Corporate Pension Risk Transfers*

Sven Klingler Suresh Sundaresan Michael Moran

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Abstract

Between 2012 and 2022, U.S. corporate sponsors of defined benefit (DB) pension plans used *pension risk transfers* (PRTs) to transfer more than $150 billion pension obligations to insurance companies, thereby reducing the pool of corporate DB plan participants by 10%. We assemble a new PRT database and study the drivers and consequences of PRTs. Consistent with a simple model, the propensity to conduct a PRT is higher for firms with higher flow-through costs from their pension plans and higher burdens for paying insurance premiums to the Pension Benefit Guarantee Corporation (PBGC). Safer plan sponsors with less default risk and less volatility in their pension assets are more likely to conduct PRTs thereby increasing PBGC's pool risk.

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*Klingler is with the Department of Finance, BI Norwegian Business School, Nydalsveien 37, NO-0442 Oslo, Norway. E-mail: sven.klingler@bi.no. Sundaresan is with Columbia Business School, 1103 Kravis Hall, 665 West 130th Street, New York, NY 10027. E-mail: ms122@gsb.columbia.edu. Moran is with Goldman Sachs Asset Management, 200 West Street, New York, NY 10282. E-mail: michael.moran@gs.com. We are grateful to seminar and conference participants at BI Oslo, CUNY Graduate Center, Stockholm School of Economics, the UBC winter finance conference, as well as Aleks Adonov, Bruno Gerard, Burton Hollifield, Michael Kisser, Olivia Mitchell, Per Strömberg, and Rusty Yerkes for their helpful comments and suggestions. We are also grateful to Moody's Analytics for providing us with EDF data for the firms in our study. The views expressed are those of the authors and do not necessarily reflect those of Goldman Sachs Asset Management. Klingler gratefully acknowledges support from the European Research Council (ERC grant no. 101040188).

Introduction

Sponsoring defined benefit (DB) pension plans can expose companies to substantial pension-related costs and risks. One way to reduce these costs and risks is to transfer the pension liabilities to a life insurance company by purchasing annuities from the insurer. This transaction is called a *pension risk transfer* (PRT) and became popular in 2012 when General Motors and Verizon purchased annuities worth $25.1 and $8.4 billion, respectively, from the Prudential Insurance Company of America. Assembling a new data set of PRTs, we estimate that during the 2012 to 2022 period, corporate DB plan sponsors in the U.S. used PRTs to transfer around $150 billion in pension obligations to insurance companies, thereby reducing the pool of corporate DB plan participants by more than 10%.

What distinguishes firms that conduct PRTs from other firms? Do these differences affect the pool risk of the remaining DB plans? Given the economic significance of PRTs, these are first-order concerns for corporate pension regulation. This is the first paper to empirically examine these questions.

To guide our analysis, we develop a simple theory that delivers two testable predictions. First, PRTs are more common for firms with higher flow-through costs from their pension plans or larger burdens from paying insurance premiums to the Pension Benefit Guarantee Corporation (PBGC). Second, sponsors with higher default risk and more risky pension assets are less likely to conduct PRTs. We measure the flow-through costs as size of the pension plan relative to the size of the sponsoring firm and construct a new measure of the PBGC burden. Using our PRT sample, we find a strong link between the propensity of conducting a PRT and the two variables suggested by our theory. In addition, using propensity score matching, we find companies that conduct a PRT have higher credit quality and less risky plan assets, thereby lowering the aggregate quality of the remaining sponsor pool insured by the PBGC.

To better understand the motives behind PRTs, we first highlight the costs and benefits of the transaction. The costs of conducting a PRT are that the sponsor must fully fund the transferred liabilities (which is costly if raising external financing is costly) and pay a markup charged by the insurer. The first benefit is that, by reducing the size of the pension plan, PRTs reduce future pension-related costs.[1] In addition, pension sponsors must purchase insurance from the Pension Benefit Guaranty Corporation (PBGC) and, in return for regular insurance payments, receive an implicit "PBGC put option."[2] Conducting a PRT reduces both future premium payments and the value of the PBGC put and therefore only firms with high PBGC premiums relative to the value of their put option benefit from conducting a PRT.

To study PRTs, we focus on corporate sponsors of DB pension plans headquartered in the U.S. and assemble a comprehensive hand-collected sample of PRTs, combining reports by PIonline, a proprietary sample of PRTs collected by Goldman Sachs Asset Management (GSAM), and information from companies' annual reports. We then measure pension-related flow-through costs as the size of projected benefit obligations (PBOs) divided by the book value of firm assets. As proxy of the PBGC burden, we estimate the potential wedge between PBGC premium payments and benefits from access to the PBGC put. To capture this wedge, we take the difference between two decile numbers assigned to the firms in our sample. The deciles are based on (i) estimates of the current PBGC premium and (ii) the value of the PBGC put—measured as default risk multiplied with the current underfunding status—both

[1]These costs arise because, under the current Financial Accounting Standards (FAS 158), fluctuations in the funding status of a pension plan "flow through" to the sponsoring firm's earnings reports and because the Pension Protection Act of 2006 requires mandatory cash contributions from sponsors of underfunded pension plans under some contingencies.

[2]See, for instance, Sharpe, 1976, Treynor, 1977, Pennacchi and Lewis, 1994, van Binsbergen, Novy-Marx, and Rauh, 2014, among many others.

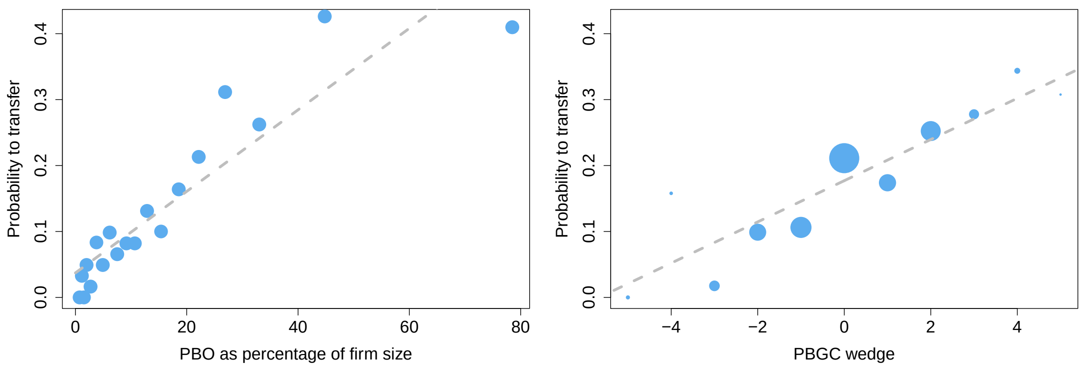

Figure 1: **Pension risk transfer probabilities.** The left-hand panel shows a binned scatter plot with 20 bins that are based on the size of pension plan obligations, relative to firm assets. The right-hand panel shows a binned scatter plot based on the estimated PBGC wedge (both averaged over 2010 to 2012). The y-axis shows the propensity that a sponsor in a given bin conducts at least one PRT during the 2012 to 2020 period. The size of the circles indicates the number of firms in each bin. The estimate of the PBGC is the difference between decile numbers for PBGC premium relative to firm size and PBGC put value relative to firm size, wincorized at ± 5.

standardized by firm size to capture the cost and benefit from the perspective of the sponsor. The wedge is then the difference between the two decile numbers and captures the intuition that the PBGC burden is higher for safer firms paying high PBGC premiums.

Examining the two motives behind PRTs, Figure 1 shows a binned scatter plot with the propensity that a firm conducts at least one PRT during the 2012 to 2022 period on the y-axis against our measures of flow-through costs or PBGC burden on the x-axis. Consistent with our hypotheses, higher flow-through costs and a higher PBGC burden correspond to a higher propensity of conducting a PRT.

We next examine the role of these motives using regression analysis. We begin by running cross-sectional logistic regressions in which the dependent variable equals one for companies that conduct at least one PRT during the sample period and zero otherwise. This analysis confirms flow-through costs and PBGC as significant drivers of the propensity to conduct a risk transfer. In particular, a one standard deviation increase in flow-through costs or PBGC wedge increases the propensity to conduct a PRT by 55% and 43%, respectively. Taking the time series dimension of our data into account, we confirm the robustness of our results in Cox Proportional Hazards models, where we use information from year t to predict PRTs in year $t + 1$.

Turning to our second hypothesis, we compare firms that conduct PRTs during our sample period to a control group of sponsors without PRTs. To obtain the control group, we use propensity score matching to find sponsors of comparable firm size within the same industry. Across the two groups, we compare the riskiness of pension plan assets and the credit quality of the sponsor, proxied by the equity allocation of the pension plan and the Expected Default Frequency (EDF) of the sponsor, respectively. As illustrated in Figure 2, PRT firms allocate less of their pension assets to equities and have lower EDFs. Further examining the differences between the two groups, we use regression analysis and find the average equity allocation is -6.5 percentage points lower for sponsors with PRTs compared to 45% for the control sample. Similarly, the logarithm of the EDF drops by -0.56 for PRT firms, compared to an average of -1.39 for the control sample. Hence, PRTs increase the risk of the sponsor pool covered by PBGC insurance because safer sponsors are more likely to conduct PRTs.

Finally, we put PRTs into a broader context, proceeding in three steps. First, we examine other de-risking measures and find that firms conducting PRTs are also more active in switching from DB to DC plans, offering lump-sum buyouts to their participants, terminating their plans, and conducting new pension freezes. Second, we show that aggregate de-risking activity is higher for firms with higher flow-through costs and larger PBGC burdens, measured by our proxies. Finally, we examine the effects of PRTs on the balance sheet

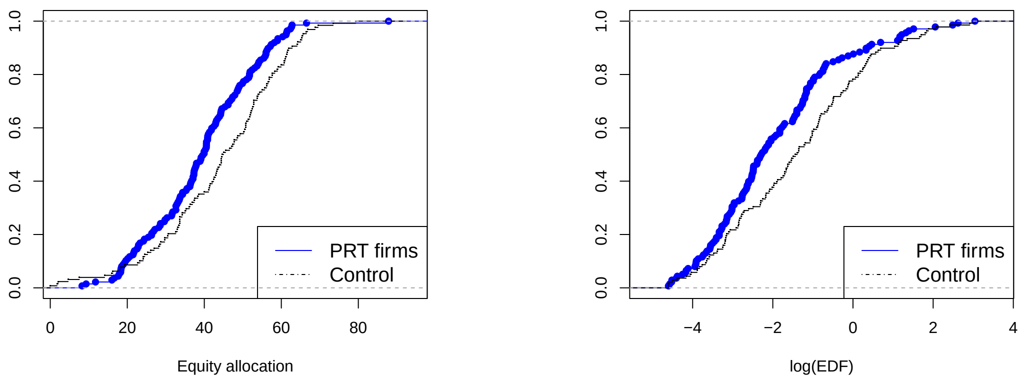

Figure 2: **Cumulative distribution functions.** This figure illustrates how firms that conduct at least one PRT during the 2012 to 2022 period compare to a control sample without PRTs across two dimensions: The allocation of equities within the pension plan and the default risk, measured by EDFs. To obtain comparable firms, we use propensity score matching on firm industry (measured by the first two digits of the SIC code) and firm size (measured as book value of firm assets, averaged over the 2010 to 2012 period). The plots show the empirical cumulative distribution functions for the two samples.

of the corporate sponsor and highlight that the significant drop in PBOs coincides with a transitory spike in pension-related costs associated with conducting the transfer.

Our study contributes to the vast literature examining the risks of corporate DB pension plans and firms' responses to these risks. Sponsoring a DB pension plan can affect a firm's investments and capital structure (Rauh, 2006, Franzoni, 2009, Campbell, Dhaliwal, and Schwartz Jr, 2012, Bartram, 2017, Axenrod and Kisser, 2021), stock price (Jin, Merton, and Bodie, 2006, Franzoni and Marin, 2006, Rauh, 2009), and even trigger earnings manipulations (Bergstresser, Desai, and Rauh, 2006). Shivdasani and Stefanescu (2010) show that DB plans affect firms' financing decisions and emphasize that the size of pension obligations directly affects a firm's credit quality. Our findings suggest that firms respond to these issues and use PRTs to reduce the relative size of their pension obligations.

In a broader context, companies have been using pension de-risking strategies such as liability-driven investments (e.g., van Binsbergen and Brandt, 2007, Ang, Chen, and Sundaresan, 2013), freezing their DB pension plans (Munnell, Golub-Sass, Soto, and Vitagliano, 2006, Munnell and Soto, 2007, Rauh and Stefanescu, 2009, Rauh, Stefanescu, and Zeldes, 2020), and offering lump-sum payments to terminated vested employees (e.g., Silverstein, 2021) for years. By contrast, PRTs of sizeable magnitude only became popular in 2012 and have received little attention in the academic literature.[3] We contribute to the pension de-risking literature by highlighting the sheer magnitude of PRTs—reducing the pool of PBGC insured plan participants by more than 10%—and the differences between PRT firms and other firms. In addition, we find that the PBGC premium burden is an important motive behind PRTs and thereby contribute to the large literature examining the effect of the PBGC insurance scheme on DB plan sponsors (Sharpe, 1976, Treynor, 1977, Pennacchi and Lewis, 1994, Love, Smith, and Wilcox, 2011, van Binsbergen et al., 2014, Romaniuk, 2019, among many others) and highlighting the issue of risk-insensitive PBGC premiums (Kiska, Lucas, and Phaup, 2005, Brown, 2008, among others).

1 Institutional Background

While the pension assets and liabilities of companies sponsoring defined benefit (DB) pension plans are off-balance sheet items (Shivdasani and Stefanescu, 2010), the sheer size of the pension obligations can make them first-order concerns to their sponsors. In our sample of U.S. corporate pension sponsors, described in Section 3, the upper quartile of pension obligations equals 20% of the sponsoring firms' assets which is comparable to the sponsors'

[3] In this context, it is important to distinguish PRTs, which are sometimes referred to as "pension buy outs" from "pension buy ins" where firms purchase annuities from life insurance companies withouth transferring the obligations. Pension buy ins are common de-risking tools in other countries, such as the U.K. and Canada, and Lin, MacMinn, and Tian (2015) or Lin, Shi, and Arik (2017), among others, analyze the differences between buy ins and buy outs from an actuarial point of view.

long-term debt. In addition, rating agencies consider the total DB plan size when examining the credit quality of a company (Shivdasani and Stefanescu, 2010) and poor pension risk management affects the sponsoring firms' stock price (e.g., Franzoni and Marin, 2006).

We highlight two particular costs faced by corporate pension sponsors in the U.S. First, if the pension liabilities exceed the pension assets, the plan is underfunded and the sponsor is liable for covering the shortfall. Under FAS 158, the Financial Accounting Standards that came into effect in 2006, sponsors of underfunded pension plans must report the funding deficit as a liability in their financial statements (e.g., FASB, 2006, Kisser, Kiff, and Soto, 2017) and the Pension Protection Act of 2006 tightened the mandatory cash contributions for sponsors of underfunded pension plans (e.g., Axenrod and Kisser, 2021). The liability for pension shortfalls exposes the sponsor to macroeconomic risks unrelated to its main business; falling interest rates increase the expected present value of pension liabilities and stock market downturns can lower the value of pension assets. Moreover, while any funding deficit is a direct liability for the sponsor, a funding surplus is not necessarily an asset because extracting a pension surplus is subject to excise taxes since the early 1990s (e.g., Rauh, 2009, Klingler and Sundaresan, 2019). Hence, sponsoring a pension plan produces *flow-through costs* to the sponsoring firms' balance sheets that add earnings volatility unrelated to the core business of the sponsor.[4]

Second, sponsors of DB plans must pay an insurance premium to the Pension Benefit Guaranty Corporation (PBGC), who guarantees to honor the participants' pension claims (up to a certain threshold) if the sponsor defaults. The PBGC premiums comprise a flat-

[4]While flow-through costs in the current reporting period are driven by the current level of underfunding, the total size of pension obligations is a more informative measure and commonly used by market participants. Shivdasani and Stefanescu (2010) provide examples from rating agencies stating that the size of the gross liability (i.e., not simply the level of underfunding) is an important input. To illustrate this point, consider General Motors, which had fully funded DB plans in 2006 but accumulated a pension funding deficit worth more than 20% of the total firm assets by 2009.

rate premium that depends on the number of plan participants and a variable-rate premium which only applies to plans with funding deficits. In 2012, U.S. Congress passed an Act known as MAP-21 (Moving Ahead for Progress) which led to substantial increases in PBGC premiums. From 2012 to 2020, the flat premium increased from $35 per participant to $83 and the variable rate premium increased from $9 per $1,000 of unfunded vested benefits (UVBs) to $45.[5] Traditionally, the cost of paying PBGC insurance premiums is balanced against access to "the PBGC put", which allows a defaulting company to put its unfunded pension liabilities with the PBGC (e.g., Sharpe, 1976, Treynor, 1977, Pennacchi and Lewis, 1994, van Binsbergen et al., 2014, among many others). However, the value of the PBGC put is lower for safer firms with less risky pension plans while the PBGC premiums neither explicitly reflect the credit quality of the sponsoring firm nor the risk in the pension plan. Hence, the substantial premium hikes after the enactment of MAP-21 could give safer plan sponsors an incentive to reduce the size of their pension plans.

1.1 Pension De-Risking Strategies

To manage the costs and risks associated with sponsoring DB plans, companies can use different *pension de-risking* strategies. The de-risking strategy we focus on in this paper is called *pension risk transfer* (PRT). When conducting a PRT, the plan sponsor purchases annuities from a life insurance company to irrevocably transfer (part of) its pension obligations to the insurer. This transaction immediately reduces the flow-through costs and PBGC premium burden for the sponsor. PRTs are sometimes called "pension buy-outs" and differ from "pension buy-ins" where the sponsor purchases annuities from an insurance

[5]In addition, MAP-21 introduced a per-participant cap on the variable-rate premium and thereby linked the potential costs of a large funding deficit to the number of plan participants. MAP-21 also links future growth in PBGC premiums to the national average wage index as published by the Social Securities Administration.

company without legally transferring the obligations to the insurer. We focus on PRTs because pension buy-ins are less common in the U.S. as they do not reduce the size of the pension plan.[6]

Conducting a PRT is subject to three constraints. First, the sponsor typically transfers the pension obligations for a subset of, mainly retired, plan participants. The focus on retired participants is driven by the annuity pricing of insurers, which is most favorable for retired participants (e.g., Inglis, 2013 or Panis and Padmanabhan, 2013). Second, data availability can further limit the subset of transferred participants because the sponsor needs to gather all relevant information on the affected participants, such as age, address, and payment details, which is time consuming. Third, Rule 95-1 from the Department of Labor requires companies to transfer their pension plans to insurance companies with good credit quality. Given these constraints, the sponsor solicits bids from different insurance companies and the PRT process usually takes between 6 and 12 months for medium-sized transfers and potentially longer for larger deals.

While PRTs have a long tradition—MetLife (2021) claims that it conducted the first PRT in history in 1921—Figure 3 shows the trend to transfer a substantial portion of a firm's pension obligations to an insurance company only accelerated in 2012. Three factors contributed to the surge in PRT activity after 2012. First, General Motors and Verizon conducted two large and highly visible PRTs in 2012 that likely inspired other pension sponsors. Second, as discussed before, U.S. congress announced a steep increase in future PBGC premiums when it passed MAP-21 in 2012.[7] Third, while General Motors and Verizon both transferred their

[6] In other countries, such as the U.K., pension buy-ins are more a more popular de-risking tool than in the U.S. In addition, sponsors in these countries can also purchase longevity hedges (e.g., longevity swaps) from life insurance companies for their pension de-risking. See Lin et al. (2015) or Lin et al. (2017) for a comparison of these three tools from an actuarial point of view.

[7] In addition, MAP-21 allowed over-funded plans to use excess assets to cover health care related liabilities and gave sponsors some latitude in using 25-year history of interest rates in discounting liabilities, thereby

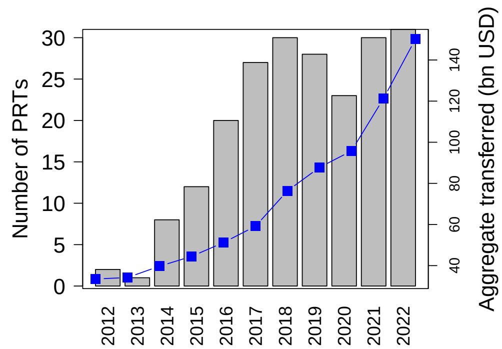

Figure 3: **PRTs over time.** The grey bars in this figure show the number of PRTs conducted by the firms in our sample in a given year. The blue line shows the cumulative dollar amount of transferred pension assets. The figures for 2022 are based on reports from GSAM and PIonline obtained on November 5.

pension liabilities to the Prudential Insurance Company of America, competition among insurance companies increased during our sample and, according to Milliman (2021), the average markup for transferring pension obligations, measured as percentage of accounting liabilities, decreased from approximately 112% in 2012 to 102% in 2021.[8]

Other De-Risking Strategies

In a broader context, we can distinguish three key types of pension de-risking strategies. First, de-riskings that reduce the size of existing pension obligations. In addition to conducting PRTs, sponsors can offer lump-sum payments to plan participants. If a participant accepts a lump-sum payment, the sponsor settles all pension-related liabilities with one payment and removes that participant from its plan without involving an insurance company.

giving sponsors some funding relief.

[8]Two reasons for this decrease in markups are increased competition among life insurance companies and a change to mortality tables finalized by the Society of Actuaries in October 2014 (e.g., Goldman Sachs Asset Management, 2014). Prior to this change, life insurance companies put a higher present value on pension liabilities than corporate sponsors as they used longer life expectancies.

While PRTs and lump-sum payments both reduce the size of existing pension obligations, a qualitative difference is that lump-sum payments are mainly targeted at inactive participants that have not reached retirement age (PBGC, 2020). Given that the pension benefits of inactive participants are typically lower than those of active or retired participants, lump-sum buyouts have a lower effect on the size of the pension plan. We further discuss lump-sum payments together with plan terminations (which involve a combination of lump-sum buyouts and PRTs) in Section 5.1.

Second, instead of reducing the existing pension obligations, companies stop the accumulation of new DB obligations by freezing their pension plans (Rauh et al., 2020) and transition to defined contribution (DC) plans (Rauh and Stefanescu, 2009). While these strategies stop the accumulation of new pension liabilities, they do not reduce the existing and future costs arising from legacy DB plans. Finally, pension sponsors can reduce their flow-through risks by using a liability-driven investment (LDI) approach (e.g., Ang et al., 2013). However, exact cash flow matching with long-dated bonds is challenging, especially in a low interest environment, and can have an adverse price impact.[9] In additiona, LDI strategies leave the number of plan participants unchanged and therefore have no direct effect PBGC premiums.

2 Hypotheses Development

We now examine the choice to conduct a PRT from the perspective of a corporate sponsor. As a starting point, we discuss the costs and benefits of conducting a PRT in a model-free

[9] Three examples are Greenwood and Vayanos (2010), who document a significant drop in the yields of long-term gilts after pension reform in U.K., Klingler and Sundaresan (2019), who show that pension funds' demand for long-dated swaps lowers swap spreads, and Greenwood and Vissing-Jorgensen (2018), who find a link between the size of the pension and insurance industry and the yield curve across countries.

setting. We then incorporate these considerations in a simple model and derive testable predictions for the propensity to conduct a PRT.

2.1 The Costs and Benefits of Conducting a PRT

We analyze the decision of a corporate pension sponsor to conduct a PRT, assuming that the size of the PRT is exogenously given. This assumption is motivated by the fact that only a subgroup of the plan participants is eligible for a transfer at a given time (e.g., due to data availability or constraints imposed by the insurer) and keeps our analysis tractable.

Focusing on the sponsor of an underfunded plan, Table 1 shows a *stylized economic balance sheet* that combines the assets and liabilities of the sponsoring firm's main business with those of the pension plan. We can separate five major items on this stylized balance sheet. First, the sponsoring firm has assets V, financed with equity E and debt D. Second, the underfunded plan liabilities (i.e., the difference between the expected present values of pension liabilities L and pension assets A) are an additional liability while neither A nor L appear directly on the sponsoring firm's balance sheet. Third, the present value of future PBGC premium payments X are a liability on the economic balance sheet and (partly) offset with the PBGC put option P. Fourth, the present value of future macro-economic flow-through costs Z is an additional liability. Finally, we view the option to transfer the plan to an insurance company as additional asset F on the stylized balance sheet.

Conducting a PRT can be thought of as exercising the option F, which removes the PBGC mispricing $X - P$ and the present value of future flow-through costs from the balance sheet but is subject to two costs. First, insurance companies charge a markup on the transferred liabilities and the sponsor also incurs fixed costs for the effort of collecting data and gathering

Table 1: **Stylized economic balance sheet of a corporate pension plan sponsor.** This table gives a stylized view on the balance sheet of a corporate pension plan sponsor, where V is the value of all firm assets, E and D are the present values of the firm's debt and equity, and $L - A$ are the unfunded pension assets, which are a liability on the sponsor's balance sheet. The other items are specific to the costs and benefits of conducting a pension risk transfer. F is the present value of the option of conducting a pension risk transfer and P is the value of the PBGC put option. Z and X are the present values of the pension-related macroeconomic costs and the costs associated with PBGC premiums, respectively.

Assets		Liabilities	
V	Firm Assets	E	Equity
		D	Debt
		$L - A$	Unfunded pension liabilities
P	PBGC put option	X	PV of PBGC premium
F	**Option to transfer the pension plan**	Z	PV of pension-related macroeconomic costs

bids from insurers.[10] We denote those as fixed costs C. Second, the sponsor can only transfer fully funded pension obligations and therefore needs to contribute $L-A$ to the plan.[11] In the absence of financing frictions, the sponsor would be indifferent between raising funding to finance the pension deficit or having it as additional liability. However, if accessing external funding is costly, the sponsor faces an additional cost $\omega(L - A)$ with $\omega > 0$.

Two financial frictions make the option to transfer the pension plan valuable. First, the value of the PBGC put option P does not necessarily offset the present value of future PBGC premium payments for all sponsors. Given the steep premium hikes between 2012 and 2020, this mispricing can be a first-order concern. Second, exact matching of pension liabilities and

[10] It is also possible that insurance companies sell annuities at a discount instead of a markup as uncovered by Koijen and Yogo (2015). However, whether the total costs C are positive or negative leaves our derivations unchanged.

[11] As sponsors only transfer parts of their plans, a theoretical possibility is that the funding for the transferred participants comes from the remaining plan. However, the sponsor faces a cost propotional to $L - A$ to avoid conflicts with the remaining participants, who would otherwise face a plan with a lower funding status

pension assets is not always possible and any pension-related costs therefore flow-through costs to the sponsoring firms balance sheet. The flow-through costs Z represent this friction.

In this simple setting, the sponsor pays a cost for conducting the transfer and benefits from removing Z and $X-P$ from its economic balance sheet. The total gains from conducting the PRT are given as:

$$Z + X - P - \omega(L - A) - C. \tag{1}$$

Assuming that sponsors with higher expected gains are more likely to conduct a PRT, we can derive the following hypothesis from our discussion.

Hypothesis 1. *PRTs are more common for firms with higher flow-through costs or a higher wedge between PBGC premiums and PBGC put.*

Following the same logic, Equation (1) implies that higher costs lower the propensity to conduct a PRT and we also examine this implication in our empirical analysis.

2.2 An Illustrative Dynamic Model

We now incorporate the costs and benefits of conducting a PRT into a simple continuous-time model with an infinite horizon which is fully developed in the appendix. We assume the sponsor takes its pension-related costs and own default risk as given and maximizes the benefits of the PRT by choosing the pension asset value A_U at which conducting the PRT becomes optimal.[12] This assumption allows us to illustrate how sponsors that conduct a PRT differ from sponsors that do not conduct a PRT.

[12] Formally, the PRT is conducted when the asset value reaches an upper (endogenously derived) boundary A_U and we draw on Leland (1994) for our derivations.

To keep our model tractable, we make four simplifying assumptions. First, the pension assets A_t follow a geometric Brownian motion with drift $r - \delta$ and volatility σ while we assume constant liabilities L. Hence, the pension risk is captured by the exogenous model parameter σ, which we interpret as a proxy for the plan's stock holdings. Second, we use a reduced-form model with constant default intensity λ to capture default risk (cf Lando, 1998) and assume default is independent of the pension assets. Third, the flow-through costs are a constant cash flow z paid until the firm either conducts a PRT or defaults. Finally, we ignore the PBGC wedge in our derivations but argue later that the presence of $X - P$ would further strengthen our results.

Proposition 1. *The optimal asset level for conducting the PRT is:*

$$A_U = \frac{\beta}{\beta - 1}\frac{1}{\omega}(\omega L + C - Z), \tag{2}$$

with $\beta = \frac{-(r-\delta-\frac{\sigma^2}{2})+\sqrt{(r-\delta-\frac{\sigma^2}{2})^2+2(r+\lambda)\sigma^2}}{\sigma^2}$ *and the propensity to conduct a PRT is:* $\left(\frac{A}{A_U}\right)^{\beta}$.

Building on Proposition 1, we derive the following hypothesis, which we prove in the appendix.

Hypothesis 2. *Sponsors with (i) riskier plan assets or (ii) higher default risk are less likely to conduct a PRT.*

The intuition behind this prediction is as follows. First, there is an "option value of waiting" because it is possible that the funding status of the plan improves in the future and the required contribution $\omega(L - A)$ decreases. This option value is higher if a plan comprises riskier assets. Second, a higher default risk lowers the present value of the flow-through costs, which are paid until the firm either defaults or conducts a PRT.

Finally, note that the PBGC wedge $X - P$ would decrease for riskier plans or riskier sponsors and therefore increase the asset value at which conducting a PRT is optimal. Hence, considering $X - P$ would further amplify the mechanism.

3 The Data

We restrict our analysis of PRTs to the 2012 to 2022 period (including the large PRTs by General Motors and Verizon) and since we later use pension plan characteristics in year t to predict the propensity to transfer in year $t + 1$, we also include 2011 in our sample of plan sponsors. We examine corporate pension sponsors that report their pension assets and projected benefit obligations (PBOs) to the Compustat corporate pension database and focus on sponsors headquartered in the U.S. that have at least five database entries during the 2011 to 2021 period.[13] This filtered sample contains $1,354$ pension sponsors and we assemble a comprehensive database of pension risk transfers for these sponsors by combining three data sources. We purchase a hand-collected set of major PRTs from PIonline and obtain a proprietary set of PRTs from GSAM. Because these data providers might overlook PRTs by smaller companies in our sample, we also search the annual reports of our sample firms manually for information on conducted PRTs (see Section A.1 in the appendix for more details).[14]

The resulting PRT sample comprises 213 risk transfers conducted by 167 different companies. As shown in the first row of Table 2, 12% of the firms in our sample conducted at

[13]We drop sponsors located outside the U.S. because we later rely on the companies' annual reports, which can differ substantially for foreign firms. In addition, as we explain in more detail in Section A in the appendix, requiring at least five observations during our sample period does not affect our sample size substantially but has the benefit that we compare averages of different firm characteristics during similar periods.

[14]The PRT observations for 2022 from PIonline and GSAM were obtained on November 5, 2022 and will be updated to include all of 2022 in a later version of the paper.

least one PRT in the 2012 to 2022 period. Panel A of Table 2 provides summary statistics of the individual transactions. We observe the transfer size, which is, on average, \$795.2 million for 189 of the PRTs in our sample. The average PRT size is \$1,050.9 million for the transfers captured by PIonline or GSAM and \$84.4 million for the transfers obtained by searching through annual reports, suggesting that PIonline and GSAM mainly capture larger PRTs that generate media attention. The last row of Panel A shows that we have information on the number of affected plan participants for a subsample of 154 transfers.[15] The average number of affected participants is 9,761.4 in a given transfer.

3.1 Measuring Flow-Through Costs and PBGC Mispricing

To obtain more granular information on the individual pension plans, we match the filtered database with Department of Labor (DoL) 5500 filings. We focus on DoL filings for single-employer DB plans and aggregate the DoL information (one sponsor is usually in charge of multiple plans) on the sponsor level. In merging Compustat with DoL filings, we first match pension plans to firms based on the reported Employer Identification Number (EIN). To overcome the problem that the EIN in the DoL filings sometimes links to a subsidiary of the Compustat entity (e.g., Rauh et al., 2020), we obtain the names of all company subsidiaries as reported in Exhibit 21 of their annual reports from WRDS and use a fuzzy-name matching algorithm to match DoL plans and subsidiaries. We furnish additional details of this matching procedure in the appendix where we also confirm the quality of our matching procedure (see Figure A1). This matching procedure reduces the number of

[15] To be precise, we directly obtain the number of affected plan participants for 98 transfers. We construct a proxy of transferred plan participants as the difference between the number of plan participants at the beginning of the reporting year and at the end of the reporting year, subtracting the number of participants that received lump sum payments (relying on data from the DoL discussed below). As a plausibility check, we compute the correlation between our measure and the observed numbers of transferred participants, which is 76%.

Table 2: **Summary statistics.** This table contains summary statistics of our sample of pension sponsors and PRTs. *Panel A* provides summary statistics for the PRTs in our sample, counting transfers on the firm-year level. *Panel B* and *Panel C* provide summary statistics of average firm and pension plan characteristics, where we first compute the time series average for each firm over the 2010 to 2012 period or the 2011 to 2021 period, respectively. We the then report cross-sectional summary statistics. Under *Difference between firms with and without PRTs*, we report the mean and median difference between firms that conduct at least one PRT during the 2012 to 2021 period and the other firms in our sample. ***, **, and * indicate significance at a 1%, 5%, and 10% level, respectively, where the p-values for this calculation are based on a t-test for difference in means or a Wilcox test for difference in medians. For a detailed description of these variables see Table A2.

							Difference between firms with and without PRTs	
	Mean	SD	25%	Median	75%	N	Diff. from Mean	Diff. from Median
Firms with PRTs	0.12					1,354		
Panel A: PRT characteristics								
mn transferred	795.2	2,387.0	63.0	205.0	615.0	189		
PI or GSAM	1,050.9	2,740.0	137.5	300.0	800.0	139		
Reports	84.4	124.7	18.7	46.5	77.8	50		
#Participants	9,761.4	16,939.0	1,077.2	3,445.5	10,875.0	154		
Panel B: Sponsor and plan characteristics (avereged 2010 to 2012)								
$PBO^{\%}$	15.15	19.14	2.31	8.32	20.23	1,218	19.93***	19.60***
$Wedge^{EDF}$	0.01	2.20	-1.00	0.00	2.00	761	1.21***	1.00***
$Wedge^{Alt}$	-0.06	1.91	-2.00	0.00	1.00	994	0.44***	0.00***
$Inactive^{\%}$	59.66	20.99	46.55	61.74	74.96	981	11.64***	11.09***

sponsors to $1,033$ and we therefore rely on the matched sample in our baseline analysis.

To measure the flow-through cost Z, we use the size of projected benefit obligations (PBOs) relative to the book value of the sponsoring firm's assets ($PBO\%$). As discussed in Section 1, the relative size of the DB plan is a key concern for both corporate sponsors and credit rating analysts. Hence, it is a better proxy for future pension-related costs than the current level of underfunding. An alternative measure, which we discuss in more detail in the appendix (Figure IA.2) and which leads to similar results, would be past fluctuations in the level of underfunding.

Measuring a potential PBGC mispricing ($X - P$) is more challenging and we proceed in three steps. First, we estimate the current level of the PBGC premium, standardized by the size of the sponsoring firm, and assign decile numbers to the firm-years in our sample.[16] Second, we multiply a proxy of default risk based on Moody's expected default frequencies (EDFs)—a proxy for default risk over the next year—with the current level of underfunding divided by firm assets and, as before, assign decile numbers to the firm-years in our sample. Finally, we approximate the PBGC wedge as the difference between the premium decile and the default decile. In addition, we replace the EDF-implied default risk and the number of plan participants (which are only available for a subset of sponsors) with an alternative proxy of default risk based on Altman's z-score and use the number of firm employees instead of the number of plan participants to approximate PBGC premiums. Figure IA.1 illustrates our approach and we perform a battery of robustness checks, using quartiles instead of deciles, or alternative proxies for X and P in the appendix (Table IA.7).

Panel B of Table 2 provides cross-sectional summary statistics of the key variables in our analysis. In the table, we use averages over the 2010 to 2012 period on the company level and then report cross-sectional summary statistics. Throughout the paper, we mitigate the potential impact of large outliers in the data by winsorizing all continuous variables at the 1% and 99% quantiles. In addition to the cross-sectional summary statistics for the full sample, we also report the mean and median difference between firms that conducted at least one PRT during the 2012 to 2022 period and the rest of our sample. This simple comparison helps us establish a set of stylized facts which we examine more carefully in the following

[16] To estimate the fixed-rate part of the PBGC premium, we multiply the per-participant premium disclosed on the PBGC website with the number of plan participants obtained from DoL filings. The variable-rate premium from the PBGC website is multiplied with the unfunded pension obligations (obtained from Compustat) and, from 2013 on, we take the minimum between this product and the per-participant cap introduced in MAP-21. This procedure is an estimation because the exact amount of unfunded pension obligations used to compute the PBGC premium is neither disclosed in DoL nor Compustat filings. However, in the post-2013 sample, 45% of the observations in our sample are above the variable premium cap, which is approximately consistent with industry estimates (e.g., PBGC (2020)).

sections.

The average $PBO\%$ is 15% for our sample and is 19.9% higher for sponsors that conduct at least one PRT during our sample period. Our two estimates of the PBGC wedge show qualitatively similar properties with a median of zero and 25% or 75% quantiles between minus two or plus two. In line with our hypothesis, firms that conduct at least on PRT have a significantly higher wedge. Finally, $Inactive^{\%}$ is based on data from the DoL and captures the percentage of inactive plan participants. Because the annuity pricing from life insurers is more favorable for inactive participants, this variable can be interpreted as an indirect proxy for the cost of conducting the PRT. As shown in the table, more than half the DB plan participants are inactive with firms that conduct a PRT having approximately 10 percentage points *more* inactive participants. We provide additional summary statistics for other relevant variables in the appendix (Table IA.2).

4 Empirical Evidence

We now use the assembled data to test Hypotheses 1 and 2.

4.1 Drivers of Pension Risk Transfers

To test Hypothesis 1, we first examine the propensity that a firm conducts at least one PRT during our sample period in logistic regressions. Afterwards, we exploit the panel dimension of our data and test how firm characteristics in year t affect the hazard rate of conducting a PRT in year $t+1$.

Cross-Sectional Analysis

We run cross-sectional logistic regressions of the following form:

$$\text{logit}(PRT_i) = \beta^Z PBO_i^{\%} + \beta^{X-P} Wedge_i + \gamma Controls_i + \varepsilon_i. \tag{3}$$

The dependent variable is an indicator that equals one if company i conducts at least one PRT during the 2012 to 2022 period and all independent variables are averaged over the 2010 to 2012 period. To proxy Z and $X-P$, the two main independent variables in Equation (3), we use the relative size of PBOs to firm assets ($PBO^{\%}$) and our proxies for the PBGC wedge ($Wedge_i$). We start by examining the role of these variables and then conduct additional tests with more controls.

Column (1) of Table 3 shows the results for using $PBO\%$ and $Wedge_i^{EDF}$. In line with Hypothesis 1, firms with higher flow-through costs and a larger wedge in their PBGC pricing are more likely to conduct a PRT. Examining this result, we first recall that $Wedge_i^{EDF}$ is based on DoL data and EDFs, which greatly reduces our sample size. Interpreting the magnitude of the coefficients, a one percentage point increase in $PBO^{\%}$ increases the odds of a PRT by 2.9% ($e^{0.029} - 1 = 0.0294$) and an increase of one category in the PBGC wedge increases the odds of a PRT by 19.7% ($e^{0.180} - 1 = 0.197$). However, given the larger cross-sectional standard deviation in $PBO^{\%}$, the economic effect of the two variables is comparable with 55% ($2.9 \times 19.14 = 55.4$) and 43.3% (19.7×2.2), respectively. In addition, computing McFadden's pseudo R^2 shows that the two variables suggested by our hypotheses explain approximately 10% of the cross-sectional variation in the odds of conducting a PRT. Column (2) shows that our results remain largely unchanged when we replace the $Wedge_i^{EDF}$ with the less precise $Wedge_i^{Alt}$, which is available for a larger part of our sample.

Table 3: **Cross sectional logistic regression for the likelihood of a PRT.** This table shows the results from logistic regressions of the propensity that a given firm conducts at least one PRT during the 2012 to 2021 period. $PBO^{\%}$ is the plan PBOs as percentage of firm size. $PBGC\ Wedge$ and $PBGC\ Wedge^{Z}$ are our estimate of the PBGC premium mispricing. For a detailed description of the additional controls see Table A2. All independent variables are averaged over the 2010 to 2012 period. ***, **, and * indicate significance at a 1%, 5%, and 10% level, respectively. The numbers in parantheses show heteroskedasticy robust standard errors.

	(1)	(2)	(3)	(4)
$PBO^{\%}$	0.029***	0.033***	0.026***	0.027***
	(0.005)	(0.004)	(0.005)	(0.005)
$PBGC\ Wedge$	0.180***		0.154***	
	(0.052)		(0.059)	
$PBGC\ Wedge^{Z}$		0.098**		0.198***
		(0.047)		(0.054)
$Inactive^{\%}$			0.023***	0.021***
			(0.006)	(0.005)
$Allocation^{Eq\%}$			0.004	0.005
			(0.007)	(0.007)
UFR			−0.009	−0.012*
			(0.006)	(0.006)
$\log(Firm)$			0.168***	0.251***
			(0.060)	(0.059)
Age			0.001	0.003
			(0.006)	(0.005)
$Labor^{Int}$			4.147	−2.379
			(6.617)	(4.855)
McFadden's adj. R^2	0.108	0.094	0.123	0.104
Num. obs.	760	989	720	773

We next add a set of control variables to our analysis. First, $Inactive_i^{\%}$ captures the fraction of inactive plan participants and, as discussed in Section 3, can be interpreted as an indirect proxy of the markup. Second, the equity allocation ($Allocation_i^{Eq\%}$) and underfunded ratio of the plan (UFR_i) capture the risk taking of the sponsor and the general health of the plan. Third, we control for firm size ($\log(Firm)_i$) and age (Age_i) to capture cross-sectional differences in the plan sponsors. Finally, as proxy for industry effects we add the labor intensity ($Labor^{Int}$) of the industry (measured by two-digit SIC codes).

As shown in Columns (3) and (4), adding these controls leads to a small drop in the coefficient on $PBO\%_i$ but leaves our main results unchanged. In addition, firms with more inactive plan participants are more likely to conduct a PRT which is supportive evidence of higher markups reducing the propensity to conduct a PRT. In addition, firms with larger funding deficits in their plans are less likely to conduct a transfer while larger plan sponsors and sponsors in more labor intensive industries are more likely to conduct a PRT.

Panel Analysis

One drawback with using average firm characteristics from 2010 to 2012 to predict PRTs over the 2012 to 2022 period is that the independent variables are less accurate if the PRT is conducted in the later part of the sample. To address this potential concern, we incorporate the time series dimension in our analysis and examine how variables observed in year t affect the propensity of conducting a PRT in year $t+1$ in Cox proportional hazard models of the following form:[17]

$$\log(\lambda_i^{PRT}(t+1)) = \beta^Z PBO_{i,t}^{\%} + \beta^{X-P} Wedge_{i,t} + \gamma Controls_{i,t} + \varepsilon_{i,t}. \quad (4)$$

We proceed analogous to our analysis from the previous section and start with the baseline specification without controls. Columns (1) and (2) of Table 4 corroborate the results from the previous section. Firms with larger flow-through costs and bigger PBGC wedges—either measured as $Wedge_i^{EDF}$ or $Wedge_i^{Alt}$—are more likely to conduct a PRT. Turning to the

[17]While a Cox proportional hazards model is more appropriate for this analysis, we note that cross-sectional logistic regressions with year-fixed effects yield virtually identical resuts (see Table IA.5 in the appendix).

Table 4: **Cox proportional hazard regressions.** This table shows the results from Cox proportional hazard regressions for the intensity of a given firm conducting a PRT in year $t+1$. *PBGC Wedge* is averaged over the previous five years. All other independent variables are observed in year t. For a detailed description of these variables see Table A2. All specifications include year industry fixed effects (measured by the first two digits of the SIC code). ***, **, and * indicate significance at a 1%, 5%, and 10% level, respectively. The numbers in parantheses show standard errors, clustered at the firm level (because some firms conduct multiple PRTs).

	(1)	(2)	(3)	(4)
$PBO^{\%}$	0.018***	0.021***	0.012***	0.013***
	(0.002)	(0.002)	(0.003)	(0.003)
$PBGC\ Wedge$	0.224***		0.102**	
	(0.037)		(0.051)	
$PBGC\ Wedge^{Z}$		0.126***		0.149***
		(0.034)		(0.058)
$Inactive^{\%}$			0.010*	0.012**
			(0.006)	(0.005)
$Allocation^{Eq\%}$			−0.015***	−0.015***
			(0.005)	(0.004)
UFR			−0.015*	−0.014**
			(0.007)	(0.006)
$\log(Firm)$			0.071	0.167***
			(0.058)	(0.055)
Age			0.005	0.005
			(0.004)	(0.004)
Industry Strata	No	No	Yes	Yes
Observations	7,868	10,212	7,022	7,346
Log Likelihood	-1,080.295	-1,366.390	-400.810	-507.053

role of the control variables, we modify the analysis from the previous section by adding industry strata (based on two-digit SIC codes) instead of labor intensity as a more granular industry control. Similar to the cross-sectional regressions, Columns (3) and (4) show both flow-through costs and PBGC wedge retain their statistical significance, despite a drop in significance. One difference when focusing on the panel dimension is that higher equity allocations have a statistically significant negative effect on the hazard rate of conducting a PRT.

4.2 Differences Between PRT Firms and Other Firms

To understand how PRTs affect the risk of the sponsor pool, we examine the difference between firms that conduct PRTs and a control sample of firms that do not conduct PRTs. To construct the control sample, we use propensity score matching and find sponsors of similar size within the same industry. Specifically, for each sponsor that conducts at least one PRT during the 2012 to 2022 sample, we find a matching firm without any PRTs within the same industry (measured by the first two digits of the SIC code) and with comparable book value of firm assets (averaged over the 2010 to 2012 period). In the appendix, we illustrate the close fit for our matching (Figure IA.3) and conduct additional tests including the size of pension obligations relative to firm value in the matching procedure (Table IA.6).

Starting with the plan allocation to equity as proxy for pension risks, Column (1) of Table 5 shows that the average equity allocation of firms with PRTs is -6.27 percentage points lower compared to the control sample. This difference remains virtually unchanged after adding firm size and industry fixed effects as controls. Similarly, Column (3) shows a substantially lower default risk for PRT firms, measured by the logarithm of the EDF. As before, controlling for firm size and industry fixed effects leaves this result virtually unchanged. Using Altman's z-score as alternative proxy of default risk, Columns (5) and (6) show qualitatively similar results with PRT firms having higher z-scores.

Taken together, Table 5 suggests that PRTs not only reduce the PBGC premium base, they also increase the riskiness of the PBGC pool as sponsors with lower default risk and plans with less risky pension assets are more likely to conduct PRTs. These findings resonate with a study by Mercer (2018) that argues: "the structure [of PBGC premiums] motivates healthy plan sponsors to exit, potentially leaving PBGC to insure an increasingly unhealthy pension universe with shrinking premium base."

Table 5: **Propensity-matched differences.** This table shows how firms that conduct at least one PRT during the 2012 to 2022 period compare to a control sample without PRTs across two dimensions: The allocation of equities within the pension plan and the default risk, measured by either EDFs or Altman's z-score. To obtain comparable firms, we use propensity score matching on firm industry (measured by the first two digits of the SIC code) and firm size (measured as book value of firm assets, averaged over the 2010 to 2012 period). The numbers in parantheses are t-statistics based on heteroskedasticity robust standard errors. ***, **, and * indicate significance at a 1%, 5%, and 10% level, respectively.

	$Alloc^{Eq\%}$		$\log(EDF)$		z-score	
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	45.55***		−1.39***		1.44***	
	(35.53)		(−9.38)		(18.14)	
$\mathbb{1}(PRT)$	−6.27***	−6.55***	−0.56***	−0.52***	0.21*	0.16
	(−3.66)	(−3.95)	(−2.76)	(−2.81)	(1.81)	(1.61)
$\log(Firm)$		−2.02***		−0.45***		−0.08**
		(−3.15)		(−7.49)		(−2.15)
Industry FE	–	Yes	–	Yes	–	Yes
Adj. R^2	0.04	0.17	0.02	0.26	0.01	0.35
Num. obs.	314	314	276	276	316	316

Impact of PRTs on the PBGC Pool

PRTs have contributed to a shrinking pool PBGC insured plan participants and thus to the erosion of the PBGC premium base. To illustrate the aggregate effects of PRTs in our sample, we compute the aggregate cumulative size of PRTs—either measured in terms of transferred participants or transferred pension assets—and put it into perspective by dividing by the total number of plan participants or total market value of pension assets reported in the DoL filings.

As illustrated by the blue line in Figure 4, PRTs reduced the number of plan participants covered by the PBGC by approximately 10% over the 2012 to 2021 period. Given that 2022 was another record year for PRTs, with a comparable amount of transferred participants as

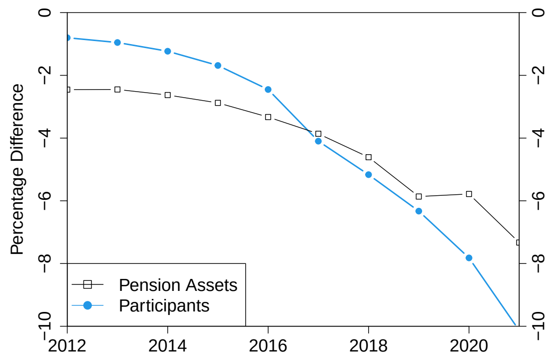

Figure 4: **Aggregate effects of PRTs.** This figure shows how PRTs reduced the size of the pension plans in our, measured either as number of plan participants or dollar value of plan assets, over our sample period. To obtain these numbers we sum all previously transferred participants or pension obligations and divide by the current total in our sample. The black line shows the effect on pension assets. The blue line shows the effect in number of plan participants.

2021, the erosion in the premium base accelerates. Turning to the effect on aggregate plan size, we first note that we keep the dollar amount of transferred pension assets/obligations fixed at the time of observation and therefore an increase in the value of plan assets can lower the illustrated percentage impact of PRTs. As shown by the black line in Figure 4, the PRT activity corresponds to a drop of approximately 7% of total plan assets. The smaller effect on the dollar amount of PRTs can be interpreted as companies mainly transferring participants with less accumulated pension obligations.

5 Broader Implications

In this section, we first put PRTs into the broader context of pension de-risking strategies. Afterwards, we highlight the implications of PRTs for the corporate sponsor.

5.1 Link to Other De-Risking Measures

To put our results in a broader context of pension de-risking, we examine the correlation between PRTs and six other de-risking measures. The first two measures capture changes over the 2012 to 2021 period in either PBOs as percentage of firm assets ($\Delta PBO^{\%}$) or DB plan participants as percentage of total plan participants including DC ($\Delta DB^{\%}$). The remaining three measures are indicator variables that equal one if the sponsor engages in the indicated activity at least once during the 2012 to 2021 period: bulk lump-sum buyout (*Lump-sums*), plan termination (*Termination*), or additional pension plan freeze (*New Freeze*).[18]

To examine the link to PRTs, we regress each of the measures on an indicator variable that equals one if a sponsor conducted a PRT during the sample period. Starting with changes in the size of PBOs as percentage of firm assets, Column (1) in Panel A of Table 6 shows a small drop of -1.00 percentage points for non-PRT firms that increases to 7.42 $(1.00+6.42)$ for firms conducting a PRT. Similarly, for the percentage of employees with DB plans, Column (2) shows a statistically significant average drop of 3.73 percentage points for the sponsors in our sample that almost quadruples to 13.70 $(3.73 + 9.67)$ percentage points for firms that conducted at least one PRT during the sample period. Next, examining the link between PRTs and lump-sum buyouts, Column (3) shows that 30% of non-PRT firms conducted lump-sum buyouts during our sample period and that this percentage increases to 71% for PRT firms, suggesting that the majority PRT firms also conducted lump-sum buyouts. A similar pattern emerges for plan terminations, suggesting that PRT firms are twice as likely to terminate their plans than non-PRT firms. Finally, an average fraction of

[18]We collect information on freezes, plan terminations, and bulk lump-sum buyouts from the DoL. The DoL defines bulk lump-sum buyouts as events where a firm gives lump-sum buyouts to more than 25% of their eligible participants or where the buyouts affect more than 10% of the participants and are five times the sample median. Plan termination is defined as the first time a sponsor indicates the inclination to terminate a pension plan.

Table 6: **PRTs and other de-risking strategies.** *Panel A* shows the results of regressing other de-risking activities during the 2012 to 2021 period on an indicator variable that equals on for firms that conduct at least one PRT during the sample period. $\Delta PBO\%$ and $\Delta DB\%$ are changes in PBOs as percentage of firm assets and DB plan participants as percentage of total plan participants over the 2012 to 2021 period. *Lump-sums*, *Termination*, or *New Freeze* are indicator variables that equal one if a company conducts at least one bulk lump sum buyout, plan termination, or new freeze during the sample period. *Panel B* shows the results from Poisson regressions counting the number of de-risking activities (PRTs, bulk lump sum buyouts, or plan terminations) during the 2012 to 2021 period or changes in PBOs to firm assets. $PBO^{\%}$ is the plan PBOs as percentage of firm size. $PBGC\ Wedge$ and $PBGC\ Wedge^{Z}$ are our estimates of the PBGC premium mispricing. All independent variables are averaged over the 2010 to 2012 period. ***, **, and * indicate significance at a 1%, 5%, and 10% level, respectively. The numbers in parantheses show heteroskedasticy robust standard errors.

Panel A: Correlation between PRTs and other de-risking strategies

	$\Delta PBO^{\%}$	$\Delta DB^{\%}$	*Lump-sums*	*Termination*	*New Freeze*
Intercept	-1.00^{**}	-3.73^{***}	0.29^{***}	0.10^{***}	0.23^{***}
	(-2.57)	(-5.30)	(19.35)	(8.23)	(12.88)
$\mathbb{1}(PRT)$	-6.42^{***}	-9.67^{***}	0.41^{***}	0.12^{***}	0.13^{***}
	(-3.77)	(-5.61)	(10.57)	(3.04)	(2.87)
Adj. R^2	0.03	0.03	0.09	0.01	0.01
Num. obs.	902	1,028	1,078	1,078	690

Panel B: Poisson and OLS regression results

	# De-riskings		$\Delta PBO^{\%}$	
	(1)	(2)	(3)	(4)
$PBO^{\%}$	0.010^{***}	0.010^{***}	-0.166^{***}	-0.272^{***}
	(0.002)	(0.001)	(0.044)	(0.042)
$PBGC\ Wedge$	0.042^{**}		-0.753^{***}	
	(0.020)		(0.245)	
$PBGC\ Wedge^{Z}$		0.083^{***}		-0.433^{**}
		(0.021)		(0.203)
Adj. R^2	0.022	0.026	0.099	0.157
Num. obs.	760	835	576	744

0.24 sponsors in our sample froze additional pension plans during our sample period. This fraction increases to 0.36 for sponsors that conducted a PRT during our sample period.

Link to Lump-Sum Buyouts and Plan Terminations

We examine if the two main drivers suggested in Hypothesis 1 also explain aggregate de-risking activity. Specifically, we sum the total amount of de-risking activities, including PRTs, plan terminations, and bulk lump sums and study the effect of flow-through costs and PBGC wedges on the count measure in Poisson regressions. Columns (1) and (2) in Panel B of Table 6 show the results of this analysis and confirm that both flow-through costs and the PBGC wedge are statistically significant explanatory variables for the aggregate count of de-risking activities. As a second test, we repeat our analysis in ordinary least squares (OLS) regressions of the change in PBO size as percentage of firm size over the 2012 to 2021 period. Consistent with our previous results, firms that start with higher level of PBOs and firms with a larger wedge in their PBGC premium burden reduce their PBOs more aggressively.

5.2 Corporate Implications

To conclude our discussion of broader implications, we examine how PRTs affect the corporate sponsor. Based on our theoretical setting, we expect a significant drop in PBOs but a significant spike in pension-related costs in the transfer year. The drop in PBOs occurs simply because the company transfers part of its pension obligations to an insurance company. The spike in pension-related costs should be transitory because PRTs are associated with a one-time expense. To test our intution, we run panel regressions of changes in PBOs or pension costs (both divided by firm assets) on indicator variables that equal one either 3, 2, or 1 year before a transfer takes place, in the year the transfer takes place, or one year after a transfer took place, controlling for industry and year fixed effects.

Figure 5 confirms our intuition. The first panel shows there are no significant changes in

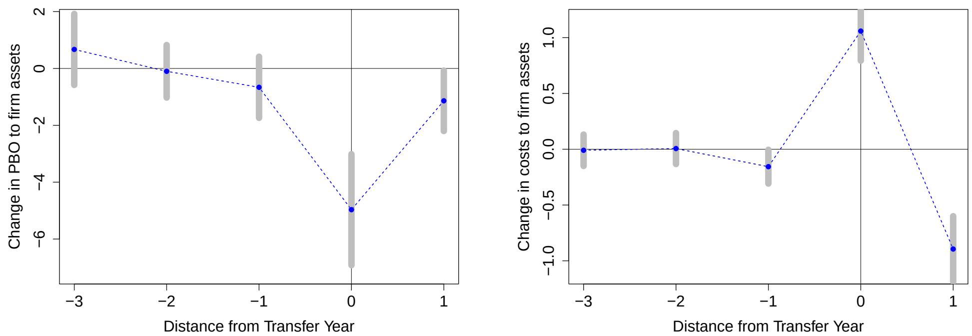

Figure 5: **Changes in PBOs and pension costs.** This figure visualizes the average changes in PBOs or pension costs, both as percentages of firm assets. The blue dots are estimated using a panel regression of changes in the indicated variables for all sponsors in our sample, where we regress on five indicator variables that equal one either 3, 2, or 1 year before a transfer takes place, in the year the transfer takes place, or one year after the transfer took place. We control for year-fixed effects and industry fixed effects. The grey bars illustrate 95% confidence intervals based on standard errors clustered at the sponsor level.

PBOs before or after a PRT but there is a significant drop in the transfer year itself. While the second panel shows no significant changes in pension costs prior to PRTs, it shows a significant spike in the transfer year itself. This spike is proceeded by a significant drop of comparable magnitude, suggesting that PRTs are associatied with large one-time payments.

6 Concluding Remarks

We examine the drivers behind the surge in corporate PRT activity from 2012 on. We focus on a sample of major corporate DB pension sponsors in the U.S., hand-collect information on whether these sponsors conduct PRTs (as well as PRT details if available), and construct a new measure of potential PBGC mispricings. The two main motives emerging from our analysis are corporate sponsors who want to reduce the flow-through costs of their pension plans and sponsors who want to reduce minimize the costs due to the PBGC wedge. In addition, we highlight a potential issue for the PBGC as safer plan sponsors and sponsors of less risky plans tend to transfer their pension obligations.

While our analysis highlights the motives behind corporate PRTs and the effect on the pool of PBGC insured plans, we are agnostic about the effect on the involved insurance companies and on the transferred plan participants. The involved life insurers are arguably better equipped to handle pension-related risks than corporate sponsors because, similar to banks, insurance companies have expertise in managing financial portfolios and investments, especially for long-term liabilities which arise from offering life insurance policies. In addition, taking the responsibility for pension payments can serve as a natural longevity hedge for life insurers.[19] From the perspective of the plan participants, it is not obvious how PRTs affect their claims. On the one hand, the life insurers conducting PRTs are well-capitalized and typically have a higher credit rating than the corporate sponsors. On the other hand, the transferred pension obligations exit the PBGC system and become subject to state insurance, which is more difficult to understand and varies across states. The National Association of Insurance commission notes that "both systems provide strong safety nets that cover the vast majority of all benefit claims" (NAIC, 2022).

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[19]To understand this argument, note that a longer life span benefits the traditional business model of life insurers because insurers receive premium payments from their customers until the customer passes away, in which case their insurance payment is due. By contrast, from the perspective of sponsoring DB obligations, a longer life span is costly for sponsoring DB pension obligations as the sponsor pays a fixed rate until the plan participant passes away. In addition, insurance companies might use the annuity proceeds to obtain funding (Koijen and Yogo, 2015).

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A Sample Construction

The starting point for our empirical analysis is the universe of firms in the Compustat pensions database and the first two columns of Table A1 show the number of reporting firms and the aggregate dollar amount of pension assets ($PA) in each calendar year. We then apply three filters to the database. First, we drop firms that are headquartered outside the U.S. because we later collect information of PRTs from annual reports filed in EDGAR. As shown in columns 3 and 4 of Table A1, this leads to a drop of approximately 400 firms every year and reduces the aggregate pension assets in our sample by approximately 40%. Second, we drop firms with less than five reporting years during the 2011 to 2020 period. We require a minimum amount of reporting years because parts of our analysis focus on averages over the sample period and large reporting gaps can bias these estimates. While this filter seems like a stringent criterion, Table A1 shows that it only results in dropping smaller firms and a drop of less than 10% of aggregate pension assets. Third, because we need a proxy for the breakdown between active and inactive employees, we match the Compustat data to detailed information on individual pension plans from the Department of Labor (DoL) 5500 filings. As we can see from the last two columns of Table A1, we are able to match the majority of firms in our restricted sample, especially when taking the aggregate pension assets as criterion.

The DoL requires each pension plan to file annual reports in their 5500 filings. In matching these data with Compustat pensions, we focus on single-employer DB plans and proceed in two steps. First, we match pension plans to firms based on the reported Employer Identification Number (EIN). As noted by Rauh et al. (2020), the problem with this approach is that the EIN in the DoL filings sometimes links to a subsidiary of the Compustat entity. Second, to overcome this problem, we collect detailed information on firm subsidiaries from

Table A1: **Sample selection.** This table illustrates our sample selection process. First, we find all firms that report positive pension plan assets and PBOs in Compustat Pensions (All Firms). Second, we focus on firms that are incorporated in the U.S. (U.S. only). Third, we focus on firms that report at least five observations during the 2011 to 2020 period (≥ 5 obs). Finally, we drop firms for which we are unable to find a match in the DoL filings (matched sample). N indicates the number of firms in each year and \$PA is the total dollar amount of pension assets in the respective sample. Under *All*, we report the total number of firms during the sample period and the total PBOs, measured as the sum of time series averages for all firms in the sample.

	All Firms		U.S. only		≥ 5 obs		Matched sample	
	N	\$PA	N	\$PA	N	\$PA	N	\$PA
2011	1,805	3,315.0	1,360	1,799.9	1,188	1,752.7	982	1,667.5
2012	1,811	3,629.3	1,354	1,934.7	1,221	1,898.6	1,004	1,801.2
2013	1,786	3,798.5	1,329	2,047.6	1,246	2,030.9	1,017	1,916.3
2014	1,768	3,853.6	1,314	2,138.3	1,276	2,120.9	1,041	1,996.0
2015	1,710	3,568.2	1,260	2,008.0	1,223	1,995.8	999	1,852.9
2016	1,634	3,626.4	1,192	2,032.4	1,165	2,020.0	948	1,868.6
2017	1,602	3,979.2	1,170	2,244.1	1,146	2,231.3	920	2,050.6
2018	1,548	3,735.1	1,132	2,075.3	1,089	2,063.7	878	1,899.1
2019	1,509	3,996.4	1,098	2,242.1	1,039	2,219.4	836	2,035.7
2020	1,457	4,182.5	1,053	2,423.6	990	2,402.7	795	2,206.3
2021	1,411	4,231.0	1,012	2,429.9	941	2,408.5	758	2,208.3
All	2,348	4,214.7	1,747	2,331.2	1,361	2,216.3	1,090	2,041.0

Exhibit 21 of the firms annual reports. Because Exhibit 21 does not contain EIN numbers, we first clean both the Exhibit 21 company names and the DoL sponsor names by standardizing common name patterns (e.g., holdings, group, company, or limited) and removing symbols or parentheses and the require an exact name match between the two. To confirm the quality of our matching procedure, Figure A1 compares logarithms of average pension assets reported Compustat to logarithms of the average market value of plan assets that we hand-matched from the DoL filings. As shown in the figure, most firms closely align around the 45 degree line.

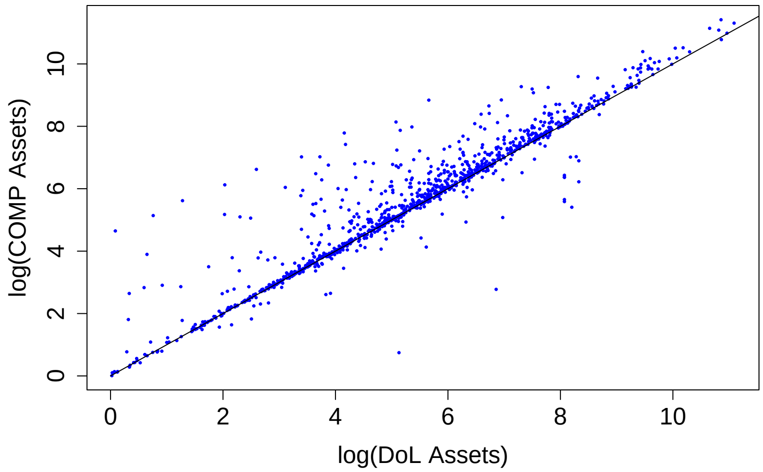

Figure A1: **Plausibility checks for our matching of Compustat pensions and DoL.** This figure compares the reported pension assets in Compustat pensions to the sum of matched plan assets from the DoL filings. We first compute averages over the full sample period and then compare the values.

A.1 Obtaining PRT Information from Company's Balance Sheets

We assemble our database of PRTs by first merging the information from PIonline and from GSAM. However, because we examine the propensity to conduct a PRT, it is crucial that we capture *all* PRTs by the firms in our matched sample. One potential concern with the data from PIonline and GSAM is that they might overlook smaller PRTs or PRTs by smaller firms.

To address this concern, we use textual analysis and search the annual reports of all firms in our matched sample for information about potential PRTs, proceeding in three steps. First, we download the two sentences before and after each occurrence of the words "pension" or "retiree". Second, we filter these hits by focusing only on occurrences that include one of the following words in the two sentences before or after the first search word occurred: "annuity", "transfer", or "purchase agreement". We then manually check each of the observations to collect information on the size of the risk transfer, the affected retirees, and the involved insurance company.

B Additional Details

This section contains additional details that we omitted in the body of the paper for brevity. Table A2 contains a description of the variables used in our analysis.

Table A2: **Variable definitions.** This table defines the variables used in the empirical analysis.

Variable	Definition	Source(s)
$PBO^{\%}$	Dollar value of PBOs, expressed as percentage of the dollar value of firm assets	Compustat & Compustat Pensions
$Wedge$	Every year, we assign decile numbers to the firms in our sample based on our estimate of the PBGC premium burden. The premium burden is estimated as the number of plan participant times the fixed PBGC premium plus the the dollar value of unfunded benefits times the variable-rate premium or, from 2013 on, the minimum of the dollar value of unfunded benefits times the variable-rate premium and the number of participants times the PBGC cap. This number is then divided by firm assets. We also assign decile numbers based on the default probability estimated based Moody's EDFs, multiplied with the level of underfunding divided by firm assets. The PBGC wedge is the PBGC burden decile minus the PBGC put decile. For our dynamic analysis we take the rolling average of this variable over the previous three reporting years	Moody's analytics, DoL filings, Compustat& Compustat Pensions

$Wedge^{Z}$	We proceed analogous to the construction of the PBGC wedge, but rely on simpler proxies of the PBGC burden and default risk. For the burden, we take the number of employees multiplied with the fixed PBGC premium plus the dollar underfunding times the variable rate PBGC premium and divide the sum by the book value of firm assets. To obtain a proxy for default risk, we truncate Altman's z-score at 0 and 3.8 and estimate the default probability as $1 - z/3.8$, where z denotes the z-score. We replace the EDF-implied default probability with the z-score implied probability and construct the measure analogous to $Wedge$ described above.	Compustat& Compustat Pensions
$Inactive^{\%}$	Number of inactive participants (either retired or terminated with vested benefits) as percentage of total plan participants. If a Compustat sponsor has more than one plan in the DoL filing, we aggregate the numbers on Compustat level	DoL 5500
$Allocation^{Eq\%}$	Percentage allocation to equities in pension plan measured as ratio between pension allocation to equities (ticker: pnate) and total pension assets	Compustat Pensions
UFR (%)	Value of PBOs minus value of plan assets (pension underfunding) expressed as percentage of PBOs	Compustat Pensions
$\log(Firm)$	Logarithm of the book value of firm assets (ticker: at)	Compustat
Age	Number of years since the company first appeared in the Compustat filings	Compustat
$Labor^{Int}$	Labor intensity is the industry average of the ratio between number of employees (ticker: emp) and invested captial (ticker: icapt). Industry is based on the first two digits of the firms' SIC numbers	Compustat
EDF	Moody's Analytic's 1-year Expected Default Frequence, measured as the probability that the firm's assets drop to the default boundary.	Moody's Analytics
z-score	Altman's z-score, which is defined as $3.3 * EBIT/at + Sales/at + 1.4 * Retained\ Earning/at + 1.2 * Net\ working\ capital/at$, where at is the book value of firm assets	Compustat

DB$^{\%}$	Percentage of plan participants in defined benefit plans as fraction of all plan participants. This variable is obtained by matching all DoL 5500 filings (including DC plans) to Compustat	DoL 5500

Internet Appendix

Not for publication

A Additional Descriptive Statistics

Table IA.2 presents summary statistics of other variables that were omitted in Table 2 in the body of the paper.

[Insert Table IA.2 near here]

Figure IA.1 illustrates our measure.

[Insert Figure IA.1 near here]

B Additional Results

Figure IA.2 shows the link between PRTs and an alternative measure of flow-through costs. Instead of using the size of PBOs, we compute the downside deviation of changes in the underfunded status (measured as PBOs minus pension assets) during the 2000 to 2009 period and standardize this measure by firm size. The first graph in Figure IA.2 shows the strong link between the alternative flow-through measure and the propensity that a given firm conducts at least one PRT during the 2012 to 2022 period. The second graph shows the link between our main measure of flow-through costs—$PBO\%$, measured as average over 2010 to 2012—and the alternative measure. As we can see from the figure, the two measures are highly correlated, confirming the intuition that the current size of PBOs is a good proxy of underfunding risk and associated flow-through costs.

[Insert Figure IA.2 near here]

Table IA.3 contains summary statistics of where the corporate sponsors of DB plans transfer their liabilities to. The table shows that—to the extent that we can observe the counterparty—the transfers are clustered within a small number of insurance companies.

[Insert Table IA.3 near here]

In addition, we compare the effect of PRTs and lump-sum buyouts on the pension plan. Using the DoL classification of bulk lump sums, we examine the effects of both types of de-risking strategies by computing percentage changes in plan participants. Table IA.4 shows that PRTs decrease the participants more substantially compared to lump-sum buyouts and this difference becomes even more obvious when we focus on percentage changes in inactive participants. In addition, the table confirms that lump sum buyouts do not target retirees (as these numbers do not decrease after a buyout), while, after an average PRT, more than one third of the retired participants are transferred.

[Insert Table IA.4 near here]

C Additional Robustness Checks

Table IA.5 shows the results of cross-sectional logistic regressions. As explained in the body of the paper, these results are consistent with the results of Cox Proportional Hazards regressions used in the body of the paper.

[Insert Table IA.5 near here]

Figure IA.3 shows the distribution of match scores from the sample of firms with PRTs and the control sample. As shown in the figure, there is a close link between the two measures and they are not significantly different from each other. Table IA.6 shows the results from an alternative propensity score matching where we match on firm size, industry, and PBOs as fraction of firm assets. As we can see from the table, the results are qualitatively similar compared to the results shown in Table 5

[Insert Figure IA.3 near here]

[Insert Table IA.6 near here]

Finally, we conduct a battery of robustness checks, using different specifications of the PBGC wedge. In Columns (1) and (2) of Table IA.7, we compare the baseline measure *wedge* to an alternative measure that is based on quartiles instead of deciles ($wedge_1 0$). In Columns (3) and (4), we compare $wedge^Z$ to an alternative measure based on quartiles instead of deciles ($wedge_1^Z 0$). Finally, in Columns (5) and (6) we use ratings from Standard and Poor's (which are only available for a subset of firms and only until 2017) and convert the ratings into default probabilities using the twenty-year average rating-category default rates published by Standard & Poor's. As we can see from the table, all different wedge specifications lead to qualitatively similar results.

[Insert Table IA.7 near here]

D Proofs and Additional Theoretical Results

This appendix contains a detailed derivation of Proposition 1 and the proof behind Hypothesis 2. Table IA.1 gives an overview of the different variables in our theory.

As explained in the body of the paper, we set up a simple continuous-time model with an infinite horizon, assuming that the pension sponsor maximizes the benefits from conducting

Table IA.1: **Variable definitions.** This table gives an overview of the variables used to derive our theory.

Symbol	Variable	Definition
A	Pension assets	$dA = (r - \delta)Adt + \sigma AdW^A$
A_U	Optimal exercises of PRT	Determined endogenously
ν	Exercise time of the PRT	$\nu = \text{argmin}\{t : A_t \geq A_U\}$
L	Pension liabilities	Constant
τ	Default time of firm	$\tau =$ first jump of Poisson process

the PRT by choosing A_U, the value of pension assets at which it is first optimal to conduct the transfer. More formally, we assume that the pension assets follow a geometric Brownian motion with dynamics

$$dA_t = (r - \delta)A_t dt + \sigma A_t dW_t^A, \tag{5}$$

where δ can be thought of as a flow rate of expenses, and set $\nu \equiv \text{argmin}(t : A_t \geq A_U)$ as the first time when conducting the PRT is optimal.

We make the following simplifying assumptions. First, we assume constant liabilities L and take the plan's investments in stocks and bonds as exogenously given. Hence, σ measures the plan's stock holdings and reflects the investment risk of the plan. Second, we assume that the risk-neutral survival probability of the sponsor between time zero and time t is given as $Q(\tau > t) = e^{-t\lambda}$, where τ is the default time and λ is a constant default intensity, and that default is independent of A_t. Third, we model flow-through costs as a constant cash flow z that, in the absence of PRTs, is paid until the firm defaults.[20] Finally, we ignore $X - P$ by

[20]In practice, Z can depend on a number of factors, including the sponsor's allocation to equities and the funding status of the plan. However, to keep the model tractable, we treat Z as a given constant.

setting it equal to zero.[21]

Under these assumptions, we can compute the expected flow-through cost savings and the costs of conducting the transfer as:

$$\mathbb{E}^Q\left[\int_{\nu}^{\infty} \mathbb{1}_{\tau>s} e^{-rs} ds\right] = \mathbb{E}^Q\left[e^{-(r+\lambda)\nu}\right] \frac{z}{\lambda+r}$$
$$\mathbb{E}^Q[\mathbb{1}_{\tau>\nu} e^{-r\nu}(\omega(L-A_U)+C)] = \mathbb{E}^Q\left[e^{-(r+\lambda)\nu}\right](\omega(L-A_U)+C),$$

where we exploit the benefit of reduced-form credit risk modelling (e.g., Lando, 1998), which enters through a higher discount rate.

Before proving Proposition 1, we discuss the economic implications of the proposition. To that end, it is useful to rewrite Equation (1) in terms of A_U, where we drop the PBGC wedge $X-P$:

$$A_U = \frac{1}{\omega}(\omega L + C - Z). \tag{6}$$

Comparing Equation (2) to the model-free version, reveals that the optimal asset level for conducting the PRT is higher in the dynamic setting because $\frac{\beta}{\beta-1} > 1$. This property illustrates "the option value of waiting"—the sponsor does not immediately transfer the plan when the transfer option is in the money.

D.1 Proofs and Additional technical results

To prove Proposition 1, we start by stating and proving the following lemma.

[21] Alternatively, we could also approximate $\mathbb{E}^Q[X(\tau)-P(\tau)] \approx \mathbb{E}^Q[e^{-(r+\lambda)\tau}](X(0)-P(0))$ which would lead to $X-P$ entering Equation (2).

Lemma 1. *For a geometric Brownian motion S_t with $dS_t = \mu S_t dt + \sigma S_t dW_t$, the propensity to hit a boundary S^B is given as:*

$$q(S_t) = \mathrm{E}^Q \left[e^{-r\tau} \right] = \left(\frac{S_t}{S^B} \right)^{\gamma}, \tag{7}$$

with $\gamma_{1,2} = \frac{-(\mu - \frac{\sigma^2}{2}) \pm \sqrt{(\mu - \frac{\sigma^2}{2})^2 + 2r\sigma^2}}{\sigma^2}$. The parameter γ depends on whether the boundary is hit below (plus and $\gamma > 1$) or from above (minus and $\gamma < 0$).

Proof of Lemma 1: For a given S^B, we derive the propensity $q(S)$ to hit the barrier from below (analogous for hitting the barrier from above). Note that q is the value of one dollar paid at time τ (the time when the boundary is hit). We express q as claim on S_t and derive the following ordinary differential equation (ODE) for q :[22]

$$-rq + \mu S q_S + \frac{\sigma^2}{2} S^2 q_{SS} = 0 \tag{8}$$

with $q(S_B) = 1$ as boundary condition. We guess the solution $q(S) = aS^{\gamma}$ and plug it into (8) to obtain:

$$\gamma_{1,2} = \frac{-(\mu - \frac{\sigma^2}{2}) \pm \sqrt{(\mu - \frac{\sigma^2}{2})^2 + 2r\sigma^2}}{\sigma^2}. \tag{9}$$

Next, the boundary condition gives:

$$a(S^B)^{\gamma} = 1 \Leftrightarrow a = (S^B)^{-\gamma}$$

Hence, we get: $q(S) = \mathrm{E}^Q \left[e^{-r\tau} \right] = \left(\frac{S}{S^B} \right)^{\gamma}$.

[22]Note that the time dimension drops out because F is independent of time as in Leland's model

Note that all steps so far are identical for hitting the boundary from below or above. However, the economics of the problem dictate which root we need. We need $\gamma_1 > 1$ for hitting the boundary from below and $\gamma_2 < 0$ for hitting the boundary from above, which completes the proof.

■

Lemma 2. *The parameter* β, *from Proposition 1 decreases in* $\sigma : \frac{\partial \beta}{\partial \sigma} < 0$.

Lemma 3. *The parameter* β, *from Proposition 1 increases in* $\lambda : \frac{\partial \beta}{\partial \lambda} > 0$.

Proof of Lemma 2 & 3: Consider $\beta_{1,2}$ as function of σ or λ and introduce the simplifying notations $\rho(\sigma) \equiv r - \delta - \sigma^2/2$ and $\Lambda(\lambda) \equiv r + \lambda$

$$\beta_{1,2} = \frac{-\rho \pm \sqrt{\rho^2 + 2\Lambda\sigma^2}}{\sigma^2}.$$

Proof of Lemma 2: Use $\rho'(\sigma) = -\sigma$ and $\frac{\partial}{\partial \sigma}(\rho^2(\sigma)) = -2\sigma\rho$. Then, taking derivatives gives:

$$\beta'_{1,2} = \frac{\pm(r + \delta + \sigma^2/2)(\rho^2 + 2\Lambda\sigma^2)^{-1/2}}{\sigma} - \frac{1 + 2\beta}{\sigma}$$

From that, it is obvious that $\beta'_2 < 0$. To prove that $\beta'_1 < 0$, we exploit $\beta_1 \times \beta_2$ as follows:

$$\beta_1 \times \beta_2 = -\frac{2\Lambda}{\sigma^2} \Rightarrow \frac{\partial}{\partial \sigma}\beta_1 \times \beta_2 = \frac{\partial \beta_1}{\partial \sigma} \times \beta_2 + \frac{\partial \beta_2}{\partial \sigma} \times \beta_1 = \frac{4\Lambda}{\sigma^3}$$

Rearranging terms gives:

$$\frac{\partial \beta_2}{\partial \sigma} \times \beta_1 = \frac{4\Lambda}{\sigma^3} - \frac{\partial \beta_1}{\partial \sigma} \times \beta_2$$
$$\Leftrightarrow \frac{\partial \beta_1}{\partial \sigma} = \underbrace{[\frac{4\Lambda}{\sigma^3} + \underbrace{(-\frac{\partial \beta_2}{\partial \sigma})}_{>0} \times \underbrace{\beta_1}_{>0}]}_{>0} / \underbrace{\beta_2}_{<0} < 0,$$

which completes the proof.

Proof of Lemma 3: First note that

$$\beta(\lambda) = \frac{-\rho + \sqrt{\rho^2 + 2\Lambda(\lambda)\sigma^2}}{\sigma^2} \text{ and } \Lambda'(\lambda) = 1$$

Hence, we obtain

$$\beta'_{1,2} = \frac{1}{\sigma^2}\frac{1}{2}\frac{1}{\sqrt{\rho^2 + 2\Lambda\sigma^2}} > 0,$$

which completes the proof.

■

Proof of Proposition 1: We start by formulating the target function of the sponsor as:

$$f(A_U) = \left(\frac{z}{\lambda + r} - (\omega(L - A_U) + C)\right) \mathbb{E}^Q[e^{-(r+\lambda)\nu}]. \tag{10}$$

Using Z for the present value of the flow-through cost ($\frac{z}{\lambda+r}$) and applying Lemma 1, we obtain:

$$f(A_U) = (Z - [\omega(L - A_U) + C]) \left(\frac{A}{A_U}\right)^{\beta}$$

Taking derivatives gives:

$$\begin{aligned} f'(A_U) &= \omega \left(\frac{A}{A_U}\right)^{\beta} - \beta\left(Z - [\omega(L - A_U) + C]\right)\left(\frac{A}{A_U}\right)^{\beta}\frac{1}{A_U} = 0 \\ \Leftrightarrow A_U &= \frac{\beta}{(\beta - 1)}\frac{1}{\omega}\left(\omega L + C - Z\right). \end{aligned}$$

Plugging the value for A_U into Lemma 1 gives the risk-neutral probability to transfer as:

$$q(A) = \left(\frac{\beta - 1}{\beta}\frac{\omega A}{\omega L + C - Z}\right)^{\beta},$$

which completes the proof.

■

Proof of Hypothesis 2: To prove that riskier plan assets decrease the probability of conducting a PRT, we use Lemma 2, which states that $\partial\beta/\partial\sigma < 0$ and start by showing that

$$\frac{\partial q}{\partial \sigma} = \left(\log\left(\frac{\beta}{\beta - 1}\frac{\omega A}{\omega L + C - Z}\right) + \frac{1}{\beta - 1}\right) X \frac{\partial \sigma}{\partial \beta}$$

with $X > 0$.

We take the derivative of q with respect to σ :

$$\begin{aligned}
\frac{\partial q}{\partial \sigma} &= \frac{\partial}{\partial \sigma}\left(\frac{\beta-1}{\beta}\frac{\omega A}{\omega L+C-Z}\right)^{\beta} \\
&= \frac{\partial}{\partial \sigma}\exp\left[\log\left(\frac{\beta-1}{\beta}\frac{\omega A}{\omega L+C-Z}\right)\beta\right] \\
&= \underbrace{\exp\left[\log\left(\frac{\beta-1}{\beta}\frac{\omega A}{\omega L+C-Z}\right)\beta\right]}_{\equiv X>0}\frac{\partial}{\partial \sigma}\left[\log\left(\frac{\beta-1}{\beta}\frac{\omega A}{\omega L+C-Z}\right)\beta\right]
\end{aligned}$$

Focusing on the derivative term, we obtain:

$$\begin{aligned}
&\frac{\partial}{\partial \sigma}\left[\log\left((1-\beta^{-1})\frac{\omega A}{\omega L+C-Z}\right)\beta\right] \\
&= \log\left((1-\beta^{-1})\frac{\omega A}{\omega L+C-Z}\right)\beta' + \frac{\beta'/\beta^2\frac{\omega A}{\omega L+C-Z}}{(1-\beta^{-1})\frac{\omega A}{\omega L+C-Z}}\beta \\
&= \log\left((1-\beta^{-1})\frac{\omega A}{\omega L+C-Z}\right)\beta' + \beta'/\beta\frac{1}{(1-\beta^{-1})} \\
&= \beta'\left(\log\left((1-\beta^{-1})\frac{\omega A}{\omega L+C-Z}\right) + \frac{1}{\beta-1}\right)
\end{aligned}$$

Hence, it remains to show that $\frac{1}{\beta-1} + \log\left(\frac{\beta-1}{\beta}\right) + \log\left(\frac{\omega A}{\omega L+C-Z}\right) > 0$. Because we can assume $\omega A > \omega L + C - Z$ (because $Z > \omega(L-A)+C$, otherwise it would *never* be optimal to conduct the PRT), we can ignore the last term and examine $g(\beta) = \frac{1}{\beta-1} + \log(1-1/\beta)$. Here, we note that $g(\beta) \to 0$ for $\beta \to \infty$ and

$$g'(\beta) = -\frac{1}{(\beta-1)^2} + \frac{1/\beta^2}{1-1/\beta} = -\frac{1}{(\beta-1)^2} + \frac{1}{(\beta-1)(\beta+1)} = \frac{-(\beta+1)+(\beta-1)}{(\beta-1)^2(\beta+1)} < 0.$$

Therefore, for $\beta > 1$, we have $g(\beta) > 0$, which completes the proof.

To prove that more default risk decreases the probability of a PRT, we take the derivative with respect to λ, using Lemma 3. As before, we start by showing that

$$\frac{\partial q}{\partial \sigma} = \left(\log \left(\frac{\beta}{\beta - 1} \frac{\omega A}{\omega L + C - Z} \right) + \frac{1}{\beta - 1} \right) X \frac{\partial \sigma}{\partial \beta}$$

with $X > 0$.

We take the derivative of q with respect to λ :

$$\begin{aligned}
\frac{\partial q}{\partial \lambda} &= \frac{\partial}{\partial \lambda} \left(\frac{\beta - 1}{\beta} \frac{\omega A}{\omega L + C - Z} \right)^{\beta} \\
&= \frac{\partial}{\partial \sigma} \exp \left[\log \left(\frac{\beta - 1}{\beta} \frac{\omega A}{\omega L + C - Z} \right) \beta \right] \\
&= \underbrace{\exp \left[\log \left(\frac{\beta - 1}{\beta} \frac{\omega A}{\omega L + C - Z} \right) \beta \right]}_{\equiv X > 0} \frac{\partial}{\partial \lambda} \left[\log \left(\frac{\beta - 1}{\beta} \frac{\omega A}{\omega L + C - Z} \right) \beta \right]
\end{aligned}$$

Focusing on the derivative term, we first define $\Omega(\lambda) = \frac{\omega A}{\omega L + C - Z}$. Then we take derivatives:

$$\begin{aligned}
\frac{\partial Z}{\partial \lambda} &= -\frac{z}{(r + \lambda)^2} = -Z/\Lambda \\
\frac{\partial \Omega}{\partial \lambda} &= -\frac{\omega A}{(\omega L + C + Z/\Lambda)^2} \equiv \Omega'
\end{aligned}$$

Then, we can continue:

$$
\begin{aligned}
&\frac{\partial}{\partial \lambda}\left[\log\left((1-\beta^{-1})\Omega\right)\beta\right] \\
&= \log\left((1-\beta^{-1})\Omega\right)\beta' + \frac{\beta'/\beta^2\Omega + (1-\beta^{-1})\Omega'}{(1-\beta^{-1})\Omega}\beta \\
&= \log\left((1-\beta^{-1})\Omega\right)\beta' + \frac{\beta'/\beta\Omega + (\beta-1)\Omega'}{(1-\beta^{-1})\Omega} \\
&= \log\left((1-\beta^{-1})\Omega\right)\beta' + \frac{\beta'}{\beta-1} + \frac{(\beta-1)\Omega'}{(1-\beta^{-1})\Omega} \\
&= \beta'\left[\log\left((1-\beta^{-1})\Omega\right) + \frac{1}{\beta-1}\right] + \frac{(\beta-1)\Omega'}{(1-\beta^{-1})\Omega}
\end{aligned}
$$

Recall $\Omega > 1$ and $\beta' > 0$. Moreover, note $\Omega' < 0$. From that, with $\beta > 1$, it is obvious that

$$\frac{(\beta-1)\Omega'}{(1-\beta^{-1})\Omega} = \Omega'\frac{\beta(\beta-1)}{(\beta-1)\Omega} = \Omega'\frac{\beta}{\Omega} < 0$$

Moreover, we have shown above that $\log\left((1-\beta^{-1})\Omega\right) + \frac{1}{\beta-1} > 0$ and Lemma 3 shows that $\beta' < 0$. Hence, the derivative is negative.

Taken together, this completes the proof.

■

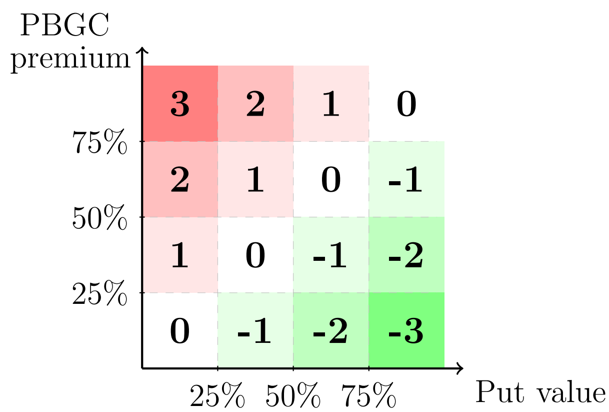

Figure IA.1: **PBGC mispricing.** Given our estimates for the PBGC premium and the PBGC put value, we split our sample into quantiles based on these numbers. While our main approach is based on deciles, we illustrate the approach here using quartiles. To estimate the PBGC premium wedge, we compute the difference between the PBGC quantile and the PBGC put quantile. A higher number corresponds to a high PBGC premium relative to the put value.

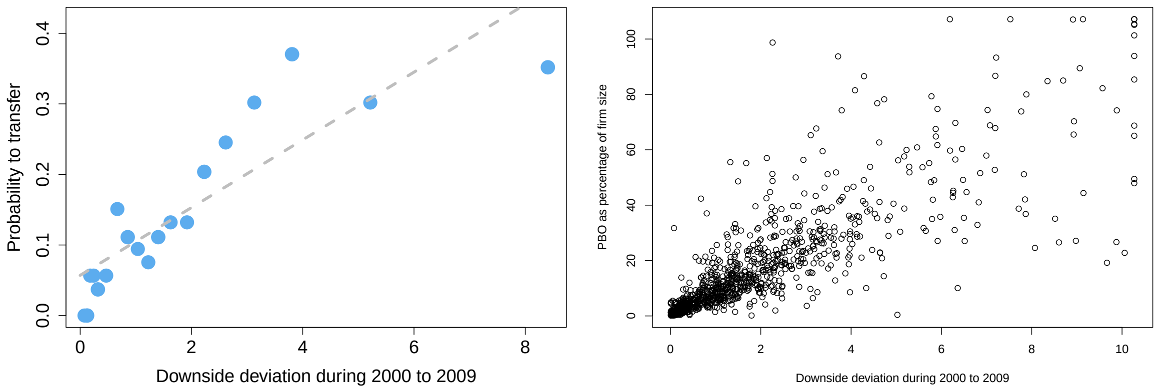

Figure IA.2: **Alternative flow-through proxy.** The first graph illustrates the link between PRT propensities and an alternative measure of flow-through costs, defined as the downside deviation of the underfunded status during the 2000 to 2009 period, standardized by firm size. The second graph illustrates the link between the alternative flow-through proxy and our measure of PBOs to firm size.

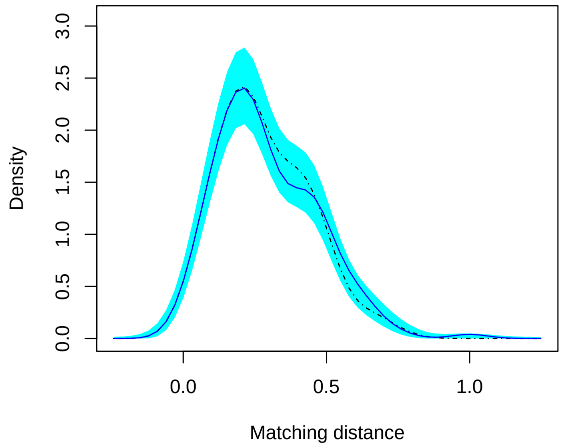

Figure IA.3: **Goodness of fit.** This figure shows the distribution of match scores for the treatment and control samples. As illustrated in the figure, the two distributions are not significantly different.

Table IA.2: **Summary statistics.** This table provides summary statistics of average firm and pension plan characteristics, where we first compute the time series average for each firm in the 2010-2019 period and then report cross-sectional summary statistics. Under *Difference between firms with and without PRTs*, we report the mean and median difference between firms that conduct at least on PRT during the 2010-2020 period and the other firms in our sample. ***, **, and * indicate significance at a 1%, 5%, and 10% level, respectively, where the p-values for this calculation are based on a t-test for difference in means or a Wilcox test for difference in medians. For a detailed description of these variables see Table A2.

							Difference between firms with and without PRTs	
	Mean	SD	25%	Median	75%	N	Diff. from Mean	Diff. from Median
UFR (%)	25.45	17.30	16.53	25.42	34.47	1,218	-2.13*	-0.78
log(Firm size)	8.11	1.80	6.95	8.06	9.22	1,218	0.47***	0.53***
Age	31.76	19.93	14.00	28.00	50.00	1,218	10.06***	19.00***
$DB^{\%}$	0.29	0.18	0.16	0.26	0.38	897	0.06***	0.08***
Frozen	0.27	0.41	0.00	0.00	0.66	981	-0.05	0.00
EDF	1.43	3.48	0.11	0.40	1.02	925	-0.18	-0.17**
z-score	1.53	1.00	0.69	1.43	2.28	1,028	0.27***	0.39***

Table IA.3: **Summaries of where the companies transfer to.** This table contains summary statistics of the PRTs for which we observe the counterparty together with information on the counterparty. PRT Liabilities is the dollar amount that we observe was transferred to the insurance company during our sample period; #Transfers is the number of transfer that we observe to the insurance company during our sample period; Total Liabilities are the total liabilities of the insurance company at group level, as measured by AM Best; AM Best Financial Strength Rating is the rating of the insurance company according to AM Best.

Company	PRT Liabilities (Billion USD)	# Transfers	Total Liabilities (Billion USD)	AM Best Financial Strength Rating
Prudential	61.51	27	618.36	$A+$
MassMutual	4.39	12	301.23	$A++$
MetLife	14.71	12	410.12	$A+$
Athene	10.13	7	96.34	A
Legal & General	4.59	5	5.64	NA
AIG	2.20	4	298.85	A
PacificLife	0.20	3	142.39	$A+$
PrincipalFinancial	0.78	3	204.49	$A+$
Other	4.05	11		

Table IA.4: **PRTs vs. Lump-sum buyouts.** This table shows means and medians of percentage changes in the total amount of plan participants, inactive participants, and retired participants, either after a PRT or a bulk lump-sum buyout. Following the DoL methodology, bulk lump-sum buyouts are defined as events where a firm gives lump-sum buyouts to more than 25% of their eligible participants or where the buyouts affect more than 10% of the participants and are five times the sample median. ***, **, and * indicate significance at a 1%, 5%, and 10% level, respectively, where the numbers in parantheses are p-values based on a t-test for difference in means or a Wilcox test for difference in medians.

	After PRT		*After bulk lump-sum*	
	Mean	Median	Mean	Median
Δ% Participants	-21.22***	-22.06***	-13.81***	-13.29***
	(0.00)	(0.00)	(0.00)	(0.00)
Δ% Inactive	-25.17***	-24.75***	-14.46***	-14.33***
	(0.00)	(0.00)	(0.00)	(0.00)
Δ% Retired	-35.68***	-36.15***	1.74	2.51***
	(0.00)	(0.00)	(0.21)	(0.00)

Table IA.5: **Logistic regressions for the likelihood of a PRT.** This table shows the results from logistic regressions of the propensity that a given firm conducts a PRT in year $t+1$. For a detailed description of the control variables see Table A2. All specifications include year fixed effects and industry fixed effects (measured by the first two digits of the SIC code). ***, **, and * indicate significance at a 1%, 5%, and 10% level, respectively. The numbers in parantheses show heteroskedasticy robust standard errors, clustered at the firm level.

	(1)	(2)	(3)	(4)
$PBO^{\%}$	0.013***	0.018***	0.013***	0.014***
	(0.003)	(0.002)	(0.003)	(0.003)
$PBGC\ Wedge$	0.208***		0.105**	
	(0.044)		(0.052)	
$PBGC\ Wedge^{Z}$		0.098**		0.160***
		(0.046)		(0.056)
$Inactive^{\%}$			0.011*	0.013**
			(0.005)	(0.005)
$Allocation^{Eq\%}$			−0.017***	−0.017***
			(0.005)	(0.005)
UFR			−0.014**	−0.015***
			(0.006)	(0.006)
$\log(Firm)$			0.075	0.173***
			(0.057)	(0.055)
Age			0.007	0.007*
			(0.004)	(0.004)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
McFadden's ajd. R^2	0.088	0.093	0.107	0.108
Num. obs.	7868	10212	7022	7346

Table IA.6: **Propensity-matched differences (robusntess).** This table shows how firms that conduct at least one PRT during the 2012 to 2022 period compare to a control sample without PRTs across two dimensions: The allocation of equities within the pension plan and the default risk, measured by either EDFs or Altman's z-score. To obtain comparable firms, we use propensity score matching on firm industry (measured by the first two digits of the SIC code), firm size (measured as book value of firm assets, averaged over the 2010 to 2012 period), and the relative size of pension obligations to firm size. The numbers in parantheses are t-statistics based on heteroskedasticity robust standard errors. ***, **, and * indicate significance at a 1%, 5%, and 10% level, respectively.

	$Alloc^{Eq\%}$		$\log(EDF)$		z-score	
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	44.95***		−1.55***		1.36***	
	(40.89)		(−9.81)		(16.87)	
$\mathbb{1}(PRT)$	−5.67***	−5.72***	−0.40*	−0.38**	0.29**	0.24**
	(−3.58)	(−3.71)	(−1.90)	(−2.09)	(2.49)	(2.40)
$\log(Firm)$		−1.84***		−0.42***		−0.03
		(−3.33)		(−6.17)		(−0.98)
Industry FE	–	Yes	–	Yes	–	Yes
Adj. R^2	0.04	0.15	0.01	0.29	0.02	0.34
Num. obs.	314	314	276	276	316	316

Table IA.7: **Robustness to using alternative wedge measures.** This table shows the results from logistic regressions of the propensity that a given firm conducts at least one PRT during the 2012 to 2021 period on different proxies of the PBGC wedge. Columns (1) and (3) repeat the main analysis from the paper using *wedge* and $wedge^z$, but removing $PBO\%$ as additional control. Columns (2) and (4) show the results for modified versions of *wedge* and $wedge^z$, using quartiles instead of deciles to proxy the wedge. Columns (5) and (6) show the results using either deciles or quartiles and default intensities obtained from credit ratings. Specifically, we use the S&P credit ratings and convert the rating into a default probability using long-run averages obtained from S&P. All independent variables are averaged over the 2010 to 2012 period. ***, **, and * indicate significance at a 1%, 5%, and 10% level, respectively. The numbers in parantheses show heteroskedasticy robust standard errors.

	(1)	(2)	(3)	(4)	(5)	(6)
$Wedge$	0.265***					
	(0.045)					
$Wedge_4$		0.529***				
		(0.101)				
$Wedge^Z$			0.115***			
			(0.039)			
$Wedge_4^z$				0.297***		
				(0.087)		
$Wedge^{rating}$					0.215***	
					(0.050)	
$Wedge_4^{rating}$						0.501***
						(0.121)
McFadden's adj. R^2	0.046	0.035	0.005	0.008	0.025	0.025
Num. obs.	761	761	994	994	627	627