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Entrepreneurial Spirit and Entrepreneurial Finance

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We introduce entrepreneurial spirit into an incomplete markets model of entrepreneurial firms and explain how it influences entrepreneurs' allocation of wealth between consumption and asset portfolios, capital structure, investment, and business exit decisions with nondiversifiable risks. The study shows that entrepreneurs with an entrepreneurial spirit prefer to choose a relatively high debt level and tend to sell their firms earlier than those without an entrepreneurial spirit, which increases the default risk and credit spreads and leads to a higher discount rate of corporate bonds. Hence, our paper provides an alternative explanation for the credit spread puzzle and firms' excessive risk management.

Key Words: The Spirit of capitalism; Credit spreads; Default time; Consumption; Portfolio allocation; Capital structure; Investment.
JEL Classification Numbers: D91, E22, G32.

1. INTRODUCTION

For the vast majority of entrepreneurs, their consumption level does not increase indefinitely as their wealth grows throughout their lives. However, maintaining a relatively certain level of consumption for a long time will not stop entrepreneurs from pursuing growth in enterprise size and personal wealth. Thus, consumption is not the only factor that can increase the utility of entrepreneurs in the process of making decisions and running businesses. The theory that people try to make money not only to increase their consumption but also to increase the scale of their wealth was first proposed by Weber (1958); he defines this phenomenon as the spirit of

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capitalism. Then, the spirit of capitalism was repeatedly demonstrated by scholars from both empirical and theoretical perspectives. One of the most representative pieces of evidence of the spirit of capitalism is the empirical results of Atkinson (1971), which show that the total wealth of most people does not decline significantly after retirement and even increases in most cases. His thesis empirically demonstrates that an increase in wealth scale can bring about an increase in agent utility. After the theory gradually matured, the spirit of capitalism became written into the utility function of the optimal control model by many scholars in the form of parameters and was widely used in the research fields of economics and finance. Zou (1994) studies the relationship between the spirit of capitalism and the long-term high growth rate of the Asian economy and finds that under the assumption of neoclassical production technology, a strong spirit of capitalism can lead to the rapid growth of capital accumulation and investment. Bakshi and Chen (1996) study the spirit of capitalism and stock market pricing in an attempt to explain the mystery of equity premiums proposed by Mehra and Prescott (1985). Luo, Smith, and Zou (2009) show the model with the spirit of capitalism, a stochastic interest rate, transitory and permanent shocks to income can explain excess smoothness anomalies of modern consumption theory. He, Luo, Nie and Zou (2020) explore the implications of the spirit of capitalism on monetary policy, growth, and welfare. Luo, Nie and Zou (2021) incorporate the spirit of capitalism into a general equilibrium consumption-portfolio choice model and predict consumption inequality, equilibrium interest rate, and equity premium.

Based on the empirical and theoretical research results above, we introduce entrepreneurial spirit into the agent's utility function similiar with Luo, Smith, and Zou (2009) and adopt a continuous time dynamic stochastic model framework based on Merton's (1971) consumption model. Chen, Miao and Wang's (2010) incomplete market model is used to explore and analyze how the spirit of capitalism influences entrepreneurs' decision making (investment, financing, and business exit), especially when entrepreneurs are in an incomplete market environment and face nondiversifiable risks. We redesigned the utility function of the agent, and the new utility function can be defined as a function of consumption and wealth. This means that the agent's wealth can also be explained by a utility function. In the model, our agent adopts constant-absolute-risk aversion (CARA) preferences regarding consumption and wealth. We introduce a parameter θ to measure the strength of entrepreneurial spirit; this concept is also known as the spirit of capitalism in many other studies.

We analyze the optimal capital structure using a dynamic incomplete markets tradeoff model in which risky debt can diversify entrepreneurs' risk. Chen, Miao and Wang (2010) show that nondiversifiable risk will lead entrepreneurs with high risk aversion to default earlier and choose higher

coupons and leverage. Nondiversifiable risks also cause entrepreneurial firms to reject more start-up projects compared to public firms in a complete market, and issuing more risky debt can prevent the nondiversifiable risks problem from leading to underinvestment. They construct a model to analyze a risk-averse entrepreneur who can decide whether to invest in an illiquid and nontradable project requiring a lump-sum investment to start his business. The project can generate stochastic cash flows with systematic and idiosyncratic (nondiversifiable) risks. The entrepreneur is also a consumer who makes intertemporal consumption decisions and invests asset portfolios consisting of a market portfolio and a risk-free asset. The entrepreneur also makes investment, capital structure and default decisions.

By introducing entrepreneurial spirit into the continuous time dynamic stochastic model framework, we make the utility function of entrepreneurs closer to the actual situation and obtain the following important conclusions. First, entrepreneurial spirit causes entrepreneurs to pay more attention to their total wealth, which leads to a higher threshold of income for investment targets under the premise of risk aversion. Correspondingly, entrepreneurs with a stronger entrepreneurial spirit withdraw from investment projects earlier than those with a weaker entrepreneurial spirit. Second, a stronger entrepreneurial spirit makes entrepreneurs more willing to increase their debt levels and thereby pass on risk. This is intuitive, as entrepreneurs are reluctant to see their wealth decrease and do all they can to reduce their risk exposure. The introduction of entrepreneurial spirit partly explains the phenomenon that some enterprises have excessive risk management in incomplete markets. Third, entrepreneurs with higher entrepreneurial spirit focus more on their wealth. Their entrepreneurial spirit causes them to lower the equity value of firms with nondiversifiable risks. Therefore, they will choose a lower threshold for cash-out and a higher threshold for bond default.

Furthermore, our paper provides an alternative explanation for the credit spread puzzle from the perspective of entrepreneurial spirit. In terms of the explanation of the credit spread puzzle, we refer to the different explanations proposed by existing scholars from empirical and theoretical perspectives. Jones, Mason and Rosenfeld (1984) find that the contingent claims analysis model cannot improve the simple riskless model for investment-grade bonds. Duffie and Lando (2001) study the credit spread term structures of corporate bonds influenced by imperfect information. Their model shows that participants in the secondary bond market assess the accuracy of their information to adjust their views about credit risk. The current asset-liability ratios can explain the credit spreads and default probabilities. Elton and Gruber (2001) find that factors such as the expected default probability, additional systematic risk and state taxes of corporate bonds relative to government bond returns can explain the credit

spread. Huang and Huang (2003) show that only a small fraction of the corporate-Treasury yield spreads can be explained by credit risk. Existing studies explain this puzzle mainly from the perspectives of market mechanisms, market incompleteness (including information asymmetry), the risk loss cost of bond maturity structures, and other unforeseeable risks. However, our paper attempts to explain this problem from the perspective of entrepreneurial spirit.

The remainder of our paper is organized as follows: we describe the setup of the dynamic incomplete markets model with entrepreneurial spirit in Section 2. In Section 3, we solve our model via backward induction. Section 4 provides a quantitative analysis of the effects of entrepreneurial spirit. Finally, we conclude the paper in Section 5.

2. MODEL SETUP

2.1. Investment opportunities

Following Chen, Miao and Wang (2010), we assume a risk-averse entrepreneur who is also a consumer, can decide whether to spend a lump-sum investment I on a start-up project at time 0 and lives infinitely. The stage when the entrepreneur has not yet exercised a real option to run his private business is referred to as the start-up phase of the entrepreneurial firm, following Bolton, Wang, Yang (2019). After the firm has made its investment, the start-up project provides a stochastic cash flow process $\{y_t : t \geq 0\}$ that follows a geometric Brownian motion:

$$\frac{dy_t}{y_t} = \mu dt + \omega dB_t + \epsilon dZ_t \,, \tag{1}$$

μ denotes the time-independent expected growth rate of the project's cash flow. B_t is a standard Brownian motion that denotes the source of market (systematic) risk of the entrepreneur's private business. Z_t is a standard Brownian motion that denotes the source of idiosyncratic risk of the entrepreneur's private business. We assume that B_t and Z_t are independent. ϵ and ω are the idiosyncratic and systematic volatility of the project's cash flow growth, respectively. We define the total volatility $\sigma = \sqrt{\omega^2 + \epsilon^2}$. We refer to this stage as the mature phase.

As a consumer, the entrepreneur considers a financial investment and consumption problem, similar to Merton (1971). The risk-averse entrepreneur decides how to allocate his liquid financial wealth between a market portfolio with return dR_t and a riskless asset with constant risk-free rate r. The return of the market portfolio dR_t satisfies the following equation:

$$dR_t = \mu_p dt + \sigma_p dB_t \tag{2}$$

where μ_p and σ_p are the expected return and systematic volatility of the market portfolio, respectively, and B_t is the standard Brownian motion, which is the same as the market (systematic) part in Equation (1). The Sharpe ratio of the market portfolio η satisfies the following equation:

$$\eta = \frac{\mu_p - r}{\sigma_p} \tag{3}$$

$\{x_t : t > 0\}$ denotes the entrepreneur's liquid (financial) wealth process. The entrepreneur invests the amount ϕ_t on the market portfolio and the remaining amount $x_t - \phi_t$ on the risk-free asset.

2.2. Entrepreneurial firm

We follow the assumption from Chen, Miao and Wang (2010). The entrepreneur pays the initial lump-sum cost I for the project in the start-up phase. In our model, the only source of external financing to support the start-up project is debt, which is a consol and issued at par value, as in Leland (1994). The debt is issued in the start-up phase and remains the same in the mature phase until the entrepreneur cashes out or defaults on the debt to retire from his business. Public diversified lenders price debt competitively. F_0 denotes the par value of debt, and b denotes the coupon of debt.

After the debt is issued and the entrepreneur starts his business, the entrepreneurial firm enters the mature phase. In this phase, the entrepreneur can decide whether to (1) continue his private business; (2) default on the debt, leading to the liquidation of the entrepreneur's firm; and (3) sell the firm to a diversified buyer to cash out. The entrepreneur earns the project's cash flow, which is equal to the payments of the profit net of the tax and coupon from the entrepreneurial firm when he is running the business. If the cash payments are negative, then the entrepreneur injects cash from his pocket into the firm.

The entrepreneur cannot diversify the idiosyncratic business risk via a riskless security and the market portfolio, but the entrepreneur can exit his business by selling the firm to diversify the idiosyncratic business risk and cash out. If the entrepreneur sells his firm, he will pay the capital gains tax and a fixed transaction cost K. The entrepreneur can maximize his utility by timing a default or cash-out after he chooses the debt level and coupon in the start-up phase. T_d denotes the default timing, and T_u denotes the cash-out timing. T_d and T_u are not contractible when issuing debt. The choices of default or cash-out timing are similar to American-style put options, but the underlying asset is the entrepreneurial firm, which is nontradable. Since the entrepreneur faces incomplete markets, we cannot use the Black-Scholes-Merton method to price the entrepreneurial firm (the entrepreneur's options). When the entrepreneur defaults, the lenders

take control of the firm. Bankruptcy is costly so that the entrepreneur is not willing to issue too much debt for tax benefits and diversify idiosyncratic risk. The entrepreneur determines capital structure via the tradeoff among idiosyncratic risk, tax benefits and bankruptcy cost. When the firm is liquidated, the lender can sell it to diversified buyers. Then, the entrepreneurial firm becomes the public firm. Let $A(y)$ denote the value of all-equity public firms and $(1-\alpha)$ denote the bankruptcy cost. Therefore, the liquidation value of the entrepreneurial firm is equal to $\alpha * A(y)$ due to bankruptcy costs. The remaining fraction $(1-\alpha)$ is deadweight loss. We assume that the lenders and the entrepreneur will not renegotiate after the entrepreneur defaults.

If the entrepreneur wants to sell the firm to cash out, he must repay the entrepreneurial firm's debt at par value F_0. The entrepreneur sells the firm to public buyers who are well diversified and can choose the firm's capital structure in complete markets. After being sold to the public, the firm is priced at the value of an optimally levered public firm, $V^*(y)$, as in Leland (1994).

After the entrepreneur defaults or sells the firm to cash out, he exits his private business and lives on his liquid financial income. His consumption and wealth influence his utility. He becomes a consumer, not an entrepreneur, and solves the consumption and portfolio choice problem in complete markets, as in Merton (1971), but his utility function is different.

2.3. Taxes

The entrepreneurial firm pays taxes on its business profits at rate τ_e. When $\tau_e > 0$, issuing debt has the tax shield benefit of the entrepreneur's private business profits. For a public firm, the effective marginal tax rate is τ_m. τ_g denotes the tax rate on the capital gains of selling the firm to cash out. Higher capital gains taxes will delay the timing of cash-out.

2.4. Entrepreneur's objective

For analytical tractability (similar to Luo et al. (2009) and Wang (2009)), we use the CARA utility function in our model for tractability reasons.[1] In the most common cases, the CARA utility function ($u(c_t) = -\frac{1}{\gamma}e^{-\gamma c}$) does not depend on wealth directly. To introduce the incentive effect of wealth on entrepreneurs into the entrepreneur decision-making model, we revise the utility function of entrepreneurs. That is, let $u(c,x) = -\frac{1}{\gamma}e^{-\gamma(c+\theta x)}$, where $\gamma > 0$ is the coefficient of absolute risk aversion, which also measures the precautionary motive. θ measures the entrepreneurial spirit. The entrepreneur's utility is generated by consumption and wealth. The wealth variable in the utility function tracks the impact of entrepreneurial spirit.

[1]The adoption of the CARA utility function is tractable for consumption and saving problems with labor income in incomplete markets.

In reality, people not only care about his consumption, but also wealth in their bank account. We assume the wealth created by the entrepreneur can increase his utility. Since the entrepreneurial firm cannot be traded before exit, we assume the entrepreneur take the financial portfolio and cash flow of the entrepreneurial firm rather than the whole value of entrepreneurial firm into his utility function.

The entrepreneur has a time-additive utility function consisting of consumption $\{c_t : t > 0\}$, financial portfolio $\{\phi_t : t > 0\}$ and wealth $\{x_t : t > 0\}$ as follows:

$$\mathbb{E}\left[\int_0^\infty e^{-\delta t} u(c_t, x_t) dt\right] \tag{4}$$

where $\delta > 0$ is the entrepreneur's subjective discount rate and $u(\cdot)$ is an increasing and concave function with respect to c_t and x_t (i.e. $U_c > 0, U_x > 0, U_{cc} < 0, U_{xx} < 0$). The entrepreneur will optimally choose his market portfolio (ϕ_t), his consumption (c_t), and whether to undertake the start-up project. After he invests in the project and starts his business, he chooses coupon b and the capital structure of the firm. The entrepreneur can maximize his utility by timing the decisions to default on debt (T_d) and cash out (T_u).

3. MODEL SOLUTION

We solve the consumption, portfolio choice, capital structure and investment decisions of the entrepreneur with reference to entrepreneurial spirit by backward induction. We first consider the case in which the entrepreneur has defaulted or cashed out to exit his business; then, we can solve the consumption and portfolio choice problem of the entrepreneur with entrepreneurial spirit, as in Merton (1971), except that the utility function in our model emphasizes entrepreneurial spirit. Second, we assume that the entrepreneur is running his business, and we determine the default and cash-out timing problem of the entrepreneur in addition to his consumption and portfolio choices, which are affected by idiosyncratic risk. Finally, we analyze the entrepreneur's initial lump-sum investment in the project and capital structure in the start-up phase.

3.1. Consumption and portfolio choices after retiring from the business

The entrepreneur does not have any private business cash flow and lives on his own financial wealth after he exits his business via default or cash-out. The entrepreneur's financial wealth, consisting of consumption, risk-

less bonds and market portfolios, evolves as follows:

$$dx_t = (r(x_t - \phi_t) - c_t)dt + \phi_t(\mu_p dt + \sigma_p dB_t) \tag{5}$$

Since the entrepreneur retires from his business and does not suffer from idiosyncratic risk, his utility-maximization problem is a dynamic consumption and portfolio choice problem in complete markets.

$$\max_{c_t,\phi_t} \mathbb{E}\left[\int_0^\infty e^{-\delta t} u(c_t, x_t)dt\right] \tag{6}$$

The value function $J^e(x, y)$ of the entrepreneur after he exits his business satisfies the Hamilton-Jacobi-Bellman (HJB) equation for the principle of optimality as follows:

$$\delta J^e = \max_{c,\phi} u(c, x) + (r(x - \phi) + \mu_p\phi - c)J^e_x + \frac{1}{2}\phi^2\sigma_p^2 J^e_{xx} \tag{7}$$

The FOC are then

$$u_c(c, x) = J^e_x \tag{8}$$

$$\phi = -\frac{\mu_p - r}{\sigma_p^2}\frac{J^e_x}{J^e_{xx}} \tag{9}$$

We estimate and verify the solution to equation (7) as

$$J^e(x) = -\frac{1}{\gamma(r+\theta)}\exp\left[-\gamma(r+\theta)\left(x + \frac{\eta^2}{2\gamma(r+\theta)^2} + \frac{\delta - (r+\theta)}{\gamma(r+\theta)^2}\right)\right] \tag{10}$$

Plugging equation (10) into equation (8) and equation (9), we obtain

$$\bar{c}(x) = (r+\theta)\left(x + \frac{\eta^2}{2\gamma(r+\theta)^2} + \frac{\delta - (r+\theta)}{\gamma(r+\theta)^2}\right) - \theta x \tag{11}$$

$$\bar{\phi} = \frac{\mu_p - r}{\sigma_p^2}\frac{1}{\gamma(r+\theta)} \tag{12}$$

An entrepreneur with a higher entrepreneurial spirit consumes less and invests less in risky assets relative to the consumption and portfolio choice problem in complete markets, as in Merton (1971), or the incomplete-market model without entrepreneurial spirit in Chen, Miao, Wang (2010) because the entrepreneur's wealth will increase his utility and consumption, and the entrepreneur is risk averse. He invests less in market portfolios to decrease the volatility of his wealth.

3.2. Optimal decision and valuation in the mature phase

In the mature phase, the entrepreneur runs his business, and his financial wealth, including the business's revenue before he exits, evolves according to the following equation:

$$dx_t = (r(x_t - \phi_t) + (1 - \tau_e)(y - b) - c_t)dt + \phi_t(\mu_p dt + \sigma_p dB_t) \tag{13}$$

The entrepreneur receives business income, which contains the idiosyncratic risk of the entrepreneurial firm via cash payments (operating profit net of coupon payments): $(1 - \tau_e)(y - b) - c_t$

The value function $J^s(x, y)$ of the entrepreneur when he is running his business satisfies the HJB equation for the principle of optimality as follows:

$$\begin{aligned}\delta J^s(x,y) = \max_{c,\phi} u(c,x) + \big(r(x-\phi) + \mu_p\phi + (1-\tau_e)(y-b) - c\big)J^s_x(x,y) \\ + \mu y J^s_y(x,y) + \frac{1}{2}\phi^2\sigma_p^2 J^s_{xx}(x,y) + \frac{1}{2}\sigma^2 y^2 J^s_{yy}(x,y) \\ + \phi\sigma_p\omega y J^s_{xy}(x,y)\end{aligned} \tag{14}$$

We can obtain the first-order conditions for consumption c and market portfolio allocation ϕ in the following equations:

$$\frac{\partial u(c,x)}{\partial c} = J^s_x(x,y) \tag{15}$$

$$\phi = -\frac{J^s_x(x,y)}{J^s_{xx}(x,y)}\frac{\mu_p - r}{\sigma_p^2} - \frac{J^s_{xy}(x,y)}{J^s_{xx}(x,y)}\frac{\omega y}{\sigma_p} \tag{16}$$

We estimate and verify the solution to equation (14) as

$$J^s(x) = -\frac{1}{\gamma(r+\theta)}\exp\left[-\gamma(r+\theta)\left(x + G(y) + \frac{\eta^2}{2\gamma(r+\theta)^2} + \frac{\delta - (r+\theta)}{\gamma(r+\theta)^2}\right)\right] \tag{17}$$

Plugging equation (17) into equation (15) and equation (16), we obtain

$$\bar{c}(x) = (r+\theta)\left(x + G(y) + \frac{\eta^2}{2\gamma(r+\theta)^2} + \frac{\delta - (r+\theta)}{\gamma(r+\theta)^2}\right) - \theta x \tag{18}$$

$$\bar{\phi} = \frac{\mu_p - r}{\sigma_p^2}\frac{1}{\gamma(r+\theta)} - \frac{\omega y}{\sigma_p}G'(y) \tag{19}$$

The discount rate is equivalent to $(r + \theta)$, and entrepreneurial spirit increases the discount rate. Equation (18) shows that the entrepreneur's optimal consumption is equal to the fraction of his certainty-equivalent wealth

$G(y)$ capturing the risk-adjusted subjective value of the firm's nontradeable equity, liquid financial wealth x, and two constant terms reflecting the effects of the expected excess returns and the wedge $\delta - r - \theta$ on consumption. Equation (19) shows that the entrepreneur's portfolio consists of the mean-variance term (the first term) and the hedging demand term (the second term). The mean-variance term is similar to that in Merton (1971) but contains entrepreneurial spirit, which decreases the allocation to market portfolios. The hedging demand term reflects that the entrepreneur can dynamically hedge the idiosyncratic risk from his private business via the market portfolio.

We now determine the boundary conditions of the entrepreneur's value function. The lower boundary can be determined by analyzing the moment when an entrepreneur defaults on debt. The equity value falls to zero at default. Since the financial wealth of the entrepreneur x remains the same immediately after default, his value function should also be the same at the time of default. Therefore, the value-matching condition is satisfied at the lower default boundary $y_d(x)$ as follows:

$$J^s(x, y_d(x)) = J^e(x) \tag{20}$$

We can see from equation (20) that the default boundary is a function of the entrepreneur's wealth level. The smooth-pasting conditions must satisfy the principle of optimality at $y = y_d(x)$ for the entrepreneur to choose the best default boundary as follows:

$$\left.\frac{\partial J^s(x,y)}{\partial x}\right|_{y=y_d(x)} = \left.\frac{\partial J^e(x)}{\partial x}\right|_{y=y_d(x)} \tag{21}$$

$$\left.\frac{\partial J^s(x,y)}{\partial y}\right|_{y=y_d(x)} = \left.\frac{\partial J^e(x)}{\partial y}\right|_{y=y_d(x)} \tag{22}$$

The two equations above mean that the marginal value of wealth and the marginal value of revenue remain unchanged at the time of default.

When the entrepreneur wants to cash out, he must spend fixed cost K on the sale and repay the debt at the par value. The entrepreneur sells his firm for $V^*(y)$ (from Chen, Miao and Wang (2010)) as follows:

$$V^*(y) = \left[1 - \tau_m + \tau_m \left(1 - \theta_1 - \frac{(1-\alpha)(1-\tau_m)\theta_1}{\tau_m}\right)^{1/\theta_1}\right] \frac{y}{r-\nu} \tag{23}$$

$$\nu \equiv \mu - \omega\eta \tag{24}$$

$$\theta_1 = -\sigma^{-2}(\nu - \sigma^2/2) - \sqrt{\sigma^{-4}(\nu - \sigma^2/2)^2 + 2r\sigma^{-2}} < 0 \tag{25}$$

The entrepreneur must pay capital gains taxes when he sells his firm. His financial wealth x_{Tu} jumps at the time of selling the firm and satisfies the following equation:

$$x_{T_u} = x_{T_u-} + V^*(y_{T_u}) - F_0 - K - \tau_g(V^*(y_{T_u}) - K - I) \tag{26}$$

The par value of debt $F_0 = F(y_0)$ is obtained using Equation (C6) in Chen, Miao and Wang (2010).

Since the financial wealth x of the entrepreneur does not change immediately after cash-out, his value function should remain the same at the time of cash-out, and his value function at the higher boundary (cash-out boundary) $y_u(x)$ satisfies the value-matching condition as follows:

$$J^s(x, y_u(x)) = J^e\big(x + V^*(y_u(x)) - F_0 - K - \tau_g(V^*(y_u(x) - K - I)\big) \tag{27}$$

The following smooth-pasting conditions at the time of cash-out ($y = y_u(x)$) must satisfy the principle of optimality for the entrepreneur to choose the best cash-out boundary as follows:

$$\begin{aligned} &\frac{\partial J^s(x,y)}{\partial x}\bigg|_{y=y_u(x)} \\ &= \frac{\partial J^e\big(x + V^*(y) - F_0 - K - \tau_g(V^*(y) - K - I)\big)}{\partial x}\bigg|_{y=y_u(x)} \end{aligned} \tag{28}$$

$$\begin{aligned} &\frac{\partial J^s(x,y)}{\partial y}\bigg|_{y=y_u(x)} \\ &= \frac{\partial J^e\big(x + V^*(y) - F_0 - K - \tau_g(V^*(y) - K - I)\big)}{\partial y}\bigg|_{y=y_u(x)} \end{aligned} \tag{29}$$

Plugging equation (10) and equation (17)-(19) into equation (20)-(22) and equation (27)-(29), we obtain

$$\begin{aligned} (r+\theta)G(y) =& (1-\tau_e)(y-b) + (\mu - \omega\eta)yG'(y) + \frac{\sigma^2 y^2}{2}G''(y) \\ &- \frac{\gamma(r+\theta)\epsilon^2 y^2}{2}G'(y)^2 \end{aligned} \tag{30}$$

subject to the boundary conditions at y_d and y_u as follows:

$$G(y_d) = 0 \tag{31}$$

$$G'(y_d) = 0 \tag{32}$$

$$G(y_u) = V^*(y_u) - F_0 - K - \tau_g(V^*(y_u) - K - I) \tag{33}$$

$$G'(y_u) = (1 - \tau_g)V^{*'}(y_u) \tag{34}$$

3.3. Financing and investment in the start-up phase

We now turn to the model solution for maximizing the firm's value by choosing the entrepreneur's initial investment in start-up projects and financing in the start-up phase. The entrepreneurial firm has two financial securities: outside lenders and inside equity (entrepreneur's equity). The equity value of the entrepreneur with an entrepreneurial spirit is equal to the certainty equivalent value $G(y)$. The creditors value debt at $F(y)$ competitively in complete markets, which excludes the idiosyncratic risk premium. The total private value of the entrepreneurial firm is

$$S(y) = G(y) + F(y) \tag{35}$$

In the start-up phase, the optimal coupon b is chosen by the entrepreneur to optimize the total value of the entrepreneurial firm:

$$b^* = \arg\max_b S(y_0; b) \tag{36}$$

Finally, we turn to computing the investment thresholds, which determine whether the entrepreneur is willing to invest in the project in the start-up phase. He makes the investment and starts his business at time 0 if his lifetime utility with the start-up project is higher than that without the project. This means that when the condition $S(y_0) > I$ is satisfied, the entrepreneur invests in the project.

We compute the ratio of the public value of debt $F(y)$ to the total value of the firm $S(y)$:

$$L(y) = \frac{F(y)}{S(y)} \tag{37}$$

to denote the entrepreneurial firm's leverage, which reflects the impact of idiosyncratic risk on the leverage choice. The entrepreneur's preferences, such as entrepreneurial spirit and risk aversion, influence the firm's capital structure. If shareholders can diversify idiosyncratic risk, this diversification has no effect on the capital structure decisions of public firms; this argument is not valid for entrepreneurial firms because entrepreneurs cannot diversify idiosyncratic risk sufficiently when running a private business.

4. QUANTITATIVE ANALYSIS

We set the values of the (annualized) baseline parameter as follows: the entrepreneur's rate of time preference $\delta = 3\%$, expected growth rate of the project's revenue $\mu = 4\%$, systematic volatility of the growth rate $\omega = 10\%$, idiosyncratic volatility $\epsilon = 20\%$, market price of risk $\eta = 0.4$, risk-free interest rate $r = 3\%$, risk-aversion parameter $\gamma = 1$, and asset recovery rate $\alpha = 0.6$. We set the tax rate τ_m to 11.29%, the same as in Hackbarth, Hennessy, and Leland (2007). We first use $\tau_e = 0$ to eliminate the effect of tax benefits, which allows us identify the benefits of debt for the diversification of idiosyncratic volatility. Next, we consider the setting where $\tau_e = \tau_m$, which introduces tax benefits into the model. We consider three values of entrepreneurial spirit $\theta = 0$, 0.1%, 0.3%. We set the values of entrepreneurial spirit below 1% to maintain the precautionary effect in the incomplete market described in Chen, Wang and Miao (2010), to make comparisons and to avoid the situation in which the entrepreneur issues too much debt at time 0 such that leverage is almost equal to 1. Finally, we set the initial cash flow of the start-up project $y_0 = 1$.

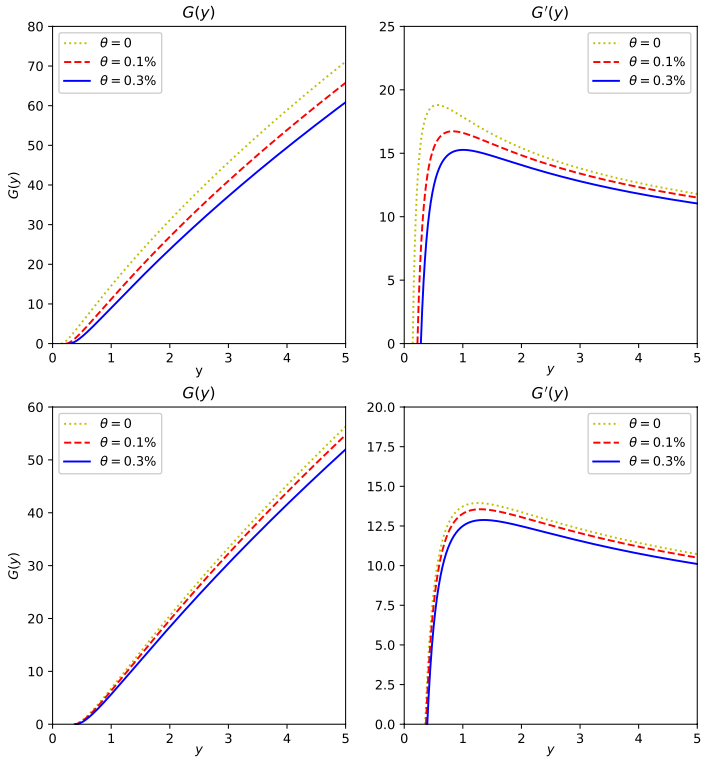
4.1. Value of private equity and the timing of default

We plot the private value of equity $G(y)$ and its derivative $G'(y)$ as functions of y in Figure 1. The top panel plots the results for $\tau_e = 0$ without tax benefits, and the bottom panel plots the results for $\tau_e = \tau_m$. When $\tau_e = 0$, the benefits for the diversification of idiosyncratic risk makes the risk-averse entrepreneur issue debt, although there is no tax benefit. The entrepreneur defaults on debt when y falls to y_d, where $G(y_d) = G'(y_d) = 0$. The bottom two panels of Figure 1 plot this case, where $\tau_e = \tau_m$. In this case, the entrepreneurial firm has an incentive to issue debt to diversify idiosyncratic risk and take advantage of tax benefits.

The sensitivity of private value of equity $G(y)$ with respect to revenue y is measured by the derivative $G'(y)$. From Figure 1, we can obtain $G'(y) > 0$, which means that the private value of equity $G(y)$ increases with revenue y. When y approaches 0, equity value is convex in revenue y, as in Figure 1, reflecting the call option feature of the entrepreneur's private equity $G(y)$. Since the firm is not tradable before cash-out or default, the entrepreneur cannot fully diversify the firm's idiosyncratic risk. We can see that $G'(y)$ decreases with y when y is far from 0, so the global convexity of $G(y)$ no longer holds, which is different from the call option feature. The concavity of $G(y)$ reflects the precautionary saving demand of the entrepreneur. The entrepreneur can partially buffer against the project's idiosyncratic shocks via precautionary saving.

Figure 1 shows that the entrepreneur with a higher entrepreneurial spirit discounts cash flows at a higher rate, as in equation 30. For a given level

FIG. 1. $G(y)$ and $G'(y)$



of coupon b, the entrepreneur with a higher entrepreneurial spirit prices his private equity at lower value (smaller $G(y)$) and thus has a greater incentive to default and sell the firm to cash out. An entrepreneur with a higher entrepreneurial spirit is also more willing to diversify idiosyncratic risk by selling a larger share of his firm to the public, which implies a larger coupon b, a higher default threshold y_d, and a higher debt value, ceteris paribus. Figure 1 also confirms that $G(y)$ decreases with entrepreneurial spirit θ and that the default threshold y_d increases with entrepreneurial spirit θ.

4.2. Capital structure of an entrepreneurial firm without the cash-out option

We now turn to the capital structure information for entrepreneurial firms without the cash-out option, which is provided in Table 1. First, we consider the special setting where $\tau_e = 0$ such that risky debt has no tax benefits and has benefits only on the diversification of idiosyncratic risk for the entrepreneur in Panel A of Table 1. Next, we incorporate the tax benefits of debt ($\tau_e = \tau_m$) into our model with entrepreneurial spirit in Panel B of Table 1.

For $\theta = 0$ in Panel A of Table 1, in which issuing risky debt has no tax benefits, the entrepreneur without an entrepreneurial spirit issues debt $F_0 = 8.10$ in market value with coupon $b = 0.3$ and values his nontradable equity at $G_0 = 14.58$, giving the total value of the entrepreneurial firm $S_0 = 22.68$. The coupon, debt value and leverage increase with the entrepreneurial spirit θ. The value of equity and firms decrease with entrepreneurial spirit θ.

The leverage of the entrepreneur L_0 reflects the entrepreneur's principle of optimality when he makes a tradeoff between the private value of equity ($G(y)$) and the public value of debt by choosing a debt coupon policy. For $\theta = 0$, the leverage ratio is 35.71%. With a higher entrepreneurial spirit $\theta = 0.1\%$, the entrepreneur issues more debt ($F_0 = 11.15$) with a higher coupon ($b = 0.45$). The entrepreneur prices his remaining nontradable equity at $G_0 = 11.21$, and the implied leverage ratio $L_0 = 49.85\%$ is higher than 35.71%, the case for entrepreneurial spirit $\theta = 0$. Risk-averse entrepreneurs with higher entrepreneurial spirit take on more leverage because they are more willing to sell more of the firm to lenders to diversify more idiosyncratic risk. For entrepreneurs with a higher entrepreneurial spirit, the credit spread is higher (from 70 basis points over the risk-free rate when $\theta = 0$ to 128 basis points when $\theta = 0.3\%$) since the leverage and default thresholds are higher.

Now, we incorporate the effect of tax benefits for the entrepreneur into the model for entrepreneurial firms with entrepreneurial spirit. We set $\tau_e = 11.29\%$. The results for the incomplete-markets benchmark without entrepreneurial spirit ($\theta = 0$) are shown in the first row of Panel B of Table 1. When the corporate tax rate is positive, the private firm issuing debt captures the benefit of the diversification of idiosyncratic risk in addition to the tradeoff between tax benefits and bankruptcy costs. The optimal tradeoff without the effect of entrepreneurial spirit for the private firm is to issue debt at competitive market value $F_0 = 15.10$ with coupon $b = 0.7$. The private leverage in the start-up phase is 69.06%. Similar to the case with $\tau_e = 0$, an entrepreneur with a higher entrepreneurial spirit is willing to issue more risky debt to diversify nondiversifiable idiosyncratic risks. The coupon, debt value and leverage increase with entrepreneurial spirit

θ. The value of equity and firms decrease with the entrepreneurial spirit θ. The entrepreneur with $\theta = 0.1\%$ issues debt at 15.34 with coupon b, which is equal to 0.72, higher than the debt value for the entrepreneurial firm without entrepreneurial spirit. The entrepreneur faces a higher credit spread of debt since the default threshold is higher and private leverage is 70.79%, higher than that in the case where $\theta = 0$. With $\theta = 0.3\%$, debt issuance continues to increase to 15.66, and leverage increases to 73.47%.

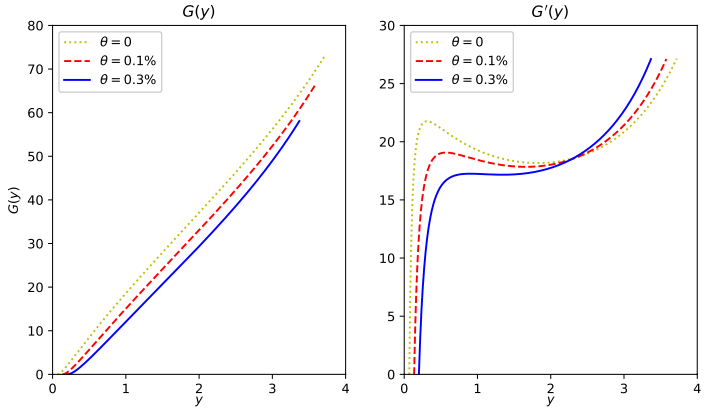
TABLE 1.

Capital structure of entrepreneurial firms: excluding the cash-out option

	Coupon b	Public debt F_0	Private equity G_0	Private firm S_0	Private leverage(%) L_0	Credit spread(bp) CS
Panel A:$\tau_e = 0$						
$\theta = 0$	0.3	8.10	14.58	22.68	35.71	70
$\theta = 0.1\%$	0.45	11.15	11.21	22.36	49.85	104
$\theta = 0.3\%$	0.55	12.86	9.01	21.87	58.81	128
Panel B:$\tau_e = 11.29\%$						
$\theta = 0$	0.70	15.10	6.76	21.86	69.06	164
$\theta = 0.1\%$	0.72	15.34	6.33	21.67	70.79	169
$\theta = 0.3\%$	0.75	15.66	5.66	21.32	73.47	179

4.3. Cash-out option: decreasing leverage

FIG. 2. $G(y)$ and $G'(y)$



We now turn to the case where the entrepreneur can exercise both the default and cash-out options to diversify idiosyncratic risks. The entrepreneur

alleviates the downside risk by defaulting on debt when the project's cash flow decreases to a sufficiently low level. If the project's cash flow increases to a sufficiently high level, which means that the firm does well enough, the entrepreneur can sell the firm to diversified investors to cash out. In addition, we set the capital gains tax rate from selling firm $\tau_g = 10\%$, capturing the tax deferral advantage. We set the investment cost for the start-up project $I = 10$ and the cash-out cost $K = 27$ as in Chen, Miao, and Wang (2010).

Figure 2 plots the value of equity $G(y)$ and its first derivative $G'(y)$ for entrepreneurs with different levels of entrepreneurial spirit, but their risk aversion is the same ($\gamma = 1$) when they have both a default option and a cash-out option.

Consistent with the boundary conditions above, the left panel of Figure 2 shows that $G(y)$ smoothly touches the horizontal axis when y is sufficiently low on the left and the cash-out thresholds when y is sufficiently high on the right. We can see that $G'(y)$ increases when y is sufficiently low or high and decreases in the middle, as shown in the right panel of Figure 2. The convexity of the function $G(y)$ when y is sufficiently low or high reflects that the default option or the cash-out option is deep in the money such that the entrepreneur tends to exercise the option and retire from his business to avoid the firm's risk. When cash flow y is in the intermediate range, $G'(y)$ decreases with y, which reflects the concavity of $G(y)$. The concavity of $G(y)$ when y is in the middle means that the precautionary saving motive of the entrepreneur outweighs his options, which are out of the money.

An entrepreneur with a higher entrepreneurial spirit will choose a higher default threshold and a lower cash-out threshold, as shown in the right panel of Figure 2. The value of equity $G(y)$ decreases with entrepreneurial spirit since the entrepreneur with a higher entrepreneurial spirit considers his wealth to be more important and dislikes nondiversifiable idiosyncratic risk.

Table 2 shows the capital structure of firms of entrepreneurs with different levels of entrepreneurial spirit that have both cash-out and default options. To compare Table 2 with Table 1, we consider the same tax setting $\tau_e = 0$ and $\tau_e = \tau_m$. If $\tau_e = 0$, the entrepreneur issuing debt does not have a tax benefit but can diversify the idiosyncratic risk. If τ_e is positive, we show that the cash-out option has an effect on the entrepreneurial firm's capital structure, which decreases the leverage compared with that in Table 1. The cash-out option value results from the benefits of diversifying idiosyncratic risk. Since both the cash-out option and debt have diversification benefits, the option of cashing out lowers the firm's incentive to issue debt compared with that in Table 1 for a risk-averse entrepreneur with the same level of entrepreneurial spirit.

TABLE 2.

Capital structure including the cash-out option

	Coupon b	Public debt F_0	Private equity G_0	Private firm S_0	Private leverage(%) L_0	Credit spread(bp) CS
Pannel A:$\tau_e = 0$						
$\theta = 0$	0.15	4.39	18.58	22.97	19.10	42
$\theta = 0.1\%$	0.28	7.52	15.07	22.58	33.28	73
$\theta = 0.3\%$	0.4	9.93	12.05	21.98	45.17	103
Pannel B:$\tau_e = 11.29\%$						
$\theta = 0$	0.55	12.43	9.58	22.02	56.48	138
$\theta = 0.1\%$	0.58	12.85	8.93	21.78	59.01	147
$\theta = 0.3\%$	0.6	13.14	8.21	21.36	61.56	156

When $\tau_e = 0$ and $\theta = 0.1\%$, debt coupon b decreases from $b = 0.45$ for the entrepreneurial firm without the cash-out option to 0.28 for a firm with the cash-out option, and the leverage ratio in the start-up phase decreases from $L_0 = 49.85\%$ to 33.28%. For entrepreneurs with a higher entrepreneurial spirit (e.g., $\theta = 0.3\%$), the leverage ratio is 45.17%, smaller than 58.81% for the case with only the default option. Although a higher tax rate τ_e increases the debt issuance and the leverage ratio due to tax benefits, the effect of the cash-out option on the capital structure of the entrepreneurial firm is similar to the case without tax benefits. Since the entrepreneur with a higher entrepreneurial spirit considers his wealth as more important and dislikes nondiversifiable idiosyncratic risk, the coupon, debt value and leverage still increase with entrepreneurial spirit θ. The value of equity and the firm still decrease with entrepreneurial spirit θ, similar to the results in Table 1.

4.4. Project choice: Break-even investment cost

We have analyzed the impact of entrepreneurial spirit on capital structure. In this section, we focus on how entrepreneurial spirit determines an entrepreneurial firm's investment in projects in the start-up phase. We compute the cutoff (break-even investment cost) for investing in the start-up project. If the investment cost is larger than the cutoff, the entrepreneur rejects the project. If the investment cost is lower than the cutoff, the entrepreneur undertakes the project. If the investment cost is equal to the cutoff, the entrepreneur is indifferent between rejecting the investment or not.

On the other hand, the entrepreneur will undertake a project in the start-up phase when the total initial value of the entrepreneurial firm $S(y_0)$ is larger than the investment cost I. The entrepreneur issues debt to finance

the firm and possesses a cash-out option that influences the total value of the entrepreneurial firm $S(y_0)$. If the entrepreneur sells the firm to exercise his cash-out option, he will pay capital gains taxes based on the lump-sum cost I. Therefore, the total value of the entrepreneurial firm $S(y_0)$ is influenced by the investment cost I^*. We can compute the cutoff (the break-even investment cost) via equation $I^* = S(y_0|I^*)$.

Table 3 reports the result of the break-even cost I^* in the case with the cash-out option for different values of entrepreneurial spirit θ and risk aversion γ. We set $\tau_e = 0$ to eliminate the tax benefit so that we can focus on the benefits of debt for idiosyncratic risk diversification.

When the market is complete, i.e., $\gamma \to 0$ and there is no tax, the entrepreneur will not issue debt or cash out since he does not need to diversify the idiosyncratic risk and take advantage of tax shield benefit. Since entrepreneurial spirit enhances the effect of idiosyncratic risk only in an incomplete market, the cutoff (break-even investment cost) is simply equal to the present value of the project's cash flow y_t, which is independent of entrepreneurial spirit in a complete market. When markets are incomplete, the cutoff decreases when the entrepreneurial spirit or risk aversion of the entrepreneur increases. The entrepreneur with entrepreneurial spirit $\theta = 0.3\%$ and risk aversion $\gamma = 1$ will undertake the project at a cost lower than 22.03 and reject the project at a cost greater than 22.03. However, the entrepreneur with entrepreneurial spirit $\theta = 0\%$ and risk aversion $\gamma = 1$ will undertake the project with costs between 22.03 and 23. An entrepreneur with a higher entrepreneurial spirit will reject more start-up projects, ceteris paribus.

As the entrepreneurial spirit θ increases, the difference in the break-even investment costs between entrepreneurs with different levels of entrepreneurial spirit increases, which means that more projects are rejected by the entrepreneur. An entrepreneur with a higher entrepreneurial spirit prices his private equity at a lower value (smaller $G(y)$) with a higher discount rate and thus has a greater incentive to default and sell the firm to cash out, ceteris paribus. Moreover, an entrepreneur with a higher entrepreneurial spirit has a lower break-even investment threshold.

TABLE 3.

	Investment threshold		
	$\theta = 0$	$\theta = 0.1\%$	$\theta = 0.3\%$
$\gamma = 0$	33.33	33.33	33.33
$\gamma = 1$	23	22.63	22.03
$\gamma = 2$	20.39	20.18	19.78

To summarize, our results show that a higher entrepreneurial spirit for a risk-averse entrepreneur in incomplete markets causes underinvestment

problems compared with the case of public firms in complete markets or of an entrepreneur without an entrepreneurial spirit in incomplete markets. The break-even cost is larger for entrepreneurs with a higher entrepreneurial spirit, which leads to more projects being rejected.

5. CONCLUSIONS

In our paper, we first summarize the incentive effect of wealth on entrepreneurs as an element of entrepreneurial spirit. Then, we study how entrepreneurial spirit influences entrepreneurs' allocation of wealth between consumption and asset portfolios, capital structure, investment, and timing of default or cash-out in a dynamic incomplete markets model framework for entrepreneurial firms with entrepreneurial spirit. In addition, our conclusion provides a possible explanation for the high credit spread puzzle with regard to entrepreneurial spirit.

An entrepreneur with a high entrepreneurial spirit consumes less and invests less in risky assets than in the consumption and portfolio choice problem of a complete market or an incomplete market model without entrepreneurial spirit. Because the entrepreneur's wealth will increase his utility in addition to his consumption, the entrepreneur is risk averse. The entrepreneur lessens his investment in market portfolios to decrease the volatility of his wealth.

An entrepreneur with a higher entrepreneurial spirit discounts the cash flows of the entrepreneurial firm at a higher rate because idiosyncratic risk is strengthened by entrepreneurial spirit. Therefore, an entrepreneur with a higher entrepreneurial spirit prices his private equity at a lower value and thus is more willing to cash out or default, ceteris paribus. An entrepreneur with a higher entrepreneurial spirit also has a stronger incentive to issue more debt to the public, while there is no tax benefit of diversifying idiosyncratic risk, which implies higher leverage, debt value and default thresholds. Risk-averse entrepreneurs with a higher entrepreneurial spirit take on more leverage, which leads to higher bond default risk and higher credit spreads.

When we include the cash-out option in our model, the entrepreneur with a higher entrepreneurial spirit will choose a higher default threshold and a lower cash-out threshold to avoid idiosyncratic risk, as he can exercise both the default and cash-out options to diversify idiosyncratic risk. The private value of equity is still decreasing with entrepreneurial spirit since the entrepreneur with a higher entrepreneurial spirit regards his wealth as more important and dislikes nondiversifiable idiosyncratic risk. The cash-out option can lower the firm's incentive to issue debt because both the cash-out option and debt can alleviate the idiosyncratic risk problem. Entrepreneurial spirit leads to excessive risk management by entrepreneurs.

In the start-up phase, the break-even cost of the start-up investment project decreases when the entrepreneur has higher risk aversion or when the entrepreneurial spirit of the entrepreneur increases due to incomplete markets. The break-even costs of the entrepreneur with a higher entrepreneurial spirit in the start-up phase are lower than those in the complete market, which leads to more projects being rejected by the entrepreneur.

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