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The impact of diverse measures of default risk on UK stock returns

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ABSTRACT

A number of recent papers examine the relationship between default risk and equity returns, and the results are mixed. These studies employ different measures of default risk and we find that correlations between eight diverse measures of default risk tend to be less than 50%. Nonetheless, we find that the relationship between stock returns and diverse measures of default risk tends to be consistent; default risk is a significant determinant of stock returns and this relationship is "hump backed", as predicted by Garlappi and Yan (2011).

1. Introduction

Default risk assessments allow those who lend and those who insure debts to accurately assess the risks to which they are exposed and thus whether and on what terms they are prepared to enter into a debt-related contract. More recently a number of papers have highlighted the relationship between default risk and equity returns, thereby widening the utility of default risk assessments to include equity investors. However, the results of studies on the relationship between stock returns and default risk leave the true relationship open to some doubt. Vassalou and Xing (2004) report that returns are highest to high default risk stocks,[1] whereas Dichev (1998), Avramov et al. (2009) and Garlappi and Yan (2011) report that high default risk firms deliver lower stock returns than low default risk firms. Vassalou and Xing (2004) also present evidence that default risk is systematic and thus priced in stock returns, whereas Avramov et al. (2009) argue that the relationship between stock returns and default risk is driven by firms with low credit quality during periods of financial crisis, and outside this subset of stocks and time periods there is no relationship between stock returns and default risk.[2]

A number of authors report non-linear relationships between default risk and stock returns but the reported shape of this relationship is again inconsistent across studies. Vassalou and Xing (2004) find that in the presence of a book to market (BM) variable (but not a size variable) the relationship between stock returns and default risk is positive and non-linear with a minimum turning point (outside the range of feasible default risk values), after which as default risk increases, returns increase.[3] By contrast, Garlappi and Yan (2011) report a "hump-backed" relationship between stock returns and default risk: as default risk increases so do stock returns up to a maximum turning point, and thereafter returns decrease. The portfolio results of Dichev (1998) also support this "hump-backed" non-linear relationship, but Dichev fails to account for non-linearities in his regression analysis. Garlappi and Yan (2011) seek to explain the "hump-backed" relationship between default risk and stock returns by suggesting that provided that shareholders are able to recover some of their investment when firms are under financial distress, after distress reaches a certain point, firms are able to lower their gearing via debt rescheduling and thus returns decrease.

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[1] See Table III, page 845, Vassalou and Xing (2004). The returns to portfolios sorted by default risk show that returns are lowest to the portfolio in the lowest default risk quintile (decile) and highest to the portfolio in the highest default risk quintile (decile).

[2] In related work, Chava and Purnanandam (2010) focus on the implications of using ex-post rather than ex-ante returns. Employing *expected* stock returns they conclude that there is a significant positive risk premium for high default risk stocks. The calculation of expected returns is not without its problems and in this paper we focus on the (larger) body of work which employs ex-post returns.

[3] They find that firm size is not a significant determinant of stock returns in the presence of default risk. These results are from regressions based on individual equity returns. See Table IX, page 858, Vassalou and Xing (2004).

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The first aim of this paper is to examine the extent to which diverse measures of default risk give rise to inconsistent empirical results for the relationship between default risk and stock returns. In light of this we comment on the mixed results reported in prior studies. Fiordelisi and Marqués-Ibañez (2013) suggest that mixed results for the relationship between bankruptcy risk and *systematic* risk might be due to the variety of measures employed to capture bankruptcy risk.

Measures of default risk employed in the above-cited studies vary from the credit ratings of Standard & Poor's (S&P) (Avramov et al., 2009) to default probabilities derived from contingent claim models based on the theories of Black and Scholes (1973) and Merton (1974) (Vassalou and Xing, 2004; Garlappi and Yan, 2011) to accounting-based models of bankruptcy (Dichev, 1998). Most of the papers which test the relationship between default risk and stock returns employ only one measure of default risk.

Our second contribution is a comparison of the default risk assessments of the leading credit-rating agencies (CRAs) with those which arise from leading academic models, to determine the extent of agreement between alternative assessments of default risk. Even where default risk measures appear similar, such as those based on the theories of Black and Scholes (1973) and Merton (1974), we show that different assumptions can lead to divergent assessments of default risk.

Throughout this paper we employ the term "default risk" to refer to the probability of default (PD)/failure/bankruptcy *and* credit ratings (which may incorporate both the PD and the loss given default (LGD)). We look at firms listed on the London Stock Exchange where the relationship between stock returns and default risk has not yet been analysed. The London Stock Exchange is of interest to investors worldwide. The UK Office of National Statistics (2012) estimates that at the close of 2010, 41.2% of shares listed on the London Stock Exchange (representing investments worth £732.6 billion) were owned by investors from outside the UK, of which European investors held 28% and North American investors 56%.

The default risk assessments of the leading CRAs have recently been called into question in the wake of the ongoing financial crisis where inaccurate assessments of the default risk of a number of collateralised debt instruments came to light in 2007. A potential lack of trust in the rating assessments of the CRAs is not new; Pinches and Singleton (1978) report that "In recent years bond rating agencies have been under increasing scrutiny because of their obvious failures to accurately predict and warn investors of impending firm-related financial difficulties" (page 29). Although the CRAs have clearly made significant errors, the question we consider is whether their corporate default risk assessments disagree with those based on academic models.

A substantial academic literature exists on the modelling of default and/or bankruptcy and/or corporate failure, yet relatively few of these publicly available assessments of credit quality have been employed out of sample in academic studies to determine whether the default risk assessments of these models tend to agree with those of the CRAs.[4] This would provide useful information about both credit ratings and alternative assessments of default risk readily available to investors.

We compare the credit-rating assessments of the two leading CRAs, S&P and Moody's, and the default risk assessments generated by the following academic models: "*z*-score" models of Altman (1968) and Taffler (1977) – this latter is set out in the papers of Taffler (1984) and Agarwal and Taffler (2008); multi-period logit (discrete time hazard) models of Campbell et al. (2008), and Chava and Jarrow (2004); a Cox proportional hazards model with time-varying covariates from Bharath and Shumway (2008); contingent claims models derived from the theories of Black and Scholes (1973) and Merton (1974), from the papers of Hillegeist et al. (2004) and Bharath and Shumway (2008). We follow Hillegeist et al. (2004) by terming these BSM models.

We begin our analysis by examining the relationship between various measures of default risk from both our selected academic models and the credit ratings of S&P and Moody's. We find considerable variation in the mean PD across our academic models. However, we are more interested in relative rather than absolute measures of default risk. We find that correlations between the measures of default risk are significant at the 1% level and yet tend to be less than 50%. Given these relatively low correlations between default risk assessments, investors in UK-listed firms might be left in some doubt as to the true relative default risk of a firm. Of the academic models, the Altman *z*-score model has the highest correlation with Moody's and S&P ratings, which given the accounting ratio-based nature of the Altman model suggests a relatively high reliance on ratios in the default risk assessments of the CRAs.

Despite the fact that correlations between different measures of default risk tend to be less than 50%, our analysis of the relationship between default risk and stock returns tends to produce consistent results. We find that default risk is a significant determinant of stock returns for all measures of default risk employed, in addition to size and BM, and we tend to find that this impact is non-monotonic; as default risk increases, so do returns up to a maximum turning point, after which returns decrease, which is the "hump-shaped" relationship predicted by Garlappi and Yan (2011).[5]

In general we find little evidence that differences in the conclusions of previous studies about the relationship between stock returns and default risk can be attributed to the different models of default risk employed, since there is reasonable consistency in the empirical results of the relationship between stock returns and default risk across diverse measures of default risk.

We make further comment on one specific case: Vassalou and Xing (2004) employ a BSM model with the same assumptions as the model of Bharath and Shumway (2008) employed in this paper. Vassalou and Xing (2004) argue that their measure of default risk does not differ significantly from the Moody's KMV measure employed by Garlappi and Yan (2011),[6] and Garlappi and Yan argue that their results differ from those of Vassalou and Xing on account of portfolio-selection procedures, namely that much of Vassalou and Xing's analysis is based on quintiles rather than the deciles employed in Garlappi and Yan. However, Vassalou and Xing also report returns sorted by default risk deciles (see Table III, page 845, Vassalou and Xing, 2004), and these suggest a monotonic increase in returns as default risk increases. This left open the possibility that a difference in the default risk measure might, at least in part, explain the different results. However, when we employ the same default risk measure as Vassalou and Xing (2004), our results confirm those of Garlappi and Yan (2011) and we find no evidence that the differ-

[4] Löffler (2004) compares ratings-based assessments of default risk with market-based assessments derived from the theories of Black and Scholes (1973) and Merton (1974). Agarwal and Taffler (2008) compare *z*-score-based assessments of default risk with market-based assessments. A number of academic authors and practitioners have employed the model of Altman (1968) out of sample (see, inter alia, Dichev (1998)).

[5] While the relationship between default risk and stock returns is found to be non-linear for the academic measures of default risk, this is not the case for the CRAs' measures of default risk, although in the case of Moody's the coefficient on the squared default risk variable approaches significance at the 10% level, which would again suggest that as default risk increases (rating decreases), returns increase up to a maximum turning point after which returns decrease.

[6] "the difference between our measure of default risk and that produced by KMV is not material for the purpose of our study" (page 837, Vassalou and Xing, 2004).