Security Design with Status Concerns

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Motivation

- Financial securities play a key role in the economy
- There is great variety of securities used in reality
- Security design literature seeks to explain their role
- Despite extensive evidence of status concerns, how they affect security design remains unexplored

Our work

- *This paper*: first work to examine security design with status concerns
- Dynamic security design framework with a status-driven entrepreneur
  - no asymmetric information, no agency problems
- Status concerns: preferences proposed by Friedman and Savage (1948)
- We solve analytically for the optimal security and other quantities

Main results

- Optimal security is considerably similar to a convertible security
  - widely used in venture capital and private equity
  - *dynamic* framework is important for tractability
- We explain why convertibles are mainly used to finance volatile projects
- Our model can generate convertibles with different conversion ratios
- Analysis can be adapted to explain “fixed salary plus bonus” compensation

Related literature

- Existing explanations of convertibles rely on agency problems
  - Constantinides and Grundy (1989), Stein (1992), Cornelli and Yosha (2003), Schmidt (2003), Repullo and Suarez (2004), Hellmann (2006), Chakraborty and Yilmaz (2011), Lyandres and Zhdanov (2014)
- Security design literature in general also focuses on agency conflicts
  - exceptions are Cadenillas, Cvitanic, and Zapatero (2007), Bolton and Harris (2013)
- Works on status concerns in other contexts
  - Becker, Murphy, and Werning (2005), Moldovanu, Sela, and Shi (2007), Auriol and Renault (2008), Besley and Ghatak (2008), Roussanov (2010), Dijk, Holmen, and Kirchler (2014), Georgarakos, Haliassos, and Pasini (2014), Hong, Jiang, Wang, and Zhao (2014)

Setting: project

- Entrepreneur requires V_0 to launch a project
- Project value V follows

$$\frac{dV_t}{V_t} = \phi_t \mu dt + \phi_t \sigma d\omega_t$$

- Entrepreneur *dynamically* chooses product novelty ϕ
- Increasing product novelty implies
  - higher expected profits due to less competition
  - future profits are more uncertain

Setting: status concerns

- Friedman and Savage (1948): status concerns are captured via preferences with a convexity
- Concave preferences reflect satiation
- Satiation is not at work when switching from “low” to “high status” goods
- Formal derivations of preferences with a convexity
  - Patel and Subrahmanyam (1978), Gregory (1980), Robson (1992)

Setting: entrepreneur's preferences

Entrepreneur's utility function $u_E(\cdot)$ over time-τ wealth $W_{E\tau}$

$$u_E(W_{E\tau}) = \begin{cases} \frac{(W_{E\tau})^{1-\gamma_E}}{1-\gamma_E} & W_{E\tau} < L, \\ \frac{(W_{E\tau}-\alpha)^{1-\gamma_E}}{1-\gamma_E} + B & W_{E\tau} \geq L, \end{cases}$$

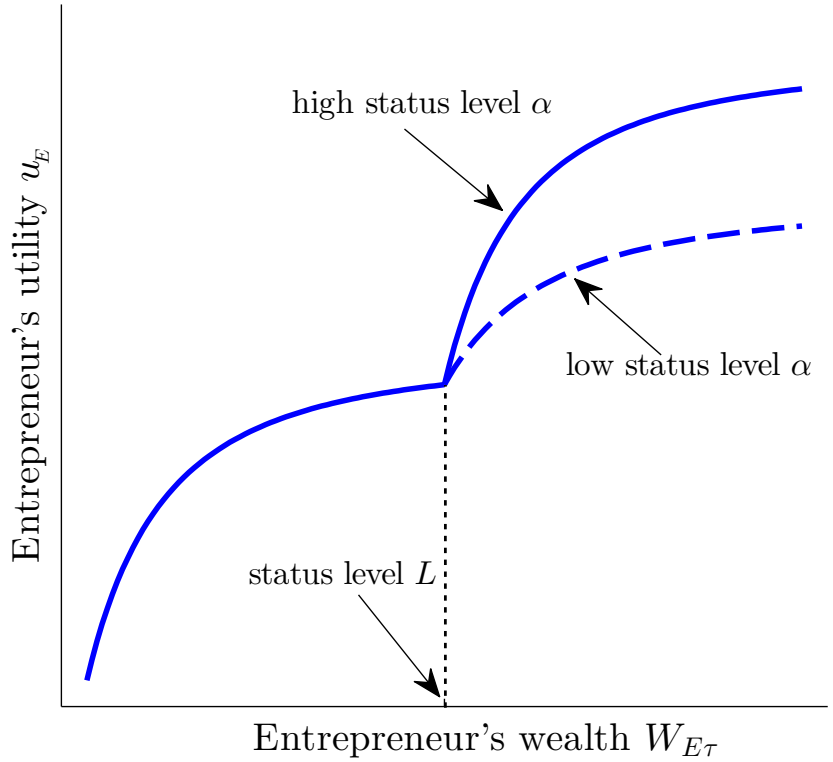
<u>Parameters are</u>:

concern for status α

status level of wealth L

attitude towards risk γ_E

B ensures continuity



Internal financing

- Start with internal financing case
  - no security is issued, entrepreneur uses own money

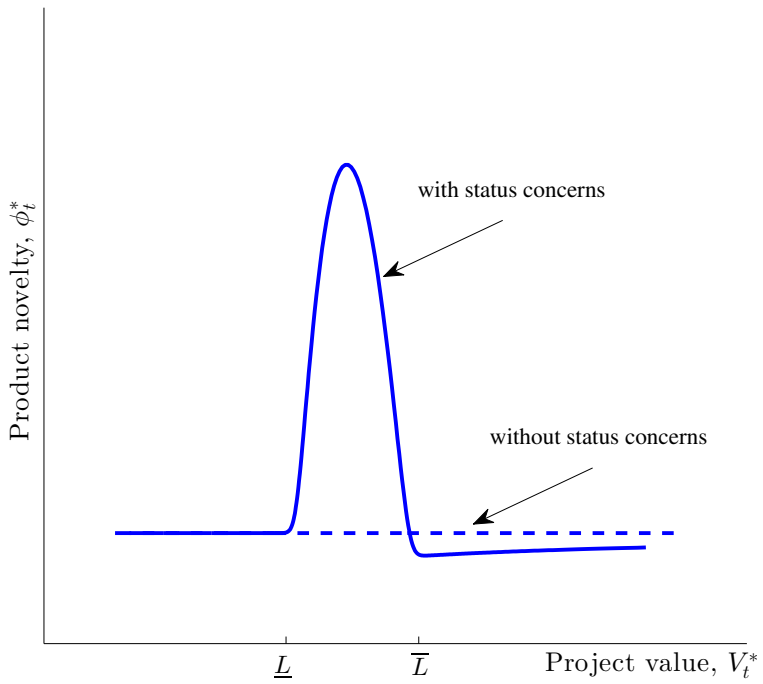
- Entrepreneur's problem

$$\max_{\phi_t} E[u_E(V_\tau)]$$

$$\text{subject to} \quad dV_t = V_t \phi_t \mu dt + V_t \phi_t \sigma d\omega_t$$

Internal financing, cont'd

- We solve analytically for optimal product novelty ϕ^*



- Key insight: avoiding middle status by increasing product novelty

Setting: external financing

- Entrepreneur raises initial investment V_0 by issuing a security $W_{FT}(V_T)$ to financier
- Security has to provide financier with expected utility $\bar{u}_F$
  - financier has CRRA utility with relative risk aversion γ_F
- Entrepreneur's problem with external financing is

$$\max_{\phi_t, W_{FT}(V_T)} E[u_E(V_\tau)]$$

$$\text{subject to} \quad dV_t = V_t \phi_t \mu dt + V_t \phi_t \sigma d\omega_t - W_{FT} d1_{\{t=T\}}$$

$$E[u_F(W_{FT})] \geq \bar{u}_F$$

Optimal security

- Optimal security $W^*_{FT}(V_T)$ is given parametrically $(W_{FT}(x), V_T(x))$:

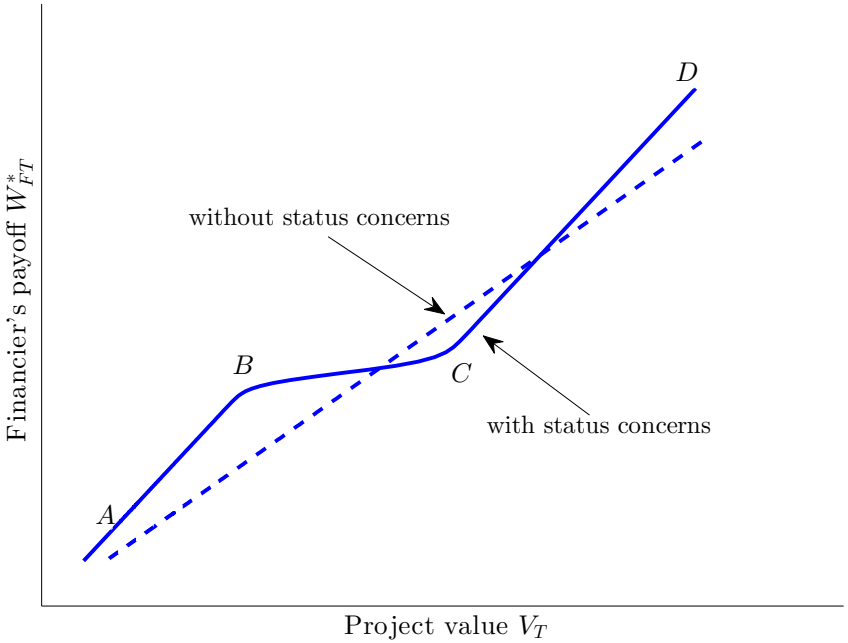
$$W_{FT}(x) = (\bar{u}_F(1-\gamma_F))^{-1/(\gamma_F-1)}\, e^{-\mu^2/(2\gamma_F^2\sigma^2)} x^{-1/\gamma_F}$$

$$V_T(x) = K_{1T} g(x)^{-1/\gamma_E} + \alpha N\left(\frac{\ln(B/\alpha) - \ln g(x) - K_{2T}}{K_{3T}}\right) + (\bar{u}_F(1-\gamma_F))^{-1/(\gamma_F-1)}\, e^{-\mu^2/(2\gamma_F^2\sigma^2)} x^{-1/\gamma_F}$$

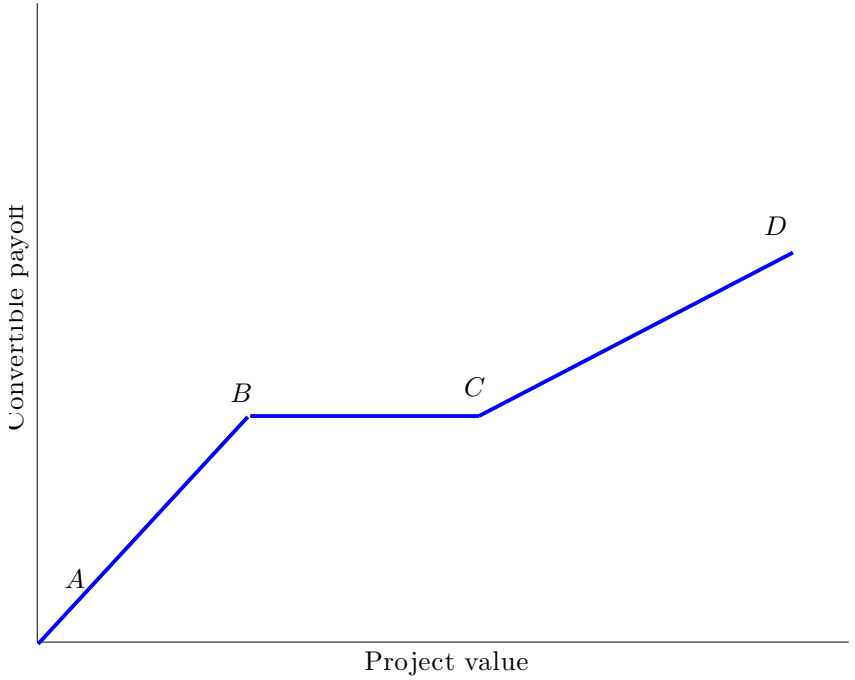
and function $g(x)$ is implicitly given by

$$\frac{K_{1T}K_{3T}\, g(x)^{(\gamma_E-1)/\gamma_E} + \gamma_E\, B\, n\left(\frac{\ln(B/\alpha)-\ln g(x)+K_{2T}}{K_{3T}}\right)}{K_{1T}K_{3T}\, g(x)^{-1/\gamma_E} + \gamma_E\, \alpha\, n\left(\frac{\ln(B/\alpha)-\ln g(x)-K_{2T}}{K_{3T}}\right)} = zx. \tag{1}$$

Payoff profile of optimal security



Optimal security



Actual convertible security

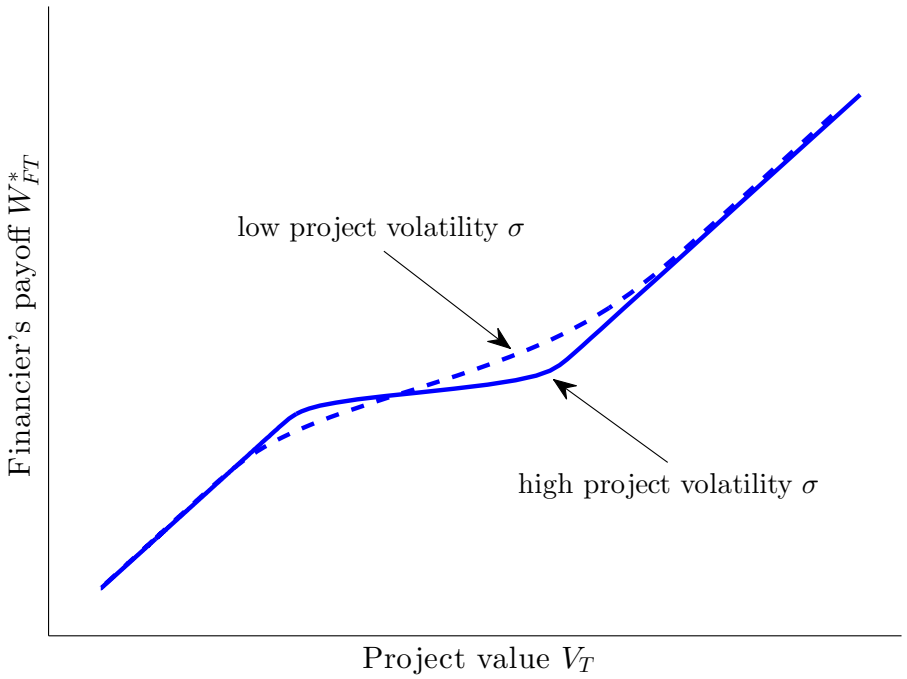
- Debt-like segment occurs for middle-status project values
- Lowering payoff sensitivity to better avoid middle status

Projects financed by convertibles

- Empirical evidence: convertibles are mainly used to finance more volatile projects
  - venture capital and private equity projects
  - “convertibles tend to be issued by the smaller and more speculative firms” (Brealey, Myers, and Allen, 2010)

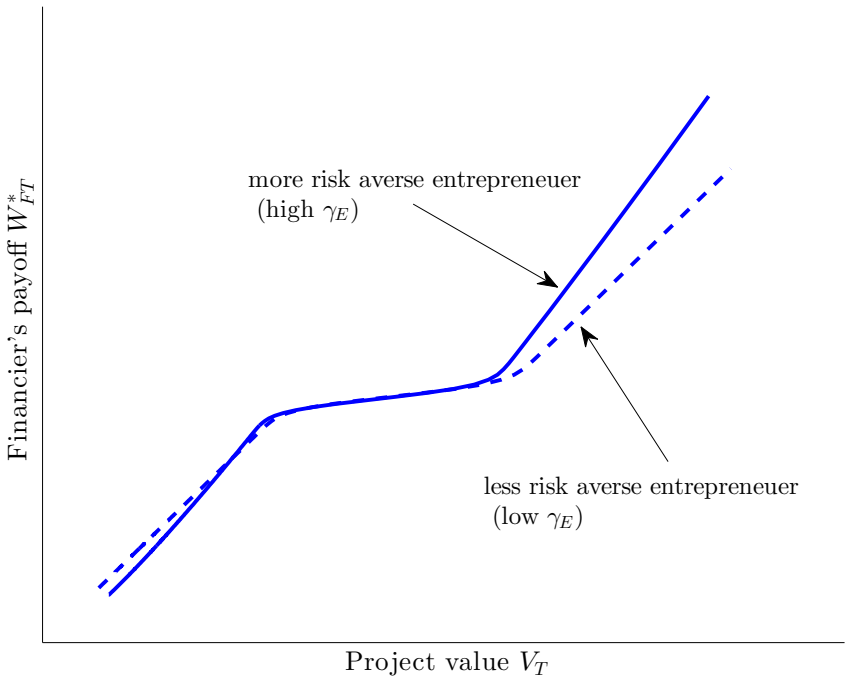
- We examine the effect of project volatility on optimal security

Optimal security and project volatility

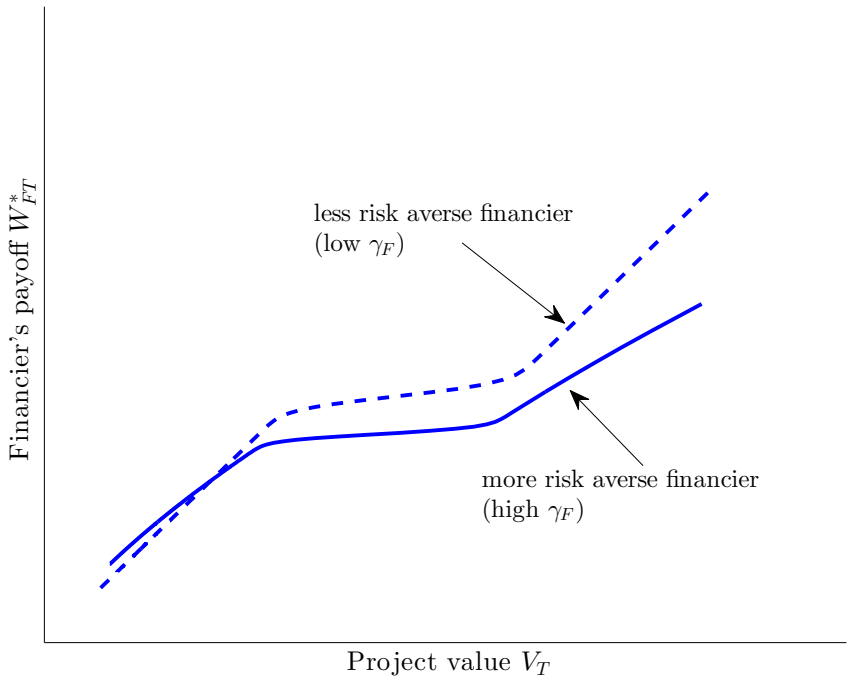


- Optimal security is more similar to a convertible for higher project volatility
  - product novelty and security are chosen to avoid middle status
  - for high volatility, controlling status via product novelty is ineffective

Optimal security and risk aversion



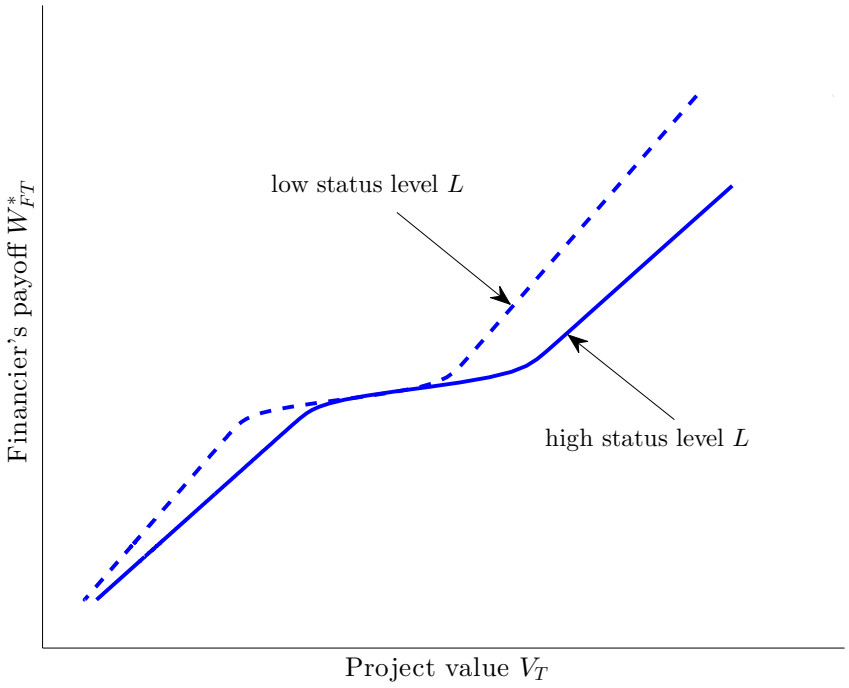
Entrepreneur's risk aversion



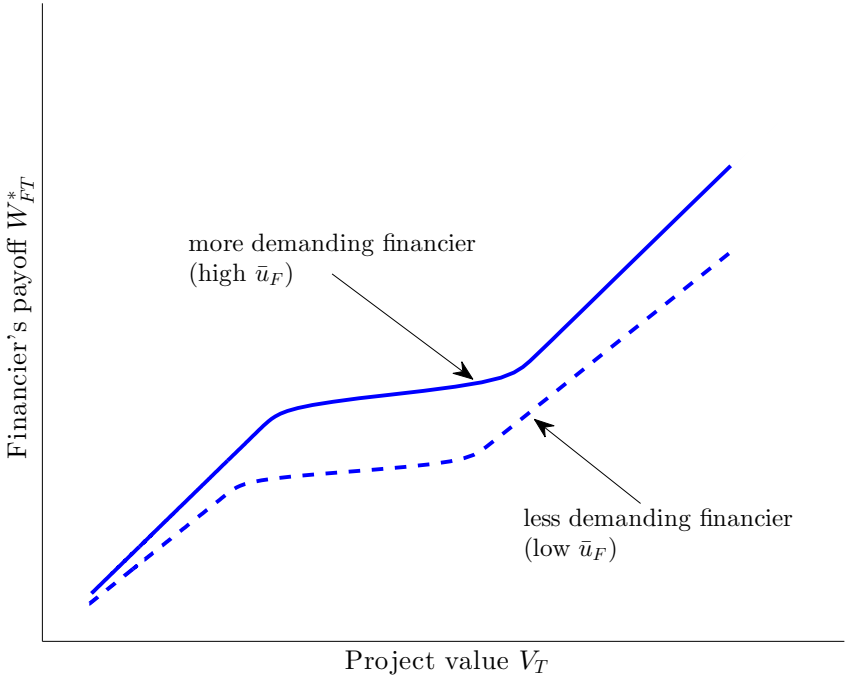
Financier's risk aversion

- Changing risk aversions affects conversion ratio
  - more risk averse entrepreneur implies a higher conversion ratio
  - more risk averse financier implies a lower conversion ratio

Other properties of optimal security



Status level



Financier's reservation utility

Optimal compensation with status concerns

- Our analysis can be applied to explain compensation schemes “fixed salary plus bonus”
- Modified economy:
  - status-driven employer hires a worker
  - employer offers a performance-dependent compensation
- Optimal compensation scheme will have
  - fixed salary (corresponds to debt component)
  - performance-related bonus (corresponds to equity component)

Extensions

- Multiplicative status specification
  - multiplicative vs additive may matter (e.g., Abel, 1990 vs Campbell and Cochrane, 1999)
  - our main results still hold

- Different risk aversions for low and high status
  - motivated by Ait-Sahalia, Parker, and Yogo (2004) and Wachter and Yogo (2010)
  - varying high-status risk aversion has an isolated effect on conversion ratio

Conclusion

- We study security design with status concerns
- Optimal security is considerably similar to a convertible security
- We can explain why convertibles are used mainly by volatile firms
- Our model can generate convertibles with different conversion ratios
- Same mechanism can be behind “fixed salary plus bonus” compensation schemes