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Pension Contributions and Tax-Based Incentives: Evidence from the TCJA*

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Abstract

We document that corporate pension contributions respond to tax-based incentives using the 2017 Tax Cut & Jobs Act (TCJA) as a natural experiment. The TCJA cut the U.S. federal corporate tax rate, temporarily increasing contribution incentives for sponsors of defined-benefit retirement plans. We exploit cross-sectional variation in ex-ante exposure to these incentives. We find that the tax break induced an extra $3 billion of sponsor contributions to medium- and large-scale plans in 2017. But we also find strong evidence of a reversal, both in terms of sponsor contributions and plan funding ratios by 2018. We find no evidence of impact on plan asset allocations. Our results suggest that the TCJA did not have a long-lasting impact on corporate defined-benefit pension funds.

Keywords: defined-benefit pension plans, contributions, Tax Cuts & Jobs Act.

JEL Classification: H22, H25, H26, H32, J32.

This paper uses the Tax Cuts & Jobs Act of 2017 (TCJA) as a natural experiment to show that sponsor contributions to corporate defined benefit (DB) pension funds respond to tax-based incentives. The TCJA resulted in a temporary tax break on pension contributions and a corresponding incentive to front-load contributions, possibly narrowing plan deficits in the process.[1] For the years affected by the TCJA, we study the impact of the tax break on sponsors' contributions, the response of the pension plans' funding ratios and risk profile (asset allocation), as well as the sponsor's funding costs.

The results suggest that plan sponsors are not constrained – in setting pension plan strategies – by the amount of cash that have at hand. While tax-based incentives do have a significant impact on the time profile of contributions, changes in these incentives do not leave a long-lasting footprint on either the level of sponsor contributions or on plan solvency.

The TCJA provides a clear-cut natural experiment. The Act permanently reduced the statutory federal corporate tax rate from 35% to 21%, beginning in 2018. Under U.S. tax law, contributions to retirement plans made in a particular year can be deducted from previous year tax returns if they are made within a "grace period" ending by the tax return due date including extensions (in practice, mid-September).[2] As a result, sponsor contributions made in both 2017 and 2018 could be deducted from 2017 income, thereby benefiting from a higher corporate tax rate. Concretely, a late-filing sponsor contributing $1bn to its DB pension plan before mid-September 2018 – rather than after the end of the grace period, for instance, in December 2018 – would have saved an extra $140m in 2017 taxes.

We find that the TCJA tax break worked exactly as may be expected of a temporary change in tax-based incentives, with sponsors front-loading planned future contributions. A cross-sectional regression points to an above-average impact of our proxy for tax-based incentives on 2017 sponsor contributions (by 1/4 of a standard deviation). Regressing 2018 contributions on our measure of tax-based incentives returns a coefficient that is about 1/4 of a standard deviation below pre-TCJA average. We interpret these results as evidence that sponsors substituted current contributions for future contributions.

In line with the result that the TCJA affected the time-profile but not the overall level of sponsor contributions, we find no evidence of a long-lasting impact on plan funding ratios. Regressions of changes in funding ratios on tax-based incentives point to a relative increase of 2.5 percentage points for sponsors subject to such incentives in 2017, and a fully-offsetting decrease in 2018. In contrast with financial press reports of pension fund re-balancing away from equities and into US government bonds during the TCJA tax break in 2017, our estimates

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[1] The sector has experienced persistent underfunding in the aftermath of the great financial crisis, with DB plan assets hovering around 80% of liabilities for the past decade. Funding ratio computed as in Klingler and Sundaseran (2019) using data from the US Financial Accounts (Table L.118.b).

[2] See Deloitte (2018). "Considerations for accelerating deductions for qualified retirement plans".

show that the TCJA had no impact on asset allocations.[3]

That said, the tax break appears to have narrowed corporate credit spreads. Our measure of exposure to tax-based incentives has a negative and significant coefficient in a regression of changes in credit spreads on sponsor-issued bonds between April 2017 and January 2019.

Our identification strategy exploits cross-sectional differences in tax-based incentives for plan sponsoring firms, as in Gaertner et al. (2018) and Zwick and Mahon (2017). Sponsors have other, non-tax-based, time-varying incentives to shore up underfunded pension funds through higher contributions. For instance, industry newsletters often mention a sustained rise in the costs of insuring pension benefits through the Pension Benefit Guaranty Corporation (driven by deteriorating funding ratios in a prolonged low interest rate environment) as a possible driver of higher sponsor contributions.[4] By using sponsor-level data, we exploit the fact that not all sponsoring firms would have been equally affected by the increase in tax-based incentives induced by the TCJA. For a sponsor's contribution decision to respond to tax-based incentives, two conditions need to be satisfied. First, the sponsor has to have a positive corporate income tax bill before deducting contributions (tax-paying sponsor). Second, plan funding has to be below the upper bound above which contributions stop being deductible (funding ratio below 150%). We say that a sponsor is exposed to tax-based incentives if it meets both these conditions, and split our sample into tax-exposed firms and non-tax-exposed firms. Non-exposed sponsors provide a counterfactual for outcome variables in the absence of the tax break.

One possible concern about our tax exposure measure is endogeneity to subsequent firm contribution decisions. The timing of tax-based incentives for retirement plan contributions, however, suggests that a sponsor is likely to take the pre-contribution tax bill as given when choosing how much to transfer to its pension plans. The "grace period" for tax deductibility of contributions gives a sponsor the option to wait until the end of its fiscal year before deciding on its contributions, by which point there is no residual uncertainty about ex-contribution tax expenses. Empirical evidence suggests that sponsors are likely to prefer to exercise this option and to hold off on decisions regarding deductible expenses until income uncertainty is largely resolved.[5]

Our pension plan data come from yearly IRS 5500 filings of listed Compustat firms that

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[3] See for example Rubin, Richard and Monga, Vipal. 2018. "Companies Race to Top Off Pension Plans to Capitalize on Tax Break." *The Wall Street Journal*, June 21. See also Rennison, Joe. 2018. "End of pension fund tax break looms over Treasury market". *The Financial Times*, August 2.

[4] See Pielichata, Paulina. 2017. "Corporate pension plans push demand for Treasury STRIPS." *Pensions & Investments*, March 30. See also Kozlowski, Rob. 2018. "2018 corporate pension contribution tally to top $32 billion." *Pensions & Investments*, March 19.

[5] Xu and Zwick (2018) show that most of CAPEX expenses are made in the last quarter, for tax-minimising purposes.

sponsor medium- and large-scale DB retirement plans.[6] As an alternative source of pension data, we could have used yearly SEC 10-K filings. Unlike the IRS data, however, the SEC filings data do not distinguish between domestic plans and plans pertaining to foreign subsidiaries. By contrast, the TCJA tax break only applies to contributions made to domestic plans. The sample starts in 2014 to avoid confounding effects from the Transportation Bill of June 2012, which increased regulatory discount rates, thereby raising funding ratios and lowering contribution incentives.

By documenting an impact of tax-based incentives on pension contributions, our paper contributes to the vast literature investigating how firms respond to changes in public policy. In particular, our results on plan funding ratios have implications for work on the incidence of corporate income taxes. The literature estimates that, on average, around 50% of the corporate tax burden is passed on workers through changes in wages (Arulampalam et al., 2012; Serrato and Zidar, 2016; Fuest et al., 2018). Current wages, however, are only one part of workers' compensation, with pensions (i.e. deferred wages) being another. If the transitory change in tax-based incentives for contributions associated with a permanent change in the corporate tax rate were to have a long-lived impact on funding ratios, workers' welfare would be impacted by the ensuing effects on retirement income uncertainty. We find no evidence of such an effect, with a temporary increase in tax-based incentives for contributions leading to a *short*-lived improvement in funding. In turn, this suggests that ignoring "uncertainty" effects on deferred compensation would not lead to underestimating the incidence of corporate tax cuts on workers.

Other researchers have also studied firms' response to the TCJA. In a paper closely related to ours, Gaertner, Lynch and Vernon (2018) also consider the effect of TCJA on sponsor contributions. Our analysis differs from theirs in three ways. First, we use data from IRS 5500 filings rather than from SEC filings. Second, we study both contributions made in 2017 and 2018, while Gaertner at al. focus only on contributions made in 2017, when the TCJA was yet to be signed into law. As a result, we can document both the effects of expectations about the upcoming change in tax-based contribution incentives and its actual impact. Third, we broaden the analysis to funding ratios, portfolio allocations and the costs of external finance for plan sponsors.

The rest of this paper is organised as follows. Section 1 provides an overview of the different incentives underpinning sponsor contribution choices, including the tax-based incentives directly affected by the TCJA tax break. Section 2 describes our data and explains how we constructed key variables. Results are in Section 3, and Section 4 contains concluding remarks.

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[6]   See Rauh (2006) and Rauh (2008) for additional information on IRS 5500 filings.

1   Contribution incentives and the TCJA

A DB pension plan is a promise of predictable retirement benefits from a plan sponsor (typically an employer) to participants (employees). Plans are funded by employer and employee contributions. In this section we review the main factors underpinning these transfers, and we discuss how the TCJA created tax-based incentives for sponsors to increase contributions.

Since corporate DB plans are subject to funding rules under U.S. law, the size of employer contributions depends on the funding status of the plan.[7] If a plan is overfunded, its sponsor has to contribute the present value of the expected yearly change in accrued benefits (normal or service cost), net of excess assets. Sponsors of overfunded plans have little incentive to contribute more than required, as the fiscal regime penalises them for drawing down plan assets net of liabilities.[8] Sponsors of underfunded plans, by contrast, are required by law to contribute more than the service cost. The Pension Protection Act of 2006 stipulates that plan funding should equal 100% of the plan's liabilities. As a result, minimum required contributions (MRCs) are typically set according to rules which prescribe that sponsors contribute the service cost plus a fraction of the funding shortfall (shortfall amortisation charge). MRC schedules are intended to close funding deficits over a medium-term horizon. Sponsors of underfunded plans might also choose to improve funding status by making *voluntary* contributions in excess of MRCs. Firms subject to federal corporate income taxation (C-corporations) can deduct pension contributions from tax returns. As a result, there are tax-based incentives for sponsors to contribute more than minimum requirements. Section 404 of the Internal Revenue Code (IRC) specifies that contributions made in a particular year can be deducted from previous-year income under two conditions. First, the contribution has to be made on account of pension benefits accrued in the previous year. Second, the contribution has to be made by the employer's tax return due date, including extensions. Concretely, a firm whose fiscal year ends in December (called a calendar-year firm) has until mid-October of the current year to make contributions that are deductible from the previous-year tax return.[9] In practice, if the firm's "plan year" (the 12-month period relevant for plan reporting) also ends in December, the firm would want to make contributions before mid-September. This is because contributions made after this date would not count towards satisfying minimum funding requirements under Section 430 of the IRC.[10] There are limits to deductibility: contributions are

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[7]   The rules are set out in the Employee Retirement Income Security Act of 1974 (ERISA) and the Pension Protection Act of 2006 (PPA). See Manning & Napier (2014) for a concise discussion of funding and contribution rules. Firms are fined for under-contributing.

[8]   Proceeds from taking excess plan assets and using them for other purposes (reversions) are subject to corporate income tax plus a 50% excise tax.

[9]   Calendar-year firms can either file tax returns by April 15 (on time) or apply for a 6-month extension and file until October 15 (late).

[10]   All firms in our sample are calendar-year firms. Plan year and firm fiscal year match by both day and month for about 95% of the firms in our sample in each year between 2014 and 2017. The share of exact matches is

only allowed to be tax-deductible up to the point where a plan is 150% funded.

The TCJA made plan contributions counted towards 2017 sponsor income more valuable than contributions counted towards 2018 income. The Act permanently reduced the statutory federal corporate tax rate from 35% to 21%, beginning in 2018. As a result, sponsor contributions made by calendar-year firms within the grace period between January 2017 and mid-September 2018 could be deducted from 2017 income and thus reduce the corporate tax bill at the old, higher tax rate. By contrast, contributions made after mid-September were deducted at a lower rate. As an example, a late-filing sponsor contributing $1bn to its DB pension plan before mid-September 2018 – rather than after the end of the grace period (e.g. December 2018) – would have saved an extra $140m in 2017 taxes. In this sense, the TCJA included a temporary tax break on pension contributions.

Sponsors have other incentives to shore up underfunded pension plans, with rising benefit insurance premia being an oft-mentioned driver by industry commentary (Figure 1).[11] The retirement benefits of private sector workers are guaranteed (up to a limit) by the Pension Guaranty Corporation (PBGC), a government agency established in the mid-1970s to protect plan beneficiaries in case of sponsor bankruptcy. In addition to a flat-rate premium which applies to all plans, there is a variable-rate premium which applies *only* to underfunded plans. Variable rate premia grow with plan deficit, so employers have incentives to make voluntary contributions in order to reduce insurance costs. Sufficiently overfunded firms are exempt from paying premia altogether.

Sponsors may also worry about the impact of unfunded pension liabilities on their cost of capital and valuations, particularly if bankruptcy risk is already a concern. Since 2006, financial accounting standards require plan sponsors to "flow through" pension fund deficits into their financial statements, meaning that employers must recognise a plan's funded status on their balance sheets (FAS 158). And credit rating agencies took pension liabilities into account even prior the change in reporting standards, when the funded status of plans was disclosed in financial statement footnotes (Clifton et al., 2003; Mathur et al., 2006; Campbell et al., 2012). As a result, unfunded pension liabilities can have material effects on sponsor cost of capital and equity valuations.[12]

That said, there are opportunity costs to diverting firm resources to pension plans through contributions. In the presence of financing frictions, a reduction in internal financial resources may limit a sponsor's ability to finance investment projects. Indeed, Campbell et al. (2012)

99.8% in 2018. Remaining firms have pension plan years that end a couple of months earlier than their fiscal year (e.g., if a firm's fiscal year ends in December, its plan year ends either in October or in November).

[11]   See footnote 4.

[12]   Ang et al. (2013) illustrate the point by referring to AT&T, whose funding status changed from $17 billion surplus in 2007 to a nearly $4 billion dollar deficit in 2008. This played a role in the decline of AT&T's equity price from 2007 to 2008.

show that an increase in mandatory pension contributions – which reduces a firm's ability to rely on internal financing for investment projects – increases the cost of capital for firms facing greater constraints on external financing, a result consistent with earlier evidence of a negative relationship between contributions and firm investment (Rauh, 2006).

Sponsor contributions started rising before the TCJA (Figure 1), an increase which would likely have continued through 2017 even in the absence of tax-based incentives. Industry commentary tends to attribute this rebound to the sharp increase in the PBGC insurance premium.[13]

2   Data and construction of variables

Our plan-sponsor level data comes from Schedules SB and R of the electronic IRS 5500 filings from the Department of Labor. All employers sponsoring funds with more than 100 employees must file Schedule SB of the IRS 5500 Form on an annual basis.[14] All employers sponsoring funds with more than 1000 employees must also file Schedule R.[15] We match the plans with Compustat employers to obtain sponsor-level information. We obtain credit spread data from Bloomberg.

An alternative source of pension data for Compustat firms are annual 10-K forms filed with the SEC. Unlike IRS data, SEC filings data do not include minimum required contributions, making it harder to disentangle the voluntary component of contributions from the mandatory. In addition, pension variables obtained from SEC filings (contributions, plan assets and liabilities) do not distinguish between domestic plans and plans pertaining to foreign subsidiaries. By contrast, the TCJA tax break only applies to contributions made to domestic plans. Similarly, the PBGC premium only applies to funding shortfalls of domestic plans.

2.1   The sample

Our sample starts in 2014 to avoid possible confounding effects from the Transportation Bill of June 2012 (Moving Ahead for Progress in the 21st Century, or MAP-21). MAP-21 allowed single-employer plans to discount liabilities using a rolling average of yields over the previous 25 years instead of over the previous 2. With interest rates at historical lows, the change

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[13]   Industry commentary has linked 2016 growth to both expectations of lower future corporate tax rates and to an upcoming increase in the PBCG variable premium (Pielichata, 2017; Kozlowski, 2018).

[14]   See Rauh (2006) and Rauh (2008) for additional information on IRS filings.

[15]   Plans with less 100 participants must file Schedule SF. This form includes very limited information on funding ratio, number of participants and investment income. Compustat firms, which are listed companies, usually don't sponsor such small plans.

amounted to an increase in the discount factor, which boosted plan funding ratios and lowered contribution incentives.[16]

To ensure that all sponsors have an equal amount of time to respond to the TCJA tax break, we restrict the sample to plans sponsored by firms whose fiscal year ends in December. About 80% of sponsors (584 firms) in our matched sample are calendar year firms. We end up with a sample of 4,997 plan-year observations and 3,145 firm-year observations (some employers have multiple plans) that were matched to Compustat.[17] According to the financial accounts of the United States, the assets held by our sample plans in 2017 represent about 30% of total private DB plan assets as of 2017 Q4 (single- and multi-employer). They account for 43% of the total assets held by all single-employer pension plans that filed the IRS Form 5500.

In order to study the impact of the TCJA on pension plan portfolio allocations, we restrict the sample to large plans covering more than 1000 employees. Sponsors of plans covering fewer than 1000 employees report information on allocations in Schedule H of the filing. Schedule H includes the option of assigning assets to "non-standard" categories that are not informative as to their risk. While firms can categorise assets as corporate stock or government bonds, they can also assign these assets to common or collective trusts, pooled separate accounts, master trusts etc. Amongst sponsors of plans covering less than 1000 employees, it is generally the larger firms that use this option. In our sample, plans held an average of 80% of assets in non-standard categories, with a median share of 96%. By contrast, sponsors of plans covering more than 1000 employees are required to submit both Schedule H and Schedule R (since 2009). Schedule R mandates that assets be disaggregated and assigned to one of five "standard" categories: stocks, investment-grade bonds, high-yield bonds, real estate and a residual bucket called "other". Investment-grade bonds are defined as those with an S&P rating of BBB− or higher; a Moody's rating of Baa3 or higher; or an equivalent rating from another rating agency. High-yield debt instruments are those with ratings below investment-grade.[18] Real estate includes real estate limited partnerships but not investment trusts, which are included in stocks. By restricting the sample to large plans, we lose around 30% of the firms in our matched sample. In the period from 2014 to 2018, about 70% of our firms filed Schedule R for all their pension plans.

We turn to the construction of variables and the corresponding summary statistics next.

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[16] van Binsbergen and Brandt (2016) calculate that reported liabilities fell to half of their market value in 2012.

[17] The number of firms filing IRS 5500 is decreasing over time, consistent with an ongoing shift away from DB plans in the U.S. private sector.

[18] If a debt instrument is not rated and is not backed by a government entity, it should be included in the "high-yield" category. Unrated debt with the backing of a government entity would generally be included in the "investment-grade" category unless it is generally accepted it should be considered "high-yield".

2.2 Outcome variables

We study the impact of the TCJA tax break on voluntary sponsor contributions, plan funding and portfolios and sponsor credit spreads.

2.2.1 Contributions

As discussed in Section 1, tax-based incentives affect only the *voluntary* component of sponsor contributions. We compute voluntary contributions by a particular sponsor to a particular plan by subtracting mandatory contributions from total contributions.[19] We define the mandatory component of pension contributions as the sum of minimum required contributions (both legacy and current) and of special contributions made to avoid restrictions on the timing of benefits payment for underfunded plans.[20] As a firm may sponsor multiple plans, we aggregate over all the plans sponsored by the same firm to obtain sponsor-level contributions (Voluntary Contributions and Total Contributions, respectively).[21]

   As larger firms naturally tend to contribute more (for example, because they have higher service costs), we scale both our contribution variables – voluntary and total – by sponsor size, captured by sponsor assets at the beginning of the current year (Assets (book)). Normalising by firm assets is standard in papers studying either pension contributions from the sponsor's perspective (e.g. Rauh, 2006) or the impact of tax-based incentives on other firm choices, such as capital expenditures (e.g. Zwick and Mahon, 2017; Xu and Zwick, 2018).[22]

   Voluntary contributions represent 0.02% of sponsor assets at the mean and 0.002% of assets at the median (Table 1). Total pension contributions are 0.31% of assets at the mean and 0.05% at the median. Both total and voluntary contributions grew in 2016 and in 2017. They declined sharply in 2018 (Figure 2, left panel).

2.2.2 Funding ratios

To assess whether the TCJA tax break had an impact on plan funding, we consider the change in funding ratios between 2016 and 2017. We chose this period because contributions made up until the end of the contribution "grace period" (in theory, mid-October 2018; in practice,

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[19] Contribution figures reported on Schedule SB as year t contributions take into account transfers made by the sponsor up to the point of filing year-t tax returns, and thus include any transfers made within the "grace period" for contributions in year $t+1$.

[20] The PPA imposes benefit restrictions that constrain sponsors of underfunded plans from improving or accelerating the payment of benefits. For example, plans are not allowed to pay lump sum benefits if they are less than 60% funded.

[21] See Tables 9 and 10 for more detail on the construction of variables.

[22] Other normalisations are appropriate when thinking about contributions from a plan's perspective (e.g. contributions as a share of plan assets or as a share of service cost).

mid-September 2018), are counted towards 2017 contributions for financial reporting purposes and thus flow into 2017 assets and funding. We compute the funding ratio for a particular plan-sponsoring firm in any given year (Funding Ratio) in a few steps. First, for each plan sponsored by a particular firm, we sum of reported plan assets (Assets) and sponsor contributions (Total Contributions) net of credit balances (Credit Balances).[23] Reported plan assets are measured at year-end market value, and they *do not* include contributions. Second, we aggregate the resulting plan-level asset measure over all the plans sponsored by the firm, and we thus obtain the funding ratio numerator. To get the denominator, we sum plan-level liabilities (Liabilities) over all the plans sported by the firm. Liabilities are the present discounted value of future pension benefits accumulated to year-end. MAP 21 allows sponsors to discount plan liabilities using an average of market rates on corporate bonds over the past 25 years.[24] Plans in our sample are 106.5% funded at the mean and 103.6% funded at the median, with a standard deviation of 15%.

2.2.3 Allocations

Schedule R of the IRS 5500 filings requires that plan assets be assigned to one of five "standard" categories: stocks, investment-grade bonds, high-yield bonds, real estate and a residual bucket called "other" which includes insurance contracts and interest- and non-interest-bearing cash. Following Rauh (2008), we define safe assets as the sum of investment-grade bonds, insurance contracts and cash. We compute the safe asset share of a particular plan by taking the ratio of safe assets to total assets. We then aggregate up to the sponsor level by taking a weighted average of safe asset shares over all plans sponsored by a particular firm, with weights proportional to plan assets (Safe Asset Share).[25] Pension plans implemented a rebalancing of portfolios away from equities and into safe assets in 2018 (Figure 2, right panel).

2.2.4 Corporate credit spreads

We consider the change in corporate credit spreads on debt instruments between April 25 2017, when the tax reform principles were first announced, and January 15 2019. We look at mid-January 2019 because our firms are calendar-year firms who report in December, and we then allow a couple of weeks for reports to be published and internalised by analysts so mar-

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[23] Credit balances arise when an employer chooses to credit current voluntary contributions towards satisfying future minimum funding requirements and the ensuing minimum required contributions.

[24] With interest rates at historical lows, these regulatory discount rates are higher than the discount rates used in the Financial Accounts of United States, which are based on AAA-rated corporate bond rates (Stefanescu and Vidangos, 2014). As a result, average funding ratios in our sample are higher than funding ratios derived from the flow of funds (Figure 2, centre panel). Financial Accounts data point to average funding of 85.5% between 2014 Q1 and 2018 Q4.

[25] We consider only firms such that *all* their sponsored plans cover more than 1000 participants.

kets can adjust accordingly.[26] We use option-adjusted credit spreads from the Merrill Lynch US Broad Market Index (investment-grade) and the Merrill Lynch US High Yield Index. For each bond included in the index, the spread is computed relative to a US Treasury bond of comparable maturity. We match bonds to sponsors by ticker.

Corporate bonds issued by sponsors in our sample are well represented in the Merrill Lynch indices. Option-adjusted credit spreads can be tracked on both our dates for 1,922 bonds matched with 243 of the sponsor firms in our sample. The investment-grade sample is made up of 1,745 bonds associated with 184 issuers, 62% of which are A2, BBB1 and BBB2 rated. The high-yield universe is more limited. It is made up of 177 bonds associated with 59 issuers, most of which (67%) are B1, BB2 and BB3.

2.3 Explanatory variables

2.3.1 Tax-based incentives

For the TCJA tax break to affect voluntary contributions, two conditions need to be satisfied. First, the firm has to have a positive corporate income tax bill before deducting contributions (tax-paying sponsor).[27] Second, the funding ratio has to be below the 150% bound above which contributions stop being deductible (funding ratio below 150%), for at least one of the sponsored plans.

We say that a sponsor is *exposed* to tax-based incentives – including the TCJA tax break – if it meets both these conditions. We define the tax exposure of sponsor s at time t (Tax Exposure) as a dummy variable which is equal to 1 if Gross Tax > 0 and if Funding Ratio < 150% for at least one plan i of sponsor s. Here, Gross Tax denotes the Federal corporate tax bill of sponsor s before deducting pension contributions. Since we do not observe Gross Tax, we obtain it by adding back the contribution deduction to the corporate tax bill from Compustat. Concretely, Gross Tax = Net Tax + $\tau \times$ sum of Total Contributions over sponsored plans, where Net Tax is the Federal corporate income tax expense from Compustat and τ is the statutory corporate income tax rate.

By using Tax Exposure as a proxy for sponsor exposure to the TCJA tax break, we assume that the gross corporate tax bill (Gross Tax) is exogenous to the sponsor's contribution decision. This assumption is justified by the timing of tax-based incentives for retirement plan contributions, which suggests that a sponsor is likely to take the pre-contribution tax bill as given when choosing how much to (voluntarily) transfer to its pension plans.

Tax-based incentives for sponsors to contribute could be captured by other proxies. These

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[26] Firms typically publish end-of-year results in mid-January.
[27] Gaertner et al. (2018) also employ this condition to assess the impact of TCJA. Zwick and Mahon (2017) use it to assess the impact of tax-based incentives on firm investment.

include estimates of corporate marginal tax rates (Graham, 1996*b,a*) and measures of tax exposure based on sponsor tax credits such as net operating loss carryforwards and investment tax credits.[28] According to the latter set of proxies, a firm is *not* exposed to tax-based incentives if its accumulated tax credits are large enough to cause it not to report any taxable income. Our tax-based incentives measure is positively correlated with marginal corporate tax rates, and negatively correlated a set of dummies capturing *lack* of exposure due to tax credits (see Table 2).

There are disadvantages to using corporate marginal tax rate estimates or exposure measures based on accumulated tax credits in order to capture the impact of the TCJA tax break on sponsor contributions. First, marginal tax rates may not be the relevant tax rates for sponsor contribution decisions. There is evidence that firms may prefer to use simple heuristics such as statutory and effective tax rates to evaluate incremental decisions, rather than harder-to-estimate marginal tax rates (Graham, Hanlon, Shevlin and Shroff, 2017). This suggests that our tax-exposure measure, which is based on the statutory tax rate, is a more suitable proxy than the marginal tax rate for capturing the impact of tax-based incentives on sponsor contributions. Second, the tax credit dummies might incorrectly classify some sponsors as not exposed to the TCJA tax break. This is because the exposure measures based on accumulated tax credits reported in Compustat include tax credits accrued to foreign subsidiaries, as well as domestic subsidiaries which are unconsolidated for tax purposes (*Corporate taxes and defined benefit pension plans*, 1988). By contrast, pension contributions are deducted from corporate income net of income from such subsidiaries, so sponsors may be subject to tax-based incentives even if the no-exposure dummies are equal to 1.

2.4   Controls for other contribution incentives

As we argued in Section 1, contribution incentives are affected by insurance premia. As PBGC insurance premia depend on plan funding, we include funding ratios as a control in our regressions. We also add controls for sponsor bankruptcy risk – because pension deficits flow through to sponsor balance sheets – and for the opportunity cost of diverting internal financial resources to shoring up pension benefits.

To control for sponsor bankruptcy risk, we use the Altman's Z-score, a weighted average of standard business ratios (working capital, operating earnings, sales, and retained earnings). To account for the opportunity cost of diverting internal financial resources to funding pension benefits, we use sponsor cash flows excluding contributions (Cash Flows), capital expenditures (CAPEX) and Tobin's Q (i.e. the market-to-book ratio of firm assets).

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[28]   Net operating losses arise when taxable corporate income falls short of applicable deductions. They can be carried forward, meaning that losses occurred in a particular year can be used to abate taxable corporate income in subsequent years. In this sense, past net operating losses result in current tax credits.

2.5 Other controls

We control for plan performance by including investment returns (Return on Investment) and liability discount rates (Discount Rate). Both these variables vary at the sponsor level. The data come from Schedule H of the IRS filings. Return on Investment is a weighted average of returns over sponsored plans, with weights proportional to plan assets. Plan returns are calculated as investment income divided by beginning-of-year investable assets (measured ex-contributions). Discount rates are the interest rates used to compute the present discount value of the pensions liability of a particular plan. Discount rates for US corporate DB plans are regulated and decoupled from expected plan returns. Under MAP-21, funds discount using an average corporate bond yield over the past 25 years, with a corridor around this average.[29] The discount rate at the sponsor level is computed as the weighted average of discount rates across all sponsored plans, with weights proportional to plan liabilities. Discount rates are 6.07% and 6.09% at the mean and median, respectively. By contrast, the average yield of a 30-year Treasury bond was 2.95% over our sample period.

Finally, we include a proxy of the relative importance of DB plans for a particular sponsor, the idea being that the larger the relative importance of DB plans in a firm's pension benefits, the more likely the sponsor to shore up those plans (for example, in order to retain current employees). We proxy the relative importance with the ratio of the total number of participants in DB plans to the current number of employees of the firm (DB Plans Share). The "significance" measure is 1.14 and 0.84, at the mean and the median, respectively.

3 The effect of TCJA on pension plans

3.1 Identification strategy

Our empirical strategy exploits cross-sectional variation in sponsor exposure to tax-based incentives to assess the impact of the TCJA tax break. We use non-tax-exposed sponsors as a control group to assess the counterfactual level of voluntary and total pension contributions in the absence of the tax break for the tax-exposed firm.[30] This allows us to estimate of the marginal impact of the TCJA tax break on contributions, funding, and portfolio allocations. The identification strategy depends on the assumption that tax-exposed (treatment) and non-tax-exposed control) firms do not differ across dimensions other than tax-based incentives that may affect voluntary contributions during the sample period.

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[29] The corridor was ±20% in 2014, ±25% in 2015 and ±30% since 2016. See Novick, Hunt, Ransenberg. 2012. "Corporate Pension Funding Update". *Blackrock White Papers*.

[30] Given the firm's other incentives to shore up underfunded pension plans, it would be difficult to estimate counterfactual outcomes using aggregate data.

Exposure to tax-based incentives is not random in our sample. Table 3 reports the correlation of our measure of tax-exposure with other variables that are likely to affect pension contribution patterns: plan funding (Funding Ratio), profitability metrics (Return on Investment and Discount Rates), PBGC premia, proxies for sponsor bankruptcy risk (Altman's Z) and the opportunity cost of internal resources (Cash Flows, CAPEX, Tobin's Q). Tax-exposed firms have more underfunded pension plans, higher PBGC variable premium, and higher pre-contributions cash flows, which all push for higher contributions. At the same time, tax-exposed sponsors have higher pension liability discount rates, which would tend to reduce sponsor incentives to contribute. The tax-exposed also display lower CAPEX (and higher Tobin's Q, although the correlation coefficient is not significant), which could be associated with relatively lower contributions if resulting from more binding constraints on external finance. On balance, it is not obvious that the significant correlates in Table 3 will bias our estimates in a specific direction. To account for all possible biases, we include the observable correlates as controls in our empirical specifications.

3.2 The TCJA tax break and contributions

A graphical analysis suggests that the TCJA tax break had a positive impact on 2017 contributions, but the increase was followed by a reversal in 2018. We split the sample into two groups according to tax-based incentives, proxied by our tax exposure measure. The first group includes firms that have pre-pension contribution tax-based incentives (i.e. Tax Exposure = 1) and the second group includes firms that have no pre-pension contribution tax-based incentives (i.e. Tax Exposure = 0). The left panel of Figure 3 plots average yearly voluntary pension contributions from 2014 through 2018, for both tax-exposed and non-tax-exposed firms. Any effect of the TCJA tax break should be reflected in 2017 contributions. The difference between voluntary contributions from tax-exposed and non-tax-exposed sponsors was relatively stable prior to the TCJA tax break (2014 to 2016). In 2017, contributions from tax-exposed sponsors increased by 0.008% of sponsor assets. By contrast, contributions from non-tax-exposed sponsors increased by 0.0024%. There is evidence of a "reversal", with pension contributions from tax-exposed firms decreasing significantly relative to non-tax-exposed firms in 2018. Given the more permanent nature of changes in other time-varying contribution incentives (such as increases in the PGBC variable premium), it is difficult to argue that this increase/reversal pattern can be accounted for by something other than the TCJA and its ensuing temporary tax break.

Regression analysis confirms the findings of the graphical analysis on impact and reversal.

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We estimate the following cross-sectional specification:

$$\frac{\text{Voluntary Contributions}_{s,t}}{\text{Assets (book)}_{s,t-1}} = \alpha_t + \beta_t \text{Tax Exposure}_{s,t} + \delta_t Z_{s,t} + \varepsilon_{s,t}, \text{ for } t = 2014, ..., 2018. \quad (1)$$

Here, Tax Exposure is our measure of tax-based incentives and Z is a vector of controls which includes the observable correlates of tax-based incentives. The β_t coefficients are the coefficients of interest, as they capture the impact of tax deductibility of contributions on contributions in each of our sample years. We plot them on the right panel of Figure 3.

Tax-based incentives had a larger impact on contributions in 2017 than in the three years pre-TCJA. The 2017 estimate of the tax exposure coefficient, $\hat{\beta}_{2017}$, is positive and significant (Table 4, columns (1) and (2)). This result is robust to including controls for the observable correlates of our tax exposure measure (column (2)), assuaging concerns about identification. According to our preferred specification (with controls, column (2)), voluntary contributions from tax-exposed sponsors were 0.033 percentage points larger than their counterpart from non-tax-exposed firms. By contrast, the average impact of tax-based incentives on voluntary contributions prior to the TCJA, $\sum_{t=2014}^{2016} \hat{\beta}_t / 3$, was around 0.02 percentage points, making the 2017 impact about one quarter of a standard deviation higher than the pre-TCJA average.

The impact of tax-based incentives on 2018 contributions was below pre-TCJA average, with a large enough deviation to fully offset the above-average 2017 effect (reversal). The 2018 estimates of the tax exposure coefficient, $\hat{\beta}_{2018}$, are at the minimum level over our five-year sample period (Table 4, columns (1) and (2)), implying that tax-based incentives to contribute were at their weakest right after the end of the tax break. In our preferred specification (with controls, column (2)), the impact of tax-based incentives in 2018 amounted to 0.007 percentage points. At around one quarter of a standard deviation lower than pre-TCJA average, this decline fully offset the 2017 increase. We interpret the fact that 2018 tax-based incentives completely reversed the effects of 2017 incentives on contributions as evidence that the TCJA tax break worked as expected, with tax-exposed firms indeed shifting planned future contributions from 2018 to 2017.

These results are robust to including sector fixed effects. Estimates with sector fixed effects are qualitatively similar to estimates without (Table 5). The second column of Table 5 changes the dependent variable to total pension contributions. We continue to find a positive impact of the TCJA tax break in 2017, followed by a reversal in 2018.

In dollar values, our estimates imply a $2.9bn to $4.1bn increase in voluntary contributions to medium- and large-scale plans associated with the tax break, depending on whether or not the specification includes controls (the impact is larger with controls). Our estimates report the TCJA impact in percentage points, so we multiply by tax exposed sponsor assets to obtain a dollar figure. Accordingly, the tax break impact on voluntary contributions in dollars in sample

is given by $(\hat{\beta}_{2017} - \sum_{t=2014}^{2016} \hat{\beta}_t / 3) A_{2016} / 100$, where $A_{2016} = \sum_{s=1}^{381} A_{s,2016}$ represents the total assets of the 381 tax-exposed sponsors in our sample at the end of 2016 (beginning of 2017). We obtain a \$1.3bn increase in voluntary contributions for the specification without controls and a \$1.9bn increase for the specification with controls. By assumption, the TCJA had no impact on contributions from the non-tax-exposed. Assuming that our sample is representative of the broader population of firms submitting Schedule SB of the IRS 5500 filings – some of which are not listed, and therefore do not appear in Compustat – we extrapolate to estimate the TCJA impact on the voluntary contributions of *all* sponsors of middle- and large-scale plans. To that end, we multiply the in-sample estimates by the ratio of total voluntary contributions by Schedule SB filers to total voluntary contributions by sponsors in our sample, which is equal to \$6.7bn/\$3.1bn. This returns a \$15bn increase in voluntary contribution for the specification without controls and a \$26.6bn increase for the specification with controls. To compute the tax break impact on total contributions for firms in sample, we repeat the same steps using the estimates in Table 5 instead. Total contributions by firms in our sample amount to \$43.5bn, while total contributions by Schedule SB filers are equal to \$107.7bn. This implies a \$37bn to \$66bn increase in total contributions to medium- and large-scale plans associated with the tax break.

3.3   The TCJA tax break and other outcomes

In this section, we study other effects of the TCJA tax break on firms and their DB retirement plans. We first examine whether or not the tax break had an impact on funding ratios. And since plan asset allocations are thought to be sensitive to changes in funding we next consider TCJA effects on pension plan portfolios. Finally, because plan funding deficits flow through to sponsor balance sheets under U.S. accounting standards, we conclude by asking whether the tax break had implications for the costs of external finance faced by sponsors. We find that our results on contributions carry over to plan funding ratios, and that the TCJA had no impact on asset allocations. By contrast, the TCJA appears to have narrowed corporate credit spreads.

Our estimates suggest that the TCJA tax break had a short-lived impact on plan funding. While the TCJA increased 2017 funding ratios, by 2018 they were already back where they would have been in the absence of the intervention. We estimate the following specification:

$$\Delta \text{Funding Ratio}_{s,t,t-1} = \alpha_t + \beta_t \text{Tax Exposure}_{s,t} + \delta_t Z_{s,t} + \varepsilon_{s,t}, \quad \text{for } t = 2017, 2018. \quad (2)$$

Here, Funding Ratio is defined as in section 2.2.2 and Z_t is a vector of controls which includes pre-TCJA plan funding status (Funding Ratio in 2016), the actual investment return on plan assets and the change in discount rates between t and $t-1$. Results are reported in columns (1)-(4) of Table 6. Tax-exposed firms experienced a increase of 2.5 to 3.4 percentage points in

the funding status of their corporate pension plans between 2016 and 2017 (relative to non-tax-exposed firms), depending on whether or not the specification includes controls. Firms that were tax exposed in both 2017 and 2018 saw a relative decrease of 2 percentage points in the funding status of their corporate pension plans between 2017 and 2018. Columns (5) and (6) report the results of estimating a variant of (2) which considers the change in funding ratios between end-2016 and end-2018, again focusing on firms that were tax exposed in both 2017 and 2018. The coefficient of 2017 Tax Exposure is not significant, confirming that the temporary increase tax incentives for contributions associated with the TCJA had no long-lasting impact on funding ratios.

We do not find evidence that the TCJA tax break affected the portfolio share allocated to safe assets. To test for whether TCJA had an impact on allocations, we regress the change in the safe assets portfolio share between 2016 and 2017 on our measure of tax exposure:

$$\Delta \text{Safe Asset Share}_{s,2017,2016} = \alpha + \beta \text{Tax Exposure}_{s,2017} + \delta Z_s + \varepsilon_s. \tag{3}$$

The controls vector, Z_s, includes the pre-TCJA plan funding status (Funding Ratio in 2016), the investment return on plan assets, the change in discount rates between 2016 and 2017 and the initial safe assets allocation (Safe Assets Share 2016). Adding the last control ensures that the estimates capture true portfolio allocation changes as opposed to valuation effects that might also alter portfolio shares. Our estimates of the tax exposure coefficient are not significant (Table 7).[31] As mentioned in the introduction, this is in contrast with financial press reports of pension fund re-balancing away from equities and into US government bonds during the tax break. As there is evidence of herding in the investment behaviour of pension funds (Scharfstein and Stein, 1990; Graham, 1999; Blake et al., 2017), it is possible that non-tax-exposed plans might have mimicked tax-exposed plans.

The TCJA tax break resulted in a narrowing of corporate credit spreads. We regress the change of the option-adjusted credit spread (OACS) between April 2017 and January 2019 of bond b issued by sponsor s on the tax-exposure measure of the sponsor:

$$\text{OACS}_{b,s,2019} - \text{OACS}_{b,s,2017} = \alpha + \beta \text{Tax Exposure}_{s,2017} + \delta Z_{b,s} + \varepsilon_s \tag{4}$$

The controls vector, Z_s, includes the change in total borrowing between 2016 and 2018, bond residual maturity (in years) and credit rating. The credit rating is a dummy variable which is equal to 1 if the bond is investment grade and 0 if it is high-yield. The tax exposure coefficient

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[31] Our specification, (3), takes a "total derivative" approach to the change in allocations resulting from a strengthening of tax incentives for contributions. Taking a "partial derivative" approach and allowing for the TCJA to impact allocations through changes in funding does not affect the results. In regressions available upon requests, we included the fitted values and residuals of equation (2) as separate regressors. Neither variable has a significant impact on changes in allocations.

is significant both with and without controls (Table 8). According to our preferred specification (with controls), firms that were tax exposed in 2017 experienced a 37-basis-point narrowing in credit spreads (column (2)). As the TCJA had no long-lasting impact on funding ratios, however, the relative decline in funding costs for tax-exposed firms is more likely due to the positive impact of the TCJA tax cut on corporate cash flows and profitability than to a shoring up of pension-related liabilities.

4   Conclusion

This paper documents that sponsor contributions to retirement plans respond to tax-based incentives. We use the Tax Cuts & Jobs Act of 2017 (TCJA) as a source of exogenous variation in tax-based incentives for contributions. The TCJA permanently lowered the federal corporate tax rate from 35% to 21% beginning in 2018. In turn, this resulted in a temporary incentive for sponsors to raise contributions reported in 2017, as they could then be deducted from federal income tax bills at the older, higher tax rate. We identify firm response to the TCJA contributions tax break by exploiting cross-sectional variation in sponsors' exposure to tax-based incentives.

Our results support the conclusion that the policy change induced an intertemporal substitution of higher contributions today for lower contributions tomorrow, and therefore it did not permanently improve the funding status of US private sector DB plans. We find that contributions and funding ratios increased – relative to what their levels would have been in the absence of the tax break – in 2017, the tax break year. That said, 2018 contributions and funding ratios fell relative to counterfactual levels. On balance, pension plan funding ended up where it would have been in the absence of the tax break by 2018.

Our findings on sponsor pension contributions have implications for work on the incidence of corporate income taxes. Estimates of the share of the corporate tax burden passed on to workers focus on wages. Wages, however, are only one part of workers' compensation, with pensions being another. Current wages, however, are only one part of workers' compensation, with pensions (i.e. deferred wages) being another. If the transitory change in tax-based incentives for contributions associated with a permanent change in the corporate tax rate were to have a long-lived impact on funding ratios, workers' welfare would be impacted by the ensuing effects on retirement income uncertainty. We find no evidence of such an effect, with a temporary increase in tax-based incentives for contributions leading to a *short*-lived improvement in funding. In turn, this suggests that ignoring "uncertainty" effects on deferred compensation would not lead to underestimating the incidence of corporate tax cuts on workers.

That said, a corporate tax change could still affect workers' welfare through deferred com-

pensation, because of changes in expected pension benefits (which would be reflected in plan service costs and mandatory pension contributions) rather than changes in uncertainty about those benefits. There is evidence that the TCJA corporate tax cut affected the current component of workers' compensation, with firms with greater expected tax savings from the TCJA more likely to announce bonus payments to workers (Hanlon, Hoopes and Slemrod, 2019). Whether similar findings also apply to deferred compensation is a question we leave to future research.

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Figure 1: Aggregate Contributions and the PBGC Variable Premium
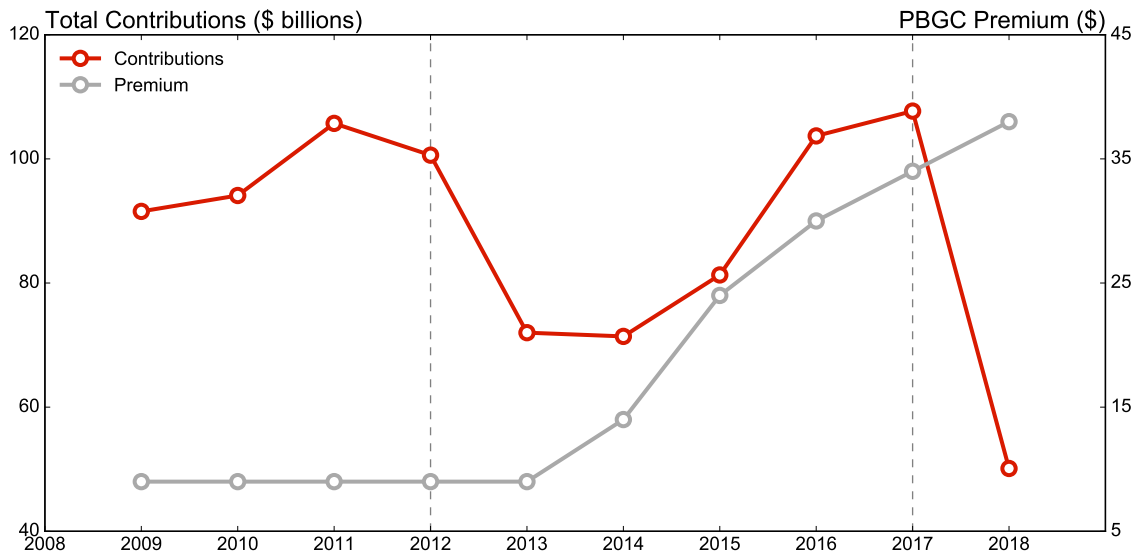
Aggregate contributions (total) of all SB filers in billions of dollars. The PBGC variable rate premium is in dollar per \$1000 of funding shortfall. It is computed as PBGC Premium (Plan) $= \max\left[0, \frac{R_t}{1000}\left(\text{Vested Benefits} - \text{Assets}\right)\right]$, where R is the variable-rate premium set by the PBGC according to the schedule in column (5) of Table 1, panel (b) and Vested Benefits represent the share of accumulated pension benefits (Liabilities) that members will receive irrespective of continued participation in the plan. Summing over plans returns the total variable premium paid by a particular sponsor in any given year (PBGC Premium). The first reference line is 2012 when Moving Ahead for Progress (MAP) was passed. The second reference line is 2017, the year of the TCJA tax break.
Sources: IRS 5500 filings, Schedule SB; PBGC website.

Figure 2: Aggregate Contributions, Funding and Portfolio Allocations
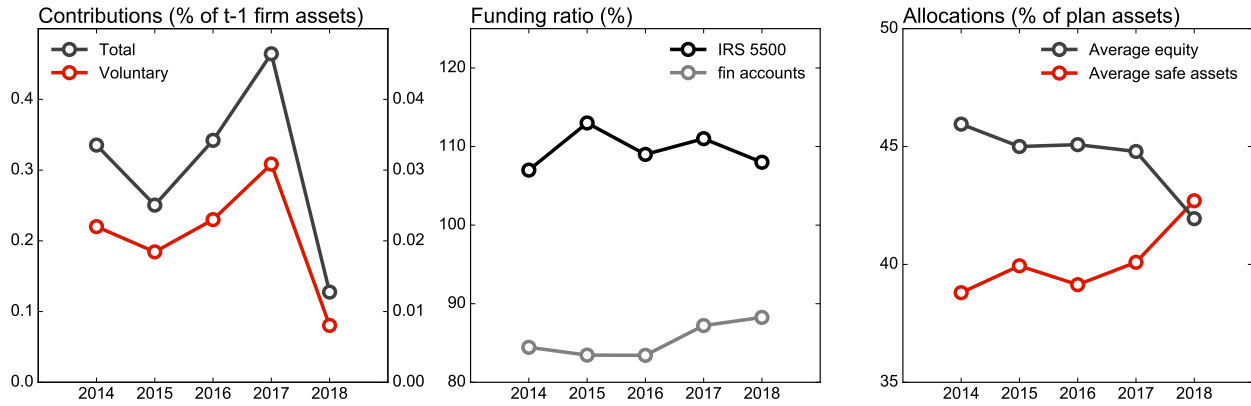
Aggregate contributions (total and voluntary) are averages across sponsors. The aggregate funding ratio is an average across sponsors of the ratio of total sponsor pension assets (sum over plans) over total sponsor pension liabilities (sum over plans). Aggregate allocations are obtained by aggregating at the sponsor level and averaging over sponsors. To aggregate at the sponsor level we take weighted averages, with weights equal to the ratio of plan assets to total sponsor pension assets. Safe assets are defined as the sum of investment-grade bonds, insurance contracts and cash.

Sources: IRS 5500 filings, Schedule SB; Financial Accounts of the United States, Table L.118.b; authors' calculations.

Figure 3: Voluntary Contributions and the Tax Cuts & Jobs Act of 2017
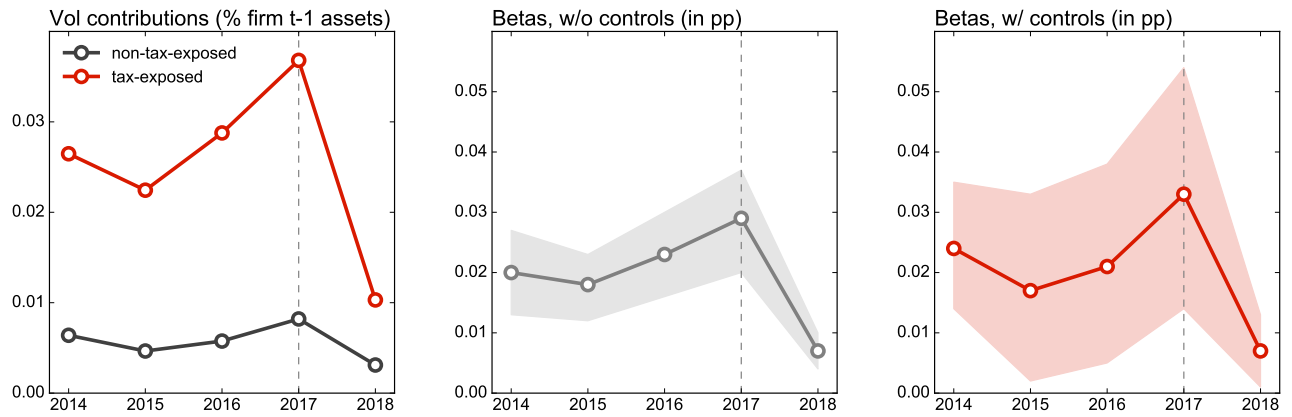
Voluntary contributions are averages across tax-exposed (treatment) and non-tax-exposed sponsors (control). Shaded areas represent 95% confidence intervals around estimates.

Sources: IRS 5500 filings, Schedule SB; authors' calculations.

Table 1: Summary Statistics

(a) Cross-section variation

	Mean	Std. Dev.	10th	50th	90th	N
Voluntary Contributions (%)	0.02	0.046	0.00	0.002	0.06	2386
Total Contributions (%)	0.31	0.66	0.00	0.050	0.86	2386
Funding Ratio (%)	106.57	15.60	91.73	103.55	124.45	2974
PBGC Premium (%)	0.004	0.02	0.00	0.00	0.005	2386
Return on Investment (%)	5.10	6.90	-4.36	6.22	14.46	2359
Discount Rate (%)	6.07	30.90	5.67	6.09	6.48	2426
Safe Asset Share (%)	42.04	19.10	20	39.26	67.53	1723
Equity Share (%)	44.19	19.39	6	47	67.2	1725
Altman's Z-Score	2.44	4.88	0.61	1.87	3.67	1001
CAPEX (%)	4.42	4.44	0.29	3.36	9.10	2158
Cash Flows (%)	8.68	6.85	1.18	8.13	16.34	2042
Tobin's Q	1.22	2.68	0.49	0.72	1.74	1022
DB Plans Share	1.14	1.10	0.15	0.84	2.35	2338

(b) Time variation

	(1)	(2)	(3)	(4)	(5)
Year	Plans	Firms	TE	NTE	PBGC
2014	900	557	122	435	14
2015	846	520	117	403	24
2016	821	503	123	380	30
2017	782	482	381	101	34
2018	670	411	282	129	38

Notes: Panel (a) presents plan-level and sponsor-level summary statistics for our sample. There are 4,997 plan-year observations and 3,145 firm-year observations during the period 2014-2018 (some firms sponsor multiple plans). All plans in the sample are middle- and large-scale plans covering more than 100 employees. Plan-level data are from IRS 5500 filings. Sponsor-level data are from Compustat. Voluntary and Total Contributions, PBGC Premium, CAPEX and Cash Flows are scaled by beginning-of-year sponsor balance sheet assets. Voluntary Contributions, Total Contributions and PBGC Premium are winsorized at the top 1% level. Funding Ratio, Cash Flows, Tobin's Q, Altman's Z, CAPEX, Return on Investment, Discount Rate and DB Pension Plans Significance are winsorized at the top and bottom 1% level. Panel (b) shows time variation in DB Pension Plans Significance, Tax Exposure and PBGC Premium. Columns (1) and (2) show the number of retirement plans and sponsoring firms in each sample year. Columns (3) and (4) break the sample down by tax-exposure. Column (5) shows the Pension Benefit Guarantee Corporation variable premium rates. Rates are quoted per $1000 of unfunded vested benefits for single-employer plans.

Table 2: Tax Exposure and Other Proxies for Tax-Based Incentives

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Marginal Tax Rate Before Interest	1.81***						
	(6.50)						
Marginal Tax Rate After Interest		0.58**					
		(2.94)					
Net Operating Loss			-0.063				
			(-1.55)				
Net Operating Loss Dummy 1				-0.989***			
				(-8.91)			
Net Operating Loss Dummy 2					-0.64***		
					(-7.85)		
Net Operating Loss Dummy 3						-0.62***	
						(-7.79)	
Investment Tax Credit							-8.51
							(-0.47)
Observations	2226	2374	1378	2473	2473	2473	1910
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents pooled probit regression estimates of the impact of different proxies for tax-based incentives to make pension contributions on the probability that a sponsor is tax exposed. The dependent variable is Tax Exposure, a dummy variable = 1 if (i) a firm has a positive ex-contributions tax bill and (ii) the firm sponsors at least one plan with funding ratio below 150%. Marginal Tax Rate Before Interest is a simulated corporate marginal tax rate based on income before interest expense has been deducted. Marginal Tax Rate After Interest is a simulated corporate marginal tax rate based on income after interest expense has been deducted. See https://faculty.fuqua.duke.edu/~jgraham/read.html for more detail. Dummy 1 is a dummy variable which is = 1 if a sponsor has a positive carryforward balance and it pays no current U.S. income tax. Dummy 2 is a dummy variable which is = 1 if if a sponsor has a positive carryforward balance and it reports no pre-tax income. Dummy 3 is a dummy variable which is = 1 if a sponsor does not report any pre-tax income. z-statistics obtained using robust standard errors in parentheses.

Table 3: Tax Exposure and Plan- and Sponsor-Level Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Funding Ratio	-1.26***								
	(-6.96)								
PBGC Premium		909.19*							
		(2.82)							
Investment Return			0.75						
			(1.81)						
Discount Rate				0.29***					
				(3.25)					
DB Plans Significance					-0.01				
					(-0.51)				
CAPEX						-1.47*			
						(-2.39)			
Tobin's Q							0.004		
							(0.30)		
Non-Pension Cash-Flows								2.72***	
								(5.82)	
Altman's Z-Score									-0.005
									(-0.57)
Observations	2374	2386	2359	2426	2338	2158	984	2042	1001
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents pooled probit regression estimates of the impact of different plan-level (rows (1)-(4)) and sponsor-level characteristics (rows (5)-(9)) on the probability that a sponsor is tax exposed. The dependent variable is Tax Exposure, a dummy variable equal to 1 if (i) a firm has a positive ex-contributions tax bill and (ii) the firm sponsors at least one plan with funding ratio below 150%. z-statistics obtained using robust standard errors in parentheses.

Table 4: Pension Contributions, Tax-Based Incentives and the Tax Cuts & Jobs Act of 2017

	2014		2015		2016		2017		2018	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Tax Exp.	0.020***	0.024***	0.018***	0.017*	0.023***	0.021*	0.029***	0.033***	0.007***	0.007**
	(5.88)	(4.81)	(6.39)	(2.21)	(6.79)	(2.52)	(6.59)	(3.36)	(5.09)	(2.47)
Obs.	531	156	502	143	482	134	471	151	400	127
R^2	0.03	0.22	0.05	0.08	0.04	0.18	0.04	0.12	0.04	0.10
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Notes: This table presents regression estimates of the response of voluntary pension contributions to fiscal incentives in each year between 2014-2018. The dependent variable is voluntary pension contributions deducted from 2014 tax returns in Columns (1) and (2); from 2015 returns in Columns (3) and (4); from 2016 returns in Columns (5) and (6); from 2017 returns in Columns (7) and (8); and from 2018 returns in Columns (9) and (10). Tax Exposure is a dummy-variable equal to 1 if (i) a firm has a positive ex-contributions tax bill and (ii) the firm sponsors at least one plan with funding ratio below 150%. The Tax Cuts & Jobs Act of 2017 reduced the federal corporate tax rate from 35% to 21% beginning in 2018. As a result, contributions counted towards the 2017 corporate tax return could be deducted at 35%, while contributions counted towards 2018 returns at 21%. Columns (2), (4), (5), (6) and (8) include the following plan-level controls: Funding Ratio, PBGC Premium, Return on Investment, Discount Rate. They also include the following sponsor-level controls: Altman's Z-score, Cash Flows, CAPEX, Tobin's Q and DB Plans Share. t-statistics obtained using robust standard errors in parentheses.

Table 5: Contributions, Tax-Based Incentives and the Tax Cuts & Jobs Act of 2017: Robustness

	2014		2015		2016		2017		2018	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Tax Exp.	0.027***	0.36***	0.022***	0.22*	0.025*	0.28*	0.041**	0.46***	0.008*	0.14**
	(3.94)	(4.88)	(3.53)	(2.37)	(2.41)	(2.58)	(2.70)	(3.48)	(2.56)	(2.92)
Obs.	156	156	143	144	134	134	151	150	127	129
R^2	0.29	0.30	0.16	0.12	0.29	0.22	0.18	0.15	0.15	0.07
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	No	Yes	No	Yes	No	Yes	No	No	No

Notes: This table presents regression estimates of the response of pension contributions to fiscal incentives in each year between 2014-2018. The dependent variable is *voluntary* pension contributions deducted from 2014 returns in Column (1); from 2015 returns in Column (3); from 2016 returns in Column (5); from 2017 returns in Column (7); and from 2018 returns in Column (9). The dependent variable is *total* pension contributions deducted from 2014 returns in Columns (2); from 2015 returns in Column (4); from 2016 returns in Column (6); from 2017 returns in Column (8); and from 2018 returns in Column (10). Tax Exposure is a dummy-variable equal to 1 if (i) a firm has a positive ex-contributions tax bill and (ii) the firm sponsors at least one plan with funding ratio below 150%. The Tax Cuts & Jobs Act of 2017 reduced the federal corporate tax rate from 35% to 21% beginning in 2018. As a result, contributions counted towards the 2017 corporate tax return could be deducted at 35%, while contributions counted towards 2018 returns at 21%. All columns include the following plan-level controls: Funding Ratio, PBGC Premium, Investment Return, Discount Rate. They also include the following sponsor-level controls: : Altman's Z-score, Cash Flows, CAPEX, Tobin's Q and DB Plans Share. t-statistics obtained using robust standard errors in parentheses.

Table 6: Funding Ratios and the Tax Cuts & Jobs Act of 2017

	ΔFR 16-17		ΔFR 17-18		ΔFR 16-18	
	(1)	(2)	(3)	(4)	(5)	(6)
Tax Exposure in 2017	3.45***	2.52***	-2.03	-2.37*	0.00	-0.01
	(4.57)	(3.23)	(-1.91)	(-2.37)	(0.01)	(0.01)
Observations	457	436	287	273	298	278
R^2	0.03	0.06	0.01	0.14	0.00	0.08
Controls	No	Yes	No	Yes	No	Yes

Notes: This table presents regression estimates relating changes in funding ratios to sponsor tax exposure in 2017. The dependent variable in Columns (1) and (2) is the change in plan funding ratios between end-2016 and end-2017. The dependent variable in Columns (3) and (4) is the change in plan funding ratios between end-2017 and end-2018, for plans sponsored by firms that were tax-exposed in both 2017 and 2018. The dependent variable in Columns (5) and (6) is the change in plan funding ratios between end-2016 and end-2018, for plans sponsored by firms that were tax-exposed in both 2017 and 2018. Funding ratio changes are reported in percentage points. Columns (2) and (4) include the following controls: Funding Ratio in 2016 (respectively, 2017), change in the Discount Rate between 2016 and 2017 (2017 and 2018), and actual 2017 (2018) Return on Investment. Column (6) includes the change in Discount Rate between 2016 and 2018 (average of 2017 change and 2018 change) and actual Return on Investment (average of 2017 return and 2018 return) as controls. Controls winsorized at the bottom and top 1%. t-statistics obtained using robust standard errors in parentheses.

Table 7: Asset Allocations and the Tax Cuts & Jobs Act of 2017

	Δ Safe Assets Share 16-17	
	(1)	(2)
Tax Exposure 2017	0.43	1.00
	(0.48)	(1.14)
Observations	317	304
R^2	0.00	0.03
Controls	No	Yes

Notes: This table presents regression estimates relating changes in the allocation to safe assets to sponsor tax exposure in 2017. The dependent variable is the change in the safe assets share of total plan assets between end-2016 (fiscal year) and end-2017 (fiscal year). Safe assets comprise investment grade bonds, cash and insurance contracts. Changes in the safe share are reported in percentage points. Column (2) includes the following plan-level controls: Funding Ratio in 2016, Safe Asset Share in 2016, change in the Discount Rate between 2016 and 2017, and actual Return on Investment in 2017. Controls winsorized at the bottom and top 1%. t-statistics obtained using robust standard errors in parentheses.

Table 8: Funding Costs and the Tax Cuts & Jobs Act of 2017

	ΔOAS	
	(1)	(2)
Tax Exposure 2017	-5.85*	-37.4***
	(-2.22)	(-5.51)
Number of bonds	1884	232
Number of firms	987	154
R^2	0.01	0.16
Controls	No	Yes

Notes: This table presents regression estimates relating changes in sponsor credit spreads to tax exposure in 2017. The dependent variable is the change in the option-adjusted spread (OAS) of bond b issued by firm s between April 25, 2017 and January 15, 2019. Changes in the OAS are reported in basis points. Column (2) includes the following sponsor-level and bond-level controls: change in total borrowings including current borrowings scaled by assets between 2016 and 2018, bond term-to-maturity and investment grade class (investment grade or high-yield). Controls winsorized at the bottom and top 1%. t-statistics obtained using robust standard errors in parentheses.

Table 9: Variable Definitions (Plan-Sponsor Level)

Variable	Definition
Total Contributions (Plan)	Total sponsor contributions reported on tax return
Required Contributions I	Contributions allocated towards unpaid MRC from prior years
Required Contributions II	Contributions allocated towards MRC for the current year
Special Contributions	Contributions made to avoid restrictions on benefits
Mandatory Contributions	Required Contributions (I+II) + Special Contributions
Voluntary Contributions (Plan)	Total- Mandatory Contributions
Credit Balances	Funding Standard Carryover Balance + Pre-Funding Balance
Assets	Market value of plan assets at year end. Contributions not included
Safe Assets	Sum of investment grade bonds, insurance contract and cash
Safe Assets Share (Plan)	Safe Assets/Assets
Liabilities	Present value of plan benefits accumulated to year end
Return on Investment (Plan)	Investment Income/(L1.Assets - Total Contributions)
Discount Rate (Plan)	Interest rate used to compute liabilities
Vested Benefits	The share of liabilities that employees will receive regardless of their continued participation in the sponsor's pension plan
Participants	Number of plan participants
PBGC Premium (Plan)	Variable-rate benefits insurance premium
	$\max[0, R\,(\text{Vested Benefits-Assets})/1000]$

Table 10: Variable Definitions (Sponsor-Level)

Variable	Definition
Aggregates of plan-level variables (IRS 5500 Filings)	
Voluntary Contributions	Sum of Voluntary Contributions (Plan) over sponsored plans
Total Contributions	Sum of Total Contributions (Plan) over sponsored plans
Funding Ratio	Sum of (Assets + Total Contributions - Credit Balances) over sponsored plans/Sum of Liabilities over sponsored plans
Safe Asset Share	Assets-weighted average of Safe Asset Share (Plan), over sponsored plans
Return on Investment	Assets-weighted average of Return on Investment (Plan), over sponsored plans
Discount Rate	Liabilities-weighted average of Discount Rates (Plan), over sponsored plans
PBGC Premium	Sum of PBGC Premium (Plan) over sposored plans
Other sponsor-level variables	
Net Tax	Federal corporate income tax expense
Gross Tax	Net Tax + $\tau \times$ sum of Total Contributions over sponsored plans. $\tau = 35\%$ until 2017, 21% after
Tax Exposure	A dummy variable = 1 if Gross Tax >0 and Funding Ratio <150% for at least one firm pension plan
Net Income	Net income
Depreciation	Depreciation and amortization
Pensions Expense	The sum of the service cost and an interest cost (the change in the present discounted value of the pension obligations arising from the approach of the time when these obligations come due) minus an assumed return on pension plan assets (see Bergstresser et al., 2006)
Cash Flows	Net Income + Depreciation + Pensions Expense + sum of Total Contributions over sponsored plans
CAPEX	Capital expenditures
Altman's Z	$\left(3.3 \times \text{EBIT} + \text{Sales} + 1.4 \times \text{Retained Earnings} + 1.2 \times \text{Net Working Capital}\right)/\text{Operating Assets} + \text{Market Value of Equity} / \text{Total Liabilities}$
Tobin's Q	$\left(\text{Assets (book)} + \text{Equity (market)} - \text{Common Equity (book)} - \text{Deferred taxes}\right)/\text{Assets (book)}$
Employees	Current number of employees
DB Plans Share	Sum of Participants over sponsored plans/Employees

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