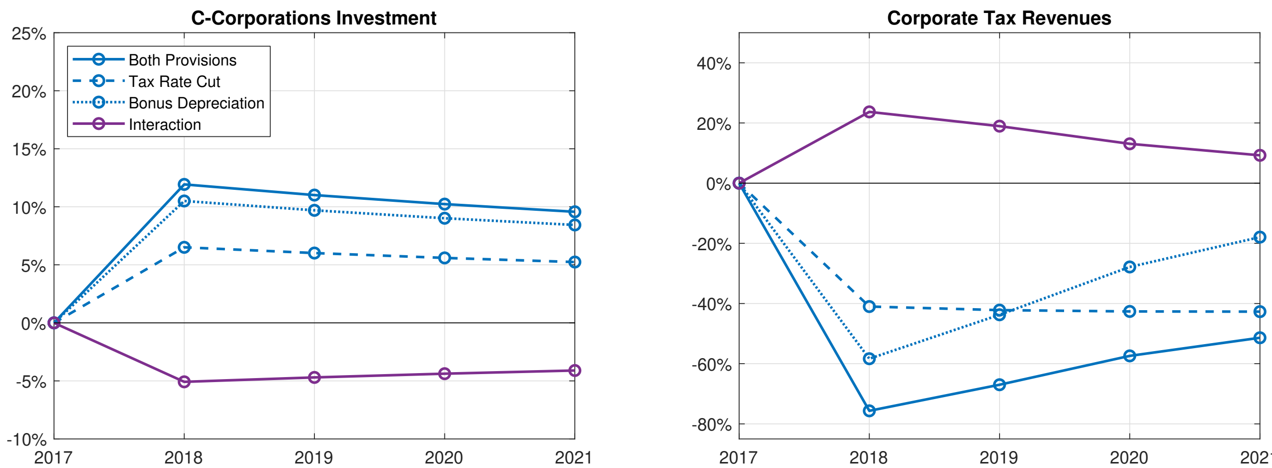

Figure 9: Decomposing the TCJA-17: Tax Rate Cut vs Bonus Depreciation

First, the expansionary effect of each provision on the investment of c-corporations is similar, as both are aimed at removing distortions to the investment decision.

Second, the interaction between these two provisions is negative. A cut to the corporate tax rate is more expansionary when the present discounted value of the tax depreciation schedule is lower. Similarly, the effect of bonus depreciation is larger when the tax rate is higher. By reducing the tax rate while accelerating the depreciation schedule, the two provisions partially offset each other.

Third, the effect of these two provisions on corporate tax revenues is similar on impact, but is different in the long-run. A reduction of the tax rate produces a permanent loss of corporate tax revenues. An acceleration of the tax depreciation schedule, instead, results in a transitory one.

4 Trump vs Kennedy

This section compares the recent Trump's TCJA-17 with the Kennedy's corporate tax cuts of the early 1960s through the lens of the theoretical framework proposed in the previous section.

The Kennedy's tax cuts were implemented between 1962 and 1965. The Revenue Act of 1962 introduced a 7% investment tax credit for businesses. In the same year, the IRS also issued a new set of more accelerated tax depreciation guidelines. The Revenue Act of 1964 then reduced the top individual tax rate from 91% to 70%, reduced individual tax rates across brackets, created the standard deduction, and reduced the corporate tax rate from 52% to 48%. In this section, I focus on the three corporate income tax provisions and follow Romer and Romer (2010) in classifying them as debt-financed.[20]

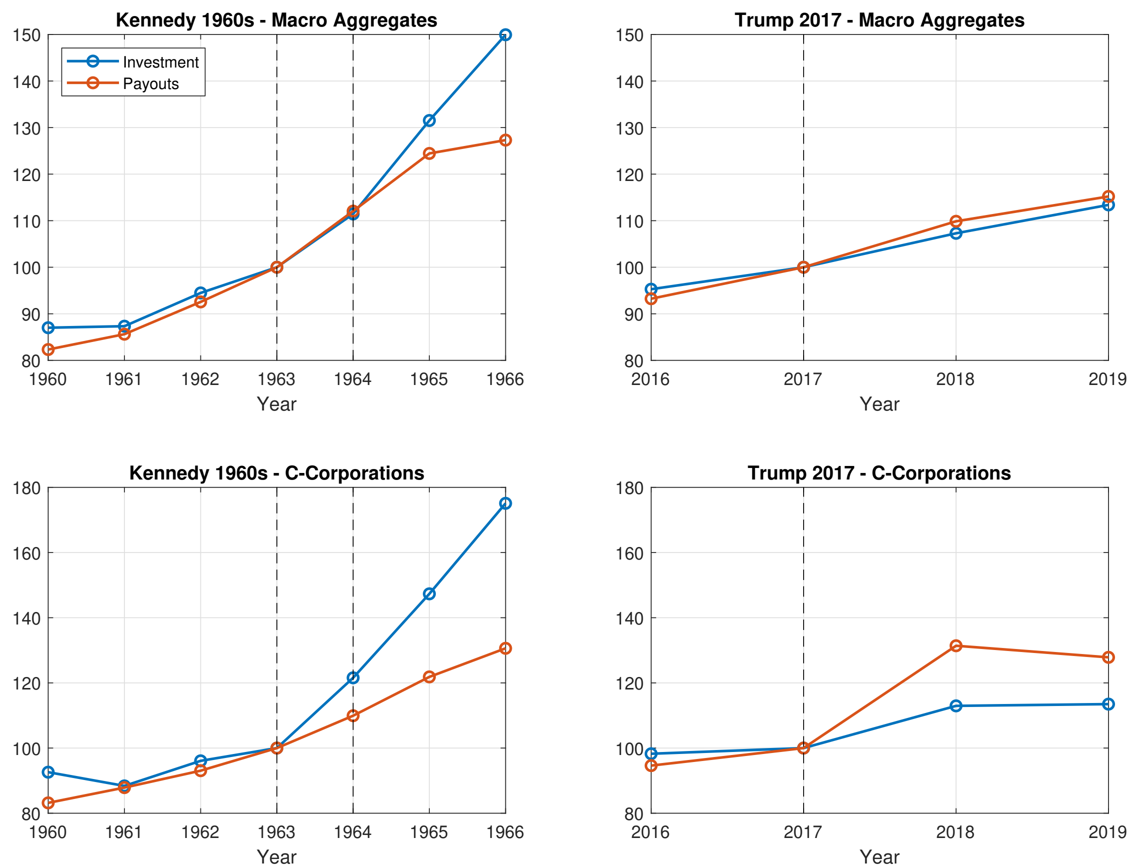

Figure 10: Investment and Payouts for Kennedy's and Trump's Reforms
Notes: Macro aggregates come from the NIPA, while data for c-corporations from Compustat. For the Kennedy's tax cuts, a perfectly-balanced sample of ≈ 760 c-corporations accounts for ≈ 35% of business investment. For the TCJA-17, a perfectly-balanced sample of ≈ 5000 c-corporations accounts for ≈ 50% of business investment.

While it is difficult to obtain estimates of the effects of the Kennedy's tax cuts due to

[20] For additional details on the Kennedy's tax cuts see Greenberg et al. (2016).

data availability, the time-series of investment and payouts to shareholders reported in Figure 10 reveal an interesting pattern.

The increase in payouts to shareholders outweighs the increase in investment after the recent TCJA-17, but not after the Kennedy's tax cuts. This can be observed both at the aggregate and at the c-corporations level. In fact, payouts does not appear to deviate much from the pre-reform trend, unlike investment which exhibits a clear acceleration. The increase in capital formation is gigantic: aggregate business investment is 50% higher in 1966 than in 1963, and c-corporations' investment is 80% higher.

4.1 Model-Implied Corporate Tax Multipliers

I use the "extended model" to assess the effects of each reform on GDP, aggregate investment and payouts to shareholders. By construction, the counterfactual experiment explains different macroeconomic outcomes through pre-existing differences in the corporate tax code, in the size of the pass-through sector, and in the composition of the policy intervention.

The TCJA-17 is simulated in the same way as before. The Kennedy's corporate tax cuts are simulated as follow. I start from the calibration for 2017 and adjust the corporate tax rate, the tax depreciation rate, and the weights of the CES consumption aggregator to match corporate tax policy and the pass-through share in 1961. I then simulate the Kennedy's tax cuts as unanticipated permanent changes to the following policy parameters:

- A permanent reduction in the corporate tax rate τ^{π} from 52% to 48%.
- A permanent increase in the tax depreciation rate δ^{π} from 0.10 to 0.1857.

As for the TCJA-17, the new tax depreciation rate applies only to new investment and further details can be found in subsection A.2.

The results are reported in Figure 11. In response to the Kennedy's tax cuts, the model predicts a large increase in GDP and investment, and a small effect on payouts to shareholders: the opposite of Trump's Tax Cuts and Jobs Act. Similarly, the corporate tax multiplier for Kennedy's tax cuts is around 2.5 for GDP, 1.85 for investment, and close to zero for payouts to shareholders. For the TCJA-17, the multiplier is around 0.6 for each variable. For every dollar of lost corporate tax revenues, the Kennedy's corporate tax cuts stimulated GDP four times more than the TCJA-17.

The intuition behind these results is the following. In the early 1960s, the corporate tax rate was high and tax depreciation policy was not accelerated as it was mimicking economic depreciation. As a result, the corporate tax wedge was well below one (around 0.72) before the reform. The Kennedy's tax cuts increased the wedge significantly (to around 0.84), thus providing strong stimulus to the investment of c-corporations. Moreover, since around 75% of economic activity was taking place in the c-corporate sector, the aggregate effect was less diluted than in 2017.

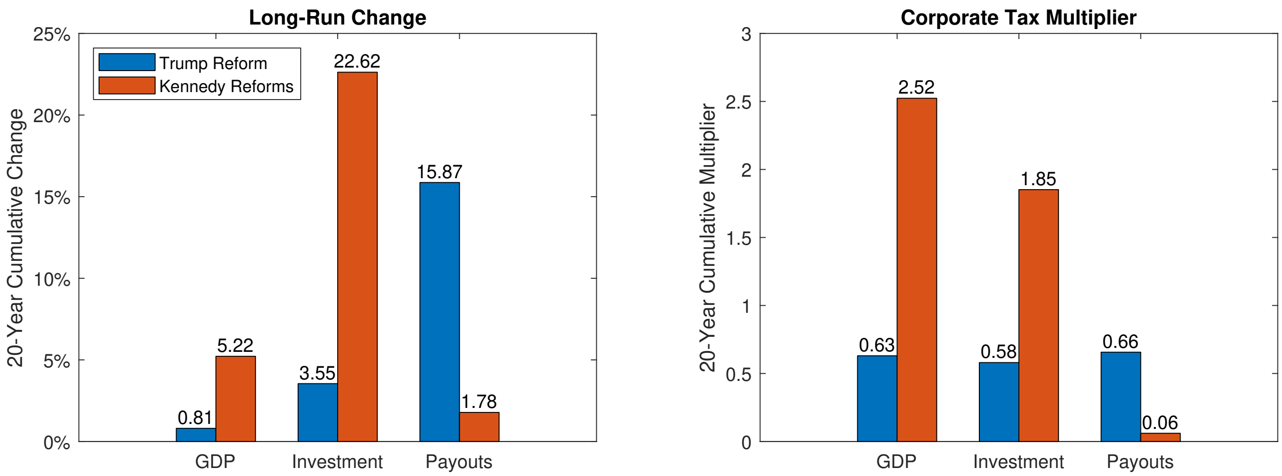

Figure 11: The TCJA-17 vs Kennedy's Corporate Tax Cuts
Notes: The long-run change is computed as the 20-year cumulative deviation from the steady-state, obtained by summing the level of each variable for 20 years after the reform and dividing it by its counterpart in the absence of the reform. The corporate tax multiplier is computed as the cumulative change in the level of each variable and divided by the cumulative change in corporate tax revenues.

To better understand how each factor (i.e. tax rate, tax depreciation, pass-through share, policy intervention) contributed to the outcomes reported in Figure 11, I perform another counterfactual experiment.

First, I control for differences in the policy intervention by simulating the exact same reform in both 1961 and 2017: an unanticipated permanent reduction in the corporate tax rate by 10%. Then, I start from the calibration for 2017 and simulate the reform after changing one of the tax rate, tax depreciation rate and pass-through share at a time. So, for example, I take the calibration for 2017, set the tax depreciation rate equal to that in 1961, and simulate the reform. I repeat the same for the tax rate and the pass-through share. The results are reported in Figure 12.

The exercise shows that differences in tax depreciation policy between the early 1960s and 2017 account for most of the difference in the macroeconomic response to the reform. Looking at long-run changes, differences in pre-reform corporate tax rates and in the pre-reform share of pass-through businesses contribute similarly to the difference between the two reforms. The interaction between these three factors, instead, can be assessed by looking at the difference between the first and the second vertical bar for each variable. For example, under the 1961 calibration, the long-run investment response is +14.24%, while the response under the 2017 calibration with each factor introduced at a time is only +8.39%, which implies an interaction effect of +5.85%.

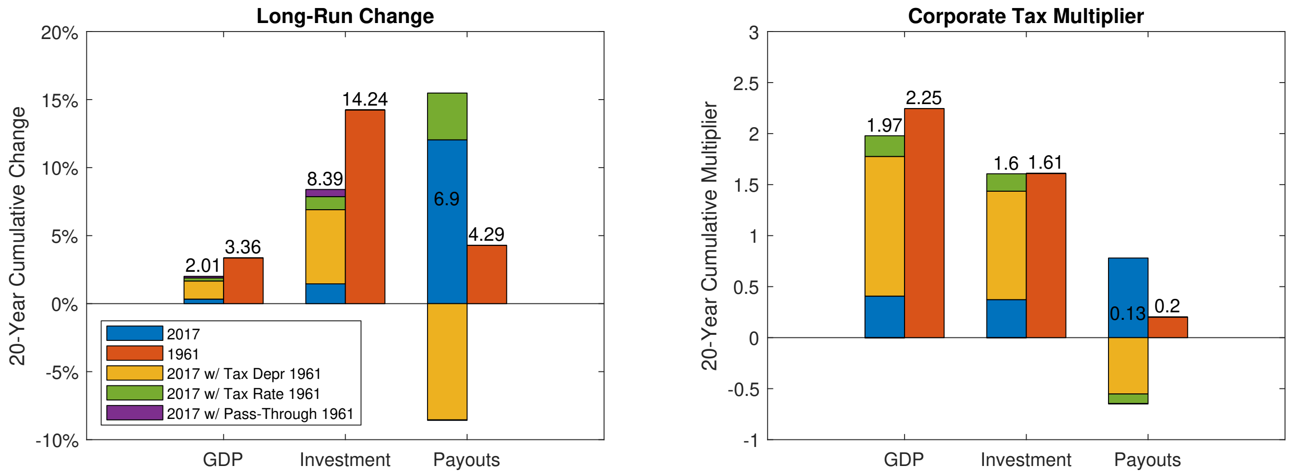

Figure 12: Understanding the Difference between the TCJA-17 and Kennedy's Reforms

For the corporate tax multiplier, interaction effects appear to be smaller. Moreover, the multiplier is unaffected by the size of the pass-through sector. This happens because a smaller pass-through sector implies larger aggregate stimulus after a corporate tax cut, but also a larger loss of corporate tax revenues - since a larger share of the economy receives the tax cut. The multiplier takes into account both effects, which almost perfectly offset each other in this specific experiment.

5 Analytic Insights

This section offers analytic results to build intuition about specific aspects of the theory. To obtain these results, I start from the "baseline model" and assume away pass-through businesses and individual income taxes by setting $\gamma = l = 1$ and $\tau^{II} = 0$. With these restrictions, I recover a neoclassical growth model featuring a corporate tax levied on the entire productive sector.

Since it is common in macroeconomics to think about corporate taxation as a form of capital taxation, I first provide a formal mapping between capital taxes and corporate taxes. I show that corporate taxes are isomorphic to a capital tax accompanied by investment subsidies. I then prove that, in the steady-state, it is possible for the government to collect corporate tax revenues and remove distortions to investment at the same time. Finally, I derive the analytic steady-state of the model and use it to characterize corporate tax distortions over the last few decades in the US.

5.1 Corporate vs Capital Taxes

It is possible to relate the proposed corporate tax with the familiar concept of a "capital income tax", i.e. a tax imposed on the income produced by the productive factor "capital". Under a constant return-to-scale technology, it is possible to unambiguously define capital income using Euler Theorem:

$$Y_t = \underbrace{MPK_t k_t}_{\text{capital income}} + \underbrace{MPL_t l_t}_{\text{labor income}}$$

Let's now consider the corporate tax base:

$$TB_t^{\pi} = Y_t - w_t l_t - ID_t^{\pi}$$

Since the labor market is competitive, $w_t = MPL_t$. By Euler Theorem, $Y_t - MPL_t l_t = MPK_t k_t$. Writing the investment deduction as a function of current and past investment, the corporate tax base becomes:

$$TB_t^{\pi} = MPK_t k_t - \sum_{j=0}^{+\infty} \delta^{\pi}(1-\delta^{\pi})^j i_{t-j}$$

which clarifies that a corporate tax in this framework is isomorphic to a capital tax accompanied by a set of subsidies to current and past investment. The size of the subsidies is dictated by the tax depreciation schedule.

To fix ideas, consider now the special case where $\delta^{\pi} = 0$, i.e. investment is not deductible from the tax base: the investment deduction is zero, and the corporate tax becomes equivalent to a capital tax. Consider then the special case where $\delta^{\pi} = 1$, i.e. investment is fully and immediately deductible from the tax base: the corporate tax is equivalent to capital tax accompanied by a subsidy to current investment at the same rate.

5.2 Corporate Tax Revenues

Under full-expensing of investment (i.e. $\delta^{\pi} = 1$), the corporate tax wedge becomes one and the distortion to the Euler Equation for capital accumulation disappears. It is interesting to see whether the corporate tax can actually collect revenues in such a case. Notice that, in light of the equivalence pointed out in subsection 5.1, this is fundamentally the same question asked in Abel (2007).

It is possible to prove that the corporate tax can collect tax revenues in the steady-state even with full-expensing of investment. Consider the corporate tax base in steady-state:

$$TB^{\pi}_{ss} = MPK_{ss} \cdot k_{ss} - i_{ss}$$

Since $i_{ss} = \delta k_{ss}$, the tax base can be rewritten as

$$TB^{\pi}_{ss} = k_{ss} \cdot (MPK_{ss} - \delta)$$

Therefore, corporate tax revenue collection is positive if $MPK_{ss} - \delta > 0$. In steady-state, the Euler Equation for capital accumulation becomes

$$1 = \beta\Big[1 - \delta + MPK_{ss}\Big]$$

which implies that

$$MPK_{ss} - \delta = \frac{1}{\beta} - 1 \equiv \rho$$

where $\rho > 0$ is the rate of time preferences. Therefore

$$TB^{\pi}_{ss} > 0$$

and the corporate tax can collect revenues in a non-distortionary fashion.

5.3 Corporate Tax Distortions over Time

It is possible to solve analytically for the deterministic steady-state of the model and express it as a function of its 'undistorted' counterpart, i.e. the deterministic steady-state in the absence of corporate taxation (i.e. when $\tau^\pi = 0$). Long-run output (Y_{ss}) can be expressed as

$$Y_{ss} = Y^*_{ss} \cdot \omega_{ss}^{\frac{\alpha}{1-\alpha}}$$

$$\text{where} \quad \omega_{ss} = \frac{1-\tau^\pi}{1-\lambda^\pi_{ss}\tau^\pi} \quad \text{and} \quad \lambda^\pi_{ss} = \frac{\delta^\pi(1+\rho)}{\rho+\delta^\pi}$$

Undistorted long-run output is given by Y^*_{ss}, and ω_{ss} is the corporate tax wedge in steady-state. Notice that λ^π_{ss} is the present discounted value of the tax depreciation schedule in steady-state.

In this frictionless environment, distortions to production are summarized by the corporate tax wedge - properly adjusted for capital-intensity. Interestingly, corporate tax revenues and payouts to shareholders depend on the tax code in a more complicated way:

$$T^\pi_{ss} = \pi^*_{ss} \cdot \tau^\pi \cdot \left[\omega^{\frac{\alpha}{1-\alpha}} \cdot (1 + \frac{\delta}{\rho} \cdot (1-\omega))\right]$$
$$d_{ss} = \pi^*_{ss} \cdot (1-\tau^\pi) \cdot \left[\omega^{\frac{\alpha}{1-\alpha}} \cdot (1 + \frac{\delta}{\rho} \cdot (1-\omega))\right]$$

and this duality further clarifies that the corporate tax code can differentially affect incentives and cash-flows.

For convenience, I then define the following measure of long-run distortions to output

$$\text{Distortion}_{ss} = 1 - \frac{Y_{ss}}{Y^*_{ss}}$$

and represent it in the corporate tax policy space in Figure 13. The figure displays a contour map of 'isodistortions' for each combination of the corporate tax rate (τ^π) and the present discounted value of the tax depreciation schedule (λ^π_{ss}). Red dots representing the corporate tax code in different years are superimposed to assess the evolution of corporate tax distortions over time.

The exercise reveals a steady elimination of distortions by US policy-makers over time, captured by the movement towards the south-east corner of the map. For example, output was roughly 16% lower than its undistorted counterpart before the Kennedy's tax cuts, but only 1.7% lower before the TCJA-17. This improvement have been achieved through several rounds of statutory tax rate cuts, changes to tax depreciation rules, and repeated use of bonus depreciation over the decades.

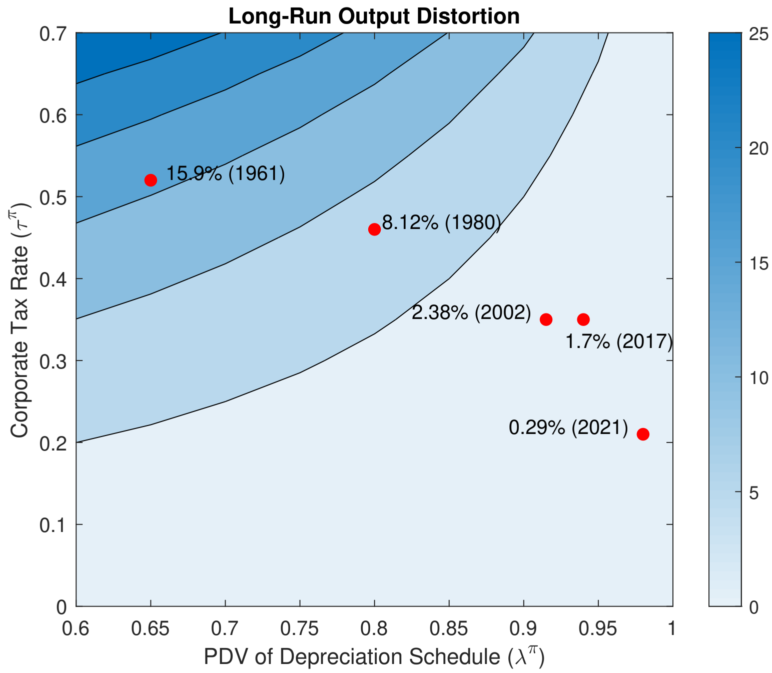

Figure 13: Corporate Tax Distortions over Time

Notes: Values for 1961 and 1980 are computed from Cummins et al. (1994). Values for 2002, 2017 and 2021 are computed from Zwick and Mahon (2017). The only two parameters used are $\beta = 0.94$ and $\alpha = 0.35$.

While the numbers reported in the figure should be taken with a grain of salt, they teach two important lessons. On the one hand, corporate tax policy has become less distortionary over time. On the other hand, policy-makers are now running short of ammunition. Given that the current level of distortions is almost zero, further reductions of the statutory corporate tax rate and/or acceleration of the tax depreciation schedule will produce little stimulus to output and investment.

6 Conclusions

This paper has focused on tax depreciation policy and the distinction between c-corporations and pass-through businesses to understand the effects of major corporate tax reforms in the US. However, these two elements are not specific to the US and can be found in basically every corporate tax code around the world. This implies that the analysis presented can be easily replicated and extended to other countries.

Moreover, while the proposed theoretical framework is intendedly stylized in order to make the transmission mechanism as robust and transparent as possible, it can be enriched along several dimensions. For example, two candidates are the introduction of sectoral heterogeneity and the analysis of corporate debt and of the interest-payment deduction. Preliminary results suggest that these two extensions do not alter the overall predictions of the model, but they do allow the theory to generate additional implications for different sectors or for corporate leverage. This could be of interest on its own, or could be used to discipline the theory further by exploiting empirical evidence from the cross-section of firms or of industries.

The theoretical framework has implications for time-series exercises as well. The fact that distortions to investment and tax-liabilities are differentially affected by a corporate tax reform, implies that neither the tax rate nor the tax-liabilities changes fully summarize corporate tax shocks. Arguably, both the corporate tax wedge and the change to tax-liabilities should be introduced in an empirical specification to properly estimate the causal effect of a reform.

Finally, the empirical analysis carried out in this paper highlights the need for further data collection by legal form of organization. While this is not necessary for many research questions, it becomes essential whenever business taxation needs to be taken into account, directly or indirectly.

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Appendix

A Modeling Details

A.1 Calibration of the Tax Depreciation Schedule

To calibrate the tax depreciation schedule I choose the policy parameter δ^π so that the present discounted value (PDV) of the tax depreciation schedule in the steady-state of the model matches an empirical counterpart from the existing literature.
Given a discount rate β, the PDV of the tax depreciation schedule in steady-state is given by

$$\text{PDV} = \sum_{j=0}^{+\infty} \beta^j \cdot \delta^\pi \cdot (1-\delta^\pi)^j = \frac{\delta^\pi}{1-\beta\cdot(1-\delta^\pi)}$$

The tax depreciation rate δ^π that produces a given PDV in steady-state is given by

$$\delta^\pi = \frac{\rho \cdot \text{PDV}}{1+\rho-\text{PDV}} \quad \text{where} \quad \rho \equiv \frac{1-\beta}{\beta}$$

TCJA-17

To calibrate δ^π in 2017, I build on Zwick and Mahon (2017). I start from their cross-sectoral average of the investment-weighted PDV of MACRS depreciation rules. They estimate a PDV for this object of 0.879. I then add an existing 50% bonus depreciation and compute the new PDV as follows:

$$0.50 + (1-0.50) \times 0.879 = 0.939$$

The associated δ^π is equal to 0.4823.
To calibrate the new value of δ^π after the TCJA-17, I increase bonus depreciation from 50% to 90%. This implies a PDV increase from 0.9395 to 0.9879, and a new value of $\delta^\pi = 0.8305$.

Kennedy's Tax Cuts

To calibrate tax depreciation policy before and after the Kennedy's tax cuts I follow Cummins et al. (1994). They estimate a PDV of the tax depreciation schedule for equipment of 0.647 in 1960.[1] This is almost the PDV under economic depreciation, so I set $\delta^\pi = \delta = 0.10$.

[1] In their paper, the definition of PDV of depreciation deductions scales the PDV of the tax depreciation schedule by the statutory tax rate. For instance, they report a value of 0.3366 for 1960, which becomes 0.647 after dividing by a statutory tax rate equal to 0.52.

After the tax cuts, they estimate a PDV of the depreciation schedule equal to 0.726 in 1965, which is accompanied by an investment tax credit equal to 0.0657. The investment tax credit can be introduced by simply increasing the PDV of the tax depreciation schedule, which becomes 0.7917. The associated tax depreciation rate is $\delta^{\pi} = 0.1857$.

A.2 Simulating Bonus Depreciation on New Investment

To capture the fact that bonus depreciation applies to new investment - as opposed to past investment not depreciated yet - I introduce auxiliary variables. Let $\delta^{\pi,B}$ and $k_t^{\pi,B}$ be the tax depreciation rate and the stock of un-depreciated investment before the reform. Let $\delta^{\pi,A}$ and $k_t^{\pi,A}$ be the same variables after the reform. Finally, let D_t^A take value equal to one after the reform and equal to zero before.

I then rewrite the investment deduction as follows

$$ID_t^{\pi} = \delta^{\pi,B} \cdot \left[(1 - D_t^A) \cdot i_t + k_t^{\pi,B}\right] + \delta^{\pi,A} \cdot \left[D_t^A \cdot i_t + k_t^{\pi,A}\right]$$

where

$$\begin{aligned} k_{t+1}^{\pi,B} &= (1 - \delta^{\pi,B}) \cdot \left[(1 - D_t^A) \cdot i_t + k_t^{\pi,B}\right] \\ k_{t+1}^{\pi,A} &= (1 - \delta^{\pi,A}) \cdot \left[D_t^A \cdot i_t + k_t^{\pi,A}\right] \end{aligned}$$

This modeling strategy ensures that - after the reform - past investment that has not been depreciated yet can still be depreciated using the old depreciation schedule, while new investment is depreciated using the new depreciation schedule.

A.3 Extended Model Details

The 'extended model' starts from the 'baseline model' and introduces: 1) endogeneous labor supply that is mobile across sectors; 2) a CES consumption aggregator; 3) variable capital utilization in the c-corporate sector.
The representative household solves the following optimization problem:

$$\max \quad \sum_{t=0}^{+\infty} \beta^t \left[\frac{\hat{c}_t^{1-\sigma}}{1-\sigma} - \frac{\hat{l}_t^{1+\phi}}{1+\phi} \right]$$

$$s.t. \quad \hat{c}_t = \left(\eta \cdot c_t^{\epsilon} + (1-\eta) \cdot \tilde{c}_t^{\epsilon} \right)^{\frac{1}{\epsilon}}$$

$$\hat{l}_t = l_t + \tilde{l}_t$$

$$c_t + p_t \tilde{c}_t + \Delta S_{t+1} P_t + \Delta \tilde{S}_{t+1} \tilde{P}_t = (1-\tau^{II}) \cdot \left[w_t \hat{l}_t + S_t d_t + \tilde{S}_t \tilde{d}_t \right] + \text{Transfer}_t$$

$$\Lambda_{t+j,t} \equiv \beta^j \cdot \frac{u'(\hat{c}_{t+j})}{u'(\hat{c}_t)}$$

The productive sector solves the following optimization problems:

C-Corporations

$$\max \quad \sum_{t=0}^{+\infty} \Lambda_{0,t} d_t$$

$$s.t. \quad d_t = \pi_t - T_t^{\pi}$$

$$\pi_t = Y_t - w_t l_t - i_t$$

$$k_{t+1} = (1 - \delta(u_t)) \cdot k_t + i_t$$

$$\delta(u_t) = \delta_0 + \delta_1 (u_t - 1) + \frac{\delta_2}{2} (u_t - 1)^2$$

$$Y_t = (u_t \cdot k_t)^{\alpha} \cdot l_t^{1-\alpha}$$

$$T_t^{\pi} = \tau^{\pi} \cdot TB_t^{\pi}$$

$$TB_t^{\pi} = Y_t - w_t l_t - ID_t^{\pi}$$

Pass-Through Businesses

$$\max \quad \sum_{t=0}^{+\infty} \Lambda_{0,t} \tilde{d}_t$$

$$s.t. \quad \tilde{d}_t = \tilde{\pi}_t$$

$$\tilde{\pi}_t = p_t \cdot \tilde{Y}_t - \tilde{w}_t \tilde{l}_t - p_t \cdot \tilde{i}_t$$

$$\tilde{k}_{t+1} = (1 - \tilde{\delta}) \tilde{k}_t + \tilde{i}_t$$

$$\tilde{Y}_t = \tilde{k}_t^{\tilde{\alpha}} \cdot l_t^{1-\tilde{\alpha}}$$

The government collects revenues and channels them into wasteful spending and transfers:

$$T_t = T_t^{\pi} + T_t^{II}$$

$$G_t = \theta \cdot T_t$$

$$\text{Transfer}_t = (1 - \theta) \cdot T_t$$

The new parameters introduced are ϕ, δ_0, δ_1, δ_2, η and ϵ. I set $\phi = 4$, which implies a Frisch elasticity of 0.25. The steady-state economic depreciation for c-corporations is given by $\delta_0 = 0.10$ since I set $\delta_1 = \frac{1}{\beta} - (1 - \delta_0) = 0.1638$. The parameter δ_2 is set equal to 0.10 to target a steady-state elasticity of depreciation to utilization of approximately 0.60, which is basically the mid-point between the values in Basu and Kimball (1997) and King and Rebelo (1999).

I set $\epsilon = 0.33$ to target an elasticity of substitution between the goods produced by the two sectors of approximately 1.5%. This implies some substitutability between the two varieties. Given ϵ, I use η to calibrate the target the relative size of c-corporations. I set $\eta = 0.55$ for the TCJA-17, and $\eta = 0.70$ for the Kennedy's tax cuts.