Multiemployer Defined Benefit Pension Plans' Liability Spillovers: Important Connections in U.S. Unionized Industries

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Abstract

A multiemployer defined pension plan (MDBP) is a collectively bargained pension plan maintained by two or more employers and a labor union. MDBPs pool risks, contributions, assets, and liabilities. Bankruptcy by MDBP firms usually results in almost constant MDBP total liabilities but a shrinking pool of contributing MDBP employers, thus increasing MDBP liabilities for the remaining MDBP employers and exposing them to "liability spillover risks." I document the economic magnitudes of public firms' MDBP liabilities and MDBP liability spillovers from other public companies, information relevant to both finance academics and policy makers. I find three companies with 5-year expected MDBP liability spillovers exceeding 1% of their book assets. On average, MDBP companies' leverage ratios increase by 4% once I consolidate MDBP liabilities into capital structure and by more than 6% once I consolidate MDBP liabilities and expected liability spillovers into capital structure.

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1. Introduction

A multiemployer pension plan is a collectively bargained pension plan maintained by two or more employers, frequently within the same or related industries, and a labor union. Fifty-two percent of private-sector multiemployer pension plans are defined benefit plans whereas only 6% of private-sector single-employer pension plans[1] are defined benefit plans. U.S. active private-sector multiemployer defined pension plans (MDBPs) have one-third of the participants, one-quarter of the assets but only 3% of the number of private-sector single employer defined benefit pensions (SDBPs). Therefore the average MDBP has assets seven times larger than the average SDBP. For the 2010 plan year, there were 1,471 U.S. active private-sector MDBPs with 10.6 million participants and $466 billion assets as compared to 45,072 U.S active private-sector SDBPs with 30.8 million participants and $1,982 billion assets (U.S Department of Labor Employee Benefits Security Administration, 2012).

Although in aggregate, SDBPs have a larger asset base than MDBPs, unprecedented levels of MDBP underfunding together with MDBP ability to produce liability spillovers amongst its participant companies makes MDBPs a unique and important area for financial research.

MDBPs pool risks, contributions, assets, and liabilities. Companies may withdraw from MDBPs by paying their share of the plan's unfunded vested benefits, but frequently MDBP withdrawal liabilities are greater than the company's share of the MDBP's

[1] Includes single employer plans, plans of controlled groups of corporations and multiemployer non-collectively bargained plans.

unfunded liabilities[2] (Moody's, 2009) and withdrawal may be difficult without the agreement of the company's unionized employees (Sanders, 2011). In the case of bankruptcy, MDBP withdrawal liabilities are general unsecured claims. Bankruptcy by MDBP firms results in essentially constant MDBP total liabilities[3] but a shrinking pool of contributing MDBP employers, thus increasing MDBP liabilities for the remaining MDBP employers. The Pension Benefit Guarantee Corporation (PBGC) intervenes only when MDBPs become insolvent (unable to pay current benefits out of plan resources), whereas PBGC takes over any SDBP terminated during the employer's bankruptcy. Through the mechanism described above MDBPs expose their participant employers to "liability spillover risks" from other employers in the same MDBP.

Narrative evidence suggests that MDBP employers are concerned with "MDBP liability spillover risks." In a letter to The US Congress dated July 13, 2010, MDBP employers expressed their concerns,

> Because of the nature of multiemployer plans, when one employer goes bankrupt, the remaining employers in the plan become responsible for paying the accrued benefits of all the workers—this is often referred to as "last man standing." As the number of employer participants dwindles, employers remaining in the plan see their liabilities increase exponentially—forcing them to cover retirees that never worked for them… Without a real resolution to this problem, more employers will be forced into bankruptcy and more workers will be left without a secure retirement. (Employers, Multiemployer Plan; Organizations, Employer, 2013, p. 1)

Jarrow and Yu (2001) define counterparty risk as the risk that the default of a firm's

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[2] MDBP withdrawal liabilities must cover the whole of the company's share of the MDBP underfunding. When a firm continues in a MDBP, the MDBP employee participants bear some of the burden of funding underfunded MDBPs by relinquishing current wages, benefits or work rules. (Moody's (2009)).

[3] Anecdotal evidence suggests that in many cases MDBPs recover a small percentage of their unsecured withdrawal liability claims. Judy McReynolds, President and CEO of Arkansas Best Corporation testified in front of the United States House Committee on Education and Workforce Subcommittee on Health, Employment, Labor and Pensions on June 20, 2012,"Many withdrawals have occurred in the bankruptcy context, and plans typically collect only pennies on the dollar of the withdrawal liabilities owed by these bankrupt or defunct companies." http://edworkforce.house.gov/uploadedfiles/06.20.12_mcreyolds.pdf

counterparty might affect its own default probability and introduce counterparty risk to Lando's (1994, 1998) reduced form model[4] The authors model a two company looping default where both companies hold each other's debt and show that counterparty risk nonlinearly increases default probability. The authors state that looping default is improbable in practical applications however MDBP companies are a practical example of looping default because all companies in the same MDBP expose each other to MDBP unfunded liability spillovers.

In this paper, I ask three research questions. First, how large are MDBP unfunded liability spillovers onto public firms? Second, how do MDBP liabilities and expected MDBP unfunded liability spillovers affect MDBP firm leverage? Third, what is the magnitude of the bidirectional unfunded liability spillovers across MDBP firms?

This paper makes several important contributions concerning MDBPs. First, I provide the first comprehensive quantification of MDBP liability spillovers. Second, my research increases the understanding of default correlation amongst public U.S. MDBP contributing firms; an understanding which is essential for firms and investors who seek to diversify their exposure to correlated risks. Finally, and most importantly, my research can inform the PBGC's simulation models and therefore U.S. policy makers.

More informed PBGC simulation models minimize the risk of taxpayers providing funds to an insolvent PBGC. The PBGC only covers MDBP participants' pensions up to an annual maximum of $12,870 as opposed to an annual maximum of $57,480 for SDBP participants' pensions. The PBGC's 2012 report noted that the multiemployer insurance

[4] Lando's model uses a doubly stochastic Poisson process to account for the dependency between credit and market risk.

program had liabilities of $7 billion and assets of $1.8 billion and estimates that by 2022 the multiemployer insurance program will have a mean deficit of $32 billion. Mitchell (2013) points out that multiemployer insurance program costs may pose more risk to the PBGC than single employer plan insurance underfunding. My research documents LMS MDBP liability spillovers onto public companies and expected MDBP liability spillovers amongst MDBP public companies informing the PBGC's estimation of MDBP company bankruptcy probabilities.

In this paper, I exploit the 2009 plan year MDBP Form 5500 filings to calculate unfunded MDBP liabilities and MDBP liability spillovers from publicly available information. MDBPs file Form 5500 with the Department of Labor (DOL) to satisfy the Employee Retirement Income Security Act of 1974 (ERISA) and Internal Revenue Code annual reporting requirements. For the 2009 plan year, for the first time, MDBPs made mandatory disclosures on Form 5500 Schedule R about employers making more than 5% of the total plan year contributions.

I examine two cases, first "last man standing" (LMS hereafter) MDBP liability spillovers where I assume all private and public major contributing companies go bankrupt except the public company for whom I calculate LMS MDBP liability spillovers and second 1-year and 5-year expected MDBP liability spillovers from other major contributing public firms. Eight companies have LMS MDBP liability spillovers larger than 10% of their book assets and 31 companies have LMS MDBP liability spillovers larger than 1% of their book assets. Three public firms have 5-year expected MDBP liability spillovers from other public companies bigger than 1% of their book value of assets. Six public companies have 1-year expected MDBP liability spillovers from other public companies larger than

0.1% of their book value of assets.

Bilateral LMS MDBP liability spillovers can be large and economically significant. For example, I calculate that Kroger inherits $700m (5.3% of Kroger's market value of equity) of MDBP unfunded liabilities in the event of Safeway's bankruptcy. Conversely, Safeway inherits $618m (7.5% of Safeway's market value of equity) of MDBP unfunded liabilities in the event of Kroger's bankruptcy.

For the 2009 plan year, the average MDBP company (out of 131) has a 2.6 times larger market capitalization, is 40% more levered and has a lower market to book ratio than the average Compustat company (out of 3,369). On average, MDBP companies' leverage ratios increases by 4% once I consolidate unfunded MDBP liabilities into capital structure and on average MDBP companies' leverage ratios increases by more than 6% once I consolidate unfunded MDBP liabilities and 1-year expected MDBP liability spillovers into capital structure.

Although the academic finance literature has paid little attention to MDBPs, unfunded MDBP liabilities are potentially relevant in assessing corporate securities. Rating agencies view a company's share of MDBP unfunded liabilities as a debt-like company liability (Moody's, 2006) and since 2006, rating agencies have incorporated estimates of unfunded MDBP liabilities into the information they use to rate bond issues. In March 2012, a Credit Suisse equity research report estimated that U.S. MDBPs are in aggregate 52% funded. Zion, Varshney, and Burnap (2012) comment,

> With the plans in bad shape, the companies that have multiemployer exposure could get hit from a number of angles, including increased contributions to the plans resulting in a drain on cash flows and a hit to earnings. Withdrawal liabilities could increase too, driving up the price of pulling out of a multiemployer pension plan. It may even impact M and A as an acquirer is going to pay less (all else equal) for

> a company with heavy exposure to underfunded multiemployer plans. In addition, as the multiemployer exposure becomes clearer, investors may decide that certain companies are more expensive than they initially appear after factoring in this off-balance-sheet liability. Even credit ratings could be impacted if the ratings agencies are able to gain new insight about a company's share of multiemployer underfunding and its impact on future cash flows. (p.2)

MDBPs' unique institutional features generate numerous unexplored financial effects. In this paper, I focus on MDBP liability spillovers but as Credit Suisse highlights, MDBPs have far reaching financial implications. Previously, little information was available on companies' MDBP exposure. However, the new schedule R information together with the new 10-K "significant" MDBP disclosures have drastically improved information on companies' MDBP exposure, providing a fertile area for financial research.

The remainder of this paper is organized as follows. Section 2 presents a literature review. Section 3 describes MDBP institutional details. Section 4 describes the data collection. Section 5 describes the MDBP unfunded liability calculations, LMS and expected MDBP liability spillover calculations. Section 6 explains how I incorporate MDBP unfunded liabilities and 1-year expected MDBP liability spillovers into leverage calculations. Section 7 describes the sample and summarizes public company liability spillovers. Section 8 describes bidirectional MDBP liability spillovers. Section 9 compares bankruptcy probabilities and 1-year expected MDBP liability spillovers calculated using three different bankruptcy probability measures. Section 10 concludes.

2. Literature Review

My research is related to three strands of literature: default correlation, contagion effects, and research on SDBPs. My study is primarily related to the financial distress

contagion literature.

All else equal, expected MDBP liability spillovers increase a firm's own default probability and increase correlations amongst MDBP sharing firm's default probabilities. Merton (1974) models equity as a call option on a firm's assets with the call's exercise price equal to the value of the firm's liabilities; when a firm with underfunded MDBP(s) files for bankruptcy, the MDBP liabilities of other firms in the same MDBP increase. This essentially increases the non-bankrupt MDBP firm asset call option's exercise price and decreases equity value.

Traditional default models using macroeconomic common factors fail to produce levels of default clustering observed in data (Das, Duffie, Kapadia, & Saita, 2007). Jorion and Zhang (2009) show that counterparty risk increases a company's own default probability. Using simulation, the authors analyze defaults of 500 companies generated first by a conventional factor model (1-year default probability of 1% and a 0.20 pair-wise default correlation coefficient) and then by adding counterparty risk to the baseline model (three counterparties for each company with a 30% debt recovery rate). With counterparty risk, the default correlation increases to 0.0262 from a baseline default correlation of 0.0243. Furthermore, the simulation results support the hypothesis that counterparty risk contributes to the fat tails observed in default distributions. With counterparty risk, the default distribution's 99.99th percentile increases from 115 to 127 defaults.

MDBP liability spillover risks share many characteristics with counterparty risks, MDBP bankrupt companies can increase the liabilities of companies with whom they share MDBPs, thus increasing the bankruptcy correlation amongst MDBP sharing companies. My research documents public companies' MDBP liability spillovers and documents an

additional source of U.S. company financial distress contagion namely MDBP liability spillovers.

Generally, an individual MDBP covers unionized employees in the same industry. Therefore companies who share MDBPs are often competitors. Lang and Stulz (1992) find that on average the market value of a value-weighted portfolio of the bankrupt firm's competitors' common stock declines by a statistically significant 1% at the time of the bankruptcy announcement. The authors define the contagion effect as the change in value of competitors that cannot be attributed to the bankrupt firm's wealth distribution and define the competitive effect as the wealth gain experienced by competitors because the bankruptcy conveys information about the competitive positions of firms in the bankrupt firm's industry. The authors find evidence of both a contagion effect and a competitive effect amongst their results. For industries with a debt-to-asset ratio exceeding the sample median, they find the value of the competitors' equity falls by 3% on average, providing evidence that for these firms the contagion effect dominates, whereas, in less competitive industries[5] with low leverage competitors' equity increases by 2.2%, providing evidence that for these firms the competitive effect dominates.

Hertzel, Li, Officer, and Rodgers (2008) find significant contagion effects for suppliers of bankruptcy filing firms in both the filing period and prefiling distress period; furthermore, they find more severe significant supplier contagion effects when the bankruptcy filing firm's industry experiences contagion effects. The authors find that the average filing-period abnormal return for supplier portfolio is -1.94%; this abnormal return

[5] Less competitive industries are defined as industries where the Herfindahl index (a proxy for imperfect competition) is less than the sample median.

decreases to -4.76% when the authors restrict the sample to bankruptcy firms where the bankruptcy filing firm's industry experiences contagion effects.

Jorion and Zhang (2009) provide empirical evidence that counterparty risk is an important credit contagion mechanism. The authors examine unsecured creditors' abnormal stock returns and credit default swap (CDS) spread changes around bankruptcy events and document an average 11-day window industry-adjusted cumulative abnormal return (CAR) of -2.29% for 230 industrial creditors.[6] The authors find that within two years of the bankruptcy filing, 2.60% of credit rated industrial creditors are delisted, whereas only 0.56% of matched control sample firms are delisted; the difference in population percentages is statistically significant from zero at the 1% level. Furthermore, 32.32% of credit rated industrial creditors are downgraded within two years of the bankruptcy event in comparison to only 12.36% of matched control sample firms; the difference in population percentages is statistically significant from zero at the 1% level. Vassalou and Xing (2004) explain that default risk contagion effects may result in a systematic component to default risk. Using Merton's (1974) model to measure default risk, the authors find that default risk is systematic, specifically, they add the change in aggregate survival rate[7] as an explanatory variable to CAPM and three-factor Fama and French (1993) regressions and find that the change in aggregate survival rate has a positive and significant risk premium.

Shivdasani and Stefanescu (2010) show that public firms' leverage ratios are about 35% higher when SDBPs are brought back onto the balance sheet. The authors find that

[6] Trade credit accounts for 98% of the debts owed to industrial creditors.
[7] Survival rate is defined as one minus the probability of default. Change in survival rate is defined as survival rate at time t minus the survival rate at time t-1.

on average, the tax benefits from SDBPs account for about 1.5% of the value of the firm. The authors do not examine MDBPs.

3. MDBP Institutional Background

MDBPs exist predominately to allow employees in transient industries such as construction, retail, hotels and entertainment to keep and continue earning pension credits when changing jobs but still working for participating employers in the same MDBP; average tenure in MDBP industries is often shorter than the three to five years required to vest SDBP pension benefits. Unlike SDBP liabilities, MDBP liabilities are not mandatorily reported on public companies' balance sheets; a feature which may help to explain MDBP existence, but also makes the plans opaque to investors.

Sanders (2011) describes how employer associations exist in MDBP industries in order to promote employers' interests in negotiations with the unions. MDBPs are a mandatory part of the multiemployer bargaining process whereby an employer association representing competing companies will agree with a single union to one solitary collective bargaining agreement (CBA). The portability of multiemployer pensions and healthcare plans weakens the power of any one employer over unionized employees. Unions demand that their members belong to the same MDBP especially across the same geographical area and if the majority of employers in the employer association want to continue the MDBP, the employer association will bargain to continue the MDBP. Sanders describes how the multiemployer bargaining structure promotes the interests of the industry's leading employers by creating an anticompetitive cartel whose rents are shared with the unions in the form of higher wages and benefits and whose weapons for policing the employer

association's membership include MDBPs.

At first glance, given the many curious features of MDBPs, one wonders why MDBPs originated and why MDBPs still exist. The most pertinent question is: Why do large credit-worthy firms belong to MDBPs together with smaller less credit-worthy firms? More credit-worthy MDBP employers may be compensated for providing essentially free insurance to less credit-worthy MDBP employers by the ability to offer lower salaries and benefits package in return for providing portable pensions to their transient employees and/or, as Sanders (2011) argues, extracting customer rents. The question of why MDBPs originated is far easier to answer. MDBPs first appeared in the late 1930s and 1940s in order to provide pension benefits to the unionized workforce in transitory employment or who worked for small employers (Segal, 2007). Before 1980, employers could share pension administrative costs and pool employees' longevity risk without exposure to MDBP withdrawal liabilities. Moreover, risk pooling ensured that MDBP employees' retirement benefits were less threatened by an individual employer's financial difficulties than SDBP employees' retirement benefits.[8]

MDBP liabilities are obscure and difficult to value. Unlike SDBP liabilities, aggregate MDBP liabilities are not recorded on public company balance sheets, and actuaries, rating agencies and financial services companies use different interest rates to discount MDBP liabilities. In contrast to SDBP actuaries who for funding purposes must use interest rates based on current investment grade corporate bond yields to discount pension liabilities, MDBP actuaries may use the valuation rate, an interest rate that reflects

[8] The PBGC began insuring SDBP retirement benefits in 1974.

long term expectation of investment earnings given the plan's investment structure to discount pension liabilities (McGill, Brown, Haley, Schieber, & Warshawsky, 2010). Zion et al. (2012) find that the median valuation rate for the 2010 MDBP year was 7.5% whereas the median 2011 discount rate for SDBP liabilities for S&P 500 companies was 4.7%. Therefore, discounting MDBP liabilities using the SDBP discount rate would increase MDBP liabilities.

MDBPs are governed by The 1974 Employee Retirement Income Security Act (ERISA); in 1980 Congress passed the Multiemployer Pension Plan Amendments (MPAA) which introduced a withdrawal liability. Employers who wish to withdraw from a MDBP must pay their share of the plan's unfunded vested pension benefits. Withdrawal liabilities can be paid as a lump sum or paid over a period, generally up to 20 years with interest. Solvent employers may withdraw voluntarily from a MDBP by paying a withdrawal liability. Plant closures, rejection of CBAs and redundancies can all trigger compulsory withdrawal liabilities for solvent employers. When an employer's contribution base shrinks by at least 70%, employers must pay a partial withdrawal liability.

A MDBP only files a claim during a chapter 11 bankruptcy if the employer withdraws from the MDBP prior to the bankruptcy filing or during the bankruptcy process. If an employer is insolvent and undergoing liquation or dissolution when it withdraws, 50% of the withdrawal liability is contingent on whether there is sufficient liquidation or dissolution value after all the other employer's debts are paid (Mazo & Lee, 2010).

ERISA requires that the computation of a MDBP's withdrawal liability is based on the actuary's best estimate of anticipated experience under the plan and reasonable

assumptions. When calculating withdrawal liabilities, plan actuaries use the valuation rate[9] or a blended rate, which is a weighted average of the valuation rate and the PBGC annuity purchase rate,[10] to discount vested pension liabilities (Mazo & Lee, 2010). The PBGC January 2010 annuity purchase rate was 4.89% for the first 20 years and 4.63% thereafter, respectively.

The Pension Protection Act of 2006 (PPA 2006) mandates that MDBPs provide an annual plan status certifications based on standardized funding and liquidity measures for determining the financial health of plans. Actuaries calculate MDBPs' funded percentage by dividing the smoothed actuarial value of plan assets by plan liabilities discounted at the valuation rate. Plans are certified as either in critical, endangered or non-distressed status. Critical status is usually associated with funding ratios less than 65% whereas endangered status is associated with funding levels greater than 65% but less than 80%. Two-thirds of MDBPs were in critical or endangered status in the 2009 plan year (Department of Labor, Department of The Treasury and PBGC, 2013). PPA 2006 mandates that critical or endangered status MDBPs address under-funding through increased employer contributions and/or reductions in adjustable benefits.

Several factors have led to the serious underfunding of many MDBPs. MDBPs' assets plummeted with the 2000 to 2002 market decline and the 2008 financial crisis. The decline of unionization across U.S. industry, obsolete and bankrupt MDBP employers and the decline in the percentage of active (current contributing employer) participants has

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[9] .Zion et al. (2012) find that the median valuation rate for the 2010 MDBP year was 7.5%

[10] The PBGC annuity purchase rate is the interest rate used to value MDBP benefits and certain assets following a contributing employer mass withdrawal. http://www.pbgc.gov/prac/interest/ida.html.

eroded MDBPs' employer contribution base. Prior to PPA 2006, the U.S. tax code deterred plans from overfunding and protecting themselves from market and industry downturns since employer contributions were only tax-deductible when MDBPs were less than 100% funded.

For fiscal years ending on or before December 15, 2011, public companies were only required to disclose their total contributions to MDBPs. In September 2011, the Federal Accounting Standards Board issued Accounting Standards Updates 2011-09, "Disclosures about an Employer's Participation in a Multiemployer Plan." The new disclosures include employer contributions made to each significant plan and to all plans in the aggregate, an indication of whether the employer's contributions represent more than 5% of total contributions to the plan, an indication of which plans are subject to a funding improvement plan, the expiration date(s) of the CBA(s), any minimum funding arrangements and the most recent certified funded status of the plan. The funded status of the plan allows investors to estimate the MDBPs' degree of underfunding. However, in order to estimate a company's MDBP unfunded liability, investors require the 10-K employer contribution information together with Form 5500 information. The new MDBP disclosures were effective for public company for fiscal years ending after December 15, 2011, with early adoption permitted.

4. Data Collection

MDBPs must file Form 5500 to satisfy ERISA and IRS annual reporting requirements. Form 5500 contains information on MDBP assets, liabilities, and major employer contributions. I download the 2009 Form 5500 (All) data from the DOL website

(http://www.dol.gov/ebsa/foia/foia-5500.html). I merge the 2009 Form 5500 (All) data with the 2009 Form 5500 schedule H, schedule MB and schedule R data using the MDBP filing's unique key. The original dataset contains information on MDBPs, SDBPs, multiemployer plans and direct filing entities therefore I select MDBPs with filing status not equal to 'processing_stopped'.[11] In order to assemble data on MDBP contributing employers, I select MDBPs with Schedule R attached. I delete observations for which either Form 5500 Schedule R's RPA94 liability is missing or Form 5500 Schedule H's end of year net plan assets are missing. MDBPs are uniquely identified by their employer identification number and their plan number may have multiple filings; where there are multiple filings for the same plan, I select the plan filing with the earliest filing date and contributing employer Schedule R information.

I collect data for both public parent companies and their subsidiaries. Form 5500 schedule R lists both the contributing employer's name and the contributing employer's employer identification number (EIN). I wish to match Schedule R subsidiaries to their public parent companies. However, as Rauh, Stefanescu, and Zeldes (2013) explain, a subsidiary's EIN often differs from its parent's Compustat EIN:

> Under the current IRS rules, subsidiaries that are at least 80% owned by the parent may elect to file consolidated income tax returns. But they can also choose to file taxes separately while still remaining consolidated with the parent company for financial purposes. In this case, the EIN and the sponsor name reported in Form 5500 will differ from its parent's. (p.12)

In order to match Schedule R companies to their public parents, I first follow Rauh et al. (2013) and match the Schedule R company's EIN to their public parent's EIN. For

[11] EFAST2 Program Management Office personnel informed me that the public could view 'filing_error' plan filings but not 'processing_stopped' plan filings.

companies that cannot be matched using their EIN, I search Hoover's database for potential public parents using the Schedule R company name. Companies may use the same name so I use the industry and the MDBP location to identify the correct Hoover's company.

When Hoover's lists a potential public parent for the Schedule R company, I search Exhibit 21 (listing of active subsidiaries) of the most recent public parent's 10-K available before the Form 5500 filing date, for the Schedule R company name. If the company is not listed on Exhibit 21, I search the rest of the public company's 10-K for mention of the Schedule R listed company. Public companies need only list in Exhibit 21 their "significant" subsidiaries who contribute more than 10% of consolidated assets or pretax income at the end of the last fiscal year (Lignon & Malm, Litigation risk, financial distress, and the use of subsidiaries, 2013). Therefore if a Schedule R company is not listed in Exhibit 21 or mentioned in the 10-K, I ascertain whether the Schedule R company's website discloses that it is a subsidiary of the parent public company.[12] If I still cannot verify the Hoover's Schedule R company match to its public parent, I search the internet to see whether the employer EIN is associated with a public company's pension plans. I also use einfinder.com to match Schedule R Company's EINs with a public company. I also search the internet for court documents or news stories that may link the Form 5500 company to its public parent.

I require that a Form 5500 company can be matched to a public company parent in at least two ways to enter my sample. I require that a MDBP has at least one U.S. incorporated public firm listed on the NYSE, NASDAQ or AMEX exchanges on the plan's

[12] EMCOR's subsidiaries all disclose on their websites that they are EMCOR's subsidiaries.

filing to enter my sample. When an individual MDBP has two or more observations for the same public company; I add together the pension contributions amounts and consolidate the public employer information into one MDBP public company observation.

In order to analyze expected MDBP liability spillovers inter- and intra-industry, I assign public companies to 10 broad industry groups: transportation, food/retail, entertainment/printing, construction/engineering/steel, mines/coal/oil, hotels/casinos, aircraft, waste management, paper/paperboard, and other. My industry groupings are inspired by Moody's (2009) industry groupings and frequently observed additional industries seen in the data. In contrast to Moody's (2009), I include a waste management industry group since I observed several MDBPs where the contributing Schedule R employers belonged to the waste management industry.

I collect public company's total MDBP employer contributions from the public company's 10-K. In my sample, 2009 plan year MDBP year ends vary from December 31, 2009, until November 30, 2010, with the majority (56%) of MDBP plan years ending on December 31, 2009, and 88% ending on or before June 30, 2010. Public companies may belong to several MDBPs; it is therefore difficult to obtain an exact date match between a company's reported 10-K total MDBP employer contributions and the public company's total Schedule R contributions. I therefore use the following methodology to collect public company total employer MDBP contributions. If the company's fiscal year ends on or before June 30, 2010, I use the most recent reported fiscal year total employer MDBP contributions. If the company's fiscal year ends after June 30, 2010, I use the average of the 2009 and 2010 fiscal year total MDBP contributions. If a company does not report its 2009 fiscal year total MDBP contributions; I use the 2010 fiscal year total MDBP

contributions.

In order to calculate bankruptcy probabilities, I follow Bharath and Shumway (2008) and use the Merton distance to default model or the Merton DD model to estimate Merton default probabilities. For robustness checks, I also calculate bankruptcy probabilities using Altman (1968) Z-scores and Ohlson (1980) O-scores.

5. Calculation of MDBP Liability Spillovers

Generally for MDBP plan years beginning after 2007, the statutory interest rate used to discount current pension liability must be between 90% and 105% of the weighted average of the rates of interest on 30-year Treasury securities during the four-year period ending on the last day before the beginning of the plan year. The present value of pension benefits accrued to date discounted at the statutory interest rate is called the RPA 94 current liability. Moody's (2006) uses the RPA 94 current liability because it is a standard liability measure across companies whereas actuarial liabilities can vary across companies both in the actual discount rate used and the methodology. Moody's(2006) use RPA 94 current liability multiplied by 90% less current assets and multiplied by 50% to estimate a MDBP's unfunded liability. I follow Moody's (2006) methodology to estimate a MDBP's unfunded liability; specifically I subtract Form 5500 Schedule H's end of year net plan assets from 90% of Form 5500's Schedule MB RPA 94 liability and then multiply by 50%.[13]

Actuaries calculate MDBP withdrawal liabilities using a company's share of the unfunded MDBP liabilities. Therefore it is reasonable to first estimate a plan's unfunded

[13] Moody's (2006) expects that union employees will share 50% of the MDBP underfunding burden through giving up current wages and other benefits in exchange for increased MDBP funding while companies will fund the remaining 50% of the MDBP underfunding.

liabilities (liabilities minus assets) to estimate a company's ongoing MDBP liability. Although the RPA 94 current liability has the advantage that it is a standard measure across companies, it uses Treasury bond interest rates to discount pension liabilities making the RPA 94 liabilities larger than liabilities discounted using corporate bond interest rates. MDBPs may invest in corporate bonds as well as treasury bonds to match their liabilities; therefore reducing the RPA94 liability by multiplying by 90% better reflects a MDBP's liabilities. Moody's halved the MDBP unfunded liability (RPA 94 liability minus plan assets) to account for further pension benefit reductions and wage concessions from labor after feedback from MDBP actuaries and other MDBP stakeholders. In my calculations, I estimate a company's ongoing MDBP liabilities rather than its withdrawal liability and follow Moody's methodology by halving the MDBP unfunded liability to account for concessions from labor providing the best estimate of a MDBP's ongoing unfunded liability. I illustrate below how I calculate an individual MDBP's unfunded liabilities denoted as UL_{MDBP}:

$$UL_{MDBP}=0.9 \text{ x } (L-A) \text{ x } 0.5 \qquad (1)$$

Where L=RPA 94 Liability and A= Current Value of Net Assets

I give a numerical example illustrating the calculation of a MDBP's unfunded liability in Appendix A.1.

I follow the methodology of Zion at al. (2012) and estimate an employer's share of the MDBP unfunded liabilities by using the Form 5500 Schedule R's employer's plan year contributions divided by the total employer plan year contributions. Company withdrawal liabilities can be calculated using either the unfunded vested benefits traceable to the

company's employees or allocating a company's share of the MDBP's unfunded liability using the company's share of total plan contributions over a specified period (McMurdy, 2009). Data on a company's traceable unfunded vested benefits are not available, and employer contributions data only became available from the 2009 plan year onwards. Therefore given the data limitations using the 2009 plan year employer contributions as a percentage of total employer contributions to allocate employer MDBP unfunded liabilities is a reasonable methodology to employ. I use the schedule MB total employer contributions for the total employer contributions. I use schedule H total contributions for the total employer contributions when schedule MB total employer contributions are missing. When the plan's total Schedule R employer contributions are greater than the total employer contributions, I use the schedule R total employer contributions to calculate the employer's share of the MDBP liabilities. Otherwise I use the total employer contributions. For the 2009 plan year, 12 out of 333 plans have schedule R total employer contributions greater than Schedule MB total employer contributions.

I calculate a schedule R company A's share of the MDBP unfunded liabilities denoted as UL_A as follows:

$$UL_A = C_A/TC \times UL_{MDBP} \tag{2}$$

Where C_A =Company A's contributions and TC=Total Employer Contributions

I give a numerical example showing the calculation of a company's share of a MDBP's unfunded liability in Appendix A.2.

YRC Worldwide (YRC hereafter) temporarily suspended their contributions to a majority of their MDBPs beginning in the second half of 2009 and continuing throughout

2010. In order to calculate YRC's MDBP liabilities, I assume that YRC's recorded 2009 Schedule R contributions represent 50% of YRC's unsuspended annual contributions. Therefore I double YRC's Schedule R pension contributions for the 2009 plan year and I adjust the plan's total employer contributions accordingly. YRC contributed in aggregate $554.1 million to 20 multiemployer pension plans in fiscal year 2008, and in 2009 Central States represented 58% of the company's monthly pension funding obligations (Fleet Owner, 2009). Therefore a reasonable estimate of YRC's 2009 plan year unsuspended contribution to the Central States is $321 million (58% of $554.1 million). After doubling YRC's 2009 Schedule R contributions, I estimate that YRC makes a $276 million contribution to Central States; my estimate is similar in magnitude to the $321 million estimate from other sources. YRC's contributions to Central States is 94% of its total 2009 Schedule R contributions. Therefore doubling YRC's 2009 Schedule R contribution in order to estimate YRC's MDBP liabilities is a reasonable adjustment to account for YRC's suspension of contributions to MDBPs in the second half of 2009.

I define a firm's LMS liability spillovers as the total liability spillovers from other Schedule R firms in the event that all other Schedule R firms file for bankruptcy. LMS MDBP liability spillovers are an extreme case and represent the maximum MDBP liability spillover onto a non-bankrupt company by other bankrupt Schedule R firms. I calculate a firm's LMS liability spillovers from both public and private Schedule R firms. In order to calculate LMS MDBP liability spillover, I make two assumptions: First, in the event of bankruptcy, a company withdraws from a MDBP and the MDBP recovers none of its unsecured withdrawal liability claim. Second, non-bankrupt MDBP companies inherit bankrupt companies' MDBP liabilities in proportion to their share of total non-bankrupt

company MDBP contributions. I calculate LMS MDBP liability spillover in two stages: First, I calculate a non-bankrupt firm A's share of the bankrupt firm(s) MDBP liability denoted by S_A by dividing the non-bankrupt firm's MDBP contribution by non-bankrupt firms' total MDBP contributions and second I calculate the MDBP spillover onto the non-bankrupt company A denoted by $SLMS_{A,-A}$ by multiplying the non-bankrupt company's share of the total MDBP spillover by the bankrupt firm(s) MDBP liability.

5.1 *Calculating LMS MDBP Liability Spillovers with Two Public Schedule R Companies*

I calculate LMS MDBP liability spillovers with two public Schedule R companies as follows:

$$S_A = C_A / (TC - C_B) \qquad SLMS_{A,-A} = S_A \times UL_B \quad . \tag{3}$$

Where S_A is company A's share of bankrupt company B's MDBP liabilities

Where $SLMS_{A,-A}$ is the spillover of bankrupt company B's MDBP liabilities onto company A

I give a numerical example illustrating how I calculate LMS MDBP liability spillovers with two Public Schedule R Companies in Appendix A.3.

5.2 *Calculating LMS MDBP Liability Spillovers with Three Public Schedule R Companies*

I calculate LMS MDBP liability spillovers with three public Schedule R companies as follows:

$$S_A = C_A / (TC - C_B - C_C)$$

$$SLMS_{A,-A} = S_A \times (UL_B + UL_C) \quad (4)$$

I give a numerical example illustrating how I calculate LMS MDBP liability spillovers with three public Schedule R companies in Appendix A.4.

5.3 Calculation of Bankruptcy Probabilities

In order to calculate a company's 1-year expected MDBP liability spillovers, I first estimate each public company's 1-year bankruptcy probabilities denoted as p_i as at 31 December 2010. When a company files for bankruptcy, I set p_i to one. The Form 5500 Schedule R companies are mostly subsidiaries of public parent companies; Kolasinski (2009) explains that a strong subisidary is generally rated no higher than its parent[14] and industrial firms mostly file for bankruptcy with their subsidiaries. Therefore, for the majority of MDBP firms, the parent public bankruptcy probability is most likely a lower bound on the subsidiary's bankruptcy probability.

I follow Bharath and Shumway (2008) and use the Merton (1974) distance to default model or the Merton DD model to calculate Merton bankruptcy probabilties. In Merton (1974) a firm defaults when the value of the firm's debt exceeds the value of the firm's assets. The Merton (1974) model assumes that the total value of a firm's assets follows geometric Brownian motion.

[14] Kolasinski gives two key reasons why subsidiaries are rated no higher than their parent: (1) a weak financially distressed parent's ability and incentive to take assets from and burden its subsidiaries with debt and (2) the likelihood that a parent's bankruptcy would cause a strong standalone subsidiary's bankruptcy.

$$dV = \mu V dt + \sigma_V V dW \tag{5}$$

where V is the total asset value of the firm, μ is the expected return on the firm's total asset value, σ_V is the constant volatility of the firm's total value and dW is a standard Wiener process. In Merton's model, the firm issues only two securities: equity and one zero-coupon bond maturing at time T. The firm's equity value is an European call option on the firm's assets with an exercise price equal to the bond's face value and a time to maturity of T. The firm's equity value fulfills

$$E = V\mathcal{N}(d_1) - e^{-rT}F\mathcal{N}(d_2) \tag{6}$$

Where E is the market value of the firm's equity, F is the bond's face value, is the instantaneous risk-free rate, $\mathcal{N}(.)$ is the cumulative standard normal distribution,

$$\mathrm{d}_1 = \frac{\ln\left(\frac{V}{F}\right) + (r + 0.5\sigma_V^2)}{\sigma_V\sqrt{T}}, \quad d_2 = d_1 - \sigma_V\sqrt{T} \tag{7}$$

In the Merton model, the firm's distance to default, DD, is given by

$$DD = \frac{\ln\left(\frac{V}{F}\right) + (\mu - 0.5\sigma_V^2)T}{\sigma_V\sqrt{T}} \tag{8}$$

and the implied probability of default, p_{Merton} , is given by

$$p_{Merton} = \mathcal{N}\left(-\left(\frac{\ln\left(\frac{V}{F}\right) + (\mu - 0.5\sigma_V^2)T}{\sigma_V\sqrt{T}}\right)\right) = \mathcal{N}(-DD) \qquad (9)$$

I collect the number of shares outstanding and share price from daily 2010 CRSP data and multiply them together to calculate the firm's market value of equity, E. I collect the 1-year Treasury Constant Maturity rate for r, the risk-free rate on a daily basis from Federal Reserve Bank data. I set T equal to one year and use the sum of current liabilities and 50% of long-term liabilities from quarterly COMPUSTAT data available on the CRSP daily date for F. I calculate the firm value assets V as the sum of E and F. I calculate the log return on assets each day and estimate an initial value for σ_V, I then solve equation (6) to get new estimates of V and σ_V and continue the iterative process until consecutive σ_V values differ by less than 0.001. I then calculate the Merton implied default probability using equation (9).

For robustness purposes, I also calculate 1-year bankruptcy probabilities using 2010 fiscal year COMPUSTAT data and Altman (1968) Z-scores and Ohlson (1980) O-scores. I follow Mansi, Maxwell, & Zhang (2013) and reverse the signs of the original Altman's Z-score coefficients so that the Z-score is increasing in bankruptcy probability. I follow Mansi et al. (2013) and calculate negative Altman Z-scores using the following model:

Negative Altman Z-score=-1.2**wcta*-1.4**reta*-3.3**ebitta*-0.60**mvliab*-0.999*sata* (10)

where *wcta* is working capital (current assets – current liabilities) divided by total assets, *reta* is retained earnings divided by total assets, *mvliab* is market value of equity divided by total liability, and *sata* is sales divided by total assets.

I follow Hillgeist et al. (2004) and calculate Ohlson (1980) O-scores using:

O-score= -0.407**size* + 6.03**tlta* -1.43**wcta* +0.0757**clca* -2.37**nita*

-1.83**ffotl* +0.285**intwo* 1.72**oeneg* -0.521**chin* -1.32 (11)

where *Size* is the ln(Total Assets/GDP price level index); *tlta* is total liabilities divided by total assets, *wcta* is working capital divided by total assets; *clca* is current liabilities divided by current assets; *nita* is net income divided by total assets, *ffotl* is pre-tax income plus depreciation and amortization divided by total liabilities, *intwo* is one when cumulative net income over the previous two years is negative and zero otherwise, *oeneg* is one when owners' equity is negative and zero otherwise, and *chin* measures changes in net income using $chin = (NI_t - NI_{t-1})/(|NI_t| + |NI_{t-1}|)$.

I follow Hillgeist, Keating, and Lundstedt (2004) and convert the negative Altman Z-scores and Ohlson O-scores to probabilities using

$$p_i = \frac{e_i^{Score}}{1 + e_i^{Score}} \tag{12}$$

Hillgeist et al. (2004) point out that although this transformation is not strictly correct for the Multiple Discriminant Analysis (MDA) estimated Z-score, McFadden (1976) shows that under normality assumptions the MDA and logit approaches are closely related.

5.4. Calculation of 1-year Expected Public Company MDBP Liability Spillovers

In order to calculate 1-year expected MDBP liability spillovers, I make the same two assumptions as in the LMS case. I calculate 1-year expected MDBP liability spillovers in two stages:

1. I calculate the LMS MDBP liability spillover onto the non-bankrupt company denoted by $SLMS_{A,-A}$.
2. I calculate the expected MDBP spillover onto the non-bankrupt firm denoted by $SEXP_{A,-A}$ by multiplying the bankruptcy event probability by $SLMS_{A,-A}$.

5.4.1 *Calculating 1-year Expected MDBP Liability Spillovers with Two Public Schedule R Companies*

$$SEXP_{A,-A} = SLMS_{A,-A} \times p_B \times (1-p_A) \tag{13}$$

where $SEXP_{A,-A}$ is the expected MDBP liability spillover of bankrupt company B onto company A.

where p_A is the probability that company A goes bankrupt in the next year.

5.4.2 *Calculating 1-year Expected MDBP Liability Spillovers with Three Public Schedule R Companies*

$$SEXP_{A,B} = SLMS_{A,B} \times p_B \times (1-p_C) \times (1-p_A)$$

$$SEXP_{A,C} = SLMS_{A,C} \times p_C \times (1-p_B) \times (1-p_A)$$

$$SEXP_{A,BC} = SLMS_{A,B} \times p_B \times p_C \times (1-p_A)$$

$$SEXP_{A,-A} = SEXP_{A,B} + SLMS_{A,C} + SEXP_{A,BC} \quad (14)$$

where $SEXP_{A,B}$ is the expected MDBP liability spillover onto A when only B goes bankrupt, $SEXP_{A,C}$ is the expected MDBP liability spillover onto A when only C goes bankrupt and $SEXP_{A,BC}$ is the expected MDBP liability spillover onto A when both B and C go bankrupt.

5.5 Calculation of 5-year Expected MDBP Public Company MDBP Liability Spillovers

In order to calculate 5-year expected MDBP liability spillovers, I further assume that 1-year bankruptcy probabilities remain constant over a 5-year period and assume a 5% discount rate. I calculate 5-year spillovers for plans with two or three public companies. I calculate expected 5-year MDBP liability spillovers onto the non-bankrupt company in two stages:

1. I calculate the LMS MDBP liability spillover onto the non-bankrupt company denoted by $SLMS_{A,-A}$.
2. I calculate the 5-year expected MDBP spillover onto the non-bankrupt firm denoted by $S5EXP_{A,-A}$ by multiplying the 5-year bankruptcy event probability by $SLMS_{A,A}$.

In the two public company case, there are five possible spillover events where company B's MDBP liability spills onto company A. I illustrate the five possible events in Table 1.

I show how I calculate spillover probabilities, discounted MDBP liability

spillovers, and discounted expected MDBP liability spillovers in Table 2. I sum up five expected discounted MDBP liability spillovers to calculate the total 5-year expected MDBP liability spillover from company B onto company A. In the three Schedule R public company case, there are 35 possible spillover events where company B's MDBP liability and/or company C's MDBP liability spills onto company A. I illustrate the 35 possible spillover events in Table 3. In Figure1, I show how I calculate spillover event probabilities, discounted MDBP liability spillovers, and discounted MDBP liability spillovers for the three Schedule R public company MDBP case using a numeric example.

6. Calculation of Leverage Ratios

I examine the effect of MDBP liabilities and expected 1-year MDBP liability spillovers on MDBP public companies' leverage ratios. I calculate MDBP liabilities and the sum of MDBP liabilities and expected 1-year MDBP liability spillovers as a percentage of long-term debt. I follow the methodology of Shivdasani and Stefanescu (2010) to calculate three measures of leverage from the reported balance sheet. I also report these three leverage measures with debt consolidated with MDBP liabilities and with debt consolidated with the sum of MDBP liabilities and 1-year expected MDBP liability spillovers. I calculate *Book D/A* as the ratio of long-term debt plus the current portion of long-term debt to the book value of assets, *Book D/D+E* as the ratio of book long-term debt to the book value of equity plus the book value of long-term debt and *Market D/A* as the ratio of the book value of long-term debt to the market value of assets (book value of assets minus book value of equity plus the market value of equity.

7. Sample Description

For the 2009 plan year, there are 4,902 first filing observations associated with 1,366 unique MDBPs. There are 1,389 observations, 333 unique MDBPs and 529 public company observations for MDBPs with at least one U.S. incorporated public company listed on Schedule R. In Table 4, I detail how I matched Schedule R companies to public companies. I lose 40 observations because I consolidate all public company observations in the same MDBP into one public company MDBP observation. My final 2009 plan year sample consists of 1,349 observations, 333 unique MDBPs and 489 public company observations associated with 154 unique public companies with 144 U.S. incorporated public companies. For the 2009 plan year, MDBP first filing dates range from June 4, 2010, to September 15, 2011, 54.1% of filing dates are between October 5, 2010, and October 22, 2010.[15] In order to summarize 2009 plan year expected liability spillovers, I use 1-year Merton default probabilities using 2010 data.

MDBP unfunded liabilities for the 2009 plan year range from -$331.5 million to $12.1 billion with a mean of $ 190.2 million and a median of $29.1 million. The distribution of plan unfunded liabilities is severely positively skewed (skew=11.1). Two plans have unfunded liabilities larger than $7 billion,[16] whereas 63.7% of plans have unfunded liabilities of less than $50 million. For an individual MDBP, the number of Schedule R public companies ranges from 1 to 6 with a mean of 1.5 companies (median 1.0 company)

[15] MDBP plans are required to file seven months after the plan year end and may apply for a onetime two and a half month extension to the filing date. Most plan years end on December 31, and I find a clustering of MDBP filing dates around mid-October 2010.

[16] The Central States, Southeast and Southwest Areas Pension Plan (Central States) has $12.1 billion in unfunded liabilities and the Western Conference of Teamsters Pension Plan has $7.0 billion in unfunded liabilities.

whereas the number of Schedule R private companies ranges from one to 16 with a mean of 2.8 companies (median 2 companies).

In my final sample, there are 154 unique public MDBP companies, 144 of whom are incorporated in the U.S. The 154 public companies appear on between 1 and 35 MDBP Schedule Rs with a mean of 3.2 Schedule Rs and a median of one Schedule R. Table 5 shows the distribution of the number of public companies appearing on MDBP Schedule Rs.

In Table 6, I compare public MDBP company fiscal year 2010 summary statistics with those of Compustat companies listed on the NYSE, NASDAQ or AMEX exchanges. On average, public MDBP companies are more than three times larger and have a lower market to book ratio than Compustat public companies. For fiscal year 2010, public MDBP companies have a mean market value of equity of $15.6 billion (median $3.6 billion) with a mean market to book ratio of 3.7 (median 1.8) whereas public Compustat companies have a mean market value of equity of $5.0 billion (median $0.6 billion) with a mean market to book ratio of 5.7 (median 1.7).

In my sample, 103 public companies are exposed to MDBP liability spillovers from other public companies. MDBP companies' mean Merton default probability is 7.7% with a median of 0.0% (95 companies). I report Merton default probability estimation summary statistics in Table 7. In 2011, 88 public equity or public debt companies filed for bankruptcy compared to 106 public companies in 2010 and 211 public companies in 2009 (Hamiton 2012). In 2011, there were 9,291 public equity or public debt companies with a 0.95% bankruptcy rate.

Company individual MDBP liabilities may be negative when a plan's net assets

exceed the plan's liabilities. Company individual MDBP liabilities range from -$44.9 million to $4.4 billion (YRC Worldwide's share of the Central State's unfunded liability) and are extremely skewed, the mean MDBP Schedule R company liability is $23.9 million with a median of $2.6 million. Schedule R employer contributions cover on average 61.9% (median 63.9%) of total MDBP employer contributions. Public company schedule R contributions cover on average 29.9% (median 19.9%) of the total MDBP employer contributions and private company schedule R contributions cover on average 32.0% (median 30.5%) of total MDBP employer contributions.

I sum public company MDBP liabilities across plans. The total 2009 plan year MDBP public company liability ranges from -$30.4 million to $6.2 billion (United Parcel Service Inc.), with a mean total public company liability of $155.3 million (median of $10.2 million). The distribution of public company total MDBP liabilities is severely positively skewed (skew=7.0), six companies have total MDBP liabilities of more than $1 billion whereas 76 companies have total MDBP liabilities of less than $10 million. Using 2010 fiscal year[17] COMPUSTAT market values and total assets, I find that the mean total public company MDBP unfunded liability as a percentage of book assets is 3.5% (median 0.2%) whereas the mean total public unfunded SDBP liability as a percentage of book assets is 2.8% (median 1.2%).[18] For the 2009 plan year, the aggregate public company MDBP unfunded liability was $23.9 billion while the aggregate public company SDBP unfunded liability of 1,366 companies was $454.6 billion. In Table 8, I present summary statistics for

[17] I use 2010 fiscal year total assets and market value of equity because 2009 plan years end from December 31, 2009, until November 30, 2010 and 2009 plans file from June 2010 until September 2011.
[18] I define public company as a company that has shares traded on the NYSE, AMEX or NASDAQ exchanges. Using Compustat data, I follow Stefanescu and Shivdasani (2010) and calculate SDBP unfunded liability as (pbpro +pbpru)-(pplao+pplau).

total public company MDBP liabilities by broad industry group. Transportation industry companies account for over one half (51.8%) of these aggregate liabilities, three companies account for 96% of aggregate transportation MDBP liabilities: UPS with $6.2 billion, YRC Worldwide with $4.6 billion, and Arkansas Best with $1.1 billion. Food/Retail companies account for 29.0% of aggregate MDBP liabilities; three companies account for 83% of aggregate food/retail liabilities: Safeway with $2.6 billion, Kroger with $2.0 billion, and Supervalu with $1.2 billion.

In Table 9, I list the 24 public companies with unfunded MDBP liabilities exceeding $100 million together with the company's MDBP liability characteristics. Forty-four companies have total public company MDBP liabilities exceeding 1% of their book assets; for these 44 companies the median total public company MDBP liability as a percentage of book assets is 3.3%.

Sixteen companies have total public company MDBP liabilities bigger than 5% of their book assets, for these 16 companies the median total public company MDBP liability as a percentage of book assets is 9.6% and the median total public company MDBP liability as a percentage of market value of equity is 14.7%. Eight companies have total public company MDBP liabilities bigger than 10% of their book assets; for these eight companies the median total public company MDBP liability as a percentage of book assets is 16.5%.

In Table 10, I present leverage ratios for nonfinancial and nonutility MDBP companies and Compustat companies with no missing leverage information and positive book equity. MDBP public companies are more levered then Compustat companies; MDBP public companies' mean leverage ratios are about 40% higher than those of Compustat companies. For MDBP companies, Book D/A increases from a mean of 0.84

(median 0.83) to 0.87(median 0.84) once unfunded MDBP liabilities are consolidated, Market D/A increases from a mean of 0.46 (median 0.46) to 0.48 (median 0.47) once unfunded MDBP liabilities are consolidated and Book D/ (D+E) increases from a mean of 0.61 (median 0.59) to 0.63 (median 0.60) once unfunded MDBP liabilities are consolidated. In sum, leverage ratios rise on average by about 4% once unfunded MDBP liabilities are consolidated.

Public companies must belong to at least one MDBP with two or more Schedule R companies in order to be exposed to LMS liability spillovers; in my sample 151 public companies are exposed to LMS MDBP liability spillovers; the mean number of MDBPs exposing these 151 companies to LMS MDBP liability spillover risks is 3.0 plans (median one plan). LMS liability spillovers from both private and public companies range from -$37.2 million to $2.65 billion (Safeway) with a mean of $88.4 million (median $6.4 million). LMS MDBP liability spillover is severely skewed (skew=6.1), eighteen companies have LMS MDBP liability spillovers larger than $100 million and 37 companies have LMS MDBP liability spillovers smaller than $1 million.

LMS MDBP liability spillovers as a percentage of book assets range from -0.2% to 92.6% (Arkansas Best) with a mean of 2.1% (median 0.2%). LMS MDBP liability spillover as a percentage of book assets is severely skewed (skew=9.0), eight companies have LMS MDBP liability spillovers larger than 10% of their book assets and 76 companies have LMS MDBP liability spillovers smaller than 0.1% of their book assets. I split the LMS MDBP liability spillovers into liability spillovers from public and private companies. For the 87 companies that have both positive public and private LMS MDBP liability spillovers, on average MDBP LMS liabilities from other public companies account for

35.1% (median 29.3%) of public and private LMS MDBP liabilities.

For the 103 public companies with LMS MDBP liability spillovers from other public firms, the mean LMS MDBP liability spillover from other public firms is $63.6 million (median $3.0 million). Public LMS MDBP liability spillover is skewed (skew=4.3), twelve companies have LMS public MDBP liability spillovers larger than $100 million and 33 companies have LMS public MDBP liability spillovers smaller than $1 million. LMS public MDBP liability spillover as a percentage of book assets has a mean of 1.8% (median 0.0%). LMS public MDBP liability spillover as a percentage of book assets is severely skewed (skew=8.9) ,three companies have LMS public MDBP liability spillovers as a percentage of book assets larger than 10% and 66 companies have LMS public MDBP liability spillovers as a percentage of book assets smaller than 0.1%.

One-hundred-and-thirty-nine public companies have LMS MDBP liability spillovers from private companies with a mean private LMS MDBP liability spillover of $48.9 million (median $5.0 million). Private LMS MDBP liability spillover is skewed (skew=6.4), eleven companies have LMS private MDBP liability spillovers larger than $100 million and 31 companies have LMS private MDBP liability spillovers smaller than $1 million. LMS private MDBP liability spillover as a percentage of book assets has a mean of 1% (median 0.1%).

Public companies must belong to at least one MDBP with two or more Schedule R public companies in order to be exposed to expected public company MDBP liability spillovers; in my sample 103 public companies are exposed to expected public company MDBP liability spillovers; of these 103 companies the mean number of MDBPs exposing them to public company MDBP liability spillover risks is 2.6 plans (median one plan).

In order to calculate expected public company liability spillover risks for an individual plan, all public companies in the plan must have no missing 1-year Merton default probabilities. For the 2009 plan year, 28 of the 103 liability spillover risk exposed companies have at least one MDBP where the expected public company MDBP liability spillover is missing due to at least one missing Merton default probability. For the remaining 75 companies, the 1-year expected MDBP liability spillover ranges from $0.0 million to $503.6 million (Arkansas Best[19]), with a mean of $10.1 million (median $0.0 million) and the 1-year expected MDBP liability spillovers as a percentage of total assets range from 0.0% to 58.5% with a mean of 0.8% (median 0.0%) One-year expected MDBP liability spillover is severely skewed (skew=7.7), six companies have 1-year expected liability spillovers of more than $5 million and 56 companies have 1-year expected MDBP liability spillovers of less than $0.1 million.

For the 12 companies[20] whose expected 1-year expected MDBP liability spillovers exceed $1 million, the mean expected MDBP liability spillover is $71.5 million (median $8.0 million). The mean 1-year expected MDBP liability spillovers as a percentage of total assets is 5.1% (median 0.1%). In Table 11, I tabulate the 12 companies with 1-year expected MDBP liability spillovers greater than $1 million and no missing 1-year expected MDBP liability spillovers. Six public companies have 1-year expected MDBP liability spillovers bigger than 0.1% of their book assets; for these six companies, the mean 1-year expected MDBP liability spillovers as a percentage of book assets is 10.3% (median 0.6%). Two companies have 1-year expected MDBP liability spillovers larger than 1% of book

[19] $179.3 million of Arkansas Best's expected liability spillover is from YRC Worldwide in the Central States Pension Plan.
[20] Includes Safeway which has one missing expected liability spillover.

assets, Arkansas Best (58.5%) and Village Super Market (1.3%).

For the 75 companies with no missing Merton default probability, the mean LMS MDBP liability spillover is 11.3 times greater than the mean 1-year expected MDBP liability spillover. I compare LMS MDBP liabilities with 1-year expected MDBP liabilities in Table 13. The LMS MDBP liability spillover is a worst case scenario because it assumes that all other public and private Schedule R companies go bankrupt. In contrast, the 1-year expected MDBP liability spillover only considers liability spillovers from public MDBP companies and assumes that public Schedule R companies' bankruptcy probabilities are independent. MDBP company bankruptcy probabilities are most likely correlated because most often MDBP sharing companies are in the same industry. Therefore, the actual 1-year expected MDBP liability spillover lies somewhere between my calculated expected 1-year MDBP liability spillover and my calculated LMS liability spillover.

I calculate 5-year expected MDBP liability spillovers for plans with two or three public companies using a 5% discount rate. Two-hundred-and-nine of the 218 non-missing MDBP expected liability spillovers observations are associated with plans with two or three public companies. On average, a company's 5-year expected MDBP liability spillovers is 3.3 times its 1-year expected MDBP liability spillovers. There are 66 firms with no missing expected MDBP liability spillovers and belonging only to plans with less than four Schedule R public companies. For these 66 companies the mean 5-year expected MDBP liability spillover is $13.1 million (median $0.0 million).and the mean 5-year expected MDBP liability spillover as a percentage of book assets is 1.0%. (median 0.0%). Three companies have 5-year expected MDBP liability spillovers bigger than 1% of book assets. In Table 13, I present summary statistics for 1-year and 5-year expected MDBP liability

spillovers.

In Table 14, I present 1-year expected MDBP liability spillover summary statistics by broad industry group for companies with no missing expected MDBP liability spillovers. Transportation has the largest mean 1-year expected MDBP liability spillover of $75.00 million (median $0.11 million) followed by Food/Retail with a mean of $16.98 million (median $0.00 million).

In Table 15, I present reported leverage ratios and leverage ratios consolidated with MDBP liabilities and expected 1-year MDBP liability spillovers for nonutility and nonfinancial MDBP companies with no missing plan expected MDBP spillovers, no missing leverage information and positive book equity. For these 66 companies, Book D/A increases from a mean of 0.83 (median 0.80) to 0.88 (median 0.83) once unfunded MDBP liabilities and 1-year expected MDBP liability spillovers are consolidated, Market D/A increases from a mean of 0.47 (median 0.47) to 0.51 (median 0.49) once unfunded MDBP liabilities and 1-year expected MDBP liability spillovers are consolidated and Book D/(D+E) increases from a mean of 0.62 (median 0.60) to 0.67 (median 0.63) once unfunded MDBP liabilities and 1-year expected MDBP liability spillovers are consolidated. In sum, leverage ratios rise on average by more than 6% once unfunded MDBP liabilities and 1-year expected MDBP liability spillovers are consolidated.

It is important to remember that MDBPs expose public companies to potential MDBP liability spillovers from both private companies and non-Schedule R public companies. In my sample, on average, other public Schedule R companies' liabilities account for just 16.3% (median 7.4%) of the total MDBP liabilities that can spill over onto public companies from all other MDBP companies. Kroger disclosed that it contributed

$7.0 million and Kellogg's disclosed that it contributed $3.6 million to the Central States in 2009[21] in their 2011 10-Ks but Kroger and Kellogg's do not appear on the 2009 Central States' Schedule R because their contributions are dwarfed by those of YRC Worldwide and Arkansas Best. Therefore, in my sample, calculated MDBP expected liability spillovers are most likely a small percentage of public companies' total expected MDBP liability spillovers from all MDBP sharing companies. On the other hand, my calculated MDBP expected liability spillovers do not account for positive competitive effects.

8. Bidirectional LMS MDBP Liability Spillovers

LMS MDBP liability spillovers exist primarily between companies in the same broad industry group. In Figure 2, I illustrate the sources of LMS MDBP liability spillover risks for companies in the transportation and aircraft industry. In Figure 3, I illustrate the sources of LMS MDBP spillover risks for companies in the food/retail/drugs industry. In Figure.4, I illustrate the sources of LMS MDBP liability spillover risks for companies in the mines/coal/oil industry. In Figure.5, I illustrate the sources of LMS MDBP liability spillover risks for companies in the manufacturing industry.

9. Robustness Checks

For my main results, I calculate 1-year and 5-year expected MDBP liability spillovers calculated with Merton default probabilities. In this section, I compare the

[21] Kroger and Kellogg's both deemed the Central States one of their significant MDBPs and disclosed this information in accordance with ASU 2011-09.

Merton default probability 1-year expected MDBP liability spillovers with 1-year expected MDBP liability spillovers calculated with Z-score and O-score bankruptcy probabilities.

I present the summary statistics for the 87 MDBP firms with all three bankruptcy probabilities and the Pearson correlations between the three bankruptcy probability measures in Table 15. The correlation between Merton default probabilities and O-score bankruptcy probabilities is 0.380 whereas the correlation between Merton default probabilities and Z-score bankruptcy probabilities is 0.230.

I present summary statistics and Pearson correlation coefficients for the 62 MDBP companies with no missing 1-year expected MDBP liability spillovers using all three bankruptcy probability measures in Table 16.

10. Conclusion

In this paper, I document the size and relevance of public companies' Schedule R MDBP liabilities, LMS, and expected MDBP liability spillovers from other Schedule R public companies. I also study the effect on public MDBP companies' leverage ratios of consolidating unfunded MDBP Schedule R liabilities and expected 1-year MDBP liability spillovers with reported debt. I document important 1-year expected bilateral MDBP liability spillovers in four different industries showing that MDBPs create important connections in U.S. unionized industries.

I find 154 public companies (144 incorporated in the U.S) listed on 2009 Schedule R Form 5500 filings. On average, MDBP public companies are three times bigger and 40% more leveraged than Compustat non-MDBP public companies. In aggregate, the 154 public companies are responsible for $23.9 billion MDBP liabilities with a mean company

MDBP liability of $155.3 million (median $10.2 million). The distribution of public companies total MDBP liabilities is severely positively skewed; six companies have total MDBP liabilities of more than $1 billion. Forty-four (28%) of public companies have total MDBP liabilities bigger than 1% of their book assets, nine public companies have total MDBP liabilities outstripping 10% of their market value of equity and three companies have total MDBP liabilities exceeding the market value of their equity.

My calculations reveal that expected MDBP liability spillovers from other public companies is not an issue for the majority of public MDBP companies. However my calculations do not include expected MDBP liability spillovers from private and non-Schedule R public companies or account for default correlation amongst MDBP companies. In my sample, on average, other public Schedule R companies' liabilities account for just 16.3% (median 7.4%) of the total liabilities from all three sources. Therefore my calculated expected MDBP liability spillovers are most likely a small percentage of the total expected MDBP liability spillovers. On the other hand, companies usually share MDBPs with companies in the same industry and my expected MDBP liability spillover calculations do not account for positive competitive effects in the event of bankruptcy.

Three industries are responsible for 86% of aggregate MDBP liabilities: transportation (51.8%), food/retail (29%), and mines/coal/oil (5.6%). Aggregate transportation industry MDBP liabilities are $12.4 billion; three companies account for 96% of these liabilities: UPS with $6.2 billion, YRC Worldwide with $4.6 billion, and Arkansas Best with $1.1 billion. Aggregate food/retail MDBP liabilities are $6.9 billion, three companies account for 83% of these liabilities: Safeway with $2.6 billion, Kroger

with $2.0 billion, and Supervalu with $1.2 billion.

For the 2009 plan year, the mean public company total 1-year expected MDBP liability spillover is $10.1 million[22](median $0.0 million). The distribution of 1-year expected MDBP liability spillovers is severely positively skewed, six companies have 1-year expected liability spillovers of more than $5 million and 56 companies have 1-year expected MDBP liability spillovers of less than $0.1 million. Three companies have 5-year expected MDBP liability spillovers surpassing 1% of book assets. On average, a firm's 5-year expected MDBP liability spillover is 3.3 times greater than its 1-year expected MDBP liability spillover.

Book D/A increases from a mean of 0.84 (median 0.83) to 0.87 (median 0.84) once unfunded MDBP liabilities are consolidated with reported debt. On average, leverage ratios increase by 4% once unfunded MDBP liabilities are consolidated with reported debt. Book D/A increases from a mean of 0.83 (median 0.82) to 0.88 (median 0.83) once unfunded MDBP liabilities and 1-year expected MDBP liability spillovers are consolidated with reported debt. On average, leverage ratios increase by more than 6% once unfunded MDBP liabilities and 1-year expected MDBP liability spillovers are consolidated with reported debt.

[22] Seventy-five companies with no missing expected MDBP spillovers used to calculate mean and median.

Table 1 Illustration of the Five Spillover Events in the 5-year Two Public Company Case

Bankruptcy Event Year 1	2	3	4	5	Spillover Event Description
B					B goes bankrupt in 1st year and A survives for 5 years
	B				B goes bankrupt in 2nd year and A survives for 5 years
		B			B goes bankrupt in 3rd year and A survives for 5 years
			B		B goes bankrupt in 4th year and A survives for 5 years
				B	B goes bankrupt in 5th year and A survives for 5 years

Table 2. Calculation of Discounted Expected 5-year Spillovers
where r.= 1-year discount rate and $SLMS_{A,B,1}$ is the LMS MDBP spillover onto A when B goes bankrupt in the first year

Bankrupt Company Year					**Event Probability**	**Discounted Spillover ($m)**	**Discounted Expected Spillover ($m)**
1	**2**	**3**	**4**	**5**			
B					$P_{E1=}(1-p_A)^5 \text{ x } p_B$	$SLMS_{A,B,1}$	$P_{E1} \text{ x } SLMS_{A,B,1}$
	B				$P_{E2=} (1-p_A)^5 \text{ x } (1-p_B) \text{ x } p_B$	$SLMS_{A,B,2}/(1+r)$	$P_{E2} \text{ x } SLMS_{A,B,2}/(1+r)$
		B			$P_{E3=}(1-p_A)^5 \text{ x } (1-p_B)^2 \text{ x } p_B$	$SLMS_{A,B,,3/}/(1+r)^2$	$P_{E3} \text{ x } SLMS_{A,B,,3}/(1+r)^2$
			B		$P_{E4=}(1-p_A)^5 \text{ x } (1-p_B)^3 \text{ x } p_B$	$SLMS_{A,B,,3}/(1+r)^3$	$P_{E4} \text{ x } SLMS_{A,B,,3} /(1+r)^3$
				B	$P_{E5=}(1-p_A)^5 \text{ x } (1-p_B)^4 \text{ x } p_B$	$SLMS_{A,B,,5}/(1+r)^4$	$P_{E5} \text{ x } SLMS_{A,B,,5.} /(1+r)^4$.

Table 3. Three Public Company Spillover Events over a 5-year Period

Bankruptcy Event Year					Spillover Event Description
1	2	3	4	5	
B					B goes bankrupt in the 1st year and A and C survive for 5 years
C					C goes bankrupt in the 1st year and A and B survive for 5 years
BC					B and C go bankrupt in the 1st year and A survives for 5 years
	B				B goes bankrupt in the 2nd year and A and C survive for 5 years
	C				C goes bankrupt in the 2nd year and A and B survive for 5 years
	BC				B and C go bankrupt in the 2nd year and A survives for 5 years
B	C				B goes bankrupt in the 1st year, C goes bankrupt in the 2nd year and A survives for 5 years
C	B				C goes bankrupt in the 1st year, B goes bankrupt in the 2nd year and A survives for 5 years
		B			B goes bankrupt in the 3rd year and A and C survive for 5 years
		C			C goes bankrupt in the 3rd year and A and B survive for 5 years
		BC			B and C go bankrupt in the 3rd year and A survives for 5 years
	B	C			B goes bankrupt in the 2nd year, C goes bankrupt in the 3rd year and A survives for 5 years
	C	B			C goes bankrupt in the 2nd year, B goes bankrupt in the 3rd year and A survives for 5 years
B		C			B goes bankrupt in the 1st year, C goes bankrupt in the 3rd year and A survives for 5 years
C		B			C goes bankrupt in the 1st year, B goes bankrupt in the 3rd year and A survives for 5 years
			B		B goes bankrupt in the 4th year and A and C survive for 5 years
			C		C goes bankrupt in the 4th year and A and B survive for 5 years
			BC		B and C go bankrupt in the 3rd year and A survives for 5 years
		B	C		B goes bankrupt in the 3rd year, C goes bankrupt in the 4th year and A survives for 5 years
		C	B		C goes bankrupt in the 3rd year, B goes bankrupt in the 4th year and A survives for 5 years
	B		C		B goes bankrupt in the 2nd year, C goes bankrupt in the 4th year and A survives for 5 years
	C		B		C goes bankrupt in the 2nd year, B goes bankrupt in the 4th year and A survives for 5 years
B			C		B goes bankrupt in the 1st year, C goes bankrupt in the 4th year and A survives for 5 years
C			B		C goes bankrupt in the 1st year, B goes bankrupt in the 4th year and A survives for 5 years
				B	B goes bankrupt in the 5th year and A and C survive for 5 years
				C	C goes bankrupt in the 5th year and A and B survive for 5 years
				BC	B and C go bankrupt in the 5th year and A survives for 5 years

Table 3. Continued

Bankruptcy Event Year 1	2	3	4	5	Spillover Event Description
			B	C	B goes bankrupt in the 4th year, C goes bankrupt in the 5th year and A survives for 5 years
			C	B	C goes bankrupt in the 4th year, B goes bankrupt in the 5th year and A survives for 5 years
		B		C	B goes bankrupt in the 3rd year, C goes bankrupt in the 5th year and A survives for 5 years
		C		B	C goes bankrupt in the 3rd year, B goes bankrupt in the 4th year and A survives for 5 years
	B			C	B goes bankrupt in the 2nd year, C goes bankrupt in the 5th year and A survives for 5 years
	C			B	C goes bankrupt in the 2nd year, B goes bankrupt in the 5th year and A survives for 5 years
B				C	B goes bankrupt in the 1st year, C goes bankrupt in the 5th year and A survives for 5 years
C				B	C goes bankrupt in the 1st year, B goes bankrupt in the 5th year and A survives for 5 years

Table 4 Schedule R Company Matches to Public Companies

Matching Method	Number of observations
Employer EIN	85
Exhibit 21	202
10-K	32
Company website	42
Same Employer EIN as 401K of Public Company	28
Same employer EIN as company already matched	15
Other (court documents, news stories, EIN match using EIN finder)	125
Total number of public company observations	**529**

Table 5 Distribution of Number of Public Companies listed on an Individual MDBP's Schedule R

Number of Public Companies	**Number of Plans**	**Percentage (%)**
1	218	65.5
2	82	24.6
3	29	8.7
4	1	0.3
5	2	0.6
6	1	0.3
Total	**333**	**100**

Table 6 Public MDBP Company Summary Statistics

Panel A Descriptive Statistics

	MDBP Public Companies 141 observations		**Non-MDBP Public Companies 4,429 observations**	
	Mean	Median	Mean	Median
Market Value of Equity ($ millions)	15,568	3,601	5,002	563
Log of book assets	8.6	8.6	6.9	6.6
Market to Book Ratio	3.7	1.8	5.7	1.7

Panel B : Broad Industry Groups

Broad Industry Group	**No of Public Companies**	**Percentage (%)**
Aircraft	5	3.2
Construction/Engineering/Steel	27	17.5
Entertainment/Printing	20	13.0
Food/Retail	27	17.5
Hotels/Casinos	2	1.3
Mines/Coal/Oil	4	2.6
Paper/Paperboard	4	2.6
Transportation	13	8.4
Waste Management	6	3.9
Other	46	29.9
Total	154	100.0

Table 7 Merton Default Probability Estimation Summary Statistics

				Quantiles			
Variable	**Mean**	**Std. dev.**	**Min**	**0.25**	**Median**	**0.75**	**Max**
N=95							
E	15596	33151	134	1385	3443	12023	194875
F	6469	32582	1	381	1247	3767	316249
V	22065	59941	254	2002	5440	16820	511124
σ_v(%)	34.07	25.06	9.91	22.69	29.17	38.27	210.40
μ (%)	15.05	34.91	-78.66	-2.22	11.59	25.69	215.48
p_{MERTON}(%)	7.71	22.07	0.00	0.00	0.00	0.43	99.87

Table 8 Total Public Company Liability Summary Statistics by Broad Industry Group

		Company Liabilities ($ millions)			Percentage of
Broad Industry Group	**N**	**Mean**	**Median**	**Sum**	**Total (%)**
Aircraft	5	96.4	14.4	482.1	2.0
Construction/Engineering/Steel	27	31.5	2.9	851.3	3.6
Entertainment/Printing	20	48.3	15.5	965.6	4.0
Food/Retail	27	257.1	19.4	6,942.9	29.0
Hotels/Casinos	2	7.5	7.5	15	0.1
Mines/Coal/Oil	4	330.7	265.4	1,332.8	5.6
Paper/Paperboard	4	27.6	24.6	110.5	0.5
Transportation	13	953.4	71.8	12,394.4	51.8
Waste Management	6	22.8	19.4	136.6	0.6
Other	46	15.1	6.4	696	2.9
Total	154			23927.2	100.0

Table 9 Public Companies with MDBP Liabilities exceeding $100 million for the 2009 Plan Year

Company Name	MDBP liability ($ millions)	Market Value of Equity ($ millions)	Total Assets ($ millions)	No of Plans	MDBP Liability as a Percentage of Book Assets (%)	Total Schedule R contributions ($ millions)	Percentage of MDBP contributions covered by Schedule R (%)
UNITED PARCEL SERVICE	6,194.8	71,645	33,597	23	18.4	925.3	82.2
YRC WORLDWIDE	4,584.4	177	2,593	9	176.8	294.0	68.3
SAFEWAY	2,554.4	8,276	15,148	16	16.9	179.3	64.5
KROGER	2,003.1	13,268	23,505	19	8.5	149.0	64.0
SUPERVALU	1,189.6	1,830	13,758	21	8.6	96.2	67.3
ARKANSAS BEST	1,145.1	693	861	8	133.0	79.4	73.8
CONSOL ENERGY	652.5	11,023	12,071	1	5.4	28.6	111.8
GREAT ATLANTIC and PACIFIC TEA	317.7	13	2,645	10	12.0	35.1	56.4
UNITED TECHNOLOGIES	310.3	72,522	58,493	1	0.5	51.4	40.8
DISNEY (WALT)	309.4	62,787	69,206	15	0.4	52.6	101.2
EMCOR GROUP	276.9	1932	2,756	35	10.0	39.5	21.0
NEWS CORP	267.3			9		48.7	88.6
WALTER ENERGY	266.3	6,793	1,658	1	16.1	11.7	108.9
ALPHA NATURAL RESOURCES	264.5	7,233	5,179	1	5.1	11.6	138.4
KRAFT FOODS	247.1		21,598	2	1.1	23.4	80.7
HILLSHIRE BRANDS	240.7	9,336	8,836	5	2.7	24.3	48.6
UNITED CONTINENTAL	164.8	7,811	39,598	1	0.4	34.5	101.5
SPIRIT AEROSYSTEMS	155.0	2,957	5,102	1	3.0	32.5	179.4
BABCOCK and WILCOX	146.7	2,991	2,501	1	5.9	13.2	63.9
PATRIOT COAL	139.4	1,762	3,810	1	3.7	6.1	54.7
US STEEL	130.4	8,393	15,350	1	0.8	57.1	98.4
ARCELORMITTAL	127.2	59,047	130,904	1	0.1		

Table 10 Leverage Characteristics of MDBP Companies and Non-MDBP Companies

	MDBP Companies 131 Companies		**Non-MDBP Companies** 3,369 Companies	
	Mean	**Median**	**Mean**	**Median**
MDBP liability as a percentage of Long Term Debt (%)	4.91	0.39		
Book D/A	0.84	0.83	0.66	0.65
Book D/A consolidated with MDBP Liability	0.87	0.84		
Market D/A	0.46	0.46	0.30	0.27
Market D/A consolidated with MDBP Liability	0.48	0.47		
Book D/(D+E)	0.61	0.59	0.44	0.44
Book D/(D+E) consolidated with MDBP Liability	0.63	0.60		
Market Value of Equity ($ millions)	13,329	3,213	5,121	591
Log of Total Book Assets	8.5	8.5	6.3	6.2
Market to Book Ratio	3.8	1.9	7.0	2.1

Table 11 Schedule R Public Companies with 1-year Expected MDBP Liability Spillovers exceeding One Million Dollars

Company Name	Expected 1-year Liability Spillover ($ millions)	Book Assets ($ millions)	No of Spillover Plans	No of Missing Spillover Plans	Liability Spillover as a Percentage of Book Assets
ARKANSAS BEST CORP	503.6	861	7	0	58.5
KROGER CO	137.8	23505	15	0	0.6
SAFEWAY INC	106.3	15148	14	1	0.7
SUPERVALU INC	61.2	13758	14	0	0.4
UNITED PARCEL SERVICE INC	20.8	33597	7	0	0.1
SYSCO CORP	9.7	10314	3	0	0.1
CVS CAREMARK CORP	6.2	62169	2	0	0.0
VILLAGE SUPER MARKET	4.7	357	3	0	1.3
REPUBLIC SERVICES INC	3.4	19462	2	0	0.0
AT&T INC	2.0	268488	2	0	0.0
WASTE MANAGEMENT INC	1.7	21476	3	0	0.0
TREEHOUSE FOODS INC	1.0	2391	1	0	0.0

Table 12 LMS and 1-year Expected Liability MDBP Spillovers

		Spillover in $millions			Spillover as a Percentage of Book Assets		
	N	**Mean**	**Median**	**Maximum**	**Mean**	**Median**	**Maximum**
LMS Spillover	75	113.4	16.7	2,223.5	3.0	0.1	92.6
1-year Expected Spillover	75	10.1	0.0	503.6	0.8	0.0	58.5

Table 13 1-year and 5-year Expected Liability MDBP Spillovers

		Spillover in $millions			Spillover as a Percentage of Book Assets		
	N	**Mean**	**Median**	**Maximum**	**Mean**	**Median**	**Maximum**
1-year Expected Spillover	66	11.1	0.0	503.6	0.9	0.0	58.5
5-year Expected Spillover	66	13.1	0.0	553.6	1.0	0.0	64.3

Table 14 Leverage of MDBP Liability Spillover Public Companies and Non-MDBP Public Companies

	MDBP with Liability Spillover Risks		**Non-MDBP Companies**	
	66 Companies		3,369 Companies	
	Mean	**Median**	**Mean**	**Median**
MDBP Liability and Liability Spillover as a percentage of Long Term Debt	9.61	0.42		
Book D/A	0.83	0.80	0.66	0.65
Book D/A consolidated with MDBP liability and Liability Spillover	0.88	0.83		
Market D/A	0.47	0.47	0.30	0.27
Market D/A consolidated with MDBP Liability and Liability Spillover	0.51	0.49		
Book D/(D+E)	0.62	0.60	0.44	0.44
Book D/(D+E) consolidated with MDBP Liability and Liability Spillover	0.67	0.63		
Market Value of Equity ($ millions)	16,693	4,865	5,121	591
Log of Total Book Assets	8.9	8.8	6.3	6.2
Market to Book Ratio	3.3	1.8	7.0	2.1

Table 15 Comparison of Bankruptcy Probability Measures

Panel A: Descriptive Statistics

Bankruptcy Probability Measure	Mean	Std. dev.	Min	Quantiles 0.25	Median	0.75	Max
N=87							
Merton Default (%)	7.93	22.97	0.00	0.00	0.00	0.10	99.87
Z Score (%)	11.50	11.68	0.00	2.85	8.48	16.16	63.49
O score (%)	26.06	25.10	1.14	6.73	16.94	35.83	97.37

Panel B: Pearson Correlations

	Merton Default	Z	O
Merton Default	1	0.230	0.380
Z	0.230	1	0.357
O	0.380	0.357	1

Table 16 Expected 1-year MDBP Liability Spillovers using Different Bankruptcy Probabilities

N=62

Panel A Summary Statistics

Bankruptcy Probability Measure	**Mean**	**Std. dev.**	**Min**	**Quantiles 0.25**	**Median**	**0.75**	**Max**
Merton Default ($m)	12.16	66.25	-0.03	0.00	0.00	0.14	503.56
Z Score ($m)	6.22	25.12	-0.01	0.03	0.29	3.08	194.53
O score ($m)	15.51	53.10	-0.04	0.06	0.58	5.06	360.76

Panel B Pearson Correlations

Merton	**Merton Default**	**Z**	**O**
Default	1	0.963	0.928
Z	0.963	1	0.906
O	0.928	0.906	1

Bankruptcy Event Year 1	2	3	4	5	Event Probability	Discounted Spillover ($m)	Discounted Expected Spillover ($m)
B					$0.9 \times 0.2 \times 0.7 \times (0.9 \times 0.7)^4 = 0.020$	90	0.020x90=1.79
C					$0.9 \times 0.8 \times 0.3 \times (0.9 \times 0.8)^4 = 0.058$	120	0.058x120=6.97
BC					$0.9 \times 0.2 \times 0.3 \times 0.9^4 = 0.035$	294.55	0.035x294.55=10.44
	B				$0.9 \times 0.8 \times 0.7 \times 0.9 \times 0.2 \times 0.7 \times (0.9 \times 0.7)^3 = 0.016$	90/1.05=85.71	0.016x85.71=1.36
	C				$0.9 \times 0.8 \times 0.7 \times 0.9 \times 0.8 \times 0.3 \times (0.9 \times 0.8)^3 = 0.041$	120/1.05=114.29	0.041x114.29=4.64
	BC				$0.9 \times 0.8 \times 0.7 \times 0.9 \times 0.2 \times 0.3 \times 0.9^3 = 0.020$	294.55/1.05=280.52	0.020x280.52=5.57
B	C				$0.9 \times 0.2 \times 0.7 \times 0.9 \times 0.3 \times 0.9^3 = 0.025$	90+204.55/1.05=284.81	0.025x284.81=7.06
C	B				$0.9 \times 0.8 \times 0.3 \times 0.9 \times 0.2 \times 0.9^3 = 0.028$	120+174.55/1.05=286.24	0.028x286.24=8.11
		B			$(0.9 \times 0.8 \times 0.7)^2 \times 0.9 \times 0.2 \times 0.7 \times (0.9 \times 0.7)^2 = 0.013$	$90/1.05^2=81.63$	0.013x81.63=1.04
		C			$(0.9 \times 0.8 \times 0.7)^2 \times 0.9 \times 0.8 \times 0.3 \times (0.9 \times 0.8)^2 = 0.028$	$120/1.05^2=108.84$	0.028x108.84=3.10
		BC			$(0.9 \times 0.8 \times 0.7)^2 \times 0.9 \times 0.2 \times 0.3 \times 0.9^2 = 0.011$	$294.55/1.05^2=267.17$	0.011x267.17=2.97
	B	C			$0.9 \times 0.8 \times 0.7 \times 0.9 \times 0.2 \times 0.7 \times 0.9 \times 0.3 \times 0.9^2 = 0.014$	$90/1.05+204.55/1.05^2=271.25$	0.014x271.25=3.77
	C	B			$0.9 \times 0.8 \times 0.7 \times 0.9 \times 0.8 \times 0.3 \times 0.9 \times 0.2 \times 0.9^2 = 0.016$	$120/1.05+174.55/1.05^2=272.61$	0.016x272.61=4.33
B		C			$0.9 \times 0.2 \times 0.7 \times 0.9 \times 0.7 \times 0.9 \times 0.3 \times 0.9^2 = 0.0174$	$90+204.55/1.05^2=275.53$	0.0174x275.53=4.78
C		B			$0.9 \times 0.8 \times 0.3 \times 0.9 \times 0.8 \times 0.9 \times 0.2 \times 0.9^2 = 0.023$	$120+174.55/1.05^2=278.32$	0.023x278.32=6.31
			B		$(0.9 \times 0.8 \times 0.7)^3 \times 0.9 \times 0.2 \times 0.7 \times 0.9 \times 0.7 = 0.010$	$90/1.05^3=77.75$	0.010x77.75=0.79
			C		$(0.9 \times 0.8 \times 0.7)^3 \times 0.9 \times 0.8 \times 0.3 \times 0.9 \times 0.8 = 0.020$	$120/1.05^3=103.66$	0.020x103.66=2.06
			BC		$(0.9 \times 0.8 \times 0.7)^3 \times 0.9 \times 0.2 \times 0.3 \times 0.9 = 0.006$	$294.55/1.05^3=254.44$	0.006x254.44=1.58
		B	C		$(0.9 \times 0.8 \times 0.7)^2 \times 0.9 \times 0.2 \times 0.7 \times 0.9 \times 0.3 \times 0.9 = 0.008$	$90/1.05^2+204.55/1.05^3=258.33$	0.008x258.33=2.01
		C	B		$(0.9 \times 0.8 \times 0.7)^2 \times 0.9 \times 0.8 \times 0.3 \times 0.9 \times 0.2 \times 0.9 = 0.009$	$120/1.05^2+174.55/1.05^3=259.63$	0.009x259.63=2.31

Figure 1 Calculation of Discounted Expected 5-year MDBP Liability Spillovers in the Three Public Company MDBP Case.

Bankruptcy Event Year 1	2	3	4	5	Event Probability	Discounted Spillover ($m)	Discounted Expected Spillover ($m)
	B		C		0.9x0.8x0.7x0.9x0.2x0.7x0.9x0.7x0.9x0.3x0.9=0.010	90/1.05+204.55/1.05^3=262.41	0.010x262.41=2.55
	C		B		0.9x0.8x0.7x0.9 x0.8 x 0.3 x0.9 x0.8 x0.9x0.2x0.9=0.013	120/1.05+174.55/1.05^3=265.07	0.013x265.07=3.37
B			C		0.9 x0.2x0.7x$(0.9x0.7)^2$x0.9x0.3X0.9=0.012	90+204.55/1.05^3=266.70	0.012x266.70=3.24
C			B		0.9x0.8x0.3x$(0.9x0.8)^2$x0.9x0.2x0.9=0.018	120+174.55/1.05^3=270.78	0.018x270.78=4.91
				B	$(0.9x0.8x0.7)^4$ x 0.9x0.2 x0.7	90/1.05^4=74.04	0.008x74.04=0.60
				C	$(0.9x0.8x0.7)^4$x0.9 x 0.8 x0.3=0.014	120/1.05^4=98.72	0.014x98.72=1.38
				BC	$(0.9x0.8x0.7)^4$x0.9 x 0.2 x0.3=0.003	294.55/1.05^4=242.33	0.003x242.33=0.84
			B	C	$(0.9x0.8x0.7)^3$x0.9 x 0.2 x0.7 x0.9 x0.3=0.004	90/1.05^3+204.55/1.05^4=246.03	0.004x246.03=1.07
			C	B	(0.9x0.8x0.7)^3x0.9 x 0.8 x0.3 x0.9 x0.2=0.005	120/1.05^3+174.55/1.05^4=247.26	0.005x247.26=1.23
		B		C	$(0.9x0.8x0.7)^2$x0.9x0.2x0.7x0.9x0.7x0.9x0.3=0.005	90/1.05^2+204.55/1.05^4=249.92	0.005x249.92=1.36
		C		B	$(0.9x0.8x0.7)^2$x0.9 x0.8 x 0.3 x0.9 x0.8 x0.9x0.2=0.007	120/1.05^2+174.55/1.05^4=252.44	0.007x252.44=1.80
	B			C	0.9x0.8x0.7x0.9 x0.2x0.7x$(0.9x0.7)^2$x0.9x0.3=0.007	90/1.05+204.55/1.05^4=254.00	0.007x254.00=1.73
	C			B	0.9x0.8x0.7x0.9x0.8x0.3x$(0.9x0.8)^2$x0.9x0.2=0.010	120/1.05+174.55/1.05^4=257.89	0.010x257.89=2.62
B				C	0.9x0.2x0.7x$(0.9 x0.7)^3$x0.9x0.3=0.009	90+204.55/1.05^4=258.28	0.009x258.28=2.20
C				B	0.9x0.8x0.3x$(0.9 x0.8)^3$x0.9x0.2=0.015	120+174.55/1.05^4=263.60	0.015x263.60=3.83
						Total Expected Spillover	**$114 million**

Figure.1. Continued

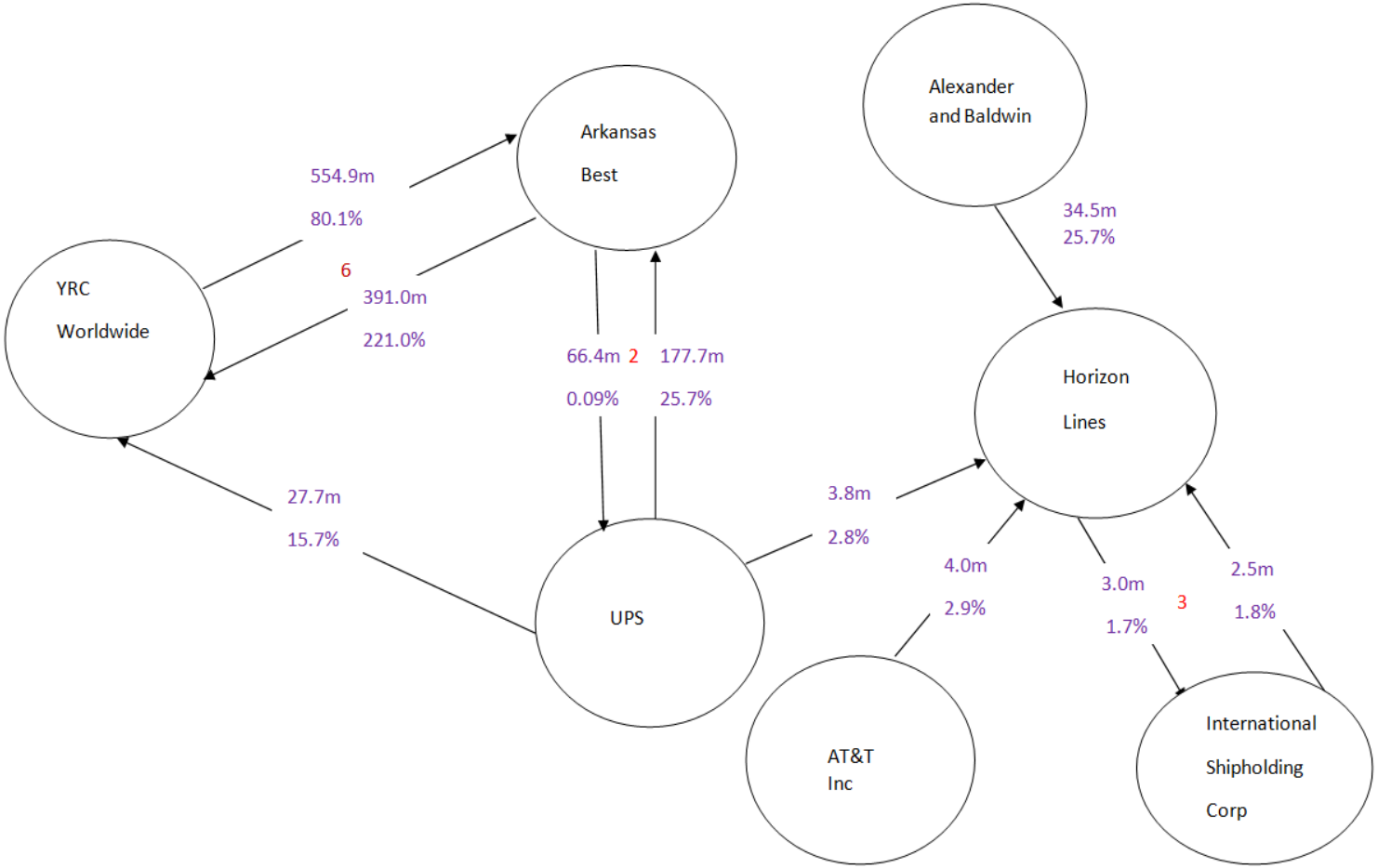

Figure 2. Sources of LMS spillovers onto Transportation/Aircraft Industry Companies.
I show only LMS spillovers of more than $50 million or more than one percent of the company's value of market equity as at November 30, 2011. When two companies share more than one MDBP, I show the number of MDBPs shared in red.

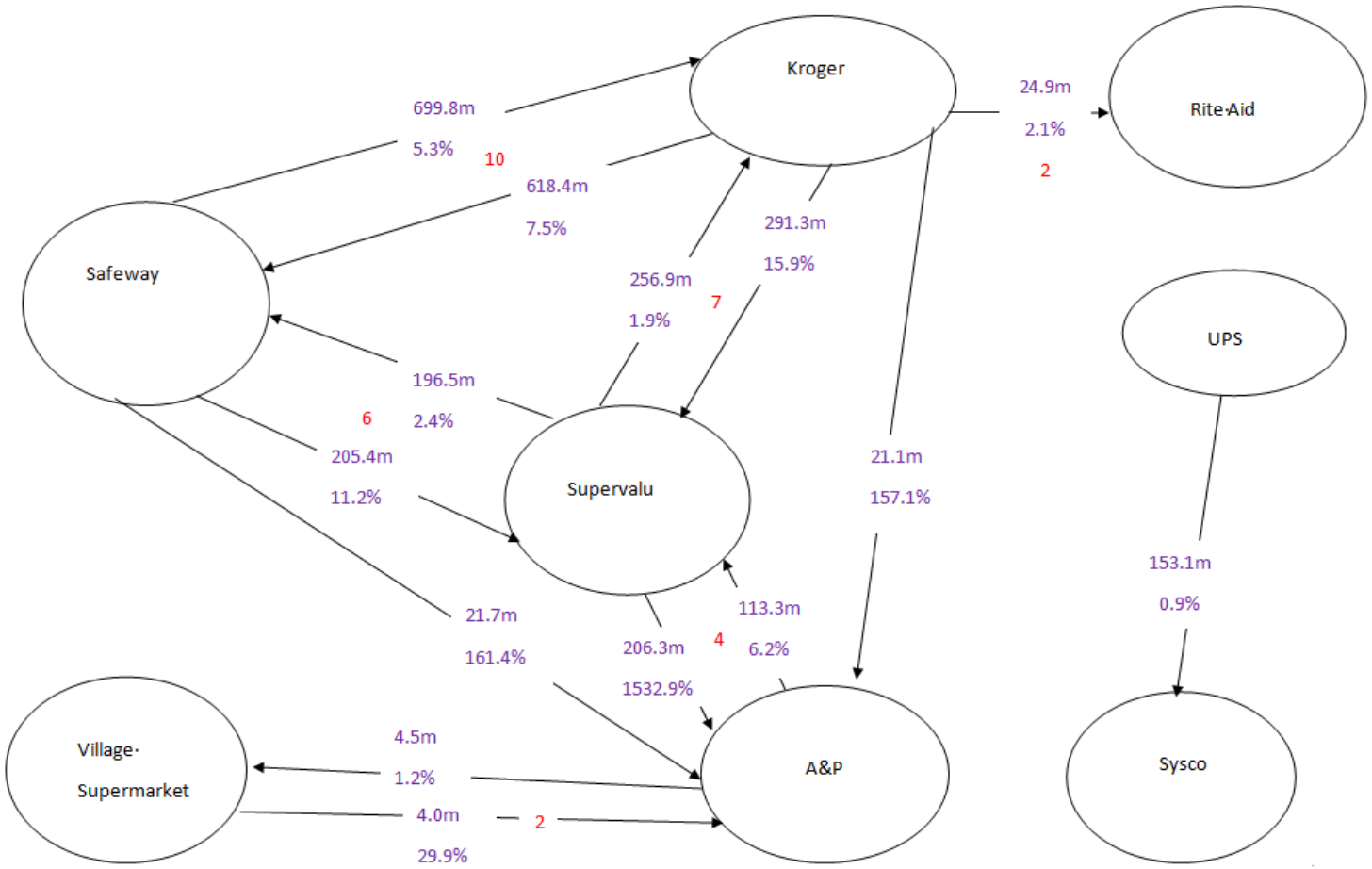

Figure 3. Sources of LMS MDBP Liability Spillovers onto Food/Retail/Drugs Companies.
I show only LMS spillovers of more than $50 million or more than one percent of the company's value of market equity as at November 30, 2011. When two companies share more than one MDBP, I show the number of MDBPs shared in red.

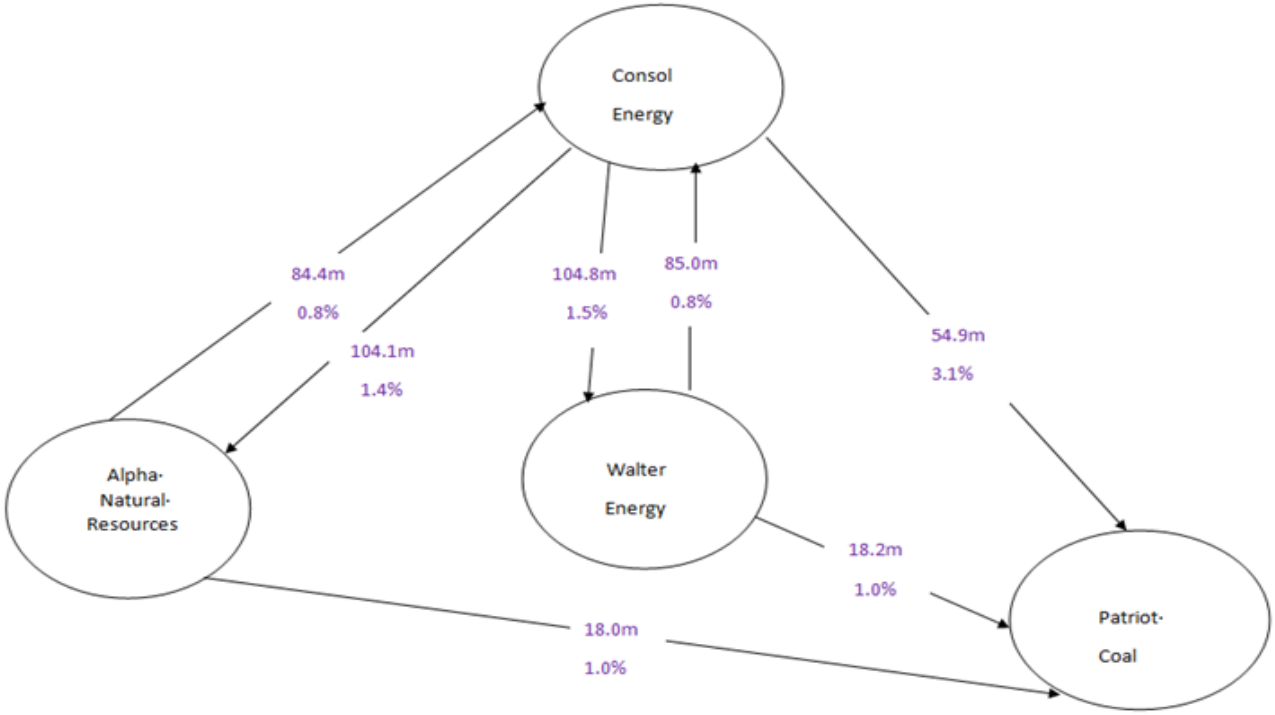

Figure 4. Sources of LMS MDBP Liability Spillovers onto Mines/Coal/Oil Companies.
I show only LMS spillovers of more than $50 million or more than one percent of the company's value of market equity as at November 30, 2011. When two companies share more than one MDBP, I show the number of MDBPs shared in red.

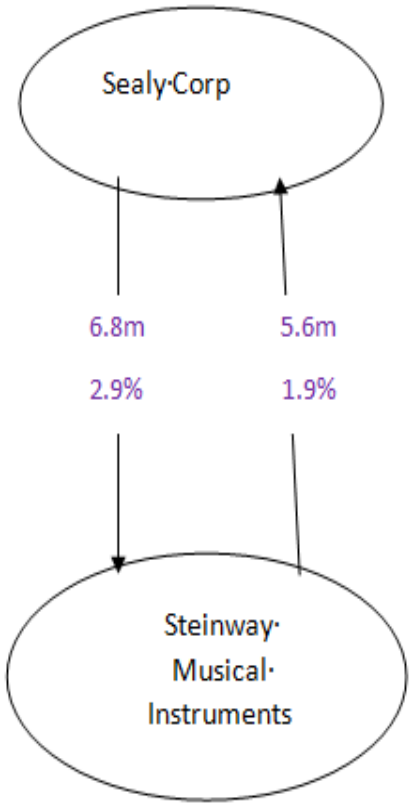

Figure 5. Sources of LMS MDBP Liability Spillovers onto Manufacturing Companies.
I show only LMS spillovers of more than $50 million or more than one percent of the company's value of market equity as at November 30, 2011. When two companies share more than one MDBP, I show the number of MDBPs shared in red.

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A.1 Calculation of an Individual MDBP's Unfunded Liabilities

I give a numerical example showing the calculation of an individual MDBP's unfunded liabilities:

Plan Data	**($ in millions)**
RPA 94 Liability	8,000
Current Value of Net Assets	6,000

MDBP's unfunded liability=

0.9 x (RPA 94 Liability-Current Value of Net Assets) x 0.5

= 0.9 x (8,000 - 6,000) x 0.5 = $900 million

A.2 Calculation of Company's Share of MDBP Unfunded Liabilities

I give a numerical example showing the calculation of three schedule R companies' share of the MDBP unfunded liabilities:

Total Employer Contributions $100 million

Schedule R Data	**($ millions)**
Company A's contributions	40
Company B's contributions	20
Company C's contributions	25

Schedule R Company's share of MDBP unfunded liabilities=

Company's contributions/ Max (Schedule MB Total Employer Contributions, Schedule R Total Employer Contributions)

Company A's share of MDBP unfunded liabilities=40/100=40%

Company B's share of MDBP unfunded liabilities=20/100=20%

Company C's share of MDBP unfunded liabilities=25/100=25%

I estimate a company's individual plan MDBP ongoing[23] liabilities by multiplying the company's share of the MDBP unfunded liabilities by the MDBP's unfunded liabilities. I give a numerical example showing the calculation of each Schedule R company's share of the MDBP liability:

MDBP Plan Unfunded Liabilities	$900 million
Company Share	
Company A	40%
Company B	20%
Company C	25%

Company A's share of MDBP Unfunded liabilities =

Company A's share x MDBP Unfunded Liabilities = 40% of $900 million=$360 million

Company B's share of MDBP liabilities =

Company B's share x MDBP Unfunded Liabilities = 20% of $900 million =$180 million

Company C's share of MDBP liabilities =

Company C's share x MDBP Unfunded Liabilities =25% of $900 million =$225 million

[23] My estimate of a firm's individual MDBP liabilities is not an estimate of the firm's withdrawal liability but rather an estimate of the firm's ongoing MDBP liability. Moody's (2009) explain that a MDBP withdrawal liability will nearly always be higher than the firm's current share of the unfunded MDBP liability. When withdrawing from a MDBP, a firm will not benefit from wage concessions from labor.

A.3 Calculating LMS MDBP Liabilities in the Three Public Company Case

I give a numerical example showing how I calculate LMS MDBP liability spillovers for Company A when three public companies are listed on the MDBP Form 5500 Schedule R.

	($ millions)
Total Employer Contributions	100
Company A's contributions	40
Company B's contributions	20
Company C's contributions	25
Company A's share of MDBP liabilities	360
Company B's share of MDBP liabilities	180
Company C's share of MDBP liabilities	225

A's new share of MDBP unfunded liabilities upon B and C's bankruptcy =

Company A's plan year contributions divided by the total employer contributions minus the sum of company B's and company C's contributions) = 40 / (100- (20+25)) = 8/11

LMS Liability Spillover onto Company A in the event that both Company B and Company C become bankrupt = Company A's new share of MDBP liabilities x sum of Company B's and Company C's MDBP liability = 8/11 x (180+225) = $294.6 million

A.4 Calculating 1-year Expected MDBP Liabilities in the Two Public Company Case

I give a numerical example showing how I calculate 1-year expected MDBP liability spillovers when there are two public companies listed on the MDBP Form 5500 Schedule R:

	($ millions)
Total Employer Contributions	100
Company A's contributions	40
Company B's contributions	20
Company A's share of unfunded MDBP liabilities	360
Company B's share of unfunded MDBP liabilities	180
Company A's bankruptcy probability	0.1
Company B's bankruptcy probability	0.2

A's new share of MDBP unfunded liabilities upon B's bankruptcy =

Company A's contributions / (Total Employer Contributions– Company B's contributions) =40/ (100-20) =0.5

Company A's expected liability spillover from company B =A's new share of MDBP liabilities x B's MDBP liability x B's bankruptcy probability x Complement of A's bankruptcy probability = 0.5 x 180 x 0.2 x (1-0.1) =$16.2 million

B's new share of MDBP unfunded liabilities upon A's bankruptcy =

Company B's contributions / (Total Employer Contributions – Company A's contributions) = 20/ (100-40) =1/3

Company B's expected liability spillover from company A = B's new share of MDBP liabilities x A's own MDBP liability x A's bankruptcy probability x Complement of B's bankruptcy

probability= 1/3 x 360 x 1/3 x 0.1x (1-0.2) =$ 9.6 million

A.5 Calculating 1-year Expected MDBP Liabilities in the Three Public Company Case

When there are three public companies listed on the MDBP Form 5500 Schedule R, I calculate the 1-year expected MDBP liability spillover onto company A from companies B and C as follows:

Expected MDBP liability spillover onto company A=

Expected Liability Spillover when only company B goes bankrupt +

Expected Liability Spillover when only company C goes bankrupt +

Expected Liability Spillover when both companies B and C go bankrupt

I give a numerical example illustrating how I calculate 1-year expected MDBP liability spillovers for Company A when three public companies are listed on the MDBP Form 5500 Schedule R.

	($ millions)
Total Employer Contributions	100
Company A's contributions	40
Company B's contributions	20
Company C's contributions	25
Company A's share of MDBP liabilities	360
Company B's share of MDBP liabilities	180
Company C's share of MDBP liabilities	225
Company A's bankruptcy probability	0.1

Company B's bankruptcy probability	0.2
Company C's bankruptcy probability	0.3

I calculate expected MDBP liability spillovers for the three different outcomes: only Company B goes bankrupt, only Company C goes bankrupt and both Company B and Company C go bankrupt.

A.5.1 Only Company B Goes Bankrupt

A's new share of MDBP unfunded liabilities upon B's bankruptcy =

Company A's contributions / (Total Employer Contributions – Company B's MDBP Contributions) = 40 / (100-20) = 0.5

Expected Liability Spillover onto Company A in the event that only Company B goes bankrupt

= Company A's new share of MDBP liabilities x Company B's MDBP liability x Company B's bankruptcy probability x Complement of Company C's bankruptcy probability x Complement of Company A's bankruptcy probability = 0.5 x 180 x 0.2 x (1-0.3) x (1-0.1) = $11.34 million

A.5.2 Only Company C Goes Bankrupt

A's new share of MDBP unfunded liabilities upon C's bankruptcy = Company A's contributions / (Total Employer Contributions– Company C's MDBP contributions)

= 40 / (100-25) = 8/15.

Expected Liability Spillover onto Company A in the event that only Company C goes bankrupt = Company A's new share of MDBP liabilities x Company C's MDBP liability

x Company C's bankruptcy probability x Complement of Company B's bankruptcy probability x Complement of Company A's bankruptcy probability

= 8/15 x 225 x 0.3 x (1-0.2) x (1-0.1) = $25.92 million

A.5.3 Company B and Company C Goes Bankrupt

A's new share of MDBP unfunded liabilities upon B and C's bankruptcy =

Company A's plan year contributions divided by the total employer contributions minus the sum of company B's and company C's contributions) = 40 / (100- (20+25)) = 8/11

Expected Liability Spillover onto Company A in the event that both Company B and Company C become bankrupt = Company A's new share of MDBP liabilities x sum of Company B's and Company C's MDBP liability x Company B's bankruptcy probability x Company C's bankruptcy probability x Complement of Company A's bankruptcy probability = 8/11 x (180+225) x 0.3 x 0.2 x (1-0.1) = $15.90545 million

A.5.4 Company A's Total 1-year Expected MDBP Liability Spillover

Outcome	***($ millions)***
Only Company B goes bankrupt	11.34
Only Company C goes bankrupt	25.92
Company B and C goes bankrupt	15.90545
Total	53.17