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Corporate innovation, default risk, and bond pricing☆

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ABSTRACT

We propose firm-level innovation performance to be an important determinant of corporate creditworthiness and examine this relation from the perspective of bond investors. We find that firms' default probabilities are negatively related to the quantity, impact, originality, and generality of their patent portfolios. Moreover, bonds issued by more innovative firms have lower issuance premiums and lower realized excess returns. Our findings are further supported by instrumental regressions that use monetary and time costs of innovation, and by difference-in-differences tests based on exogenous shocks from state-level R&D tax credits.

1. Introduction

Corporate bonds provide a significant source of external financing for U.S. companies, especially given historically low yields in recent years.[1] Whether and how bond investors price a firm's inventions and intangible assets is a timely, relevant issue that calls for empirical investigation, especially since a firm's long-term success and survival largely depend on its innovation competitiveness in the knowledge-based economy.[2] While credit rating agencies have suggested that a firm's innovation competitiveness determines its credit risk profile and thereby provides useful information beyond its financial characteristics (Standard and Poor's, 2006), the role

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[1] In May 2013, the Barclays U.S. Corporate High Yield index fell below 5%, and the average yield of HQM 5-year corporate bonds fell below 2%.

[2] In the past 30 years, U.S. firms have invested significantly in innovation in order to thrive, and sometimes merely to survive, in competitive markets. For example, Skinner (2008) shows that, over the period from 1980 to 2005, U.S. public firms' overall capital expenditures increased by less than 50%, while their R&D investments increased by about 250%, and these investments were more than twice the amount of their capital expenditures in 2005.

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of corporate innovation in bond pricing remains underexplored in the extant literature. In addition, although innovation activities increase firm value in general (Griliches, 1984, 2000; Hall, 1993), the extent to which bond investors benefit from these activities remains a separate but important issue.

In this study, we use publicly available patent records—an alternative information source distinct from accounting R&D expenses—to measure firms' innovation performance and examine performance relevance for both corporate default risk and corporate bond pricing. Because patents represent exclusive rights to use certain knowledge in a technologically competitive economy and reflect firms' intangible intellectual assets and market prospects, patent records provide useful information about the outputs of corporate innovation. Accordingly, we use patent data to measure innovation performance by the level, impact, generality, and originality of a firm's innovation activities *relative* to its competitors in the same industry (Alcácer and Chung, 2007; Barker and Mueller, 2002; Ciftci et al., 2011). Our attempt to investigate patents' credit implications for bond investors is economically relevant, given the substantial overlap in bond-issuing and patenting activities: over the period from 1976 to 2006, 49.6% of new bonds were issued by firms with patent records in terms of issuance size.

For bond investors, patent information is more important than R&D information for two reasons. First, the territorial principle in U.S. patent laws requires all inventors who wish to protect their intellectual property to file patents to the U.S. Patent and Trademark Office (USPTO), and patent applicants are required to provide the public with reasonably detailed information (e.g., abstracts, claims, descriptions, technological classes) about their innovations. Such mandatory disclosure reduces information asymmetry due to innovation activities and helps investors weigh an innovation's cash flow consequence against its risk consequence, which is a major challenge for bondholders trying to assess an innovative firm's creditworthiness.[3] Second, patent information is not directly subject to accounting manipulation for short-term financial reporting purposes. In contrast, managers have incentives to manipulate R&D expenditures to achieve short-term performance goals (Bushee, 1998; Dechow and Sloan, 1991; Murphy and Zimmerman, 1993) or over-invest in R&D due to over-optimism and private benefits (Hall, 1993; Jensen, 1993). That said, the extant literature is yet to offer a unified understanding of the relation between R&D investment and creditworthiness (e.g., Eberhart et al., 2008; Gow et al., 2010; Shi, 2003).

We first propose that outsider investors, *ex ante*, consider a firm that is more competitive in innovation to have a lower default probability, as firms owning more and higher-quality patents are more likely to earn first-mover advantages and become market leaders because they are equipped with more recent and influential technologies. In addition, patents raise entry costs for newcomers and help prevent competitors from using similar technologies. Further, firms with more competitive patent portfolios are more likely to gain quasi-monopoly power in the market. Such competitive advantages in innovation thus improve firms' financial stability and decrease their default risk.[4] Accordingly, this line of argument leads to our first hypothesis:

Hypothesis 1. A firm's perceived default risk is negatively associated with its innovation performance.

Since bond investors are more concerned about a bond issuer's solvency, the bond issuer's probability of default should be a key determinant in corporate bond pricing. Investors would demand a lower risk premium if they consider firms with stronger patent performance to be less risky. To directly test if bond investors incorporate the expected association between the information content of patents and default risk into bond pricing, we examine if innovation performance, when measured using patents, is negatively associated with the costs of bond financing. We present our second hypothesis as follows:

Hypothesis 2. A firm's bond premiums are negatively associated with its innovation performance.

Our empirical analyses show that outsider investors consider a firm that is more competitive in innovation to have higher survival likelihood and price the firm accordingly in the bond market. We first find that innovatively competitive firms (i.e., firms owning more and higher-impact patents with higher generality and originality scores) are associated with lower default probability, after we control for R&D expenditures and other financial metrics. We then find that innovatively competitive firms have lower yields on newly-issued bonds (an *ex ante* proxy of risk premiums) in the primary market, as well as lower excess bond returns (an *ex post* proxy of risk premiums) in the secondary market.

To help support a causal interpretation of our findings, we implement the following tests. First, we conduct two-stage least squares (2SLS) regressions by using monetary and time costs of patenting activities as instrumental variables.[5] We find a consistently negative relation between perceived default risk and *predicted* innovation measures, suggesting that our baseline finding is unlikely driven by omitted variables at the firm level, since predicted innovation measures are purged of firm-level omitted variables. Second, we conduct a difference-in-differences test to examine the cross-sectional variation of the innovation-creditworthiness association based on the adoption of state-level R&D tax credits (Wilson, 2009), which is an exogenous shock to innovation activities. We find that default

[3] Since the mid-1980s, U.S. firms have become more active in patenting their inventions and defending their intellectual property rights (Hall, 2005; Hall and Ziedonis, 2001; Kortum and Lerner, 1998), which makes patents a good data source for constructing measures of firms' innovation performance. Recent studies show that patents may be more useful in predicting future earnings and cash flows than R&D expenses (Baily, 1972; Hirshleifer et al., 2013, 2014; Megna and Klock, 1993; Pandit et al., 2011). In addition, patents are valuable outputs of corporate innovation (e.g., tradable assets in intellectual property markets) (Lev, 2001), and can serve as either collaterals or valuable assets for sale when a borrower becomes financially distressed (Chava et al., 2013; Mann, 2014).

[4] Prior studies report that firms with more and better patents are associated with lower litigation risk (Lanjouw and Schankerman, 2004), generate less volatile earnings (Pandit et al., 2011), and are, therefore, less likely to go bankrupt (Eisdorfer and Hsu, 2011).

[5] We use industry-average R&D expenditures per patent and the industry-average duration for a patent's application to be approved to measure monetary and time costs of firms' patenting activities, respectively. These two instrumental variables satisfy the relevance and exclusiveness conditions based on both Kleibergen and Paap's (2006) identification test and Hansen's (1982) over-identification test; in addition, these variables are intuitively exogenous to credit risk, except when working through the potentially endogenous independent variable (i.e., firms' innovation performance).