Kinky Tax Policy and Abnormal Investment Behavior *

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Abstract

This paper documents tax-minimizing investment, in which firms accelerate capital purchases near fiscal year-end to reduce taxes. Between 1984 and 2013, average investment in the fourth fiscal quarter (Q4) is 37% higher than the average of the first three fiscal quarters. Q4 investment spikes also occur internationally. We use research designs based on variation in firm tax positions and the 1986 Tax Reform Act to show tax minimization causes spikes. Spikes are larger when firms face financial constraints or higher option values of waiting until year-end. Models without a purchase-year, tax-minimization motive are unlikely to fit the data.

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When proposing tax changes, policymakers often appeal to the effect of taxes on corporate investment. These proposals presume a model of how firms respond to taxes. Research going back to Hall and Jorgenson (1967) has made much progress in characterizing this model and estimating the size of investment responses to taxes. However, because most research relies on quasi-experiments based on non-random tax changes, the extent to which estimated tax effects reflect unobservable firm or macroeconomic factors remains unclear.[1]

This body of research has also identified patterns at odds with the standard representative-firm, user-cost model. Some tax instruments have large effects on investment, while others do not. The immediacy of tax benefits appears to play a larger role in driving firm responses than the standard model predicts. Small and mid-market firms yield larger elasticities than large firms, leaving open the question of whether the firms that drive aggregate activity respond to taxes. Furthermore, because we cannot observe public firms' tax positions from financial accounts, efforts to identify tax effects for these firms face problems with measurement error.[2]

This paper presents novel evidence of how tax policy affects business investment. We develop a new measure of investment behavior, which is simple, transparent, and most importantly, orthogonal to low and medium frequency firm-by-time and policy shocks. Our approach allows us to remove time-varying omitted factors coinciding with the identifying variation we exploit, thus addressing one of the key concerns with existing empirical work. We demonstrate the first order importance of taxes for corporate investment behavior and further illustrate that tax asymmetry—in particular, the immediacy of the incentive to respond—matters critically for fitting the data.

We begin by documenting a robust but hitherto unappreciated stylized fact about investment behavior among public companies in the US. Firms frequently backload their investment near fiscal year-end, leading to quantitatively significant spikes in capital expenditures (CAPEX)

[1] The literature relying on policy-induced variation includes Cummins, Hassett and Hubbard (1996), Goolsbee (1998), Chirinko, Fazzari and Meyer (1999), Desai and Goolsbee (2004), House and Shapiro (2008), Edgerton (2010), Becker, Jacob and Jacob (2013), Yagan (2015), Ljungqvist and Smolyansky (2014), Zwick and Mahon (2017), Giroud and Rauh (2016), and Ohrn (2016). Hassett and Hubbard (2002) survey the early research and offer a consensus view, which is mostly consistent with subsequent findings.

[2] Yagan (2015) finds dividend taxes do not affect corporate investment. Suárez-Serrato and Zidar (2016), Giroud and Rauh (2016), and Ohrn (2016) find meaningful effects of tax rate changes on firm location, investment, and employment. Zwick and Mahon (2017) find depreciation incentives have a significant effect on investment that is more pronounced for small firms than for large firms, with a response driven by the immediacy of realized tax benefits. Edgerton (2010) uses financial accounting data to study the role of corporate tax asymmetries and finds less evidence that immediacy matters for public firms, while acknowledging measurement limitations may drive these results.

in the fourth fiscal quarter (Q4). This pattern is pronounced among firms across the size distribution and present nearly every year of our sample, which spans from 1984 to 2013. Over the full sample period, fiscal Q4 CAPEX is on average 37 percent higher than the average of the first three fiscal quarters. The pattern is robust to non-December fiscal year-end, to changes in fiscal year-end, as well as to within-year seasonality of sales and cash flows. Moreover, fiscal Q4 investment spikes exist internationally. Based on data from 33 countries, we document fiscal Q4 spikes nearly universally during the period between 2004 and 2014. Although the magnitude of spikes varies across countries, the general pattern of Q4 spikes remains robust.

We confirm that fiscal Q4 investment spikes do not merely represent reporting behavior by firms using commercial lending data based on the Equipment Leasing and Financing Association's Monthly Leasing and Finance Index (MLFI-25) from 2005 through 2014. These data reveal that the month of December sees significantly higher new business volume than other months, which validates firms' reported fiscal year-end investment spikes from the lending side. In corporate financial statements, fiscal Q4 investment spikes are also associated with new debt issuance spikes. Census survey data from domestic manufacturers similarly reveal spikes in aggregate capital goods shipments coinciding with the months during which firms commonly have fiscal year-ends.

We interpret Q4 investment spikes as reflecting a tax-minimization motive. Depreciation allowances are deducted from firms' pre-tax income and hence reduce their tax bill. Deduction conventions usually allow firms to deduct depreciation for year-end purchases as if the capital had been deployed halfway through the year. Because tax positions can be better estimated close to fiscal year-end when most revenues and expenses for the year have been recorded, backloading investment allows firms to maximize the tax benefit of depreciation. The sharp nature of Q4 spikes allows us to show that tax motives are driving an important part of this investment behavior.

We use two research strategies to identify the link between tax minimization and Q4 investment spikes. The first strategy exploits the budget kink created by the asymmetry in corporate tax positions: when a firm moves from positive to negative tax position, the firm must defer the tax benefits of investment from the current year until some future year. We combine Q4 CAPEX spike data from Compustat with tax position data from corporate tax returns for the years 1993 through 2010. Fiscal Q4 investment spikes are substantially higher when firms move from having an immediate incentive to offset taxable income with additional investment to having to carry forward those benefits to future years. Regression estimates show that within-firm, a positive-taxable-income fiscal year has a spike between 6% and 11% higher than a negative-taxable-income fiscal year, which is large compared to the sample average of 37%. Additionally, taxable firms with large stocks of net operating loss carryforwards, which serve as an alternative tax shield, show significantly smaller Q4 spikes.

In the second research strategy, we study the effect of tax policy changes on investment spikes using the Tax Reform Act of 1986 in the US. Three components of the Tax Reform Act of 1986 affected firms' tax-minimization incentive and as a result the potential size of fiscal Q4 investment spikes. First, the Investment Tax Credit (ITC), through which firms could receive reductions in tax liabilities as a percentage of the price of purchased assets, was repealed. Second, the top corporate income tax rate decreased significantly. Third, the Modified Accelerated Cost Recovery System (MACRS) was introduced as the new depreciation system, under which new investment in general gets a lower depreciation amount per year. It also applies a lower depreciation allowance for property placed in service during Q4, if Q4 investment is above 40% of the whole tax year. Each change lead to lower tax benefits from new corporate investment and hence a lower incentive for firms to backload investment. Consistent with a tax-minimization motive, regression estimates confirm that after 1987, fiscal Q4 investment spikes are 5% to 10% lower than before.

In the last part of the paper, we ask what types of firms are more inclined to employ tax-minimizing investment strategies. Firms relying heavily on internal funds for investment financing are expected to retime their investment more strategically to save taxes and retain cash. We test this prediction by studying the effects of tax changes on investment spikes interact with different proxies for financial constraints. Regression estimates show that financially constrained firms conduct more tax-minimizing investment. Firms facing higher option values for waiting until fiscal year-end to make investment decisions—those with longer average investment durations, those with positive skewness in earnings and less downside variance, and those that beat their analyst earnings forecasts—also show higher investment spikes on average. The last finding suggests that earnings management and tax planning are interconnected decisions. We also find supportive evidence that spikes are related to "Use it or Lose it" budgeting incentives thought to characterize internal capital markets, though such incentives are unlikely to explain differential behavior based on tax incentives.

We also study the cumulative impact of investment spikes on the level of investment. The exercise addresses the concern that Q4 spikes have no medium or long term effects beyond the quarter after a spike occurs and provides further evidence that spikes reflect time-varying opportunities for firms to offset tax bills associated with positive earnings shocks. We follow the average quarterly investment levels up to 8 quarters after large Q4 spikes and confirm that investment spikes do not fully reverse in the subsequent quarters. Firm-years with Q4 spikes exceeding 200% show investment levels 4% higher (10% of the sample mean) than within-firm averages. Investment levels remain high the following year before reverting to their pre-spike level two years later. In contrast, Q4 spikes are negatively autocorrelated over time, which suggests a process with some mean reversion rather than mechanical repetition of spike patterns each year.

The outline of the paper is as follows. Section 1 explains the tax policies related to corporate investment and describes our data. Section 2 describes the fiscal Q4 CAPEX spikes both in the US and other countries and examines the robustness of spikes to possible confounds. Section 3 establishes the link between tax minimization and fiscal Q4 spikes by exploiting firms' tax position and policy reforms in the US. Section 4 studies cross-sectional and dynamic drivers of of tax-minimizing investment. Section 5 concludes.

1 Policy Background and Data

1.1 Policy Background

When making an investment, a firm is permitted a sequence of tax deductions for depreciation over a period of time approximating the investment's useful life. Allowable depreciation deductions offset the firm's taxable income, reducing its tax bill. Since the Tax Reform Act of 1986, the US tax code's schedule of depreciation deductions is specified by the Modified Accelerated Cost Recovery System (MACRS). MACRS assigns a recovery period and depreciation method for each type of property. The recovery period refers to the number of years it takes to completely depreciate the investment, while the depreciation method refers to the speed of depreciation.[3]

[3]The common recovery periods for equipment investment are 3-, 5-, 7-, 10-, 15-, and 20-year. Structures are typically depreciated over 27.5 or 39 years. The most common depreciation methods for equipment are 200-percent declining balance and 150-percent declining balance, switching to straight-line. For structures, the depreciation method is straight-line. More detail is available in IRS publication 946.

Under MACRS, averaging conventions establish when the recovery period begins and ends. The convention determines the number of months for which firms can claim depreciation in the year they place property in service. The most common convention for equipment investment is the half-year convention, where firms treat all property placed in service during a tax year as placed at the midpoint of the year. This means that a half-year's worth of depreciation is allowed for the year the property is placed in service. Because the half-year convention applies even to investments made at the end of the year, the code creates an incentive for firms to accelerate the timing of investment purchases at the end of the fiscal year in order to realize the deductions a year earlier. In other words, the schedule creates a nonlinearity (or "kink") in the marginal incentive to invest near the end of the fiscal year because of discounting applied to the tax savings from future deductions. Our research design exploits this kink and the sharp behavior it induces to separate investment responses driven by the tax code from other confounding factors.

Our focus is primarily on tax policy that affects the incentive for large firms to invest during our sample period of 1984 to 2013 in the US, though we also study the interaction between investment behavior and tax policy in a sample of developed and developing countries. In addition to the depreciation schedule, other tax policy parameters interact with investment to affect firms' tax liabilities. For example, because the corporate income tax rate affects the size of the tax deduction for depreciation, a higher tax rate will amplify the incentive to use investment to minimize taxes. If investments are financed through equity, then dividend taxes will have a similar though more indirect effect through changing the cost of capital.[4]

During the past two recessions, policymakers have introduced additional first-year (or "bonus") depreciation to stimulate investment and have expanded the Section 179 provision, which allows small and medium-sized businesses to fully deduct the cost of eligible purchases during the year of purchase.[5] Until 1986, our US sample period included an Investment Tax Credit (ITC), which generates reductions in tax liability as a percentage of the purchase price of investments. Different from Section 179 or bonus depreciation, as a credit the ITC reduces tax liabilities dollar-for-dollar. Starting with the Revenue Act of 1962, the ITC went through many

[4] King (1977), Auerbach (1979), and Bradford (1981) theoretically analyze the difference in incentives for equity-financed and internally financed investments on the margin. In an empirical analysis of payout taxes, Yagan (2015) finds that investment does not respond to the 2003 dividend tax cut in the US; Alstadsæter, Jacob and Michaely (2015) find that investment responds for cash-constrained firms following a dividend tax cut in Sweden.

[5] House and Shapiro (2008) and Zwick and Mahon (2017) study these programs in detail.

rounds of major changes, including being suspended, reinstated, and eventually repealed in 1986. Between 1979 and 1985, the ITC was set at 10 percent for spending on business capital equipment and special purpose structures. By targeting investment directly, both depreciation incentives and the ITC create a strong incentive for firms to retime investment as a tax planning strategy.

On the other hand, MACRS requires firms to use the mid-quarter convention if total depreciable property placed in service during the last quarter of the tax year exceeds the total depreciable property placed in service during the entire year by more than 40%.[6] Mid-quarter convention treats such property as placed into service at the midpoint of fiscal Q4. However, a few factors make this 40% threshold less salient in the data. First, the threshold does not apply to structures or other property that is depreciated under a non-MACRS method, all of which get lumped into the CAPEX numbers in the financial statement. Second, the threshold does not apply to investments made by incorporated foreign subsidiaries, if the depreciation is instead taken overseas. The consolidated CAPEX in financial accounts includes both categories and may therefore overstate the investment spike relevant for domestic tax purposes. Third, the 40% threshold does not restrict "bonus" depreciation allowed under IRC Section 168(k), which will offset the lost depreciation from switching to mid-quarter for the residual, non-bonus investment basis.

1.2 Data

Our primary sample includes Compustat US firms spanning the years from 1984 through 2013. The sample excludes financial firms and utilities, as well as firm-years without quarterly capital expenditure (CAPEX) information. Firms with asset amounts less than $10 million are also excluded from the sample. The full US sample includes 158,859 firm-year observations for 17,527 unique firms.

Firms report year-to-date CAPEX in their quarterly 10-Q filings. To produce our primary measure of investment behavior, we first use this year-to-date data to back out CAPEX in each quarter. For example, in fiscal year 2012, US Airways reports quarterly year-to-date CAPEX as: Q1 $87 million, Q2 $191 million, Q3 $428 million, and Q4 $775 million. Thus CAPEX

[6] Excluding nonresidential real property, residential rental property, any railroad grading or tunnel bore, property placed in service and disposed of in the same year, and property that is being depreciated under a method other than MACRS.

for each quarter is: Q1 $87 million, Q2 $104 million, Q3 $237 million, and Q4 $347 million. The year-to-date format makes within-year changes in CAPEX less salient, though this example indicates strong bunching of investment in the last quarter of the year. We use the *Q4 spike* as our key measure of tax-driven investment behavior, defined as the ratio of Q4 CAPEX to the average of Q1 through Q3, which equals 243% in this case.[7]

Table 1 presents summary statistics for the sample of US and international firms. For the US sample, the average firm-year has $2.7 billion in assets and $172 million in CAPEX. The average Q4 spike is 137% (with median 119%), which indicates that Q4 CAPEX is 37 percent higher than the average of CAPEX for the first three fiscal quarters. Sales also display some Q4 periodicity due perhaps to the holiday season with a Q4 sales spike yielding a mean value of 112%. In Section 2, we demonstrate the robustness of the Q4 CAPEX spike to this seasonality in addition to a host of other potential confounds. Similar summary statistics are documented for international firms.[8] Appendix Table A.1 provides detailed definitions for other firm characteristics.

For some analyses, we supplement the Compustat US data with corporate tax returns from the Statistics of Income (SOI) division of the IRS Research, Analysis, and Statistics unit. Each year the SOI produces a stratified sample of approximately 100,000 unaudited corporate tax returns that includes all the largest US firms.[9] We use these data to design sharp tests of whether the Q4 CAPEX spike depends on a firm's tax position as measured using tax accounting data.

We draw international evidence of Q4 CAPEX spikes from the Compustat Global database. Starting from 2004, Compustat Global collects quarterly CAPEX information systematically. We focus on countries with sufficient available quarterly CAPEX information during the period of 2004-2014. In addition, we use OECD and tax agency reports for each country to compile a comp lete time series of corporate income tax rates for each country. Table 1, panel (b) presents summary statistics for the sample of international firms. In total, 15,764 firms and 80,303 firm-year observations from 33 countries (excluding the US) are included in our international sample.

We also draw from Compustat Segment data, which provides detailed information on seg-

[7]This example suggests US Airways may have crossed the 40% threshold at which point depreciation conventions switch from half-year to mid-quarter. This would be the case if all CAPEX included here were subject to the threshold, as a spike of 243% corresponds to a fourth quarter share of 45%. See discussion in Section 1.1.

[8]Q4 CAPEX spikes are censored at 500 to ensure outliers are not driving our results.

[9]Please refer to Zwick and Mahon (2017) for a detailed description of the data.

ment structures and financial characteristics of each segment. We use this data to measure corporate or budgetary complexity of firms.[10]

Finally, we draw data on equipment lending from the Equipment Leasing and Finance Association's (ELFA) Monthly Leasing and Finance Index (MLFI-25) and on aggregate investment from the Manufacturers' Shipments, Inventories, and Orders (M3) survey data from the Census Bureau. The MLFI-25 measures monthly commercial equipment lease and loan activity reported by participating ELFA member companies, which represents a cross section of the equipment finance sector. The M3 survey provides monthly statistical data on economic conditions in the domestic manufacturing sector.

2 Investment Spikes in Fiscal Q4

In this section, we document the size and persistence of Q4 CAPEX spikes and assess their robustness to potential measurement and reporting issues. Figure 1 presents the time series of fiscal Q4 investment spikes for US firms in Compustat between 1984 and 2013. We plot the median ratio of quarterly CAPEX to the average CAPEX within a firm's fiscal year. The fourth quarters, indicated by red dots, consistently display higher CAPEX compared to the first three quarters. The fiscal Q4 spikes are relatively lower during the 2001 and the 2008 recession periods but remain above 100%.

We conduct a number of simple robustness checks to confirm this behavior is both present and real. First, we show that steady growth cannot mechanically explain the magnitude of Q4 spikes. To account for the average fiscal Q4 spike of 137%, investment would have to grow 17.5% per quarter on average, implying a counterfactual amount of annual growth in investment. In panel (a) of Appendix Figure B.1, we plot the quarterly median CAPEX level instead of the ratio. In panel (b) we use the average of lagged two period to forward two period quarterly CAPEX as the denominator to calculate ratio. These two methods are immune to discrete jump in the denominator when moving across years, and fiscal Q4 spikes are clear and large in both panels.

Second, the fiscal Q1 consistently displays the lowest CAPEX within a year, which suggests at least some of the Q4 spike represents intertemporal substitution from Q1. We show that Q4

[10] We only keep segment information for firms whose segment data adds up to more than 80% of the sales and CAPEX at the consolidated level.

investment spikes are not offset completely in the following quarter. In panel (c) of Appendix Figure B.1, we plot the Q4 investment spikes with red dots being the average of Q4 and next fiscal Q1 to the average CAPEX within a firm's fiscal year. Although the drop in the following fiscal Q1 attenuates the Q4 investment spikes, we still usually observe the median spike above 100%. It appears that Q4 investment spikes are not caused by firms simply shifting next fiscal Q1 investment one quarter forward. We further explore the relationship between spikes and the level of investment in Section 4.4.

Third, in panel (d) of Appendix Figure B.1, we focus on firms that move their fiscal year-end to six months later. The y-axis measures the ratio of quarterly CAPEX to average CAPEX in a firm-year. Green bars indicate the fiscal year-end quarter according to the old regime, and red bars indicate the fiscal year-end quarter after switching. CAPEX spikes transition to the new fiscal Q4 after the switch. The consistency of this pattern before and after the fiscal year-end change further validates that CAPEX spikes are indeed related to the fiscal year-end.[11]

Fourth, in Appendix Figure B.2 we show that fiscal year-end investment spikes are not driven by calendar year seasonality and are still present for firms that do not display seasonality in cash flows or sales. In the U.S. sample, 57.1% of firms have fiscal year-ends in December, 10.4% in June, 8.2% in September, 7.4% in March, with the remaining 16.9% distributed across the other eight months. Appendix Figure B.2, panel (a) plots the time series of Q4 CAPEX spikes for firm-years with non-December fiscal year-ends. Fiscal Q4 CAPEX spikes still hold for the non-December subsample, alleviating the concern that calendar time patterns drive year-end spikes. Panel (b) plots the time series of sample firms' book depreciation spikes and shows higher book depreciations in the fourth quarters, indicating these patterns reflect real investment expenditures from the perspective of the firm's financial accounts.[12] Panels (c) and (d) plot Q4 CAPEX spikes for firm-years with smooth cash flows and sales, defined as having fiscal Q4 cash flows and sales are lower than the average of the first three fiscal quarters. Though partly attenuated, fiscal Q4 investment spikes remain robust after controlling for seasonality in cash flows and sales.

To further confirm that these spikes reflect real activity, we explore the possibility of Q4 spikes from the lending and borrowing perspective. Figure 2, panel (a) plots the monthly over-

[11] Similar patterns emerge for firms that switch their fiscal year-ends by three or nine months. Focusing on six month switches yields yields the largest sample.

[12] Financial accounting applies economic depreciation for new investments, rather than the half-year convention that applies for tax depreciation. Spikes in book depreciation therefore indicate the spike expenditures are not just made on the last day of the fiscal year.

all new business volume based on the Equipment Leasing and Financing Association's Monthly Leasing and Finance Index (MLFI-25). This business primarily covers loans and leases to small businesses, which typically have fiscal year-ends in December. Each year the month of December experiences significantly higher new business volume than previous months. For example, in 2014 new business volume ranged from around $6 to 9 billion per month before December, and in December 2014 it increased sharply to around $13 billion. Similar December spikes can be seen throughout the whole decade of the sample.

Appendix Table B.1 studies the correspondence between Q4 investment spikes and debt spikes for all sample firms (panel (a)) and firms with non-December fiscal year-ends (panel (b)). With firm fixed effects and year fixed effects, regression estimates confirm that Q4 investment spikes are associated with new debt issuance spikes. One might be concerned that some lending side unobservables might be driving the December spikes in new business volume. If for some reason lenders offer cheaper loans in December, then December lending spikes may not come as a surprise. However, in a study of the seasonal variation of syndicated loans, Murfin and Petersen (2016) show late spring and fall to be the "sales" seasons for these loans. Firms borrowing during season sales issue at 19 basis points cheaper than winter and summer borrowers (January/February and August). In particular, December does not belong to the sales season.

Figure 2, panel (b) asks whether Q4 spikes appear to influence aggregate investment patterns using data from the Census Bureau's manufacturer shipments, inventories, and orders (M3) survey. For each month, we compute the ratio of monthly shipment value to the average monthly value within that month's calendar year. We plot the average for each calendar month over the period from 1958 to 2016. For non-defense capital goods, the month of January consistently has the lowest shipment value, approximately 85% of the level for the year on average. March, June, September, and December, commonly used as fiscal year-ends, display significantly higher shipment values compared to other months. The largest spikes occur in December at 112% and June at 110%, which correspond to the most common fiscal year-ends among firms in the Compustat sample. Importantly, we do not observe similar patterns for consumer goods, where tax incentives do not play a major role.

Investment expenditures are not the only cost that firms can manage near fiscal year-end for tax purposes. The IRS allows firms to deduct R&D expenditures in the tax year when incurred. Firms may also claim the R&D credit against tax for certain qualified R&D expenditures and combine the credit as one component of the general business credit. Appendix Figure B.3 presents the time series of fiscal Q4 R&D spikes for US firms in Compustat between 1989 and 2013.[13] The fourth quarters, indicated by red dots, consistently display higher R&D compared to the first three quarters, and the first fiscal quarter displays the lowest R&D within a year.

Last, we move to an international sample to show that fiscal Q4 CAPEX spikes occur nearly universally. For the period from 2004 to 2014, Figure 3 plots the time series of fiscal Q4 investment spikes for countries with at least nine years of data. In each plot, fiscal Q4s are indicated by red dots. We sort countries according to their average corporate income tax rate during the period—Switzerland has the lowest average corporate income tax rate (about 8%), while Pakistan has the highest (about 35%). Across the 24 countries listed in Figure 3, we observe fiscal Q4 CAPEX spikes throughout. Countries such as Indonesia, China, and Mexico show the highest spikes, while the United Kingdom, Australia, New Zealand, and France show much lower spikes than average.[14] As a whole, the evidence from international data are remarkably consistent with the pattern prevailing in the US data. This suggests that factors more general than the specific US institutional setting are responsible for Q4 CAPEX spikes.

3 Investment Spikes and Tax Policy

In this section, we present direct evidence that Q4 CAPEX spikes are driven by a tax-minimization motive. We pursue two complementary strategies. First and most direct, we show that firms only spike consistently when they are in the position to use depreciation deductions during the current tax year. Second, we show that the Tax Reform Act of 1986, which considerably reduced the marginal incentive to shift investment, led to a subsequent decline in spike patterns.

[13] R&D is net of R&D related salary and benefit expenses, which is calculated at industry average according to the Business Research and Development and Innovation Survey (BRDIS) conduct by the National Science Foundation. We assume salary and benefit expenses are flat over four quarters in the same fiscal years. Fiscal Q4 R&D spikes remain robust when we include salary and benefit expenses.

[14] Australia, New Zealand and France use the effective life for property depreciation. For example, for property placed in service in the last month of a fiscal year, a firm only gets to depreciate 1/12 of the first year depreciation amount for the current tax year. The effective life method significantly reduces the tax savings from fiscal year-end investment.

3.1 Investment Spikes and Tax Position

We combine Q4 CAPEX spike data from Compustat with tax position data from corporate tax returns for the years 1993 through 2010. We follow Zwick and Mahon (2017) and define D(taxable) as an indicator for whether a firm has positive income before depreciation expense and thus an immediate incentive to offset taxable income with additional investment. Zwick and Mahon (2017) show that bonus depreciation and Section 179 only affect investment when firms have positive taxable income before depreciation. In studying bonus depreciation, they focus on the level of investment and exploit cross-industry variation in exposure to changes in the depreciation schedule. By studying Q4 CAPEX spikes, we remove any slow-moving, firm-by-time omitted variables that might interfere with their design. We complement their findings by documenting a strong tax-minimization motive among large public firms, who are not affected by Section 179.

Figure 4, panel (a) plots the relationship between Q4 spikes and firm tax position. We divide firms into $1,000 bins based on their taxable income before depreciation expense is taken into account and plot for each bin the average Q4 CAPEX spike. The results starkly confirm the hypothesis that immediate tax position is a first order driver of the Q4 spikes. To the right of zero, the median Q4 spike is approximately 120% on average and considerably above 100% for all bins. Just to the left of zero, the median spikes are centered around 100% with no clear pattern above or below.

Table 2 presents firm-level regressions designed to measure the size and robustness of the tax position result. All regressions include firm and year fixed effects. Thus the regressions measure spike responsiveness while only exploiting variation in a firm's tax position over time. Unlike regressions with the level of investment on the left hand side, these are considerably less subject to the concern that tax position and investment are jointly correlated with growth opportunities. Column (1) shows that positive tax position leads firms to exhibit a spike that is 7.6% higher than for nontaxable firms, which is large compared to the average sample mean of 131%. Column (2) adds the following controls: ln(assets), Market-to-Book, Cash/Assets, CAPEX/PPE, and Sales 4/3. Even controlling for the level of investment does not materially alter the coefficient on tax position. Columns (4) through (7) show that the results are very similar in the pre-2000 and post-2000 samples.

Column (3) adds a measure of cash flow (EBITDA/Assets) as an additional control, which reduces the coefficient to 2.9%. As cash flows may serve as a measure of the intensity of a firm's tax position, this regression likely "overcontrols" for confounding factors, causing a downard bias in the tax position coefficient. We include the regression because it suggests an alternative interpretation of the sensitivity between investment and cash flows, which has been used in countless studies going back to Fazzari, Hubbard and Petersen (1988) to measure financial constraints. Such a sensitivity may instead reflect a tax-minimization motive. We return to this issue in Section 4.

When filing tax returns, firms can deduct net operating loss carryforwards if they enter the tax year with past losses.[15] Because loss carryforwards serve as an alternative tax shield, a firm with a large stock of carryforwards has a weaker incentive to backload investment for tax reduction. We examine this prediction in Figure 4, panel (b) by plotting median Q4 CAPEX spikes for groups of firms sorted according to the ratio of lagged loss carryforward stock to current year net income before depreciation. The figure shows a strong negative relationship between the presence of this alternative tax shield and the size of Q4 spikes.

3.2 Investment Spikes and the Tax Reform Act of 1986

The US passed the Tax Reform Act of 1986 (TRA86, enacted October 22, 1986) to simplify the income tax code and broaden the corporate tax base. Three key changes affected corporate incentives regarding CAPEX spending.

First, TRA86 abolished the Investment Tax Credit (ITC). Between 1979 and 1985, the ITC was set at 10 percent for spending on business capital equipment and special purpose structures. The ITC is not refundable, and thus is valuable for a firm only if there is a tax liability.[16] As with depreciation deductions, under the ITC regime, a firm has a greater incentive to wait to fiscal year-end to make tax-minimizing investments, as its tax liability can be better estimated near year's end. As a 10 percent credit, the ITC was considerably more generous than first-year deductions for most investments. Thus removal of the ITC predicts lower Q4 investment spikes after 1987.

Second, the corporate income tax rate for the top bracket decreased significantly after 1987: the top rate dropped from 46% in 1984-1986 to 40% in 1987, to 34% in 1988-1992, and then remained at 35% in 1993-2013.[17] The decrease in the corporate income tax rate further

[15] See IRS publication 536 for more details on the tax treatment of net operating losses.

[16] The safe-harbor leasing provision in the Economic Recovery Tax Act of 1981 allowed the sale of unused tax credits to firms with current tax liabilities, but it was eliminated at the end of 1983.

[17] Please refer to Appendix Table A.2 for details of corporate income tax changes during the period of 1984-2013.

reduced the tax-minimization incentive of CAPEX spending, as for a given amount of CAPEX, the reduction in tax liability is lower when the tax rate is lower.

Third, the depreciation system switched from the Accelerated Cost Recovery System (ACRS) to the Modified Accelerated Cost Recovery System (MACRS) after 1987.[18] In general, MACRS lengthens the recovery periods for property. For example, automobiles and trucks had a depreciation schedule of 3 years under ACRS, but 5 years under MACRS; non-technical office equipment had a depreciation schedule of 5 years under ACRS, but 7 years under MACRS.[19] In addition, MACRS requires firms to use mid-quarter convention if the total depreciable bases of MACRS property placed in service during the last 3 months of the tax year are more than 40% of the total MACRS property during the entire year. For property placed in service during Q4, only 1.5 months of depreciation is allowed under the mid-quarter convention instead of 6 months of depreciation under the half-year convention. The lengthening of depreciation periods and the mid-quarter convention requirement further reduced the incentive for tax-minimizing investment, as a same amount of investment leads to a smaller first-year depreciation deduction and lower initial tax savings after TRA86.

Each major change listed above leads to a smaller tax saving for a given amount of investment. The tax-minimization hypothesis thus predicts a weaker incentive to wait until fiscal year end to invest and lower fiscal year-end spikes as a consequence. We formally test this prediction in regression form and present estimates in Table 3. The coefficients of interest are on dummy variables D(1984-1986) and D(1987), which indicate the corresponding years for the pre-TRA86 period in our sample and the phase-in year for the rate changes and ITC phase-out, respectively. Firm fixed effects are included in order to control for time invariant firm characteristics. We also include firm financial characteristics such as the level of CAPEX/PPE, Sales 4/3, ln(assets), Market-to-Book, and Cash/Assets to control for the effect of contemporaneous non-tax shocks.

In general, analysis of tax regimes and investment suffer endogeneity issues, as tax reforms are likely to be in response to some macroeconomic factors that could also affect investment. However, endogeneity concerns are primarily expressed with respect to the level of investment. Since we focus on the timing of investment within the same fiscal year, rather than investment levels, it is quite unlikely that shocks affecting the level of investment would also systematically

[18]IRS publication 534. ACRS set up a series of useful lives based on 3 years for technical equipment, 5 years for non-technical office equipment, 10 years for industrial equipment, and 15 years for real property.

[19]MACRS lengthens the lives of property further for taxpayers covered by the alternative minimum tax (AMT).

shift investment toward a particular part of the fiscal year.

We run regressions for different time periods for robustness. Columns (1) and (2) show regression estimates for the period of 1984 to 1993, as the corporate income tax rates after 1993 are slightly higher. Columns (3) and (4) show regression estimates for the period of 1984 to 2000, as after 2000 the bonus depreciation policy significantly changes the first-year tax benefits of investment. Columns (5) and (6) present regression estimates for the whole period of 1984 to 2013. In all six specifications, D(1984-1987) shows significantly higher fiscal Q4 spikes. On average, Q4 spikes drop by between 4.9% and 10.6% after TRA86, a large change relative to the mean Q4 spike of 37%. In addition, Columns (7) and (8) present regression estimates with dependent variable being a dummy variable indicating Q4 investment is over the 40% threshold for mid-quarter convention requirement. The probability of firms passing the 40% threshold drops by 1.6%, a fairly small decrease relative to the 20.7% average before 1987.

4 Cross-Sectional and Dynamic Drivers of Investment Spikes

In this section, we develop a dynamic model of investment in the presence of a tax motivation to backload investment. We link the model to data and examine how different factors influence the magnitude of fiscal year-end investment spikes. We also explore the interaction between tax-minimizing investment and other patterns of corporate behavior, asking what role capital budgeting and earnings management play in determining Q4 spikes.

4.1 A Dynamic Model of Tax-Minimizing Investment

Beginning with a discrete time, neoclassical investment model with adjustment costs (Abel, 1982; Hayashi, 1982; Winberry, 2015), we introduce predictable time variation in the value of the investment tax shield. We calibrate the model to match partial equilibrium investment moments quantitatively. We then apply the model to answer two questions. First, can a standard calibration deliver investment spikes that are quantitatively comparable to those observed in the data? Second, what parameters govern the magnitude and frequency of investment spikes?

The model follows Winberry (2015), modified to include a tax asymmetry and two sub-periods within the fiscal year with different after-tax investment prices. Firms choose labor n

and capital k to maximize profits. The labor choice is static, given by:

$$n(k,\varepsilon) = \max_n \left\{ e^{\varepsilon} k^{\theta} n^{\nu} - wn \right\} = \left(\frac{\nu e^{\varepsilon} k^{\theta}}{w} \right)^{\frac{1}{1-\nu}}, \quad \theta + \nu < 1$$

where ε is a productivity shock and θ, ν, and w are parameters. Productivity evolves according to a lognormal AR(1) process:

$$\log \varepsilon = \rho \log \varepsilon_{-1} + \xi,$$

where $\xi \sim \mathcal{N}(0, \sigma_{\varepsilon}^2)$. Investment, i, yields capital for next period according to the law of motion, $k' = (1-\delta)k + i$. Adjustment costs follow the standard convex form, $-\frac{\phi}{2}\left(\frac{i}{k}\right)^2 k$. We abstract from fixed costs to focus on the dynamics from a richer tax environment.

Define the firm's gross operating surplus (GOS) prior to depreciation deductions as:

$$GOS(k,\varepsilon) = e^{\varepsilon} k^{\theta} n(k,\varepsilon)^{\nu} - wn(k,\varepsilon)$$

The firm's tax bill equals a linear tax τ on taxable income, defined as GOS less depreciation deductions, if taxable income is positive and zero otherwise: $TB = \tau \max\left\{TI, 0\right\}$.

We divide each fiscal year into two halves, I and II. In the first half, depreciation deductions on current investment are disallowed. Instead, these deductions carry forward into the second half of the year. Taxable income in each half is given by:

$$\text{(I)}\;\; TI = GOS - \hat{\delta}\hat{k} \qquad\qquad \text{(II)}\;\; TI' = GOS' - \hat{\delta}\hat{k}' - q^{II}\hat{\delta} i',$$

where $\hat{\delta}$ is the rate of tax depreciation, $\hat{k}$ and $\hat{k}'$ are the depreciation stocks, and q^{II} is the after-tax price of investment in the second half. Depreciation stocks evolve according to analogous laws of motion to actual capital, except for the difference in deductibility across halves:

$$\text{(I)}\;\; \hat{k}' = (1-\hat{\delta})\hat{k} + q^{I} i \qquad\qquad \text{(II)}\;\; \hat{k}'' = (1-\hat{\delta})\hat{k}' + q^{II}(1-\hat{\delta})i'.$$

Last, define the after-tax price of investment as $q_t \equiv 1 - \tau z_t$, where

$$z_t = \begin{cases} \mathbb{E}_t\left[\sum_{s=0}^{\infty}\left(\prod_{j=0}^{s}\frac{1}{R_{t+j}}\right)\cdot(1-\hat{\delta})^s\cdot\hat{\delta}\right] - \frac{\hat{\delta}}{R_t} & (I) \\ \mathbb{E}_t\left[\sum_{s=0}^{\infty}\left(\prod_{j=0}^{s}\frac{1}{R_{t+j}}\right)\cdot(1-\hat{\delta})^s\cdot\hat{\delta}\right] & (II), \end{cases}$$

where the removal of $\frac{\hat{\delta}}{R_t}$ from z_t^I captures the lower value of deductions due to deferral.[20]

We can now write the recursive firm problem for each half of the fiscal year. The firm's state variables are the capital stock, k or k', stock of depreciation deductions, $\hat{k}$ or $\hat{k}'$, and productivity ε. The first half value function is defined by the Bellman equation:

$$\begin{aligned} V^I(k,\hat{k},\varepsilon) &= GOS(k,\varepsilon) - \tau \max\left\{GOS(k,\varepsilon) - \hat{\delta}\hat{k}, 0\right\} \\ &\quad + \max_i \left\{ -q^I i - \frac{\phi}{2}\left(\frac{i}{k}\right)^2 k + \beta \mathbb{E}_{\varepsilon'|\varepsilon} V^{II}(k',\hat{k}',\varepsilon') \right\} \\ \text{s.t.} \quad & \hat{k}' = (1-\hat{\delta})\hat{k} + q^I i \qquad k' = (1-\delta)k + i \qquad i \geq 0. \end{aligned} \tag{1}$$

where the first three terms are constant with respect to the choice problem over k'. The second half value function is defined by the Bellman equation:

$$\begin{aligned} V^{II}(k',\hat{k}',\varepsilon') &= GOS(k',\varepsilon') \\ &\quad + \max_{i'} \left\{ -\tau \max\left\{GOS(k',\varepsilon') - \hat{\delta}\left[\hat{k}' + q^{II} i'\right], 0\right\} \right. \\ &\qquad \left. - q^{II} i' - \frac{\phi}{2}\left(\frac{i'}{k'}\right)^2 k' + \beta \mathbb{E}_{\varepsilon''|\varepsilon'} V^I(k'',\hat{k}'',\varepsilon'') \right\} \\ \text{s.t.} \quad & \hat{k}'' = (1-\hat{\delta})(\hat{k}' + q^{II} i') \qquad k'' = (1-\delta)k' + i' \qquad i' \geq 0. \end{aligned} \tag{2}$$

We note three differences between the first half value function (1) and the second half value function (2). First, the after-tax price of investment q_t is higher in (1) because the present value of future deductions z_t is lower. Second, the investment decision affects current taxes in (2), but only affects future taxes in (1). Third, the continuation values deterministically alternate between (1) and (2), such that firms know which problem they face in the next period. When combined with the irreversibility of investment ($i \geq 0$), these features create an option value for shifting investment between the first and second halves of the fiscal year. Furthermore, the value functions show how the incentive to use investment to minimize taxes is stronger in the second half because there is no uncertainty about the firm's tax position as a function of investment.

The model delivers several comparative statics, which we explore numerically in simulated data and then empirically. First, the magnitude of investment spikes is increasing in the dis-

[20]For tractability, we do not model tax loss carryforwards or carrybacks across fiscal years, so deductions unused in a particular year are lost. As long as loss offsets are partial or occur with a delay, the incentive to use investment to reduce taxes will be stronger if the firm is currently taxable.

count rate firms apply to depreciation deductions. A higher discount rate raises the value of accelerating deductions. We proxy for high discount rates using common markers of financial constraints from the finance literature. Second, the magnitude of investment spikes is increasing in the average duration of a firm's investment, to the extent this investment benefits from the additional deduction at the end of the tax year. This result is driven by differences in the present value of deductions for long- versus short-lived investment. Third, the magnitude of investment spikes is increasing in the optionality of delaying investment until period two. Firms with a higher volatility in their productivity term, in particular those with positive skewness, will tend to have larger investment spikes. This optionality motivation also implies some high frequency intertemporal substitution, which manifests in a negative autocorrelation in spike size for firms over time.

We solve the model by value function iteration and numerically simulate the model for 10,000 firms with different productivity shock paths over $T = 500$. We set the discount rate $\beta = .98$ and output elasticities $\nu = .21$ and $\theta = .64$. Economic and tax depreciation are $\delta = \hat{\delta} = .05$. The tax rate is $\tau = .35$. Productivity persistence is $\rho = .94$ with standard deviation $\sigma_\varepsilon = .026$. The convex adjustment cost is $\phi = 2.69$.

Figure 5 presents key stylized facts from the simulated data. Panel (a) plots average fiscal second-half (H2) investment spikes, indicating that the model is able to match the data's quantitatively large spikes backloaded at the end of the fiscal year. Panel (b) plots average investment rates and spike patterns for the baseline discount factor ($\beta = .98$) and a high discount rate ($\beta = .6$). High discount rates yield larger spikes. Panel (c) plots average investment rates and spike patterns for three simulated versions with different assumed rates of economic depreciation. Longer-lived investment items show larger spikes. Panel (d) shows that more profitable firms tend to show larger spikes, consistent with investment being used to shield against large tax bills when profits are high. Panel (e) plots the cumulative within-firm level of investment after H2 spikes. The figure indicates incomplete reversal of investment in the quarter after a spike and relatively smaller spikes for the firm in subsequent years.

4.2 Investment Spikes and Financial Constraints

Firms that face costly external finance should place a higher value on the tax savings associated with retiming investment, as they apply higher effective discount rates when trading off taxes paid this year versus in the future (Zwick and Mahon, 2017). We follow past literature and test this prediction by studying how tax-induced Q4 spikes vary among firms sorted according to four proxies for financial constraints: a non-dividend payer dummy, a speculative grade dummy, a dummy variable indicating CAPEX exceeding internal cash flow, and a dummy variable indicating CAPEX exceeding internal cash flow and not having an S&P rating (Faulkender and Petersen, 2012).

Rather than studying the direct correlation between financial constraint measures and fiscal Q4 CAPEX spikes, which might be confounded by omitted factors, we interact the financial constraint measures with the time series variation in Q4 spike incentives induced by TRA86. The high discount rate prediction suggests that the decrease in Q4 spikes following the tax change should be larger for financially constrained firms. Table 4, columns (1) through (4) confirm this prediction: firms that are more constrained experience a larger drop in their Q4 spikes after 1987. The effects are consistently at least 50 percent larger for firms more likely to face financial constraints.

One implication of the tax-minimization incentive of firms' CAPEX spending for the study of financial constraints concerns the investment-cash flow sensitivity. A large literature in macroeconomics and finance studies how firm investment responds to changes in cash flow. The idea is that if firms rely more on internal funding for investment (and hence are more financially constrained), their investment should display larger sensitivities to cash flow. Our paper provides an alternative explanation for investment-cash flow sensitivities—firms experience larger incoming cash flows, which tend to correspond to higher taxable incomes, might invest more due to tax minimization. This is especially true in the case of one time or low persistence shocks to cash flows and would hold even if cash flow shocks were uncorrelated with other drivers of investment, as long as those shocks come in before-tax dollars.

To show the importance of this idea, we decompose the conventional investment-cash flow sensitivity into different fiscal quarters and present the results in Table 5. To enable comparison to past work, in column (1) we replicate the annual investment-cash flow sensitivity analysis by showing a firm's CAPEX is positively related to its cash flow after controlling for Tobin's Q. As is standard, both firm fixed effects and year fixed effects are included to show the within-firm sensitivity. In columns (2) and (3), we decompose annual CAPEX into four quarters and run the same regressions but with cash flow interacted with dummy variables indicating different fiscal quarters. Column (2) interacts a fiscal Q4 dummy with Cash Flow/Assets. Column (3) interacts dummies for each fiscal quarter with Cash Flow/Assets. While investment-cash flow sensitivity remains positive with a smaller magnitude, the fourth fiscal quarter displays sensitivities twice as large as that of the first three quarters. A financial constraint hypothesis alone would have a difficult time explaining the sudden spike in sensitivity—is the fourth quarter more financially constrained than the first three? The tax-minimization hypothesis has no trouble explaining this pattern.

4.3 Investment Duration, Earnings Volatility, and Earnings Management

This section considers dynamic factors that influence a firm's decision to backload investment. We study firm characteristics that tend to increase the option value associated with backloading investment to minimize taxes and ask whether these factors indeed contribute to higher Q4 spikes on average.

Figure 6, panel (a) presents a binned scatterplot of Q4 spikes for firms sorted by the average duration of equipment investment for a firm's respective industry. The measure is derived from the inverse of the present value of depreciation deductions (via Zwick and Mahon (2017) at the NAICS four-digit level) with higher values representing longer equipment investment duration. The intertemporal demand elasticity for longer lived items is higher when benefits of shifting investment are temporary (House and Shapiro, 2008). Consistent with this idea, median Q4 spikes are 10 to 20% higher for firms in long duration industries versus firms in short duration industries.

The tax-minimization hypothesis suggests that investment spikes cluster in fiscal Q4 because tax positions can be better estimated close to fiscal year-end when most revenues and expenses for the year have been recorded. Firms with more volatile earnings are more likely to wait until the fiscal year-end for investment planning as their taxable incomes are more difficult to predict. Furthermore, given that expensing and depreciation affect book earnings, the resulting effect on book earnings would likely provide incentives or disincentives for corporate investment.

Figure 6, panel (b) presents a binned scatterplot of firm Q4 CAPEX spikes against Q4 earnings surprises. The vertical line with earnings surprise equal to zero indicates that firms exactly meet the median analyst forecast.[21] Firms clearly tend to beat the analyst earnings forecasts,

[21] Using the mean or median analyst forecasts generate very similar results.

and firms that meet or beat their analyst forecasts conduct more tax-minimizing investment. More generally, we see a positive relationship between earnings and Q4 spikes, which also appeared in the within-firm analysis in Section 3.1.

In years when a firm manages to beat or meet the analyst forecasts, be it the annual or Q4 earnings forecast, Q4 spikes are higher. When we regress the magnitude of spikes on an indicator for whether the firm beats or meets its earnings forecast, the effect size is approximately 5%. The result suggests that earnings management and tax planning are connected decisions, with an active trade-off margin operating between them.

Figure 6, panels (c) and (d) present binned scatterplots for firms sorted by the volatility and skewness of earnings. Volatility is measured by the standard deviation of a firm's EBITDA/Assets and skewness is the measured by the skewness of EBITDA/Assets. Interestingly, firms with higher volatility show lower Q4 spikes, while firms with more positive skewness show higher Q4 spikes. These seemingly contradictory patterns can be reconciled by the fact that earnings variance tends to come from large negative shocks to earnings. Tax code asymmetries imply that only positive suprises should be correlated with investment spikes, which is consistent with the positive relationship between spikes and earnings skewness.

Figure 7 provides further supporting evidence of the idea that spikes represent a firm's decision to realize a tax-minimizing option in response to a temporary positive earnings shock. We plot binned scatterplots with the median Q4 spike on the y-axis and different lagged Q4 spikes on the x-axis, ranging from one to six years prior. The plots present residuals after firm fixed effects have been removed and thus reveal the autocorrelation of investment spikes within firm over time. The graphs indicate a negative slope that weakens to approximately zero after four years. The negative slope suggests that Q4 spikes do not fully persist year after year, instead reflecting a process with some mean reversion.

4.4 The Cumulative Effect of Investment Spikes

Having established the robustness of Q4 spikes, we now ask to what extent these spikes reflect only high frequency retiming of investment versus a longer lasting cumulative change in the level of investment. The exercise serves two purposes. The first is to address the concern that Q4 spikes have no medium or long term implications beyond the quarter after a spike occurs. The second is to provide further evidence that spikes reflect time-varying opportunities for firms to offset tax bills associated with positive earnings shocks.

Figure 8 plots in event time the ratio of average quarterly CAPEX to average CAPEX in Q2 and Q3 of the base year. The dotted lines indicate 95% confidence intervals. We follow the average quarterly CAPEX relative to base up to eight quarters after Q4. Approximately one-third of the ratio reverses following the decrease in the next fiscal Q1 CAPEX; however, the cumulative level remains persistently above 1 even after 8 quarters. The series also shows a noticeable but smaller spike in the following fourth quarter.[22]

Figure 8 suggests that the Q4 CAPEX spikes represent a higher level of investment during the spike year and not only intertemporal shifting. Table 6 presents firm-level regression estimates that confirm this finding. All regressions include firm fixed effects and year fixed effects. Thus, the regressions compare within-firm investment levels around large spikes. We examine investment levels from one year before to two years after large spikes, where large spikes are defined as CAPEX 4/3 exceeding 200% in columns (1) and (2), and CAPEX 4/3 exceeding 300% in columns (3) and (4). Columns (2) and (4) add ln(assets), Market-to-Book, Cash/Assets, and EBITDA/Assets as additional controls in order to absorb the impact of time-varying firm characteristics on investment levels.

Firm-years with large Q4 CAPEX spikes indeed experience higher investment levels. Interestingly, the spikes in investment levels are persistent and do not reverse even after two years. In terms of the economic magnitude, years with CAPEX 4/3 exceeding 200% show investment levels relative to lagged capital 4% higher than the average, or approximately 10% of the sample mean. In the following year, the investment level remains high, only reversing partly two years later. Furthermore, the reversal does not offset the level increase from the spike year. Adding additional firm controls does not alter this conclusion.

4.5 Investment Spikes and Internal Capital Markets

An alternative explanation for the Q4 CAPEX spikes is related to firm budget cycles. Many firms have budgets expiring at the end of fiscal years, where accounts will be set lower subsequently if the budget amounts are not exhausted. Those firms face a "Use it or lose it" dilemma. Moreover, in some firms, evaluation of employee or manager performance might also be linked to budget spending, where more spending can be interpreted as better performance. These

[22] Appendix Figure B.4 presents a plot using the average quarterly CAPEX in the first three quarters base year as the benchmark. The results are very similar.

factors create an incentive for firms to rush to spend budgets near fiscal year end. Similar year-end "rush to spend" behavior has been observed in other forms of organizations.Liebman and Mahoney (2013) study spikes in year-end procurement spending for the US federal government and show that expiring budgets lead to wasteful year-end spending, while an agency that has the ability to rollover the unfinished budget does not exhibit year-end spending spikes. Oyer (1998) connects seasonal sales patterns to year-end incentive contracts among salespeople and executives.

Due to the lack of firms' budget data, a direct test of the budget hypothesis is not viable. As an alternative, we study different measures of budgetary complexity and the quality of internal governance. If the rush in fiscal year-end CAPEX spending is true, then we would expect it to be more pronounced in firms with more complex budgetary structure where budgets across different divisions cannot be uniformly managed. Also we expect firms with worse internal governance to display a larger year-end spending rush. We test this idea and present the results in Table 7.

We use two different measures to capture the complexity of a firm's budgetary structure: the number of segments and the number of two digit SIC codes in the corporate segment. We use the Entrenchment index of Bebchuk, Cohen and Ferrell (2009) and the G index of Gompers P. Ishii and Metrick (2003) to capture the quality of internal governance. The variation explored in Table 7 is mainly cross-sectional and all measures are standardized for easy interpretation.

Table 7 shows that firms with more complex budgetary structures indeed display higher Q4 spikes—a one standard deviation increase in complexity measures leads to a 1-2% increase in fiscal Q4 CAPEX spikes. Firms with worse internal governance measures also display higher fiscal Q4 CAPEX spikes—a one standard deviation increase in internal governance measure leads to around 3% increase in fiscal Q4 CAPEX spikes, which is about 8% of sample mean. The economic magnitudes of the effects shown in Table 7 are somewhat smaller than our estimated tax effects, but this finding may reflect our inability to measure budget incentives directly. We therefore interpret this result as suggesting that "Use it or lose it" incentives are likely contributing to Q4 spikes, though such incentives cannot obviously explain the responsiveness of spikes to tax changes.

5 Conclusion

This paper studies a new channel through which taxes affect corporate investment behavior. Because tax positions can be better estimated close to fiscal year-end, backloading investment expenditures allows firms to maximize the tax benefit of depreciation. Tax-minimizing investment leads to robust and quantitatively significant spikes in fiscal Q4 CAPEX. Similar behavior occurs in many countries.

Our findings have a number of implications for tax policy. Tax incentives that directly target investment expenditures have pronounced effects on investment planning decisions for even the largest firms in the economy. These effects are driven especially by how the code treats expenditures in the year of purchase. Policymakers may want to consider these factors as they debate the relative merits of proposals that lower corporate tax rates while slowing depreciation deductions versus proposals that accelerate depreciation deductions, such as in the cash flow tax proposal of Auerbach (2010).[23] However, because we focus on the timing of investment at a relatively high frequency, caution is warranted in drawing conclusions about the effect of taxes on aggregate investment.

Our analysis suggests that financially constrained firms and those that value immediate liquidity may be particularly sensitive to tax policy changes. The results are consistent with models in which firms use high effective discount rates to evaluate investment decisions, in particular the after-tax costs of those investments. Models of corporate behavior without a first-year, tax-minimization motive are unlikely to fit the patterns revealed in the data.

This paper highlights implications for microeconomic models of firm behavior, but only briefly addresses the macroeconomic effects of tax-minimizing investment. Perhaps such behavior can provide a concrete microfoundation for the accelerator model of aggregate investment. Another natural question is whether fiscal Q4 spikes help account for the patterns of lumpy investment highlighted by Caballero and Engel (1999) and Cooper and Haltiwanger (2006). We hope to explore these issues in future work.

[23]Batchelder (2017) discusses in detail how behavioral factors and financial frictions should enter into cost-benefit analysis of these sorts of proposals.

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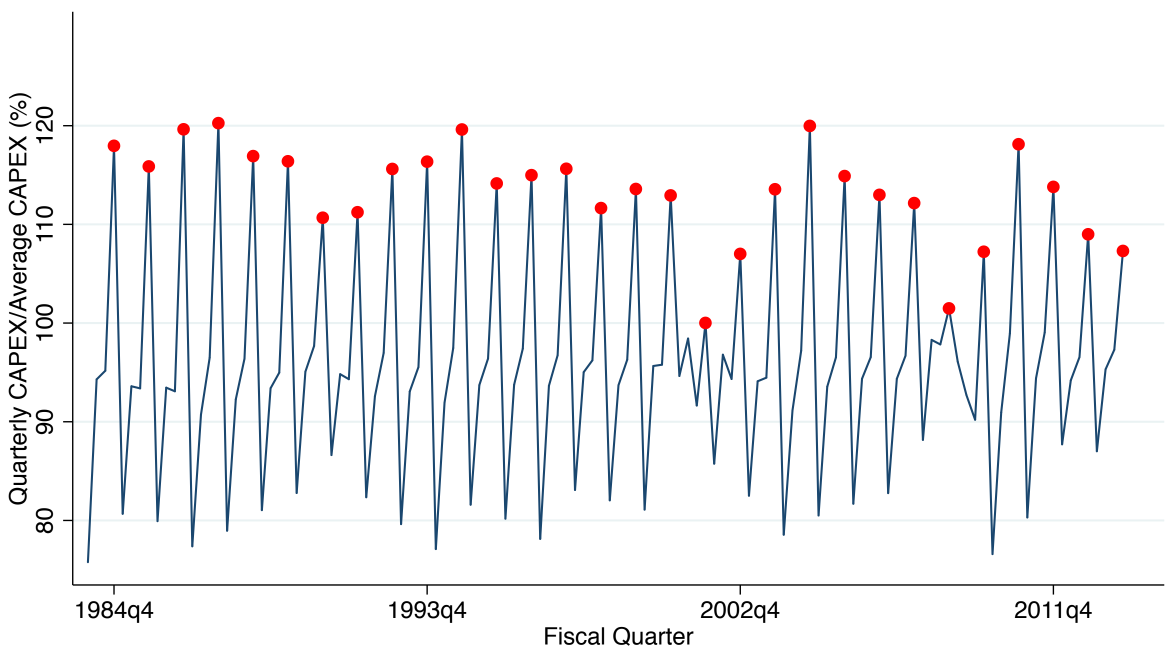
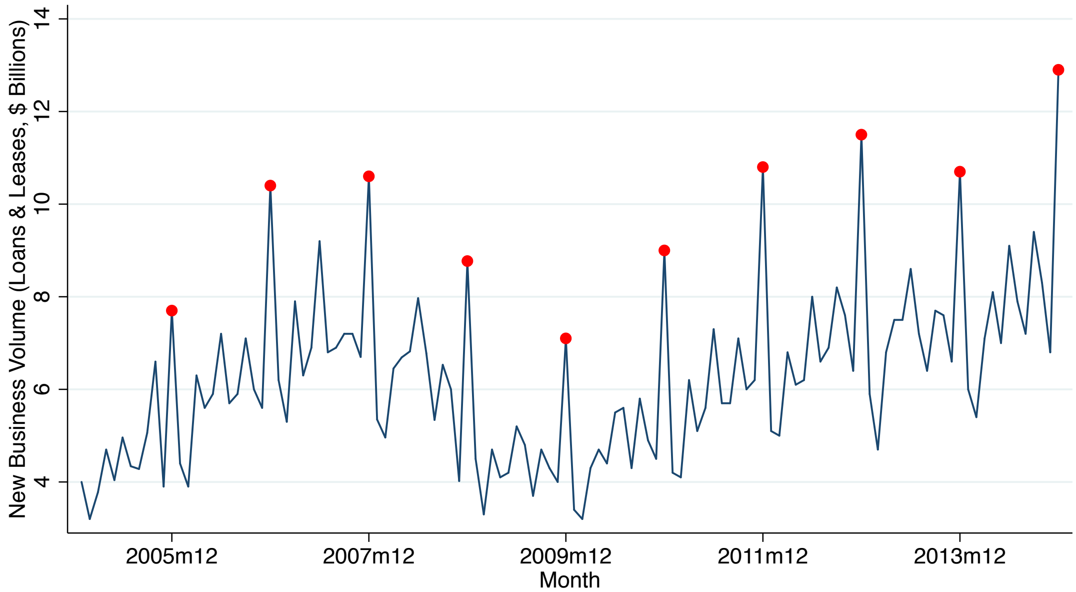
Figure 1: Time Series of Fiscal Q4 Investment Spikes (1984-2013)



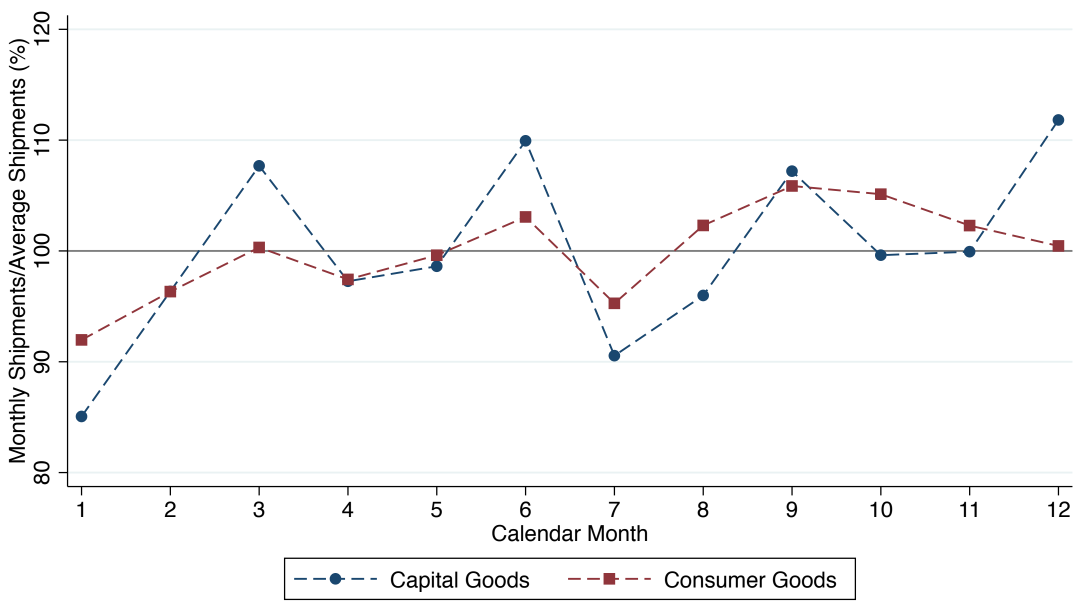
Notes: This figure shows fiscal fourth quarter (Q4) capital expenditure (CAPEX) spikes for US firms in Compustat between 1984 and 2013. We plot the median ratio of quarterly CAPEX to the average CAPEX within a firm's fiscal year. Red dots indicate Q4.

Figure 2: Spikes in Aggregate Investment Series

(a) Spikes in Capital Lending Volume (2004-2014)

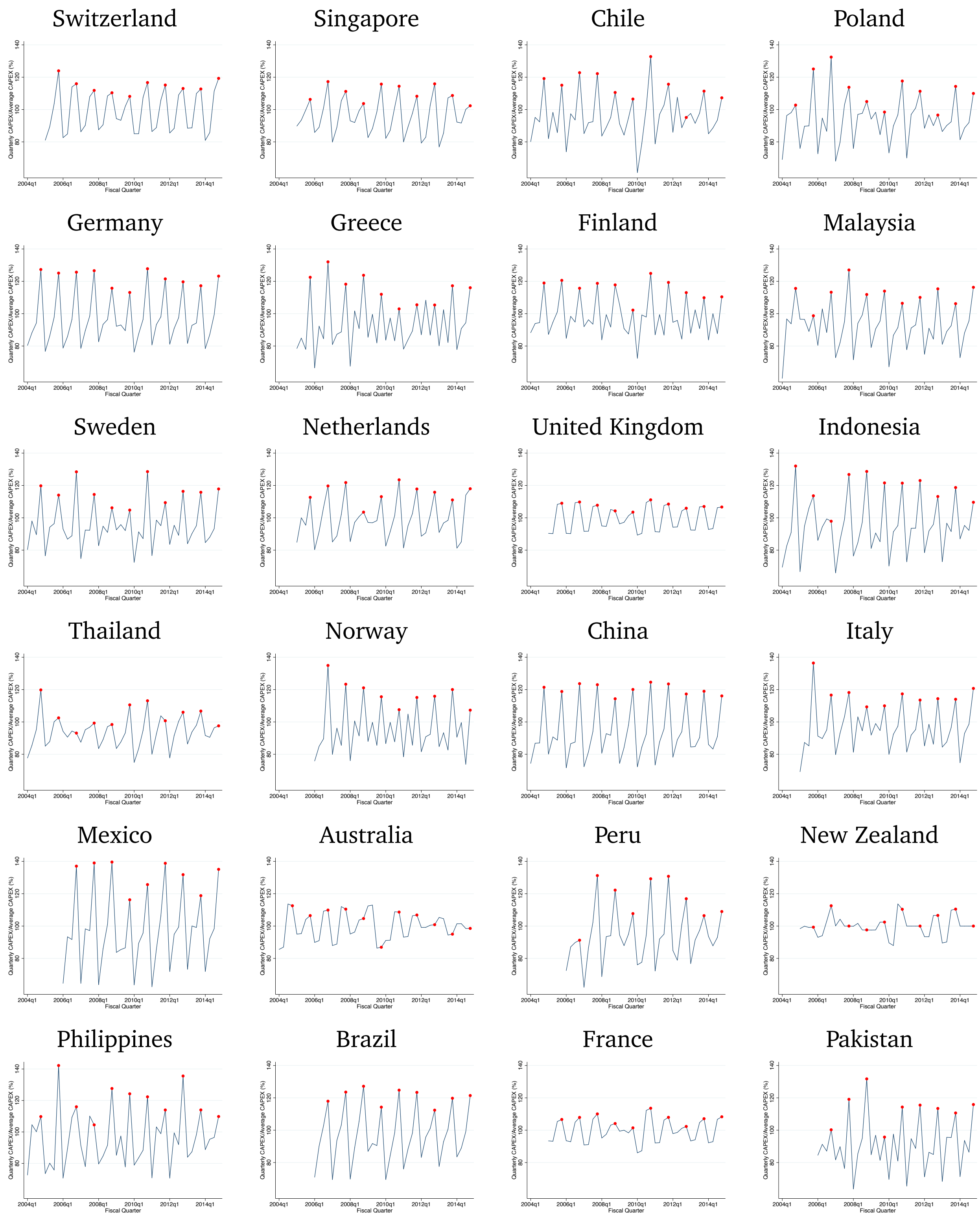


(b) Spikes in Capital Goods Shipments (1958-2016)



Notes: This figure provides evidence that Q4 investment spikes are not artifacts of financial reporting and may affect aggregate quantities. Panel (a) plots monthly overall new business volume from the Equipment Leasing and Finance Association's (ELFA) Monthly Leasing and Finance Index (MLFI-25, available at `http://www.elfaonline.org/data/MLFI`). The MLFI-25 measures monthly commercial equipment lease and loan activity reported by participating ELFA member companies, which represent a cross section of the equipment finance sector. Panel (b) presents the within-year seasonality of aggregate non-defense capital goods and consumer goods. The data comes from the Census Bureau's manufacturer shipments, inventories, and orders (M3) survey of the domestic manufacturing sector. For each month, we compute the ratio of monthly shipment value to the average monthly value within that month's calendar year. We plot the average for each calendar month over the period from 1958 to 2016.

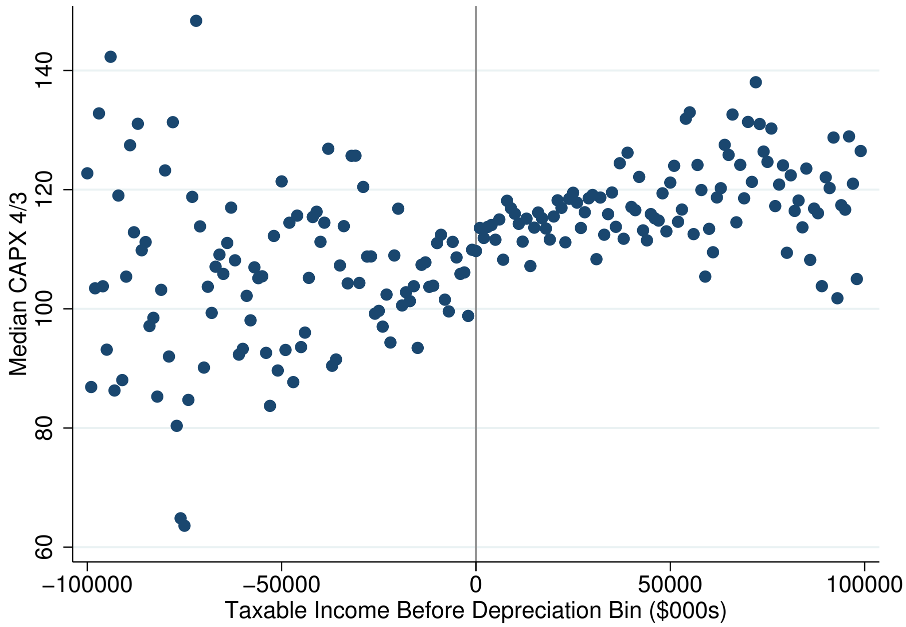
Figure 3: International Evidence of Fiscal Q4 Spikes (2004-2014)



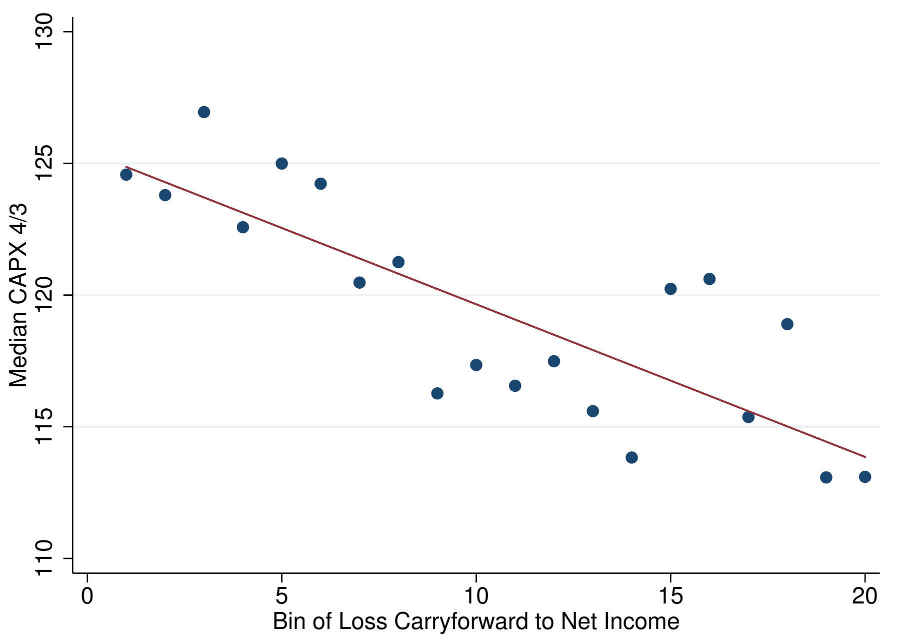
Notes: This figure shows fourth quarter CAPEX spikes across country. Countries are sorted according to their average corporate income tax rate during the sample period: Switzerland has the lowest average corporate income tax rate (≈8%) while Pakistan has the highest (≈35%).

Figure 4: Fiscal Q4 Spikes and Tax Incentives

(a) Firm-Years Sorted by Tax Position



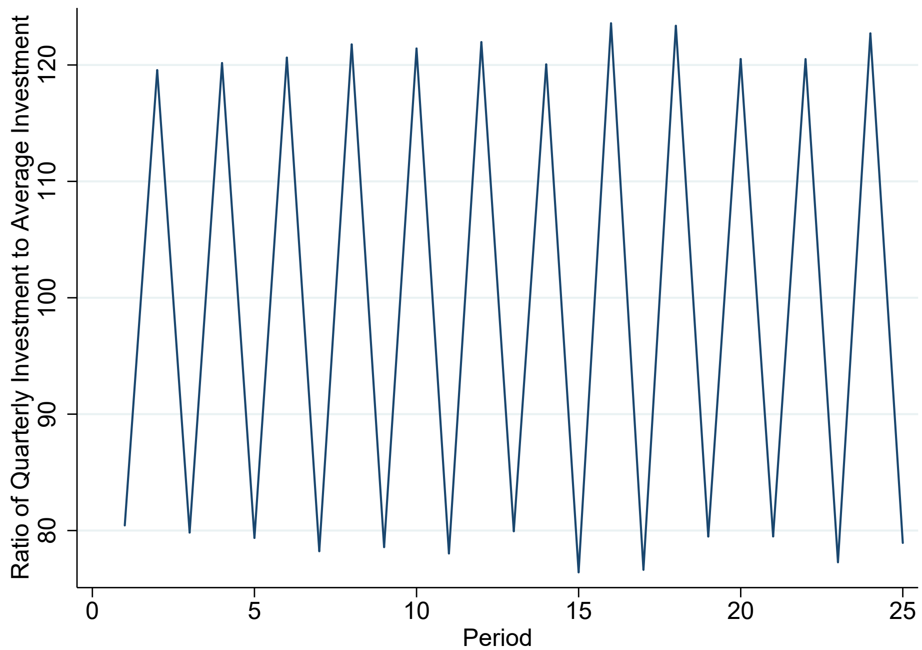
(b) Firm-Years Grouped by NOL Stock



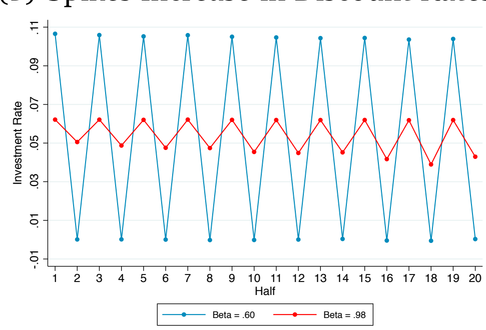
Notes: This figure shows the relationship between fourth quarter capital expenditure (CAPEX) spikes and firm-level incentives to use investment as a tax shield. Both figures identify a firm's tax position by combining CAPEX spike data from Compustat with tax position data from corporate tax returns for the years 1993 through 2010. In Panel (a), we divide firms into $1,000 bins based on their taxable income before depreciation expense is taken into account and plot for each bin the median ratio of fourth fiscal quarter CAPEX to the average CAPEX of the first three fiscal quarters. In Panel (b), we focus only on firms with positive tax position and group firms by the ratio of the stock of net operating loss carryforwards to net income before depreciation.

Figure 5: Stylized Facts in Model Simulated Data

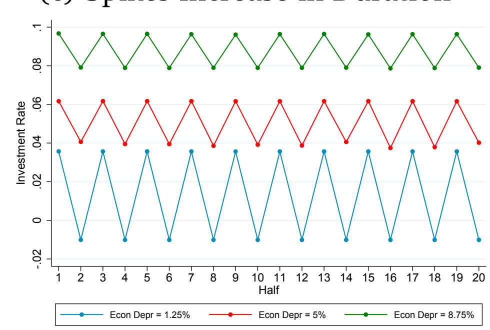
(a) Fiscal H2 Spikes



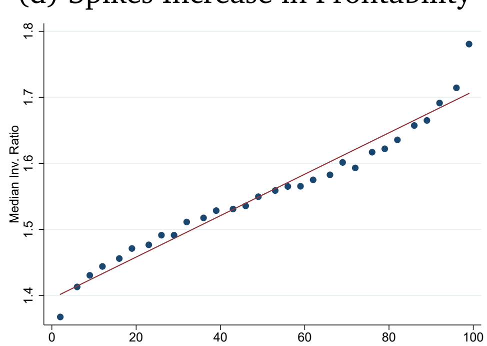
(b) Spikes Increase in Discount Rates



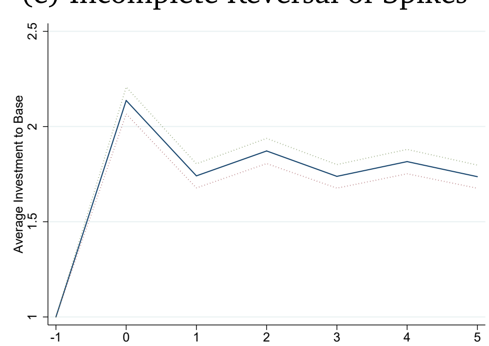
(c) Spikes Increase in Duration



(d) Spikes Increase in Profitability

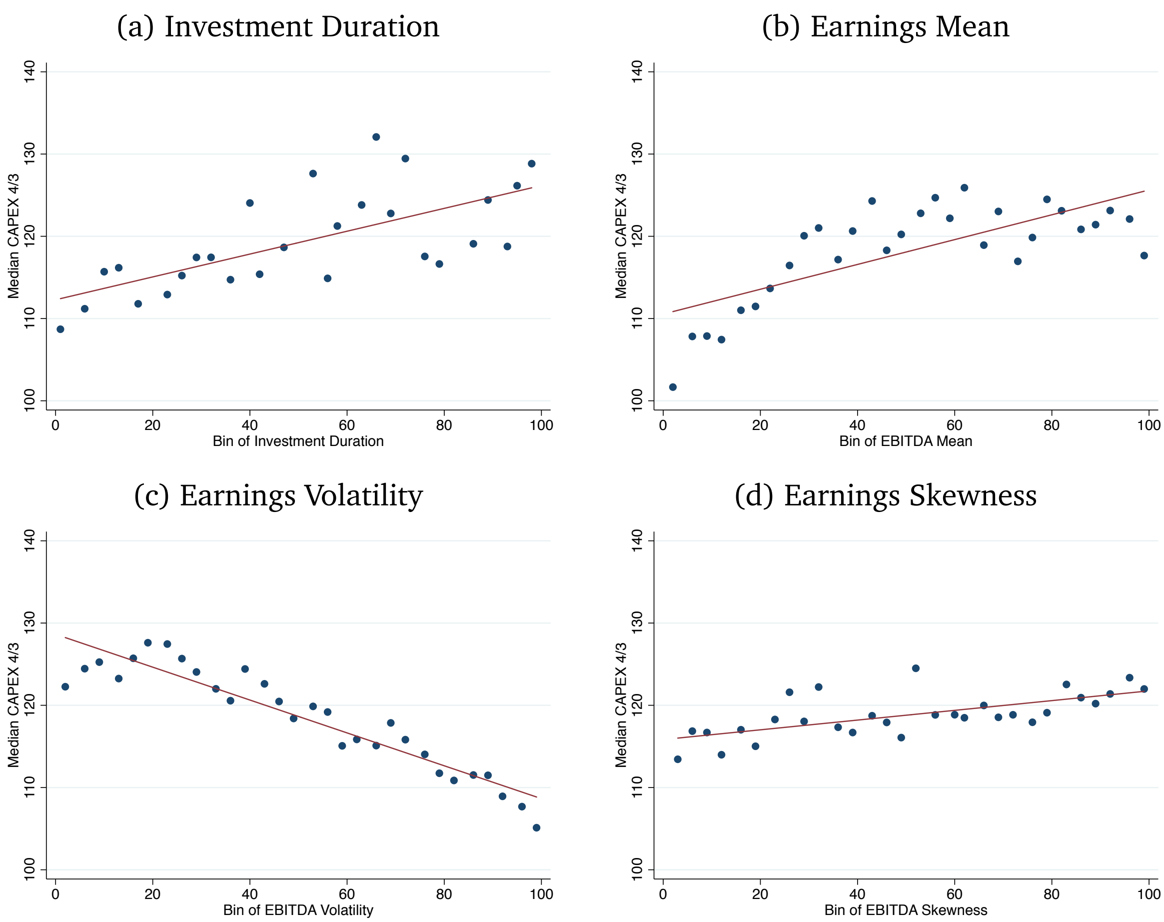


(e) Incomplete Reversal of Spikes



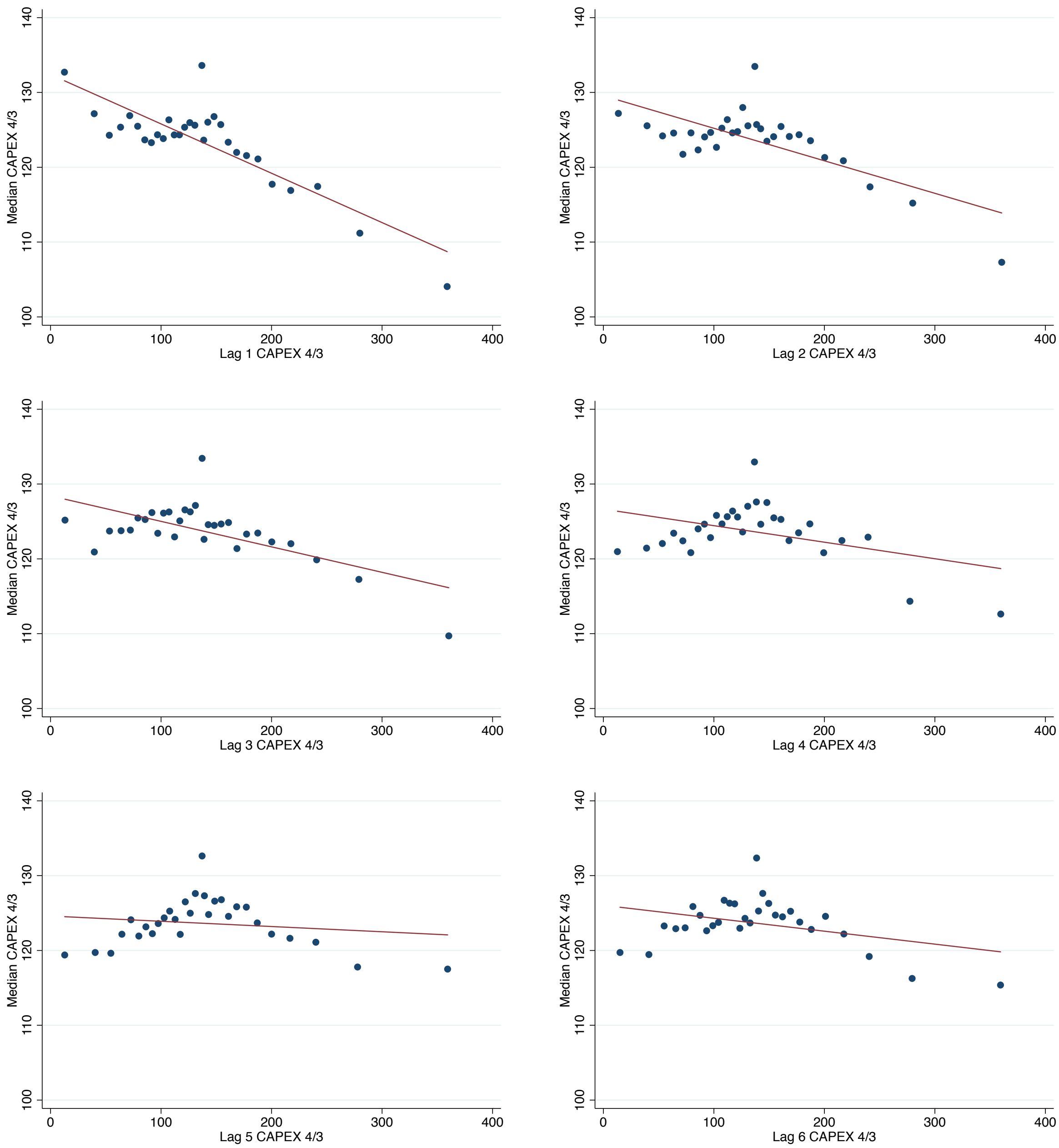
Notes: This figure presents stylized facts from simulated data based on the model in Section 4.1. Panel (a) plots average fiscal second-half (H2) investment spikes for simulated firm data. We plot the median ratio of semiannual investment to average investment within a fiscal year. In panel (b), we plot average investment rates and spike patterns for two simulated versions with different assumed discount factors. In panel (c), we plot average investment rates and spike patterns for three simulated versions with different assumed rates of economic depreciation. Panel (d) plots median H2 spikes against the binned data from the mean of gross operating surplus relative to capital. Panel (e) plots the cumulative level of investment after H2 spikes where the numerator is average semiannual investment starting from H2 of the base year and the denominator is H1 of the base year.

Figure 6: Cross-Sectional Determinants of Q4 Spikes



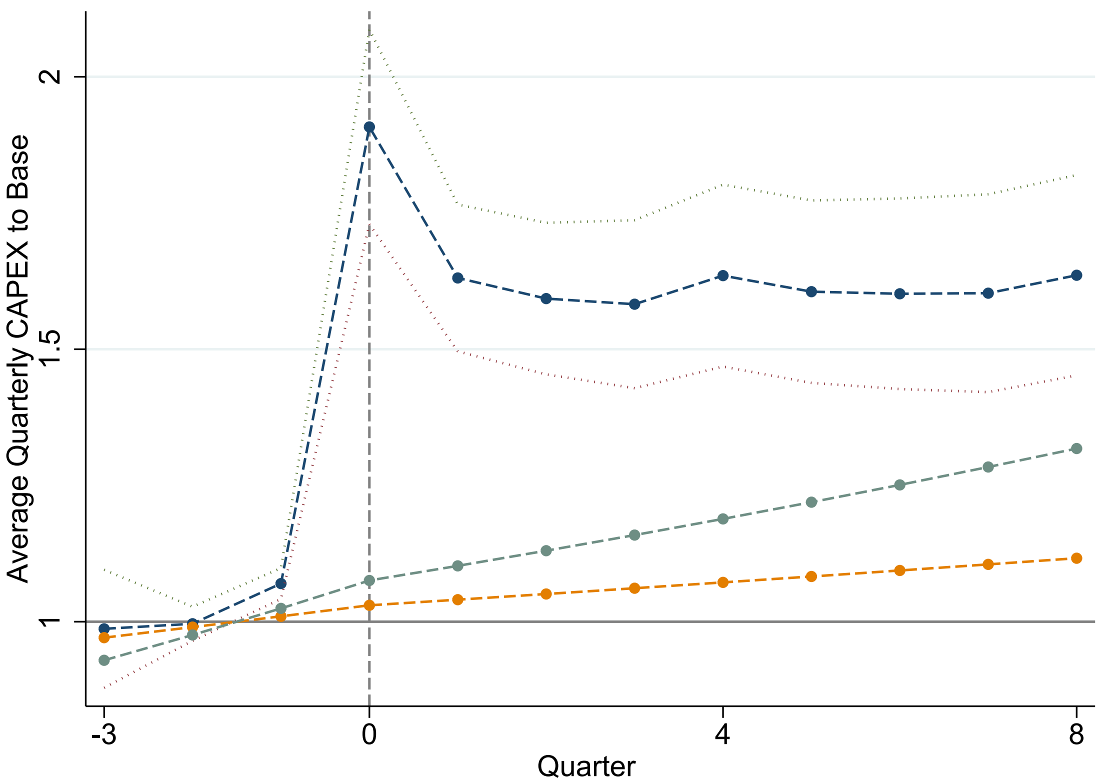
Notes: This figure presents binned scatterplots of median sample firm Q4 CAPEX spikes against investment duration, earnings volatility, and earnings surprises. In panel (a), investment duration is derived from the inverse of the present value of depreciation deductions (via Zwick and Mahon (2017) at the NAICS four-digit level) with higher values representing longer equipment investment duration. Panels (b), (c), and (d) plot median Q4 spikes against the mean, variance, and skewness of EBITDA/Assets, respectively.

Figure 7: Fiscal Q4 Spikes Autocorrelation



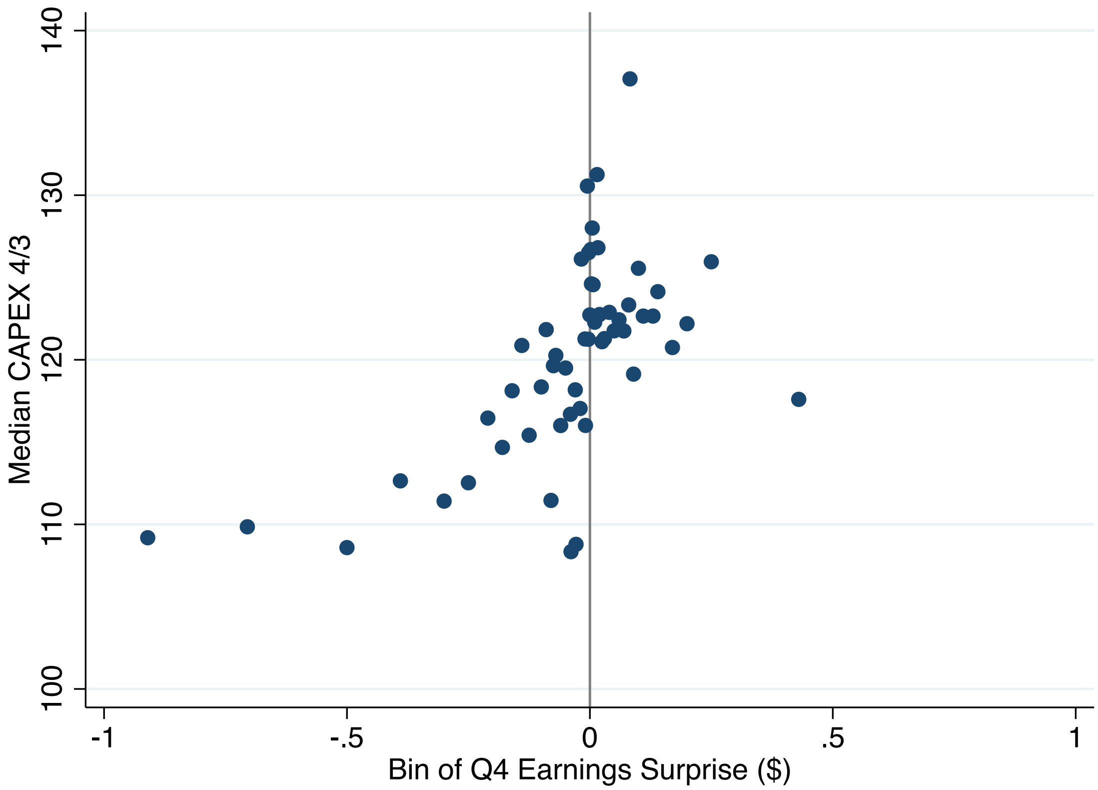
Notes: This figure presents binned scatter plots of the autocorrelation of Q4 CAPEX spikes within firm over time. The graphs plot the median Q4 spike versus lagged spikes for one to six years after absorbing firm fixed effects.

Figure 8: Cumulative Investment after Fiscal Q4 Spikes



Notes: This figure presents the cumulative level of investment after fiscal Q4 spikes. We plot the ratio of average quarterly CAPEX to CAPEX$\frac{Q2+Q3}{2}$ in the base year. The numerator is calculated as the average quarterly CAPEX starting from Q4 of the base year: for quarter 4 ($t = 0$) the numerator is CAPEX Q4, for next fiscal year quarter 1 ($t = 1$) the numerator is CAPEX$\frac{Q4+F.Q1}{2}$, for next fiscal year quarter 2 ($t = 2$) the numerator is CAPEX$\frac{Q4+F.Q1+F.Q2}{3}$, and so on. The dotted lines are 95% confidence intervals. The yellow (green) line plots a counterfactual investment series with steady investment growth of 2% (3%) per quarter.

Figure 9: Q4 Spikes and Earnings Management



Notes: This figure presents binned scatterplots of median sample firm Q4 CAPEX spikes against earnings surprises. The gray line with earnings surprise equal to zero indicates that firms exactly meet the median analyst forecast.

Table 1: Summary Statistics

(a) US Sample (1984-2013)

	N	Mean	Median	SD	P10	P90
Assets ($M)	119,386	2,701.59	219.00	15,697.69	27.51	3,875.80
Depreciation ($M)	119,194	126.15	9.03	708.88	0.78	177.78
CAPEX ($M)	119,372	171.85	10.97	1,080.88	0.78	232.54
PPE ($M)	119,323	939.52	50.52	5,534.65	3.45	1,326.50
Sales ($M)	119,379	2,318.03	212.47	12,055.00	17.13	3,646.90
M/B	114,357	1.88	1.42	1.39	0.88	3.37
Cash Flow/Assets	115,896	0.05	0.09	0.23	-0.13	0.22
Cash/Assets	119,307	0.17	0.08	0.21	0.01	0.47
EBITDA/Assets	119,146	0.09	0.12	0.16	-0.08	0.23
CAPEX/PPE	117,581	0.40	0.23	0.59	0.07	0.83
CAPEX 4/3 (%)	119,386	136.97	119.07	85.46	47.76	248.63
Sales 4/3 (%)	115,915	111.70	107.05	27.86	84.90	143.44

(b) International Sample (2004-2014)

	N	Mean	Median	SD	P10	P90
M/B	52,788	1.89	1.29	2.08	0.75	3.28
Cash Flow/Assets	79,310	0.04	0.07	0.21	-0.12	0.20
Cash/Assets	80,303	0.18	0.12	0.18	0.02	0.42
EBITDA/Assets	79,812	0.06	0.09	0.22	-0.10	0.23
CAPEX/PPE	79,556	0.46	0.19	1.12	0.04	0.81
CAPEX 4/3 (%)	80,303	134.58	114.80	89.57	40.13	256.53
Sales 4/3 (%)	77,281	113.24	106.09	37.67	80.19	151.58

Notes: Panel (a) presents summary statistics for the sample of US firms. There are 17,527 firms with 158,859 firm-years during the period 1984-2013. Panel (b) presents summary statistics for the sample of international firms from 33 countries during the period of 2004-2013. 15,764 unique firms and 88,067 firm-years are included in the international sample. CAPEX 4/3 and Sales 4/3 are censored at 500%, which excludes approximately 2% of the data. Financial ratios are winsorized at the top and bottom 1% level.

Table 2: Fiscal Q4 CAPEX Spikes and Tax Status

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
D(taxable)	7.6***	6.3***	2.9**	10.8***	6.7**	6.8***	6.3***
	(1.4)	(1.4)	(1.5)	(3.1)	(3.1)	(1.7)	(1.8)
CAPEX/PPE		4.7***	4.5***		4.4**		5.0***
		(1.2)	(1.2)		(2.2)		(1.8)
EBITDA/Assets			34.4***				
			(5.6)				
Observations	49178	47582	47524	19429	18744	29749	28838
R^2	0.0779	0.0981	0.0996	0.103	0.127	0.0832	0.0972
Controls	No	1	2	No	1	No	1
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period				Pre-2000	Pre-2000	Post-2000	Post-2000

Notes: This table presents regression estimates of firm Q4 CAPEX spikes on firm tax position by combining CAPEX spike data from Compustat with tax position data from corporate tax returns for the years 1993 through 2010. We follow Zwick and Mahon (2017) and define taxable as an indicator for whether a firm has positive income before depreciation expense and thus an immediate incentive to offset taxable income with additional investment. All columns include firm and year fixed effects. Columns (2), (5), and (7) include the following controls: ln(assets), Market-to-Book, Cash/Assets, CAPEX/PPE, and Sales 4/3. Column (3) adds EBITDA/Assets as an additional control. Columns (4) and (5) are run using just the years 1993 through 2000 and columns (6) and (7) use the years from 2001 to 2010. Standard errors are clustered at the firm level.

Table 3: Fiscal Q4 CAPEX Spikes and the Tax Reform Act of 1986

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
D(1984-1987)	10.2***	5.0***	10.0***	5.4***	10.6***	6.1***	4.3***	1.6***
	(1.3)	(1.5)	(1.2)	(1.3)	(1.2)	(1.3)	(0.5)	(0.6)
Observations	24744	22886	61262	56986	117155	109968	117155	109968
Adjusted R^2	0.07	0.08	0.06	0.08	0.06	0.09	0.06	0.07
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period	84-92	84-92	84-00	84-00	84-13	84-13	84-13	84-13

Notes: This table presents regression estimates of firm Q4 CAPEX spikes around the Tax Reform Act of 1986. The top corporate tax rate was 46% in 1984-1986, 40% in 1987, 34% in 1988-1992 and 35% in 1993-present. The Tax Reform Act of 1986 also repealed the Investment Tax Credit and lengthened the depreciation periods for property. In addition, it required mid-quarter convention if property placed in service during Q4 is over 40% of the whole tax year. D(84-87) is a dummy variable equal to 1 for the years 1984-1987. The dependent variable is Q4 CAPEX spike measure in Columns (1)-(6), and is a dummy variable indicating Q4 investment is over the 40% threshold in Columns (7) and (8) . Columns (1) and (2) include the period from 1984 to 1992, columns (3) and (4) include the period from 1984 to 2000, and columns (5) and (6) include the period from 1984 to 2013. Columns (1), (3), (5), and (7) only include firm fixed effects, while columns (2), (4), (6) and (8) include the following controls: ln(assets), Market-to-Book, Cash/Assets, CAPEX/PPE, and Sales 4/3. Standard errors are clustered at the firm level.

Table 4: Investment Spikes and Financial Constraints

	(1)	(2)	(3)	(4)
D(84-87)	4.23***	0.15	3.88**	4.30***
	(1.55)	(2.26)	(1.70)	(1.50)
D(1984-1987)*nodiv	4.55*			
	(2.55)			
D(1984-1987)*junkrating		7.68*		
		(4.45)		
D(1984-1987)*fp			4.84**	
			(2.34)	
D(1984-1987)*fp2				5.16**
				(2.48)
Observations	109968	27742	108818	108818
R^2	0.0908	0.157	0.0932	0.0920
Controls	Yes	Yes	Yes	Yes
Year FE	No	No	No	No
Firm FE	Yes	Yes	Yes	Yes

Notes: This table presents regression estimates relating the magnitude of firm Q4 investment spikes to various proxies for financial constraints used in prior work: a non-dividend payer dummy, a speculative grade dummy, a dummy variable indicating CAPEX exceeding internal cash flow, and a dummy variable indicating CAPEX exceeding internal cash flow and not having an S&P rating (Faulkender and Petersen (2012)). Columns (1) through (4) interact financial constraint proxies with tax policy changes around the Tax Reform Act of 1986. Control variables include ln(Assets), Market-to-Book, Cash/Assets, CAPEX/PPE, and Sales 4/3. Firm fixed effects are included. Standard errors are clustered at the firm level.

Table 5: Decomposing the Investment-Cash Flow Sensitivity

	LHS Variable is CAPEX/Assets		
	(1)	(2)	(3)
$\frac{CashFlow}{Asset}$	0.034***	0.007***	0.007***
	(0.005)	(0.001)	(0.001)
$\frac{CashFlow}{Asset} * Q2$			0.001
			(0.001)
$\frac{CashFlow}{Asset} * Q3$			0.001
			(0.001)
$\frac{CashFlow}{Asset} * Q4$		0.006***	0.007***
		(0.001)	(0.001)
Tobin's Q	0.012***	0.003***	0.003***
	(0.000)	(0.000)	(0.000)
Observations	129728	470825	470825
Adj R-Squared	0.529	0.435	0.435
Firm FE	Yes	Yes	Yes
Year FE	Yes		
Year-Quarter FE		Yes	Yes

Notes: This table presents regression estimates of investment-cash flow sensitivity using either annual or quarterly investment measures. To enable comparison to past work, column (1) presents estimates at an annual frequency with CAPEX/Assets as the left hand side variable and annual Cash Flow/Assets and Tobin's Q as key right hand side variables, and includes firm and year fixed effects. Columns (2) and (3) use quarterly CAPEX/Assets as the left hand side variable and include firm and year-by-quarter fixed effects. Column (2) interacts a fiscal Q4 dummy with Cash Flow/Assets. Column (3) interacts dummies for each fiscal quarter with Cash Flow/Assets. Standard errors are clustered at the firm level.

Table 6: Cumulative Effect of Q4 CAPEX Spikes

	(1)	(2)	(3)	(4)
D(Lagged 1Y)	-0.03***	-0.03***		
	(0.01)	(0.00)		
D(Spike≥200%)	0.06***	0.05***		
	(0.01)	(0.01)		
D(Forward 1Y)	0.04***	0.04***		
	(0.01)	(0.01)		
D(Forward 2Y)	-0.05***	-0.04***		
	(0.01)	(0.01)		
D(Lagged 1Y)			-0.03***	-0.03***
			(0.01)	(0.01)
D(Spike≥300%)			0.08***	0.07***
			(0.01)	(0.01)
D(Forward 1Y)			0.05***	0.05***
			(0.01)	(0.01)
D(Forward 2Y)			-0.06***	-0.05***
			(0.01)	(0.01)
Observations	119090	114352	119090	114352
Adjusted R^2	0.31	0.34	0.30	0.34
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes

Notes: This table examines the level of CAPEX/PPE around firm-years with large Q4 CAPEX spikes. Dummy variables indicate time period from one year before to two years after large spikes. Large Q4 spike (CAPEX 4/3) threshold is 2 in Columns (1) and (2), and 3 in Columns (3) and (4). Columns (2) and (4) include ln(assets), Market-to-Book, Cash/Assets, and EBITDA/Assets as controls. Firm fixed effects and year fixed effects are included. Standard errors are clustered at the firm level.

Table 7: Investment Spikes and Complicated Firms: Use it or Lose it?

	(1)	(2)	(3)	(4)
# Segments	2.63***			
	(0.35)			
# SIC2		1.56***		
		(0.33)		
G Index			2.78***	
			(0.72)	
E Index				2.46***
				(0.74)
Observations	94280	94262	18407	17087
R^2	0.0195	0.0190	0.0259	0.0262
Controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Notes: This table presents regression estimates relating firm Q4 investment spikes to measures of corporate or budgetary complexity and internal governance of firms. These measures include: (1) the number of segments; (2) the number of two digit SIC codes in the corporate segments; (3) the G-index of Gompers, Ishii, and Metrick (2001); and (4) the Entrenchment-index of Bebchuk, Cohen, and Farrell (2002). The G-index and Entrenchment-index regressions only include the time period of 1990-2007 due to data availability. Control variables include ln(Assets), Market-to-Book, Cash/Assets, CAPEX/PPE, and Sales 4/3. The non-dummy right hand side variables are standardized for ease of interpretation. Year fixed effects are included. Standard errors are clustered at the firm level.

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A Institutional Background

Table A.1: Variable Definition

CAPEX/ PPE	Capital Expenditures/ Property, Plant and Equipment
Cash/Assets	Cash and Short-term Investment/L.Assets
Cash Flow/Assets	(Income Before Extraordinary Items+Depreciation and Amortization)/L.Assets
Dividend Payers	A dummy variable =1 if a firm pays dividend in a given year
EBITDA/Assets	Earnings before interest, tax, depreciation and amortization/L.Assets
Faulkender-Petersen I	A dummy variable =1 if a firm's investment expenditures exceed its internal cash flow
Faulkender-Petersen II	Faulkender-Petersen I × A dummy variables=1 if a firm does not have an S&P domestic long term issuer credit rating
Leverage	(Debt in Current Liabilities + Long-Term Debt)/ (Debt in Current Liabilities + Long-Term Debt+ Common Equity)
Investment Duration	The inverse of the present value of future depreciation deductions (at NAICS four-digit level)
Sales Volatility	Standard deviation of a firm's sales, normalized by the average sales
Market-to-Book	(Asset − Common Equity + Common Shares Outstanding × Closing Price (Fiscal Year))/Assets
Speculative Grade	A dummy variable =1 if a firm receives an S&P long term issuer credit rating below or equal to BB+ in a given year
Tobin's Q	(Total Asset + Common Shares Outstanding × Closing Price (Fiscal Year) − Common Equity − Deferred Taxes)/Asset

Table A.2: Historical U.S. Corporate Income Tax Rate and Bonus Depreciation

Year	Income Bracket	Tax Rate (%)
1984-1986	First $25,000	15
	$25,000 to $50,000	18
	$50,000 to $75,000	30
	$75,000 to $100,000	40
	$100,000 to $1,000,000	46
	$1,000,000 to $1,405,000	51(a)
	Over $1,405,000	46
1987	First $25,000	15
	$25,000 to $50,000	16.5
	$50,000 to $75,000	27.5
	$75,000 to $100,000	37
	$100,000 to $335,000	42.5
	$335,000 to $1,000,000	40
	$1,000,000 to $1,405,000	42.5
	Over $1,405,000	46
1988-1992	First $50,000	15
	$50,000 to $75,000	25
	$75,000 to $100,000	34
	$100,000 to $335,000	39 (b)
	Over $335,000	34
1993-2013	First $50,000	15
	$50,000 to $75,000	25
	$75,000 to $100,000	34
	$100,000 to $335,000	39(c)
	$335,000 to $10,000,000	34
	$10,000,000 to $15,000,000	35
	$15,000,000 to $18,333,333	38(d)
	Over $18,333,333	35

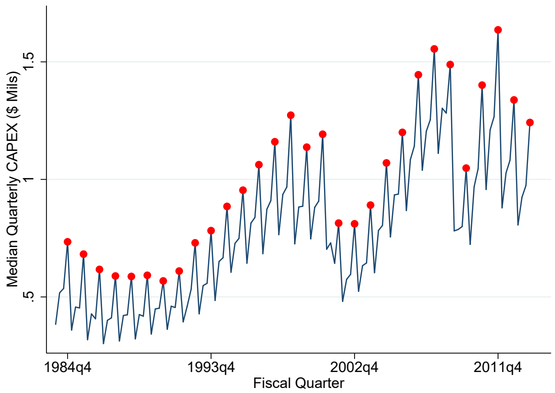
Year	Bonus Depreciation
2001-02	30% Tax years ending after 9/10/01
2003	50% Tax years ending after 5/3/03
2004	50%
2008-09	50% Tax years ending after 12/31/07
2010-11	100% Tax years ending after 9/8/10
2012-13	50%

Notes:
(a) The Deficit Reduction Act of 1984 placed an additional 5 percent to the tax rate in order to phase out the benefit of the lower graduated rates for corporations with taxable income between $1,000,000 and 1,405,000. Corporations with taxable income above $1,405,000, in effect, pay a flat marginal rate of 46 percent.
(b) Rates shown effective for tax years beginning on or after July 1, 1987. Taxable income before July 1, 1987 was subject to a two tax rate schedule or a blended tax rate.
(c) An additional 5 percent tax, not exceeding $11,750, is imposed on taxable income between $100,000 and $335,000 in order to phase out the benefits of the lower graduated rates.
(d) An additional 3 percent tax, not exceeding $100,000, is imposed on taxable income between $15,000,000 and $18,333,333 in order to phase out the benefits of the lower graduated rates.
Source: IRS

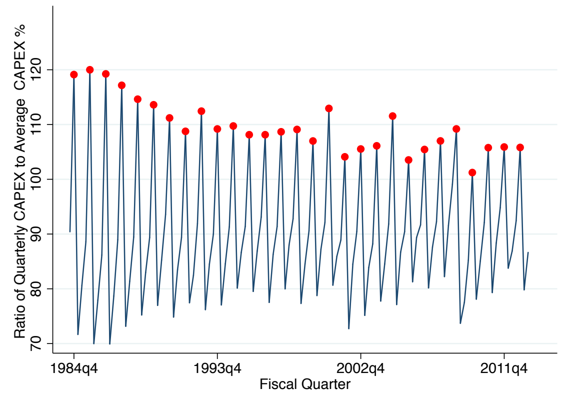
B Additional Robustness

Figure B.1: Robustness of Q4 Investment Spikes

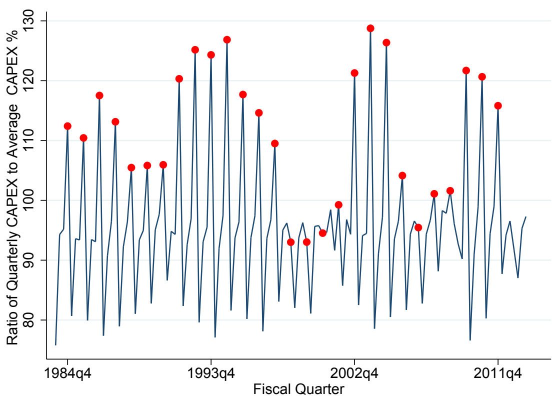
(a) Quarterly CAPEX Level



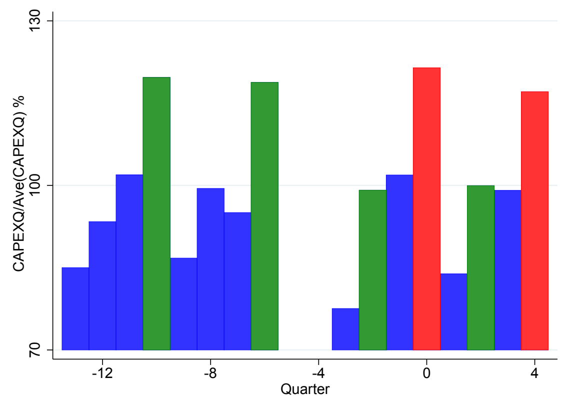
(b) Alternative Spike Measure



(c) Fiscal Q1 Drop



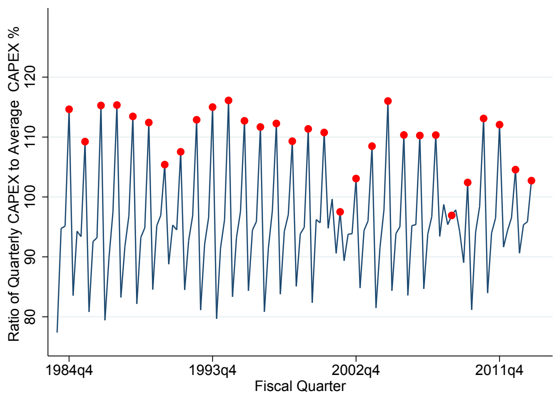
(d) Fiscal Year-end Change



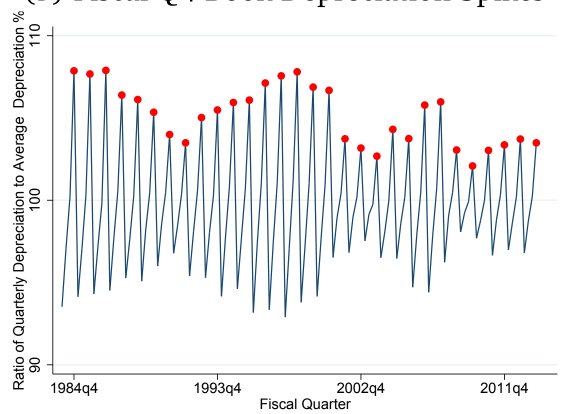
Notes: This figure illustrates the robustness of fiscal Q4 investment spikes. Panel (a) plots the median quarterly CAPEX level ($mil) for each year. Panel (b) plots the median ratio of quarterly CAPEX to $\frac{l2.CAPEX+l1.CAPEX+f1.CAPEX+f2.CAPEX}{4}$. Panel (c) plots the Q4 investment spikes with red dots being the average of Q4 and next fiscal Q1 to the average CAPEX within a firm's fiscal year. Panel (d) plots the time series of CAPEX for 76 sample firms that switched their fiscal year ends to six months later. The Y axis measures the ratio of quarterly CAPEX to average CAPEX in a firm-year. Quarter 0 indicates the new fiscal year-end quarter upon switching. Green bars indicate the fiscal year-end quarter according to the old regime, and red bars indicate the new fiscal year-end quarter after the change. Two quarterly reports are missing on Compustat due to the fiscal year-end changes.

Figure B.2: Robustness of Q4 CAPX Spikes over Time

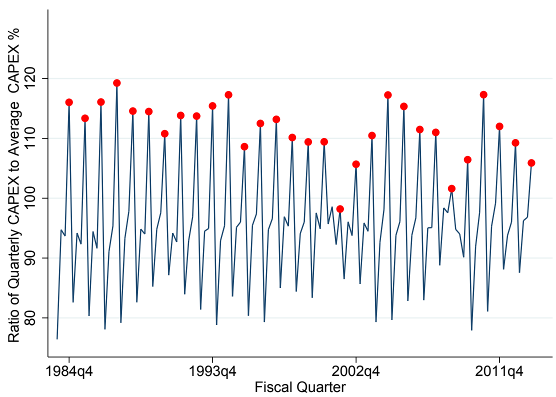
(a) Non-December Fiscal Year End



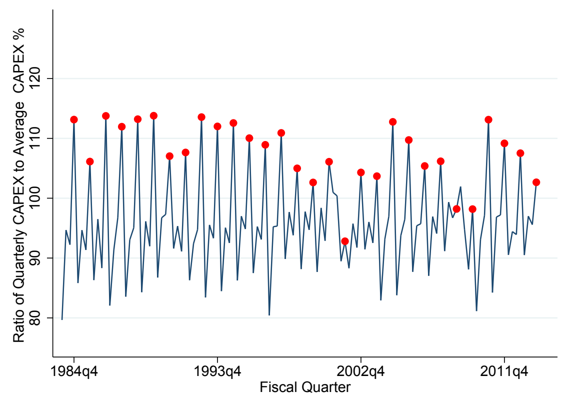
(b) Fiscal Q4 Book Depreciation Spikes



(c) Stable Fiscal Year-End Cash Flows

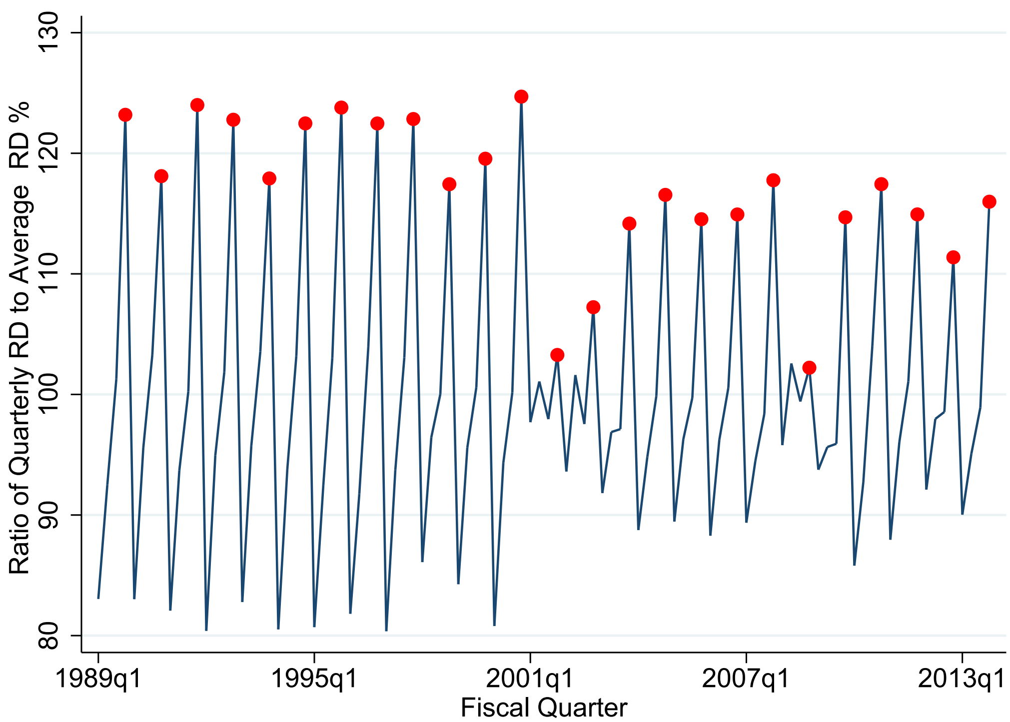


(d) Stable Fiscal Year-End Sales



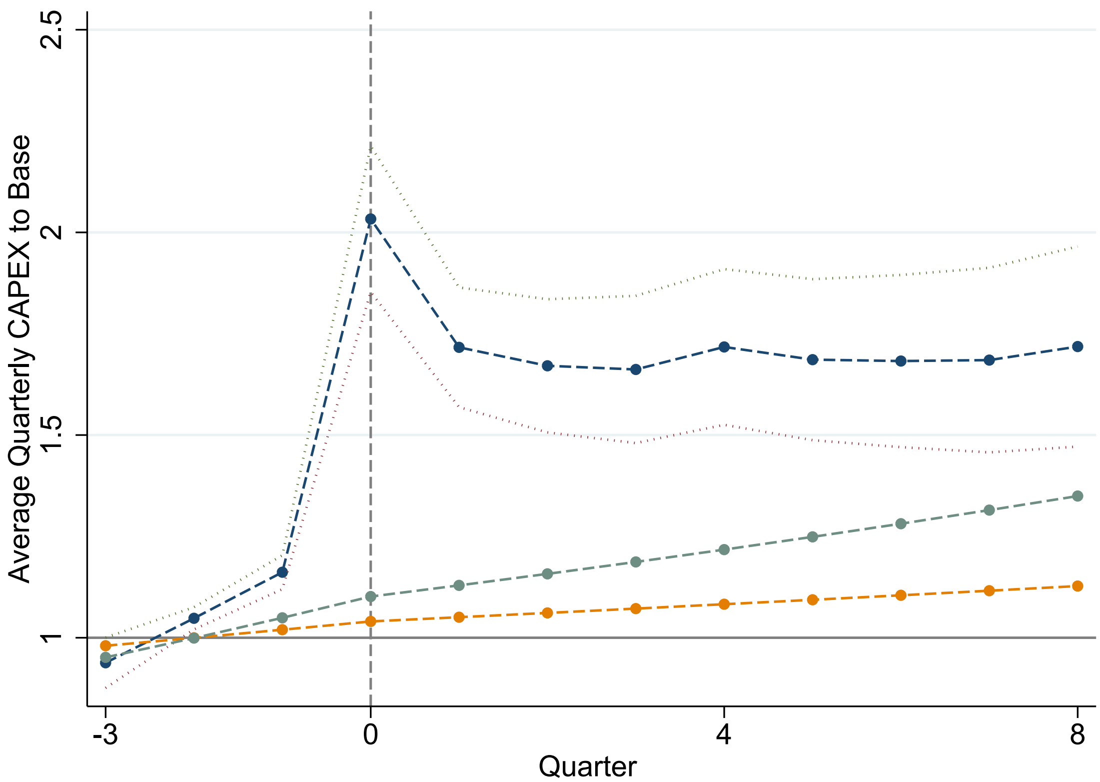
Notes: This figure illustrates the robustness of fiscal Q4 CAPEX spikes. Panel (a) plots the time series pattern of Q4 CAPEX spikes for firms with non-December fiscal year-end. Panel (b) plots the median ratio of quarterly book depreciation to the average book depreciation within a firm's fiscal year. Panels (c) and (d) plot the time series of Q4 CAPEX spikes for firms with stable fiscal year-end cash flows and sales, respectively. Stable cash flows and sales are defined as firm-years for which fiscal Q4 cash flows and sales are lower than the average of the first three fiscal quarters.

Figure B.3: Time Series of Fiscal Q4 R&D Spikes



Notes: This figure shows fourth quarter Research and Development (R&D) spikes for US firms in Compustat between 1989 and 2013. We plot the median ratio of quarterly R&D to the average R&D within a firm's fiscal year. Red dots indicate the fourth fiscal quarter. R&D is net of R&D related salary and benefit expenses, which is calculated at industry average according to the Business Research and Development and Innovation Survey (BRDIS) conduct by the National Science Foundation.

Figure B.4: Cumulative Effect of Q4 CAPEX Spikes



Notes: This figure presents the cumulative level of investment after fiscal Q4 spikes. We plot the ratio of average quarterly CAPEX to CAPEX$\frac{Q1+Q2+Q3}{2}$ in the base year. The numerator is calculated as the average quarterly CAPEX starting from Q4 of the base year: for quarter 4 ($t = 0$) the numerator is CAPEX Q4, for next fiscal year quarter 1 ($t = 1$) the numerator is CAPEX$\frac{Q4+F.Q1}{2}$, for next fiscal year quarter 2 ($t = 2$) the numerator is CAPEX$\frac{Q4+F.Q1+F.Q2}{3}$, and so on. The dotted lines are 95% confidence intervals. The yellow (green) line plots a counterfactual investment series with steady investment growth of 2% (3%) per quarter.

Table B.1: Investment Spikes and Debt Spikes

(a) Debt Spikes for all Sample firms

	(1) Debt Issues $\frac{Q4}{A(Q1-Q3)}$%	(2) Long-term D$\frac{Q4}{A(Q1-Q3)}$%	(3) Current D$\frac{Q4}{Ave(Q1-Q3)}$%	(4) Total D$\frac{Q4}{Ave(Q1-Q3)}$%
CAPEX $\frac{Q4}{Ave(Q1-Q3)}$%	8.05***	3.34***	1.10*	2.40***
	(0.68)	(0.27)	(0.61)	(0.28)
Observations	49333	94948	88384	95028
Adjusted R^2	0.07	0.04	0.03	0.07
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes

(b) Debt Spikes for firms with non-December Fiscal Year End

	(1) Debt Issues $\frac{Q4}{A(Q1-Q3)}$%	(2) Long-term D$\frac{Q4}{A(Q1-Q3)}$%	(3) Current D$\frac{Q4}{Ave(Q1-Q3)}$%	(4) Total D$\frac{Q4}{Ave(Q1-Q3)}$%
CAPEX $\frac{Q4}{Ave(Q1-Q3)}$%	5.82***	2.15***	0.75	1.50***
	(0.95)	(0.39)	(0.79)	(0.36)
Observations	16993	34371	32702	34310
Adjusted R^2	0.07	0.03	0.05	0.09
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes

Notes: This table presents regression estimates relating the magnitude of firm Q4 investment spikes to Q4 debt spikes. Firm and year fixed effects are included. Firm Q4 investment spikes are standardized for ease of interpretation. Standard errors are clustered at the firm level.