How should we discount the costs of financial distress?*

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Abstract

Practitioners and academics usually discount expected future costs of financial distress using a government bond yield, and sometimes using the firm's own cost of debt. We argue that this practice is wrong and that it *underestimates* the true present value of distress costs, because distress is more likely to happen when other assets perform poorly. Thus, the costs of financial distress must be discounted by *less* than the risk free rate. Equivalently, we argue that the risk adjusted probability of financial distress is *significantly larger* than the actual probability. We present two strategies to estimate the correct discount rate. First, we replicate the distress costs using a government bond and the firm's risky debt, and we derive the risk adjusted probability as a simple function of the corporate bond spread and the risk free rate. The second strategy is to estimate the risk adjustment directly from the historical time series of financial distress and some well established asset pricing models. We find that the probability of distress is indeed higher in bad times. The two methods give qualitatively similar results, but the first suggests a larger bias than the second. According to the replicating approach, the optimal bond rating is AA, while according to the second approach it is BBB. We conclude that our risk adjustment can explain why firms seem to be "debt-conservative".

Key words: Financial distress, corporate valuation, capital structure, discount rates.

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1 Introduction

There is a large literature that argues that financial distress can have both direct and indirect costs for firm value and performance (Warner, 1977, Altman, 1984, Weiss, 1990, Ofek, 1993, Asquith, Gertner and Scharfstein, 1994, Opler and Titman, 1994, Sharpe, 1994, Gilson, 1997, and Andrade and Kaplan, 1998). However, there is much debate as to whether such costs are high enough to matter much for corporate valuation practices and capital structure decisions. Direct costs of distress such as those entailed by litigation fees are relatively small.[1] Indirect costs such as loss of market share (Opler and Titman, 1994) and inefficient asset sales (Shleifer and Vishny, 1992) are believed to be more important, but they are also much harder to quantify. Andrade and Kaplan (1998), for example, estimate costs of the order of 10% to 20% of firm value at the time of distress for a sample of highly leveraged firms. However, they also argue that part of these costs might actually not be genuine *financial* distress costs, but instead effects of the economic shocks that drove firms to distress. They suggest that from an ex-ante perspective distress costs are probably small, specially in comparison to potential tax benefits of debt.[2] In contrast, for example, Opler and Titman (1994) argue that distress costs can be substantial for certain types of firms, such as those that engage in substantial *R&D* activities.

While previous literature has analyzed in detail the potential sources of distress costs and has attempted to estimate the effects of such costs on *current* firm value and performance, it has given much less attention to the valuation of the negative cash flows associated with financial distress.[3] In particular, the literature has mostly ignored the question of what is the appropriate rate to discount these cash flows. Altman (1984), for example, uses a risk-free rate to compute the present value of bankruptcy costs. This practice is also

[1] Warner (1977) and Weiss (1990), for example, estimate costs of the order of 3%-5% of firm value at the time of distress.

[2] Altman (1984) finds similar cost estimates of 11% to 17% of firm value on average, three years prior to bankruptcy. However, it is not clear that all such costs can be attributed to genuine financial distress (Opler and Titman, 1994, and Andrade and Kaplan, 1998).

[3] To be fair, not all the literature agrees with the proposition that distress only has costs. Wruck (1990) argues that organizational restructuring that accompanies distress might have benefits, and Ofek (1993) suggests that leverage might force firms to respond more quickly to poor performance. In addition, Eberhardt, Altman and Aggarwal (1997) find that firms appear to do unexpectedly well post-bankruptcy.

common in recent theoretical models of optimal capital structure (Leland, 1998, Titman and Tsyplakov, 2004, Hennessy and Whited, 2004). These models assume risk-neutral valuation, and thus implicitly discount the costs of financial distress by the risk free rate. Perhaps not surprisingly given the lack of academic research on the topic, the major corporate finance textbooks such as Brealey and Myers (2003), Ross, Westerfield and Jaffe (2002) and Grinblatt and Titman (2001) largely ignore the question of how to discount the costs of financial distress.

In this paper we argue that the common practice of risk-free discounting is incorrect if the risk of financial distress has a systematic component. As suggested by Denis and Denis (1995), the incidence of distress is often correlated with macroeconomic shocks such as major recessions. The potentially systematic component of distress risk raises the possibility that firms might care more about financial distress than what is implied by risk-free discounting. In particular, this insight suggests that expected future distress costs should be discounted by a rate that is *lower* than the risk free rate. This also implies that existing research has underestimated the total impact of such costs on firms' decisions and performance.

We derive the distress risk adjustment in two ways. First, we use a replication argument that exploits the fact that distress costs tend to happen when the firm's debt is in default. This idea allows us to derive a formula for the NPV of distress costs as a function of bond yield spreads, recovery rates and the risk free rate. Second, we use asset pricing models to directly price the costs of distress, and we show that the magnitude of the bias implied by risk-free discounting is proportional to the covariance between distress costs and the economy's asset pricing kernel. Notably, if this covariance is positive the bias is even larger if one uses the company's cost of debt instead of the risk free rate to discount distress costs, since the adjustment implied by the firm's cost of debt is in the opposite direction of that implied by the correct covariance adjustment.

The paper proceeds as follows. In the next section we derive our arbitrage formula for the value of distress costs, and the bias that is implicit in risk-free discounting. In section 3 we use asset pricing models to value distress costs, and section 5 concludes the paper.

2 Arbitrage pricing of the costs of financial distress

Our first strategy to value the costs of financial distress starts from the observation that the costs of distress tend to occur in states in which the firm's debt is in default. If this is the case, the cost of distress can be replicated by a portfolio that includes the firm's debt and a risk-free bond. As we show below, this argument implies that the net present value of distress costs can be obtained from data on the risk free rate, the firm's yield spread and the bonds' recovery rate.

We define ϕ as the deadweight losses that the firm incurs in case of default, ρ as the recovery rate on defaulted bonds, r^F as the risk free rate and r^D as the promised yield on the firm's debt. In order to derive a formula that is easy to implement we make the following assumptions:

Assumption A1: *The deadweight loss ϕ in case of default is uncorrelated with the pricing kernel*

Assumption A2: *The recovery rate on defaulted bonds ρ is uncorrelated with the pricing kernel*

Assumption A3: *The pricing kernel is iid*

If the pricing kernel is determined by macroeconomic variables, these assumptions imply that both the recovery rate and the deadweight losses are uncorrelated with the state of the economy. We discuss the role of these assumptions below.

We think of ϕ as a one time cost paid in case of distress. Each period t, either the firm is in distress or not. If the firm is in distress, it pays ϕ to reorganize and gets a fresh start next period. Otherwise, the firm moves to period $t + 1$, and so on. This view is consistent with the empirical setup of Andrade and Kaplan (1998). The alternative is to treat ϕ as a cash windfall occurring each period with some probability. The difference is that, in case of distress, we treat ϕ as a one time payment, while the cash windfall view would capitalize other future defaults[4].

Proposition 1 *Under A1, A2 and A3, the Net Present Value of the costs of financial distress is given by*

$$\Phi = \frac{\tilde{p}}{\tilde{p} + r^F} E(\phi)$$

where the risk neutral distress probability $\tilde{p}$ *is given by*

$$\tilde{p} = \frac{r^D - r^F}{(1 + r^D)} \times \frac{1}{1 - E[\rho]}$$

Proof. Let $\tilde{p}$ be the risk neutral probability of financial distress. In general the NPV of the costs of financial distress at time t satisfies the Bellman equation

$$\Phi_t = \frac{\tilde{p}_{t+1}\tilde{E}_t\left[\phi_{t+1}\right] + (1 - \tilde{p}_{t+1})\,\tilde{E}_t\left[\Phi_{t+1}\right]}{1 + r_t^F}$$

where $\tilde{E}_t[.]$ represents expectations under the risk-neutral measure. Assumption A1 implies $\tilde{E}[\phi] = E[\phi]$ and assumption A3 implies $\tilde{E}_t[.] = \tilde{E}[.]$ and $r_t^F = r^F$ so that on average, we have

$$\Phi = \frac{\tilde{p}E[\phi] + (1 - \tilde{p})\,\Phi}{1 + r^F}\ .$$

This proves the first part of the proposition.

We then obtain $\tilde{p}$ from A2, A3 and the bond pricing formula

$$D = \frac{\tilde{p}E[\rho]\left(1 + r^D\right)D + (1 - \tilde{p})\left(1 + r^D\right)D}{1 + r^F}$$

which implies

$$\frac{r^D - r^F}{1 + r^D} = \tilde{p}\,(1 - E[\rho])$$

QED ■

[4] The formula in this case becomes

$$\Phi = \frac{\tilde{p}E[\phi]}{r^F}$$

Suppose that $\tilde{p} = 1$, then the difference between our approach and the cash windfall approach is clear. If default is sure, the NPV is $\frac{E[\phi]}{1+r^F}$ in our view, and $\frac{E[\phi]}{r^F}$ otherwise. It is clear that the cash windfall approach does not correspond to the Andrade-Kaplan setup.

Notice that the probability of distress does not appear in the formula derived in proposition 1. In particular, the term $E(\phi)$ can be directly interpreted as the loss in value that the firm incurs *conditional* on the event of distress.

The formula also implies that if we define r^{ϕ} as the correct rate to discount the term $pE(\phi)$ (the ex-ante expected distress costs), we obtain:

$$r^{\phi} = \frac{p}{\tilde{p}} r^{F} \tag{1}$$

In other words, if the risk-neutral probability of distress is larger than the true probability of distress, then the correct rate to discount distress costs must be lower than the risk-free rate. The magnitude of the bias is given by the ratio of the probabilities.

Arbitrage pricing implies quite large risk-neutral probabilities of distress, and large distress costs as a consequence. In other to show that we use the data in Altman, Brady, Resti, and Sironi (2003) to estimate the expected recovery rate $E(\rho)$ as 0.4118. This is the average recovery rate in a sample of high yield bonds during the period 1982-2003. Using a value of 5% for r^{F}, we plot our estimates for the risk-neutral probability of distress in Figure 1. In order to compare it with the true probability, we use the average Annual Global Issuer Weighted Default Rate from Moody's (1920-2003), which is reported per whole-letter bond rating. We also use the current (10-year) yield spreads for each bond rating, obtained from www.bondsonline.com to compute risk-neutral probabilities. This figure shows that the risk-adjustment makes a substantial difference to the probabilities. For example, at a BB rating the probability of distress goes up from 1% to around 4%. Equation 1 then implies that using the risk-free rate to discount costs of distress is wrong by a factor of 3. For example, if the risk-free rate is 5% the correct discount rate is around 1.7%.

In order to translate these risk-neutral probabilities into NPV of distress costs we only need to add an estimate for $E(\phi)$. The papers discussed in the introduction suggest that the term $E(\phi)$ should be of the order of 3% to 20% of firm value. We take a value of 15%, and plot the implied NPV in Figure 2. We also plot the implied NPV for each bond rating/default rate computed under risk neutrality. Clearly, Figure 2 suggests that the NPV of distress costs that is implied in yield spreads is far from being small, and that it is much larger than estimates that simply use the default rate and the true probability of default.

Relaxing assumptions A1 and A2 is unlikely to change these results substantially. Relaxing assumption A1 will probably make distress even riskier than in Figures 1 and 2, because deadweight losses are likely to be higher in bad times. For example, it might be harder for firms to dispose of assets at fair prices if the economy is doing poorly. On the other hand, assumption A2 might decrease the riskiness of distress if recovery rates co-vary negatively with the pricing kernel. In this case the yield spread will also reflect recovery risk, but recovery risk will not translate directly into distress risk. In other words, the portion of the yield spread that is due simply to the probability of default decreases, decreasing the risk adjustment that is implied in Proposition 1.

There is mixed evidence for a systematic covariance of recovery rates with macroeconomic factors. While Altman, Brady, Resti, and Sironi (2003) present some evidence that recovery rates are negatively related to aggregate default rates, Acharya, Bharath and Srinivasan (2004) argue that industry-specific conditions can explain this finding. They also relate recovery rates to Fama-French factors, GDP growth and the SP500 return, and do not find significant relationships, even without controlling for industry variables. Therefore, assumption A2 does not appear to be inconsistent with currently available evidence. In section 5 we further discuss the implications of the large costs of distress that we found in this section, and propose alternative interpretations.

3 Using standard asset pricing models

3.1 Theory

Let m_t be the pricing kernel of the economy and let p_t be the probability of financial distress. The risk free rate $1 + r^F = \frac{1}{E[m]}$ and we define ε_t such that

$$m_{t+1} = \frac{1 + \varepsilon_{t+1}}{1 + r_t^F}$$

and we assume that m_t is *iid*. For the costs of financial distress we get

$$\Phi_t = E_t \left[m_{t+1} \left(p_{t+1} \phi_{t+1} + (1 - p_{t+1}) \Phi_{t+1} \right) \right]$$

Under the assumption (A3) that the pricing kernel is *iid*, we take unconditional expectations and we get

$$\Phi = \frac{E[p\phi] + E[\varepsilon p \phi]}{r^F + E[p] + E[p\varepsilon]} \tag{2}$$

In the simplest capital structure model, the firm is supposed to choose its debt level in order to maximize the present value of tax benefits, minus the costs of distress Φ. A critical part of this choice is to estimate Φ. Previous literature has discussed the estimation of $E[\phi]$, which represents the *expected* loss in cash flows resulting from financial distress. But how should the firm discount these expected cash flow losses? If we define the correct discount rate for the costs of financial distress as r^ϕ, equation 2 implies that:

$$\Phi = \frac{E[p\phi]}{E[p] + r^\phi} = \frac{E[p\phi] + E[\varepsilon p \phi]}{r^F + E[p] + E[p\varepsilon]} \tag{3}$$

We summarize this discussion in the following proposition.

Proposition 2 *The correct rate to discount expected costs of financial distress can be expressed in terms of the risk free rate as:*

$$r^\phi = \frac{r^F}{1 + \frac{E[\varepsilon p \phi]}{E[p\phi]}}$$

The correct discount rate for the costs of financial distress is less than the risk free rate if and only ε and $p\phi$ co-vary positively, i.e., if and only if distress if more likely to happen in bad times. We will compute the exact bias in the next section.

Using the cost of debt of the firm to discount the costs of financial distress is worse than simply using the risk free rate. The market value of perpetual debt as a function of next period payments to the bond holders (X) is

$$D = \frac{E[(1+\varepsilon) X]}{1 + r^F} \tag{4}$$

Discounting by the cost of debt only worsens the problem. The cost of debt can be defined as:

$$1 + r^D = \frac{\bar{X}}{D}$$

where $\bar{X}$ is the promised payment. If Y is the firm's value we have

$$X = \min\left(Y, \bar{X}\right)$$

and so

$$1 + r^F = \frac{E\left[(1+\varepsilon)\min\left(Y, \bar{X}\right)\right]}{D} < \frac{\bar{X}}{D} = 1 + r^D$$

The cost of debt is clearly higher than the risk free rate, while we will see that the proper discount rate should be less than the risk free rate.

Using the expected return on debt is also a conceptual mistake. In fact, we can show the following:

Corollary 1 *The correct discount rate for the costs of financial distress is less than the risk free rate if and only if the expected return on debt is more than the risk free rate.*

Proof. The expected excess return on debt is

$$\frac{E[X] - \left(1 + r^F\right) D}{D} = \frac{-E[\varepsilon X]}{D} = \frac{\bar{X}}{D} E\left[\varepsilon p (1-\rho)\right]$$

Under A2, we can write

$$\frac{E[X] - \left(1 + r^F\right) D}{D} = \left(1 + r^D\right)\left(1 - E[\rho]\right) E[\varepsilon p]$$

Under A1, we know from proposition 1 that

$$r^{\phi} = \frac{r^F}{1 + \frac{E[\varepsilon p]}{E[p]}}$$

QED ■

3.2 Standard pricing kernels

To compute the size of the bias due to the systematic risk associated with financial distress, we need to take a stand on the pricing kernel of the economy. There is no agreement as to what this kernel is, so we will illustrate our approach using the most commonly used kernels. We discuss the relevance of each kernel together with the results.

3.2.1 Consumption based models

We use aggregate consumption growth to define the pricing kernel m_t. The consumption $CAPM$ with $CRRA$ preferences is simply

$$m_t = \delta \left(\frac{c_t}{c_{t-1}} \right)^{-\gamma}$$

where c_t is the sum of the consumption of non-durables and services, in real terms, and γ is the degree of risk-aversion of the representative agent. Another popular model is based on habit formation. Here, we follow Campbell and Cochrane. The pricing kernel is

$$m_t = \delta \left(\frac{s_t}{s_{t-1}} \frac{c_t}{c_{t-1}} \right)^{-\gamma}$$

and the surplus consumption ratio follows

$$\log s_{t+1} = (1-\varphi) \log \bar{s} + \varphi \log s_t + \lambda (s_t) \left(\log \frac{c_{t+1}}{c_t} - g \right)$$

and the market price of risk follows

$$\lambda (s_t) = \frac{\sqrt{1 - 2 \log \frac{s_t}{\bar{s}}} - \bar{s}}{\bar{s}}$$

3.2.2 Factor models

A factor model says that the expected return on any asset i is given by

$$\begin{aligned} E\left(r^i\right) &= r^F + \lambda' \beta^j \\ \lambda &= E(f) - r^F \end{aligned}$$

Given that the pricing kernel is defined by

$$E\left(mR^i\right) = 1$$

we can look for a representation

$$m = E(m) \times \left[1 + b'(f - E(f))\right]$$

so that

$$E\left(r^i\right) = \frac{1}{E(m)} - b'cov\left(r^i, f\right)$$

So that

$$b = -var(f)^{-1}\left(E(f) - r^F\right)$$

Given the vector b, we can construct the stochastic process

$$\varepsilon_t = 1 + b'(f_t - E(f))$$

We will use the CAPM (with the market return as the only factor) and the 3 factors model of Fama and French.

3.3 Estimating the bias implied by asset pricing models

In order to compute the magnitude of the bias implied by Proposition 2, we need to estimate the covariance of financial distress costs with the economy's asset pricing kernel. Proposition 2 implies that bias depends on the covariance between the pricing kernel ε and $p\phi$, which is equal to the probability of distress times the deadweight costs that the firm incurs conditional on distress.

There is much debate in the literature on how to estimate the actual cash flow losses that are exclusively due to financial distress. One of the main problems is that it is hard to establish that a particular change in cash flow is really due to *financial* distress, and not to underlying economic shocks that might have driven the company into distress (see Andrade and Kaplan, 1998). In particular, while the literature does provide some estimates of the *average* deadweight costs of distress, no paper has attempted to estimate a time series of these deadweight costs that would allow us to estimate their covariance with the asset pricing kernels. Because of this difficulty, our estimate of the bias will be based only on the *probability* that financial distress occurs. In other words, we will estimate the bias as:

$$\widehat{Bias} = \frac{Cov\left[\varepsilon, p\right]}{E\left[p\right]} \tag{5}$$

where $Cov[\varepsilon, p]$ is the time-series covariance between the probability of financial distress and the pricing kernel, and $E[p]$ is the time-series average probability of financial distress. We believe this strategy will, if anything, *underestimate* the bias in the valuation of financial distress costs, because the actual cash flow losses that firms incur conditional on financial distress are likely to be positively correlated with the asset pricing kernel, that is, they are likely to be higher in "bad" states of the world. In this sense, the values calculated in this section should be seen as a lower bound for the costs of financial distress.

In order to compute a time-series for the probability of financial distress, we follow two alternative strategies. Our first strategy is to use the annual default rates in the high yield bond market from Altman, Brady, Resti, and Sironi (2003). These authors compute the weighted average default rate on bonds in the high yield bond market, where weights are based on the face value of all high yield bonds outstanding each year and the size of each defaulting issue within a particular year. The time period for which they have data is 1982-2003.

Our second strategy is to follow the previous literature, and say that a firm-year is financially distressed if the firm's operating income (EBITDA) is less than a certain percentage of its yearly interest expense.[5] Asquith, Gertner and Scharfstein (1994) use 90% as the percentage cutoff to define financial distress. Andrade and Kaplan (1998) require only that EBITDA is lower than financial distress (corresponding to a 100% cutoff), and also use other more qualitative criteria to define an event of distress. We also report results for cutoffs of 105%, 95%, and 85%. We then compute the cross-sectional average probability of distress p_t, which is the just the fraction of firms that are in distress in a given year, and use the series p_t to compute the statistics required in equation 5.

In order to estimate p_t using this first strategy we consider the universe of manufacturing firms (SIC 2000–3999) with data available from COMPUSTAT on operating income (EBITDA) and interest expenses. We restrict the sample period to 1982–2003 to allow

[5] Asquith, Gertner and Scharfstein (1994) use exactly this definition of financial distress. Andrade and Kaplan (1998) require only that EBITDA is lower than financial distress, and also use other more qualitative criteria to define an event of distress.

comparison with the first method. In order to make it more likely that our distressed firm-years are indeed financially distressed, we eliminate from the sample firm-years for which operating income is negative. The main issue with this method is that the sample changes over time, with the entry of young firms that have very small or negative profits. We estimate the time varying probability of distress in two ways. One way is to use a balanced panel of firms, the other is to control for firm fixed effects. Both make the probability series stationary and lead to similar results.

The consumption data that is required to compute the pricing kernels described in section 3.2 come from the NIPA, and include services and non durable goods.

3.4 Results from pricing models

Figure 3 shows the time series for the different pricing kernels, the default rate and the 95% accounting measure of distress from COMPUSTAT. The pricing kernels are clearly different, which begs the question of which one is more appropriate. We believe the basic choice is between financial kernels and real kernels. If the costs of financial distress are borne by shareholders and bondholders, then the financial kernels seem more relevant. On the other hand, if the costs are borne by the employees, then the consumption kernels may be more relevant. For instance, employees will have to be compensated with high wages if a firm is likely to go bankrupt, especially if bankruptcy coincides with a bad labor market. Of course, in equilibrium the costs are borne by the shareholders since higher wages (or higher turnover of good employees) reduce profits.

Table 1 presents our estimates for the bias in equation 5. The covariance of distress probabilities with asset pricing kernels is positive for all the models, but the magnitude of the bias varies from 2% to 17%. It is strongest if we use the simple consumption CAPM (column 1), and weakest if we use the factors models together with the COMPUSTAT accounting measure. This is not very surprising, since the factors models are based on market data and tend to move much faster that the accounting data. The estimated bias is more consistent across pricing kernels when we use the default rate on high yield bonds.

We will use the CAPM-Altman estimate of 12% as our benchmark.

4 Implications for Capital Structure

In order to give a flavor of our results' implications for capital structure choices, we compare the present value of distress costs that we calculated above with the tax benefits of debt, a type of comparison that is standard in the trade-off theory of capital structure. In order to compare our present value estimates to the tax benefits of debt at different bond ratings, we use the simple textbook approach to value tax benefits (the formula TD). We calculate typical (market) leverage ratios for manufacturing firms at each bond rating using COMPUSTAT, and assume a tax rate of 10%. As discussed by Graham (2000), using TD with the corporate rate of 34% overestimates the average tax benefits of debt by a factor of 2 to 3. The tax rate of 10% results in estimates for the tax benefits of debt that are close to Graham's. For example, the average benefit in our sample is 3.9% of firm value, whereas in Graham this number is around 4% to 5%.

To compare these values with our arbitrage estimate of the NPV of distress, we download current yield spreads at each rating from www.bondsonline.com, and use a risk free rate of 5%.

Figure 4 plots our two measures for the NPV of distress with the tax benefits of debt. As in Figures 1 and 2 we use 10% as the estimate of deadweight costs of distress. According to our first measure, the optimal bond rating is AA. If this picture gives a true representation of distress costs and tax benefits, then the conclusion is that debt conservatism is not a puzzle at all, but it is caused by very large costs of financial distress.

However, as we mentioned above, our first measure is more of an upper bound for distress costs. Our second measure based on estimates from the asset pricing model, is closer to a lower bound on distress costs. We use a bias of 12% to discount distress costs, that is, instead of using a discount rate of 5% we use $\frac{5\%}{1.12}$ which is equal to 4.46%. This figure suggests an optimal bond rating of BBB for the firm. We conclude that the optimum probably lies between AA and BBB.

5 Final Remarks

Our main point in this paper is that the common practice of discounting costs of financial distress by a risk free rate or by the firm's cost of debt underestimates the net present value of distress costs. The magnitude of the bias depends on how it is computed. Replicating arguments that use the firm's cost of debt to calculate the implied risk-adjustment for the distress costs imply a very large bias. If the bias is computed using standard asset pricing models the bias relative to risk free discounting is much smaller. In both cases, we emphasize that using the expected return on the firm's debt or the firm's own cost of debt, is a conceptual mistake.

The present value of distress costs computed from arbitrage arguments can be seen as an upper bound for such costs. That computation assumes that the entire yield spread is due to bondholders' losses in default states. If part of the yield spread is due to other factors such as liquidity, it is less clear that high yield spreads should imply higher distress costs. In addition, the arbitrage formula assumes that default states and distress states coincide. If this is not strictly true, debt payoffs will not provide a perfectly replicating portfolio to value distress. More research is required to establish what is the exact fraction of the yield spread that should be taken into account when calculating the implied costs of financial distress.

On the other hand, the bias calculated from asset pricing models can be seen as a lower bound for the true bias. We computed the bias using only the covariance between distress probabilities and the pricing kernels, but deadweight losses from distress are also likely to be higher in bad states of the world.

The bond pricing replicating argument suggests that all firms should try to get an AA bond rating, while the asset pricing models suggest that the optimal is around BBB. The truth probably lies in between these two estimates, and future research should be able to narrow the discrepancy. Nevertheless, we find it encouraging to see that our estimates are in the right ballpark.

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Table 1: Risk Adjustment to Discount Rate for Cost of Financial Distress

Discount Rate = Risk Free Rate / (1+ risk adjustment)

Distress Measures		Pricing Kernels: Consumption CAPM	Campbell-Cochrane	Market CAPM (one factor)	Fama-French (3 factors)
Interest Payments over Income (%)	85	0.16	0.16	0.05	0.05
	90	0.17	0.16	0.04	0.04
	95	0.17	0.17	0.04	0.04
	100	0.17	0.16	0.04	0.03
	105	0.17	0.16	0.04	0.02
Bond Default Rate		0.17	0.15	0.12	0.10

Notes: Sample period is 1981-2003. Compustat data includes only manufacturing firms (NAICS=3) continuously present in the sample. First distress measure is fraction of firms whose interest payments exceed x% of their income, with x ranging from 85 to 105. Second distress measure is default rate on the high yield bond market from Altman, Brady, Resti and Sironi (2003)

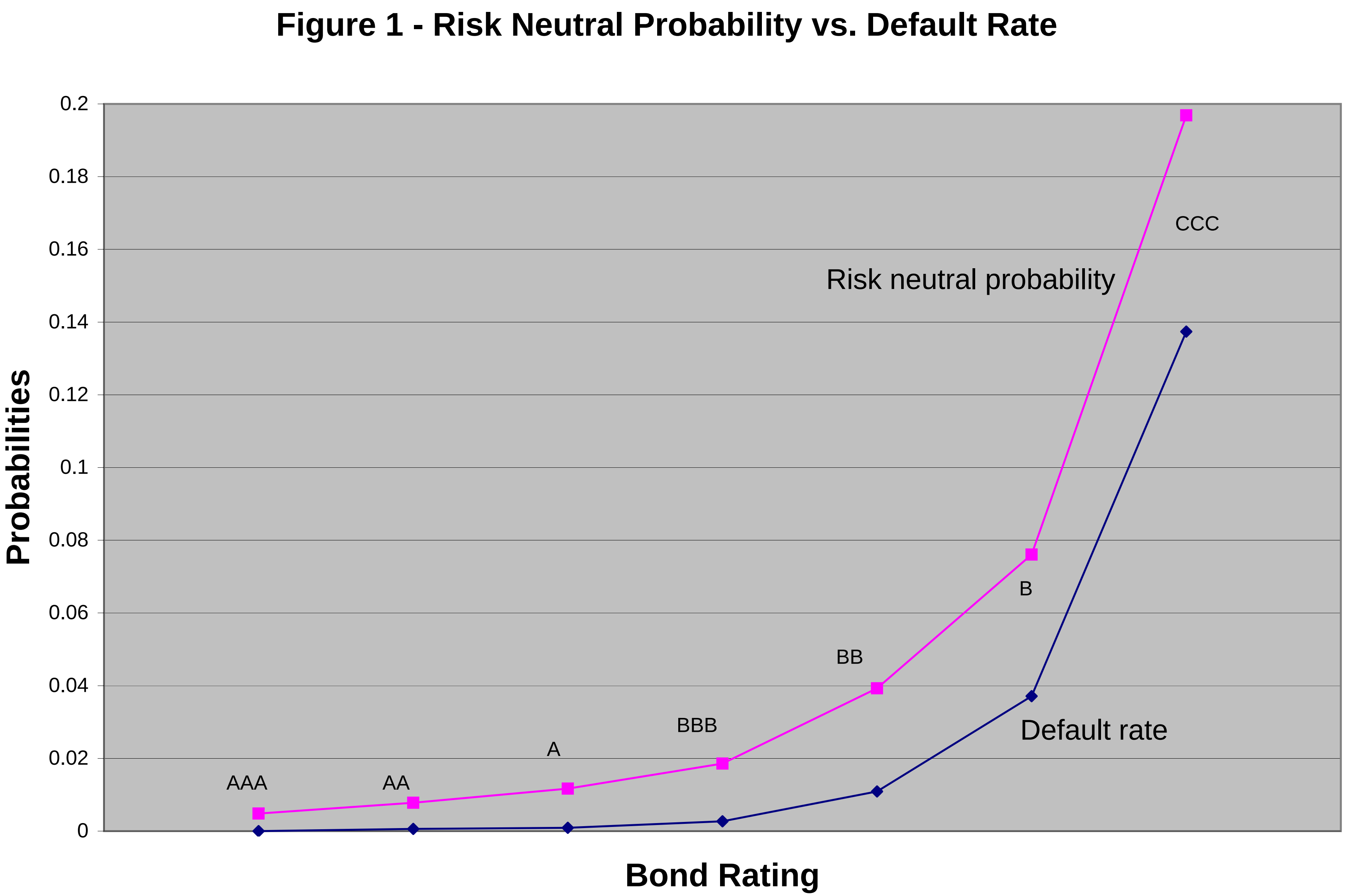


Figure 1 - Risk Neutral Probability vs. Default Rate
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Probabilities
CCC
Risk neutral probability
B
BB
BBB
A
AAA
AA
Default rate
Bond Rating

Figure 2 - Arbitrage Method

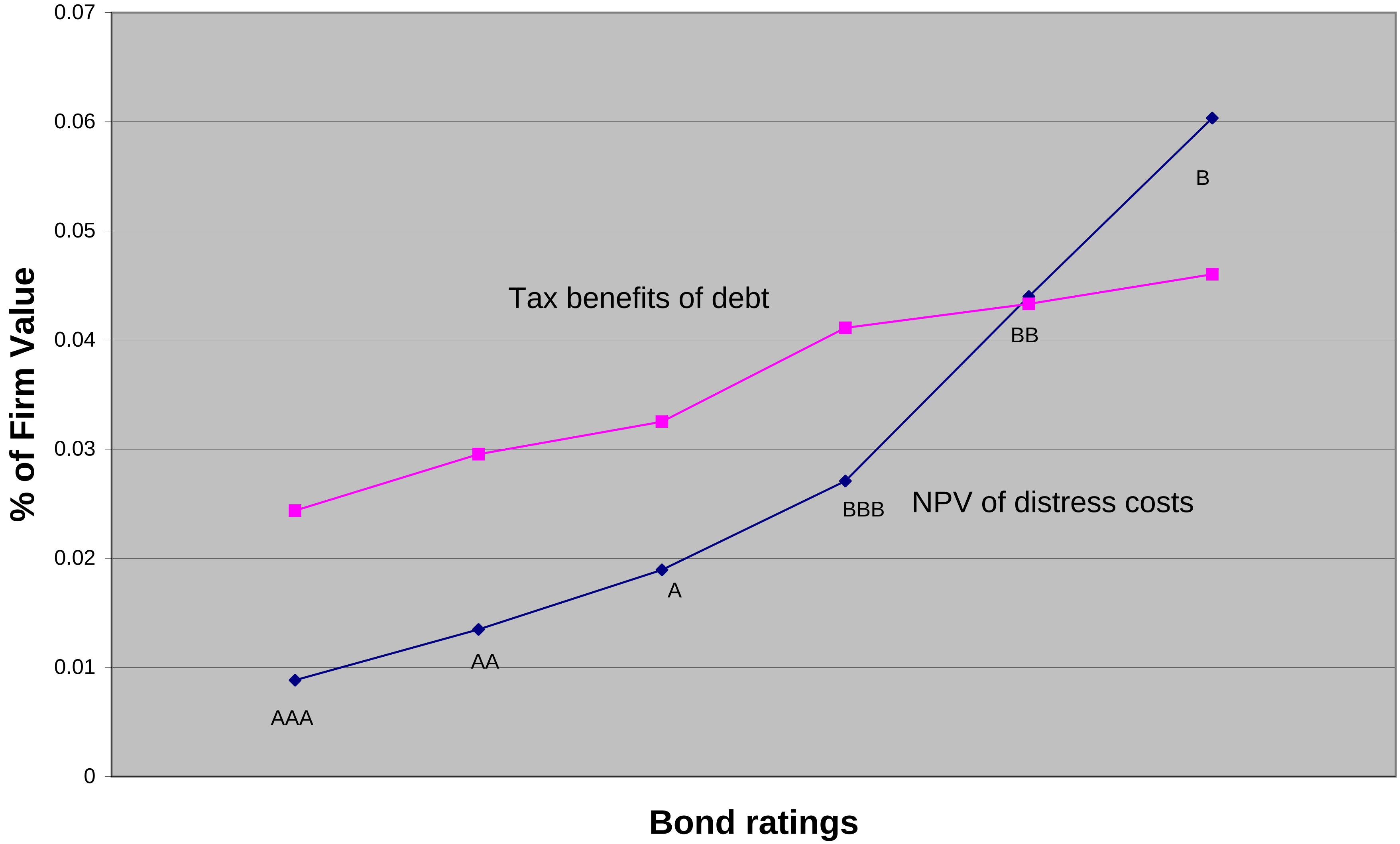
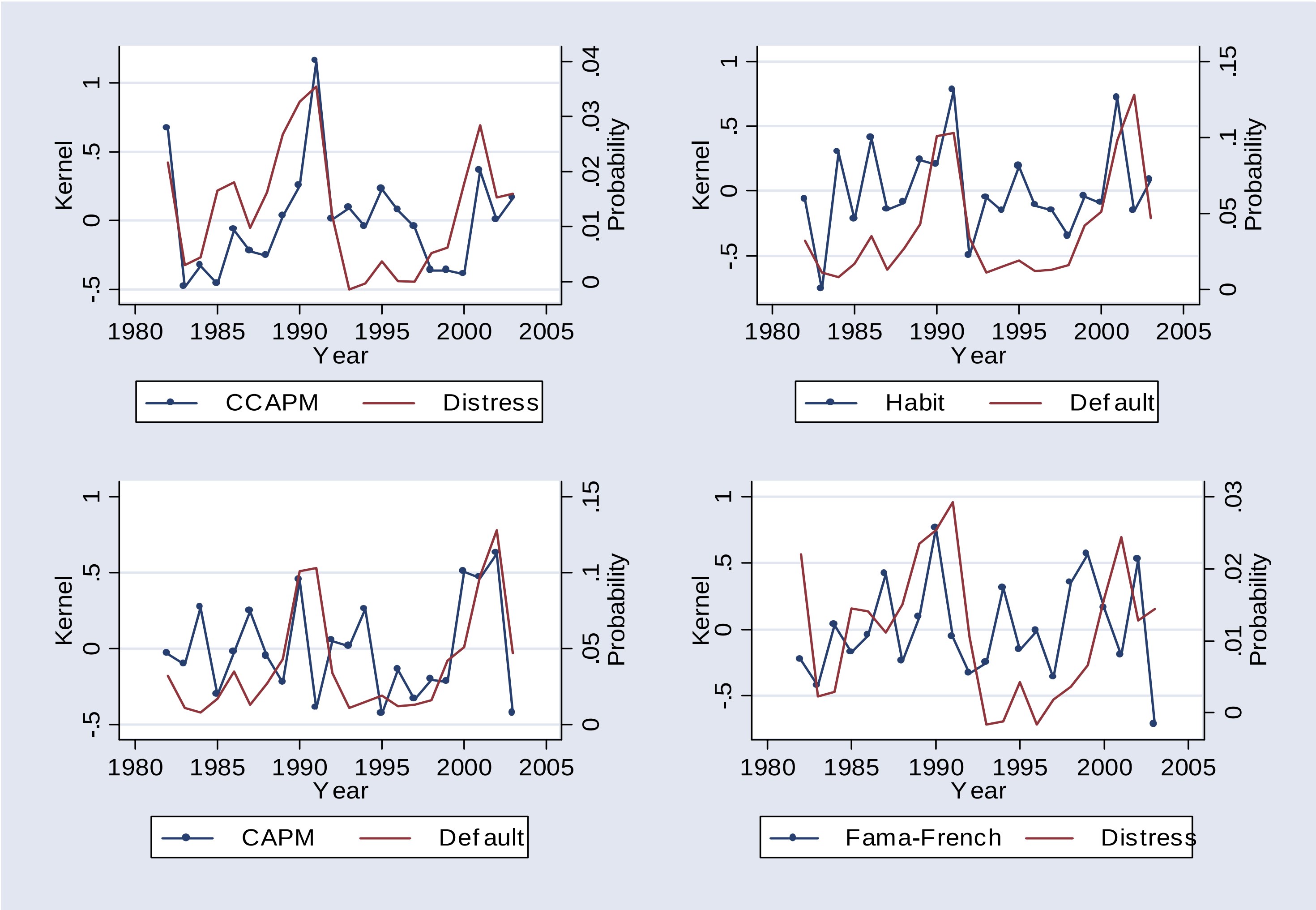
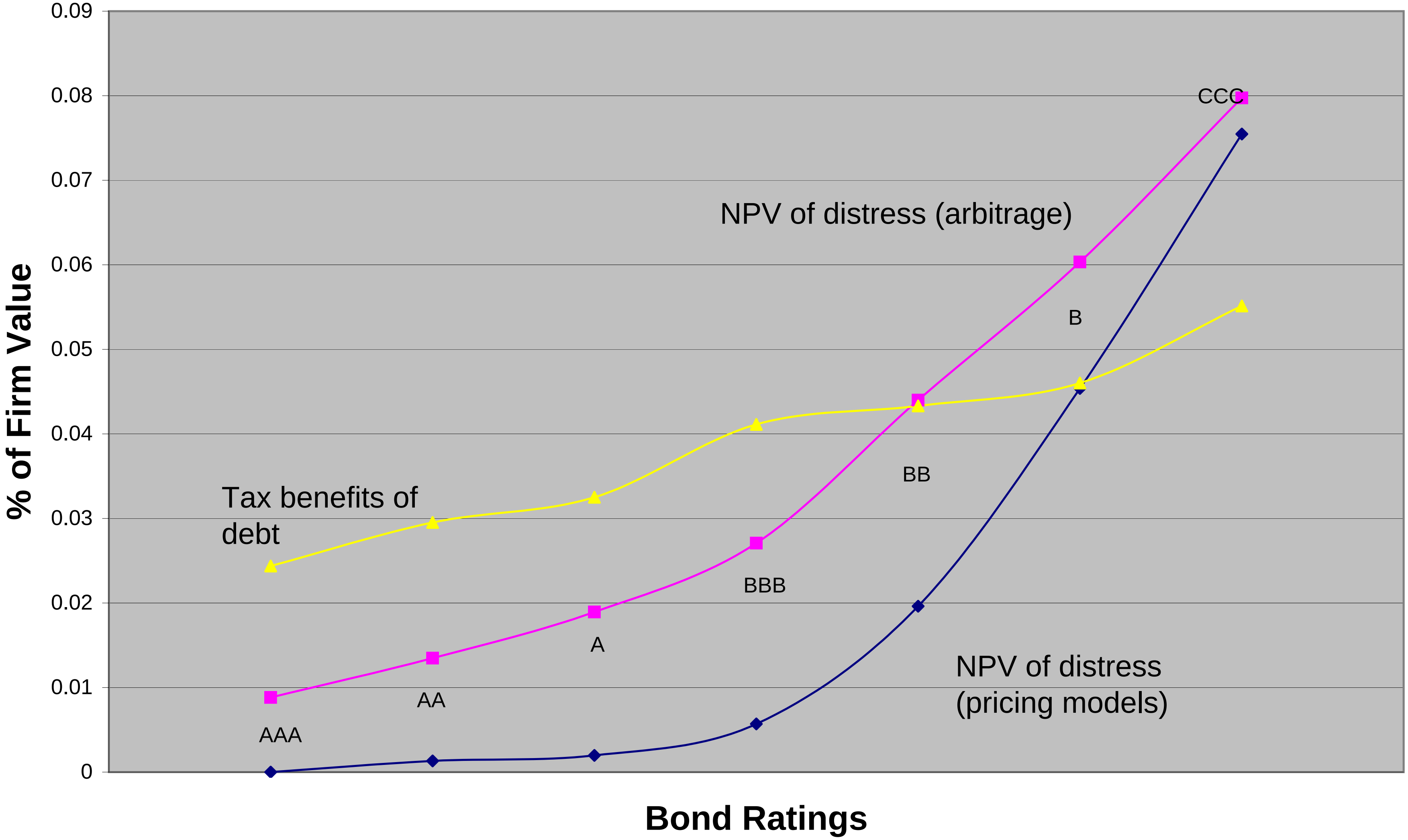


Figure 3. Pricing Kernels and Probability of Distress



Note: CCAPM is consumption CAPM with constant relative risk aversion of 40. Habit is Campbell-Cochrane model. CAPM is one factor (market) model. Fama-French is 3 factors model (market, size, Tobin's Q). Distress is probability that interest payments are more than 95% of operating income from COMPUSTAT. Default is default rate on high yield bonds, from Altman, Brady, Resti and Sironi (2003)

Figure 4



% of Firm Value
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Bond Ratings
AAA
AA
A
BBB
BB
B
CCC
Tax benefits of debt
NPV of distress (arbitrage)
NPV of distress (pricing models)