Original Article

Dissecting cost impact of pension funds' swing into bonds

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ABSTRACT The changing investment and regulatory landscape has prompted pension funds to ponder their investment strategies, but there are very few studies to quantify the actuarial impact of an asset allocation shift by pension funds. In their bid to match assets and liabilities to reduce risk, more and more pension funds have taken investment strategies of swinging into bonds. The article attempts to fill the gap in the literature by quantifying the price impact and gauging the actuarial cost of such a move. We find that the inadequate bond supply may result in a statistically and economically significant impact on bond yields and an actuarially significant impact on the cost of providing pension benefits.

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INTRODUCTION

Recent years have seen a marked shift of pension funds' investment strategies. Against the backdrop of falling pension asset values and rising liabilities in the wake of the unprecedented global financial crisis and a changing regulatory landscape, pension funds are increasingly reducing investments in equities while allocating more assets in fixed income securities, especially bonds.

The shift in allocation strategies may raise important questions concerning the impact on bond yields and resulting effects on the cost of pension benefits. Whether the shift to bonds from equities could affect bond prices will depend on, among other things, the balance between bond demand and supply. If bond supply falls short of demand, bond prices may go up and bond yields may go down. The adequacy of bond supply may have significant actuarial implications as the imbalance may not only increase the cost of purchasing an immunized portfolio, but also hike pension liabilities.

Despite a large literature studying the link between population aging and financial market returns, little has been done to quantify the potential actuarial impact of pension funds' swing into bonds. The article attempts to fill the gap in the literature by quantifying the price impact and gauging the actuarial cost. Specifically, we first

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apply econometric techniques to quantify the impact of the imbalance on bond yields by controlling for various fundamental macroeconomic factors such as growth, inflation, fiscal policy and monetary policy. We then translate the impact on yields into cost effects on pension benefits.

We demonstrate that in light of the bond shortage, the impact of stepping up purchases of high quality corporate bonds on reducing bond yields is statistically and economically significant. A one percentage point increase of pension flows in terms of GDP lowers corporate yields by at least 28 basis points. We further show that the yield reduction would in turn raise the cost of pension markedly. Our conservative estimates reveal that the bond shortage would increase pension liabilities by at least 4 per cent and normal cost by at least 8 per cent every year.

ONGOING SHIFT TO BONDS

Several arguments have been floated in support of the bond allocation. First, pension benefits resemble bonds and thus bond investments by pension funds could match liabilities and reduce the interest rate risk. Second, investing in bonds could take advantage of the tax benefits of bonds for corporate plans. Third, with plan assets invested in a matching bond portfolio, capital markets would be more transparent and more efficient as actuarial assumptions would be less affected by judgment. Fourth, an equity-to-bond shift in pension funds adds value for shareholders in a transparent financial environment. Fifth, as a defined benefit pension fund is part of the company, its asset allocation should be managed as part of the company's overall capital structure. Hence, holding bonds in pension funds would reduce financial risk.

The Pension Protection Act (PPA) and the accounting reform have also prompted pension funds to adopt a liability-driven investment (LDI) strategy and switch to bonds. The act imposed stricter funding requirements and reduced a great deal of smoothing for measuring assets and liabilities, resulting in high volatilities of funded status and contribution requirements. The accounting reform would make the double squeeze of declining assets and mounting liabilities more visible by putting deficits on public display on the corporate sponsor's balance sheet.

The unprecedented global financial crisis has provided a further incentive for shifting to LDI and bonds (Xiao and Xiao).[1] The volatility of stock markets and deterioration of funding levels over the recent years have given plan sponsors plenty of food for thought. With a dramatic fall in asset values, many plan sponsors have seen their once over-funded plans become significantly under-funded. One of the top three lessons global pension plans learned from the crisis, according to the Pyramis 2010 survey, is a better match of assets and liabilities. According to the 2011 SEI Global Poll, 63 per cent of pension funds surveyed employed a LDI approach, more than triple that of 2007. It highlighted the continued trend of placing emphasis on the plans' liabilities and moving away from the historical focus on absolute returns when managing pension investments. In terms of asset allocation, 74 per cent favored long-duration bonds although investments in derivatives remained low.

Putting theory into practice, some companies have invested a vast majority of its pension assets into bonds. For example, in 2009, J.C. Penney Co. Inc. announced that it would reduce the equity exposure and raise the fixed-income allocation of its US$4 billion defined benefit plan from 20 per cent to 75 per cent, ultimately reaching 100 per cent in bonds. Recently, Ford announced that it would increase bond holdings from 45 per cent of pension fund assets to 80 per cent. The Federal Reserve data show that the shift from equity to bonds resulted in an increase of 80 per cent of private defined benefit pension assets allocated to bonds in 5 years.

With more and more pension funds making a similar move, would there be enough bonds available? One simple and intuitive measure of potential excess demand can be obtained by comparing the size of pension fund balance sheets with the amount of outstanding high quality long-term bonds available for pension funds. Federal Reserve Flow of Funds data show that total pension fund assets reached 10.4 trillion at

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the end of 2011. The 2012 Global Financial Stability Report of the IMF[2] demonstrates that the imbalance between demand and supply in global markets for safe assets has intensified since the unprecedented global financial crisis. The shrinking supply of safe assets could not meet the growing demand from various types of investors who traditionally invest in safe assets. As pension fund mainly invest in safe assets, the problem would become acute. The outstanding amount of investment-grade government and corporate securities on a global scale available for pension funds was only 4.6 trillion. Assuming in the most optimistic case that US pension funds could use all domestic and international bonds for asset-liability matching, only 45 per cent of the pension funds balance sheets would be immunized. The upshot is that the amount of high quality long-term bonds is far from sufficient in meeting the pension investment demand.

With the mounting demand outstripping the shrinking supply, what are the implications for pension cost? To tackle this issue, we first examine the impact on bond yields, a key driver of the cost, as shown in the section 'Impact of bond flows on long-term bond yields', and then translate the yield impact into cost impact, as shown in the section 'Impact on the cost of providing pension benefits'.

IMPACT OF BOND FLOWS ON LONG-TERM BOND YIELDS

Whether pension inflows impact corporate yields is an open question. We tackle the issue directly and systematically by presenting in this section our econometric methodology and regression results. We employ a reduced form model to characterize demand and supply factors affecting bond yields, as in Warnock and Warnock.[3] In this framework, the dependent variable is the long-term bond yield driving the interest rate assumption used to discount pension benefit streams. The current and suggested practice in selecting discount rates dictates that high-quality corporate bond yields (a rating of A and above) are good proxies for corporate pension plans. In particular, we pick long-term yields constructed by Moody's and Barclays. These data are widely used and provide a long time series to allow regressions with a high degree of freedom. The independent variables reflect monetary and fiscal policies as well as macroeconomic conditions. Because the bond yield is a forward-looking asset price, we try to rely on variables encompassing forward-looking expectations. Specifically, we assume that bond yields are a function of pension flows, expected growth, expected inflation, volatility, and monetary and fiscal policy. The econometric formulation of the model is as follows:

$$Y_t = \alpha + \beta_1 \star PF_{t-1} + \beta_2 \star EG_{t-1} + \beta_3 \star EI_{t-1} + \beta_4 \star Vol_{t-1} + \beta_5 \star MP_{t-1} + \beta_6 \star FP_{t-1} + \varepsilon_t$$

where Y denotes yields; t denotes time; $i = 1, 2, 3, 4, 5, 6$ are coefficients to be estimated; PF, EG, EI, Vol, MP, FP denote variables measuring pension flows, expected growth, expected inflation, volatility, and monetary and fiscal policy, which we briefly discuss below.

Pension flows data are available from the Federal Reserve Flow of Funds and then scaled by nominal GDP available from the Bureau of Economic Analysis. The Fisher Equation tells us that nominal long-term interest rates are governed by real interest rates and expected inflation. The higher the real rates and the higher the expected inflation, the higher the long-term nominal rates demanded by investors. Expected GDP growth helps capture factors that impact real interest rates. Higher growth expectations tend to drive up real rates, and in turn nominal rates. Both 1-year-ahead expected inflation and 1-year-ahead expected GDP growth are available from the Consensus Economics Survey.

Bonds are risky, thus investors must be compensated for bearing risk. Corporate bonds carry both interest rate and default risk. As yields rise or default risk premiums increase, investors' holdings of existing bonds become less valuable. To proxy for the risk, we use the volatility of long-term yields, calculated as the rolling 36-month or 60-month standard deviation

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of changes in long yields, depending on the length of the time series. All of the yields data are obtained from the Federal Reserve and DataStream.

The expectations theory of the term structure shows that long rates are dictated by short rates. Current monetary policy, captured by the effective federal funds rate, has a direct impact on the short end of the yield curve. Federal funds rates are obtained from the Federal Reserve. Fiscal policy affects rates by the amount of borrowing or indebtedness. To measure the stance of fiscal policy, we use the structural budget balance expressed as a percentage of potential GDP. This measure is free from business cycle conditions and available from the Congressional Budget Office.

To address potential endogeneity, we run two-stage least square (2SLS) regressions, a type of instrument variables regression to ensure the unbiasedness and consistency of the results. Specifically, we first select instrument variables and then run regressions in two stages. Instrument variables are lagged regressors. In the first-stage regression, we regress each regressor on its instruments and obtain fitted values. In the second-stage regression, we run the original regression with all of the right-hand variables replaced by the fitted values from the first-stage regression.

Table 1 presents 2SLS regression results for Aaa, Aa and A corporate yields estimated using quarterly data from 1962Q1 to 2011Q4. Aaa corporate yield data are constructed by Moody's and available from the Federal Reserve. Aa corporate yields and A corporate yields are constructed by Barclays and available from Datastream. When effective federal funds rate, expected inflation, structural balance, yield volatilities and expected growth are controlled for, the negative and statistically significant coefficients of pension flows across credit ratings indicate clearly that pension purchases of corporate bonds drive down bond yields. Specifically, a one percentage point increase of pension flows reduces corporate yields by at least 28 basis points. All the control variables show the expected sign, indicating that other forces are also at play in influencing corporate yields. The positive and statistically significant coefficients of the effective federal funds rate and expected inflation imply that they drive up bond yields, consistent with theoretical and empirical studies. A one percentage point of Fed tightening results in at least a 40 basis point increase in yields. Rising yield volatilities boost yields appreciably. A one percentage point increase in volatility hikes yields by at least 172 basis points. A widening of the structural fiscal deficit by a one percentage drives up bond yields by at least 17 basis points. In line with the literature and economic theory, rising inflation and growth expectations tend to boost yields, although the coefficient of expected growth is not statistically significant in all cases. The overall fit of the regression measured by the adjusted R^2 is at least 86 per cent.

Table 1: Determinants of yields of Aaa, Aa, and A corporate bonds

	Aaa	*Aa*	*A*
Pension flows	**−0.49**	**−0.28**	**−0.34**
Fed funds rate	**0.40**	**0.63**	**0.62**
Expected inflation	*0.11*	*0.14*	*0.14*
Structural balance	*−0.17*	**−0.21**	**−0.24**
Volatility	**2.55**	**1.72**	**1.77**
Expected growth	0.09	**0.31**	0.10
Adjusted R^2	0.86	0.89	0.87
# of Obs.	199	143	143

Note: This table presents 2SLS regression results of yields of Aaa, Aa, and A corporate bonds. Quarterly data from 1962Q1 to 2011Q4 are used for Aaa corporate bonds while quarterly data from 1976Q1 to 2011Q4 are used for Aa and A corporate bonds. The significance level is calculated based on robust standard errors adjusted for serial correlation. Numbers in bold and italics indicate significance at the 1 percent level and 5 percent level respectively.

IMPACT ON THE COST OF PROVIDING PENSION BENEFITS

Using the relation between bond yield changes and bond purchases identified in the previous econometric analyses, we are able to quantify the impact of the bond yield changes on the cost of pension benefits. To that end, the following components need to be determined: the sensitivity of pension liabilities to yield changes, the amount of pension liabilities, the

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appropriate discount rate and the demand for corporate bonds.

The sensitivity of the pension liability to interest rate changes is usually measured by duration. The duration of traditional defined benefit pension liabilities is typically in the range of 12–15 years (a 1 per cent change in interest rates commonly changes pension liabilities by about 12–15 per cent) depending on the relative weights of active and retired participants. Plans with mostly young employees will have longer durations and plans with mostly retirees will have shorter durations. The higher the duration, the greater the changes in pension liabilities in response to interest rate changes. To be conservative, we assume the duration to be 12 years, corresponding to a typical plan with a 50/50 mix of actives and retirees. As duration is only the first-order linear approximation of changes in pension liabilities as a result of interest rate changes, we improve the approximation by employing appropriate convexity adjustments to more accurately capture pension liability changes due to bond yield changes.

As comprehensive data on pension fund liabilities are unavailable, we apply the funded ratios identified by Milliman's[4] pension funding study (2012) to pension fund assets in order to estimate private pension liabilities. The Milliman's study of the 100 US public companies with the biggest defined benefit pension assets represents more than 56 per cent of the $2.2 trillion of private defined benefit assets reported by the Federal Reserve Flow of Funds (2012). The study identifies a ratio of assets to liabilities to be 79 per cent. Assuming the funded ratio is similar for the plans included in the survey and the plans not included, we estimate the aggregate pension liabilities to be $2.8 trillion. For discount rates, we use the yields of high-quality corporate bonds with at least a rating of A to measure liability changes, consistent with the PPA and FASB rules. Given the share of fixed income assets in the portfolio of the US insurance industry is about 75 per cent, a moderate assumption of the allocation for fixed income securities would be for plan sponsors to increase the fixed income securities to 60 per cent of the pension fund portfolio. To this end, corporate bonds need to increase by $472 billion.

The timing and span of the asset allocation shift are uncertain, but the trend is set to continue in response to evolving regulatory landscape and the volatile economy. The shift is even likely to accelerate as more and more plans sponsors freeze or terminate their plans. For illustrative purposes, we assume that pension funds reach the target in 3 years.

As shown in our econometrics analysis results, when macroeconomic conditions, monetary policy, fiscal policy and financial market conditions are controlled for, a one percentage point increase of pension flows decreases Aa corporate yields by 28 basis points, lowers A corporate yields by 34 basis points and reduces Aaa corporate yields by 49 basis points. High-quality corporate bond yields could be one of A, Aa and Aaa bond yields, or could be a combination of these yields. We illustrate next with a conservative estimate of the impact using Aa corporate yields and demonstrate briefly the potential extent of the cost impact using other yields. To gauge the magnitude of the cost impact, we take two measures. One is the increase in pension liabilities. The other one is the increase in the normal cost that dictates pension contributions.

If the shift happens over 3 years, using the corporate bonds yield changes in relation with the purchase of corporate bonds, the demand for corporate bonds of $472 billion would trigger the decline of the Aa corporate bond yield by 31 basis points each year. Assuming an average duration of 12 years, the pension liability discounted at Aa corporate yields would increase by 4 per cent each year.

Alternatively, we can quantify the impact on the normal cost as a result of bond undersupply. Using the rule of thumb – a change of one per cent in the interest rate alters the normal cost by about 25 per cent (Hustead)[5] – the reallocation of pension fund assets in a 3-year horizon would increase the normal cost by about 8 per cent each year.

Using the same methodology, results using other corporate yields would be much higher.

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For example, corporate bond purchase of $472 billion in 3 years could reduce the Aaa corporate yield by 55 basis points, hiking the pension liability and normal cost by 7 per cent and 14 per cent each year, respectively.

Our hypothetic scenario analyses demonstrate that, if pension plans invest 60 per cent of their pension assets in fixed income securities, the inadequate supply of bonds would have a substantial impact on the cost of providing pension benefits. In particular, our conservative scenario, where private pension funds are moving to bonds in 3 years and Aa corporate yields are used to discount pension flows, reveals that the shortage would increase pension liabilities by 4 per cent and the normal cost by 8 per cent each year. If a lower discount rate is used, pension liabilities could rise by as much as 7 per cent, or about 1 per cent of GDP. Hence, pension plan sponsors would face the deterioration in funded status and a significant increase in contribution requirements. This presents a challenge for plan sponsors to fulfill their benefit obligations. For plan sponsors who embrace an all-bond strategy, the massive reallocation from equities to bonds would result in a significant pension cost burden.

CONCLUSIONS

This article represents a first attempt to quantitatively examine the imbalance between high quality long-term bond supply and demand and to explore the actuarial implications for pension funds. In response to the new climate, characterized by higher funding targets, greater contribution requirements, more transparent pension accounting and volatile stock markets, pension fund managers are increasingly employing strategies such as asset liability management or LDI, resulting in more pension assets allocated to high-quality long bonds.

However, bond supply is insufficient to meet the growing demand. Using econometric techniques, we demonstrate that the imbalance has an economically and statistically significant impact in lowering bond yields. When macroeconomic conditions, monetary policy, fiscal policy and financial market conditions are controlled for, a one-percentage-point increase of pension flows reduces Aa corporate yields by 28 basis points, A corporate yields by 34 basis points and Aaa corporate yields by 49 basis points.

With quantitative results on yields at hand, we further illustrate the implications for pension funds by analyzing the impact on pension liabilities and the normal cost. Our results demonstrate that, if pension plans shift assets toward fixed income securities to achieve a 60 per cent asset allocation in 3 years, the inadequate supply of bonds would have a pronounced impact on the cost of pensions. In the most conservative scenario, the pension liability would rise by 4 per cent and the normal cost would jump by 8 per cent each year.

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