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DEFAULT PROBABILITIES AND INFORMATION COSTS

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Abstract

As default modeling becomes more involved, the information held by investors (or more precisely missing him) gets a larger importance see e.g. Jeanblanc-Yor (2000) and Duffie-Lando (2001). This paper takes a rather different viewpoint on the capital markets imperfection and considers the case where the whole knowledge on the underlying firm assets behavior is possible but with costs. In line with Merton (1987), one claims that these costs increase expected returns required by investors on the underlying firm assets value. Information costs (and other shadow costs) are thus suspected to change arbitrage prices of risky bonds and thus the associated default probabilities. Numerical simulations investigate how information costs change the way investors perceive risk neutral default probabilities.

I. Introduction

As default modeling becomes more involved, the information held by investors gets a larger importance. In the reduced form approach, when bondholders are assumed not completely uninformed on the default process, Jeanblanc-Yor (2000) show that the filtration must be *enlarged* (specific information thus induce a higher level of sophistication). In the structural approach, Duffie-Lando (2001) first remark that bond investors cannot observe the issuer's assets directly but receive instead only imperfect accounting reports. They then demonstrate that such information implies the existence of a default arrival intensity.

This short paper takes a rather different viewpoint on the imperfection of capital markets. It considers the case where the whole knowledge on the underlying firm assets behavior is possible but at a cost [1]. In line with Merton (1987), these costs are expected to lower the risk neutral drift required by investors on the underlying state variable. Information costs (and other more general shadow costs) are then suspected to change arbitrage prices of risky bonds and hence the observed default probabilities. Here, shadow costs are related to the underlying information to be gathered. Information costs on the bond price itself (viewed as a derivative) appear indistinguishable from a liquidity premium (see Ericsson-Renault (2000)).

The rest of this paper is organized as follows. Section II sheds lights on the role of information costs in asset pricing and option pricing with respect to Merton's (1987) model of capital market equilibrium with incomplete information. It then derives the analytic effect of information costs on the perceived risk neutral default probability. Simulations are presented in Section III, and section IV concludes the paper.

II. The Structural Framework within Information Costs

II.1 The Role of Information

An important question in financial economics is how frictions affect equilibrium in capital markets. In a world of costly information, some investors will have incomplete information and others spend time and money to gather information about the financial instruments and financial markets. Information costs then offer an explanation for limited participation in financial markets. Differences in information can also explain some puzzling phenomena in finance such as the 'home equity bias' or the 'weekend effect'.

In general, a fixed cost to participate in the market is viewed as summarizing both transaction costs (as brokerage fees) and information costs (such as the cost of understanding financial institutions, the cost of gathering information about assets, etc.). Our definition of information costs is similar to that in Merton (1987) who provides a simple capital market equilibrium model with incomplete information. In fact, our analysis is intimately based on the capital asset pricing models for the valuation of derivatives and Merton (1987)[2]. Merton's (1987) results conclude that asset returns are an increasing function of their beta risk, residual risk, and size and a decreasing function of the available information for these assets. The use of Merton's (1987) is justified because empirical studies now support many implications of his model of capital market equilibrium with incomplete information[3].

For instance, an idea underlying Merton (1987) is that the costs of gathering and processing data lead some investors to focus on stocks with high visibility and also to entrust a portion of their wealth to money managers employed by pension plans. In this context, a trading strategy shaped by real-world information costs should incorporate an investment in well-known, visible stocks, and an investment delegated to professional money managers. This investor recognition hypothesis has been tested by Shapiro (2000). Extending Merton (1987), he examines equilibrium in a dynamic pure-exchange economy with two agents. One agent may be affected by real-world frictions not captured in his description of the economy. His empirical findings then indicate that asset prices are consistent with the investor recognition hypothesis and with his specification of both the direct and the delegated components of equity investment under incomplete information.

Information costs also affect other financial assets. Using the concept of shadow costs of incomplete information, Bellalah (1999) and Bellalah and Jacquillat (1995) provide a simple framework for the valuation of standard options in a context of incomplete information. When there is no information cost, the formulas reduce to those in the Black and Scholes (1973) theory. The proposed models account for information uncertainty and have the potential to explain the smile effect.

II.2 The structural framework

In the following, one focuses on the effects of information costs on the perceived default probability. To this end, one suppose that the conventional Black-Scholes (1973) and Merton (1974) assumptions hold except that there is some information costs. Hence, (except the costly information) the financial market is perfect, the interest rate level constant and there exists a unique equivalent martingale measure (see Merton (1987)). Denoting by r the continuously compounded risk free interest rate and λ_V the weighted average shadow cost, the risk neutral price process of the underlying firm assets value, V, is well described by the stochastic differential equation:

$$d\ln V = \left(r + \lambda_V - \frac{1}{2}\sigma^2\right)dt + \sigma dZ$$

where Z is a standard Brownian motion and σ the constant volatility.

To make the framework as simple as possible, let's assume that the firm asset value is used as a signaling variable and that the default is declared at maturity of the bond if its process is not above a threshold K. Following Longstaff-Schwartz (1995), one may further assume that the recovery m is constant. As a result, any default risky corporate bond may be priced by:

$$G_d(t,T;K) = p_0(t,T)(1-(1-m)Q_K[\tau_V < T]).$$

Here p_0 represents the price of an equivalent risk free bond, m denotes the recovery rate and Q_K is the forward risk neutral default probability. Due to the behavior of the state variable, both p_0 and Q_K depend on the riskless interest rate r. In addition, the default probability depends on the way the default event may be declared. Due to the simple assumption we make, one has $N(-d_2)$ where $d_2 = \dfrac{\ln(V/K) + \left(r + \lambda_V - \frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}}$.

Let's assume now that a term structure of anticipated default probabilities $\left(\hat{q}(T)\right)_T$ is observed. This term structure appears biased because there exist some information costs. The unbiased risk neutral default probability, corrected from the information costs, is straightforwardly shown to be equal to:

$$N\left(N^{-1}(\hat{q}(T)) + \frac{\lambda}{\sigma}\sqrt{T}\right).$$

One observes that the unbiaised default probability is function of the square root of the term considered, the shadow cost and the firm volatility. More interesting, the unbiased default probability is seen larger than the observed one because λ is expected to be strictly positive. The correction bias appears independent of the default thresholds as well. In the sequel, attention will be focused on the bias induced by informational costs on the perceived default probability.

III Numerical Simulations

The following numerical analysis is divided in three different points since one has already demonstrated that only three different parameters do matter. The base case considers that the underlying firm value has a 40% volatility and supposes that the observed probability of default for the following 5 years is 20%.

Figure 1 first plots default probabilities obtained when it is assumed that there are information costs. The observed 5 years-default probability is supposed to be either 0, 0.5, 10 or 25 per cent. For this first experiment, information costs are allowed to be worth up to 60%. Figure 1 illustrates that, even when the *observed* default probability is null, there exists a level of information costs such that the unbiased risk neutral probability of a default is one, this level remaining nonetheless quite unrealistic. This figure also illustrates that information costs have clear potential to lower the default probability.

Figure 1:

Unbiased default probability.

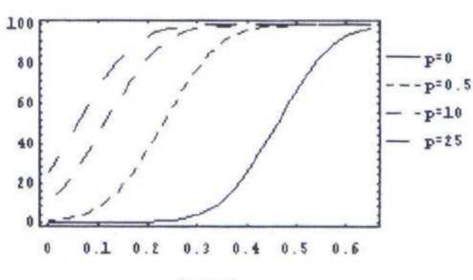
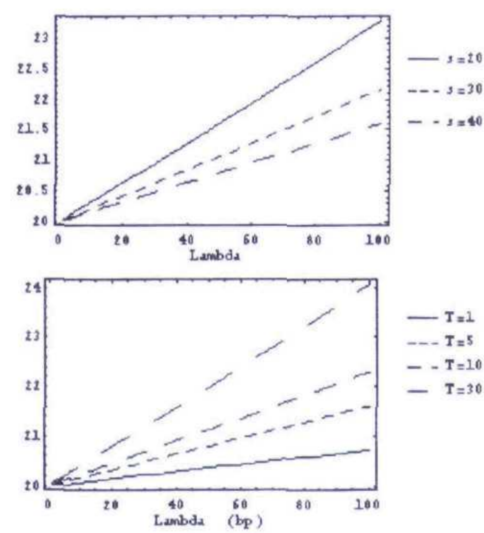


Figure 2 investigates both the volatility and maturity effects when the level of information costs is rather small (less than 100 basis points). Recall that the observed probability of default for the following 5 years is supposed to be 20%; this is the value when the information costs are null. The first raph (on the left) plots the unbiased default probability for different volatility. It appears that the pricing bias is a decreasing function of the volatility of the underlying variable. In other words, information costs more affect the default probability as the volatility gets smaller. The second graph (on the right) investigates the maturity effect. The pricing bias is an increasing function of the maturity. One may retain for instance that a one percent cost induces a 10 percent error for a 10-year default probability.

Figure 2 : The volatility and maturity effects. Information costs are expressed in basis points.



IV Conclusion

Since bond investors cannot freely observe the issuer's assets directly, implications of the informational imperfection have become one of the major concerns in the study of term structures of credit spreads on corporate bonds (Duffie-Lando (2001)). In this paper, one considers the consequences of costly investigation on the underlying firm assets behavior and relates them to the theoretical framework originated by Merton (1987). Information costs are then shown to drastically change the perceived default probability. This could partly explain the very low credit spreads levels sometimes observed as in 1999.

Endnotes

[1] It completes Duffie-Lando (2001) in the sense that information is likely to become imperfect as it gets more costly.

[2] The work of Sharpe (1964) and Lintner (1965) on the capital asset pricing model provided the general equilibrium model of asset prices under uncertainty. This model represents a fundamental tool in measuring the risk of a security under uncertainty. The first work of Black and Scholes (1973) was to test the standard CAPM by developing the concept of a zero-beta portfolio. A zero-beta-minimum variance portfolio can be implemented by buying low beta stocks and selling high beta stocks. If the realized returns on this portfolio are different from the interest rate, this would be a violation of the predictions of the original CAPM.

[3] Recently, Peress (2000) concludes that differences in private information can explain differences in households' portfolios but also that the effect of the information costs is complicated. Indeed while high transaction costs rationalize low participation, he shows that the net effect of the information costs may be a rise in participation. There is a main difference however between Merton (1987) and Peress (2000). In both models agents spend time and resources to gather information about the security's payoff, but in Merton's one investors are not all aware of the existence of the security but, if they are, they have information of the same quality.

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