THE VALUATION OF PENSION BENEFITS SUBJECT TO PERSONAL TAXES

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1. Introduction

Properly specified discount rates should reflect the personal tax regime applicable to the cash flow in question and there is a considerable literature on this question. Brennan (1970) modifies the CAPM to reflect the tax regime applicable to equities and bonds and subsequent papers extend this to more complex personal tax regimes (Lally, 1992; Cliffe and Marsden, 1992). However all of these models relate to equities and bonds. The present paper is concerned with a stream of pension benefits, which may or may not be subject to personal taxes, and which are generally valued by reference to the yields on bonds that may or may not be subject to personal tax. If the pension benefits are tax free, but the bonds used to value them are not, then the yield on the bonds must be adjusted to reflect this tax difference and Lally (2000) deals with this type of situation. However, if the pension benefits are taxed, the situation is more complex and existing treatments of this situation are in error. This paper presents the correct adjustments and estimates the error from existing treatments of this issue.

2. Analysis: Nominal Pension Benefits and Taxed Bonds

Consider a pension benefit due in N years, denoted B_N, that is fixed in nominal terms and taxed at a personal tax rate of T. Suppose the asset used to value this benefit is a conventional government bond, with a spot rate for N years denoted y_N that is also subject to personal taxation at rate T. It might seem that personal tax could be ignored, because it applies equally to both the benefit and the bond used to value the benefit, and therefore the pre-tax pension benefit should be valued using the pre-tax discount rate (as in Lucas and Zeldes, 2006; Inkmann and Blake; Novy-Marx and Rauh, 2011). However this is not correct because the entire pension benefit is taxed whilst only the yield on the bond is taxed. Remarkably, Novy-Marx and Rauh (2011) make this error despite recognising the presence and relevance of personal taxes to their analysis.

The correct formulation is as follows. Letting P denote the present value of the benefit B_N, then P must be such that the post-tax outcome from investing it in government bonds is equal to the post-tax pension benefit, i.e.,

$$P[1+y(1-T)]^N = B_N(1-T)$$

So

$$P = \frac{B_N (1-T)}{[1+y(1-T)]^N} \tag{1}$$

By contrast, when taxes are ignored, the result is as follows.

$$P = \frac{B_N}{[1+y]^N} \tag{2}$$

Clearly equations (1) and (2) differ except in the case that

$$(1+y)^N = \frac{[1+y(1-T)]^N}{1-T}$$

For given values of y and T, the value for N solving this equation is as follows.

$$N = \frac{Ln(1-T)}{Ln\left[\frac{1+y(1-T)}{1-T}\right]} \tag{3}$$

For example, if y = .05 and T = .25 then N = 24 years. So, for benefits arising in less than 24 years, equation (2) overestimates the value relative to the correctly specified equation (1). Otherwise, equation (2) underestimates the value. In respect of a stream of pension benefits, it follows that there will be some patterns of benefits for which the net effect of these estimation errors is zero. The simplest example is a level perpetuity, i.e., an infinite stream of benefits at the same level B. In this case equations (1) and (2) both reduce to

$$P = \frac{B}{y}$$

More generally, in respect of a stream of benefits, the question of whether the net effect of using (2) rather than (1) is over or under, and whether the difference is material, will be case specific. So, consider the following example drawn from Novy-Marx and Rauh (2011), relating to the valuation of the stream of defined benefit pension obligations of the US states.

In particular, we consider the pension benefits for the beneficiaries designated as "Annuitants" (ibid, Figure 3). This stream of benefits declines from $160b per year to zero over the next 50 years. Using equation (2) and the Treasury spot rates given in Novy-Marx and Rauh (ibid, Figure 4), they value the pension obligations at $2.28t (ibid, Table III). However, application of equation (1) along with a personal tax rate of 25% yields a figure of $1.91t, i.e., 20% smaller.[1] This is a substantial error and it is monotonically increasing in the tax rate T. If T were raised to 30%, the overstatement from the use of equation (2) rises to 25%.

3. Analysis: Nominal Pension Benefits and Tax-Free Bonds

Now suppose that the government bonds used to value the taxed pension benefits are free of personal taxation. Such a situation would arise if US municipal bonds were used to value the pension benefits, because such bonds are exempt from taxation, and is also considered by Novy-Marx and Rauh (ibid). In this case it might seem that the correct approach would be to gross up the yield on the tax-free municipal bonds to a figure for taxed bonds, which would then be used to value the pre-tax pension benefits. This is the approach adopted by Novy-Marx and Rauh (2011, page 1234). However, again, this is not correct because the entire pension benefit is taxed whilst only the grossed-up yield on the bond would be taxed. The correct formulation is as follows. Letting P denote the present value of the benefit B_N, then P must be such that the post-tax outcome from investing it in tax-free government bonds with yield $\hat{y}$ is equal to the post-tax pension benefit, i.e.,

$$P[1+\hat{y}]^N = B_N(1-T)$$

So

$$P = \frac{B_N(1-T)}{[1+\hat{y}]^N} \tag{4}$$

By contrast, Novy-Marx and Rauh (ibid) proceed as follows.

[1] The tax rate of 25% is favoured by Novy-Marx and Rauh (ibid, page 1234) and is drawn from analysis by Poterba and Verdugo (2008).

$$P = \frac{B_N}{\left[1 + \frac{\hat{y}}{1-T}\right]^N} \tag{5}$$

If the yield y on taxed bonds is the grossed-up counterpart to the yield $\hat{y}$ on tax-free bonds then the last two equations are equivalent to equations (1) and (2). Accordingly, the empirical analysis in the previous section applies equally here.

4. Conclusions

This paper specifies the correct treatment of tax in the valuation of taxed pension benefits and contrasts it with the procedure that is generally employed in the literature. In principle, errors could be in either direction. However, for one example relating to the pension liabilities of the US states, recourse to the generally employed method yields an overstatement of about 20%.

REFERENCES

Brennan, M., 1970, Taxes, Market Valuation and Corporate Financial Policy, *National Tax Journal*, vol. 23, 417-27.

Cliffe, C. and Marsden, A., 1992, The Effect of Dividend Imputation on Company Financing Decisions and the Cost of Capital in New Zealand, *Pacific Accounting Review*, vol. 4, 1-30.

Inkmann, J. and Blake, D. 2011, Managing Financially Distressed Pension Plans in the Interests of Beneficiaries, working paper, University of Melbourne.

Lally, M. 1992, The CAPM Under Dividend Imputation, *Pacific Accounting Review*, vol. 4, 31-44.

_____ 2000. 'The Valuation of GSF's Defined Benefit Pension Entitlements', *New Zealand Economic Papers*, vol. 34 (2), 183-199.

Lucas, D. and Zeldes, S. 2006, Valuing and Hedging Defined Benefit Pension Obligations, working paper, NBER.

Novy-Marx, R. and Rauh, J. 2011, Public Pension Promises: How Big are they and what are they Worth?, *The Journal of Finance*, vol. 66, 1211-1249.