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

- 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
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 $\phi$

- 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 Subrahmanyan (1978), Gregory (1980), Robson (1992)
Setting: entrepreneur’s preferences
Entrepreneur’s utility function $u_E(\cdot)$ over time-$\tau$ wealth $W_{E\tau}$

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

Parameters are:
- concern for status $\alpha$
- status level of wealth $L$
- attitude towards risk $\gamma_E$
- $B$ ensures continuity
Internal financing

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

- Entrepreneur’s problem

\[
\max_{\phi_t} E[u_E(V_\tau)] \\
\text{subject to } dV_t = V_t \phi_t \mu dt + V_t \phi_t \sigma d\omega_t
\]
Internal financing, cont’d

- We solve analytically for optimal product novelty $\phi^*$

- 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 $\gamma_F$.

- Entrepreneur’s problem with external financing is:

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

subject to

\[
dV_t = V_t\phi_t \mu dt + V_t\phi_t \sigma d\omega_t - W_{FT} d1_{\{t=T\}}
\]

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

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

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

$$V_T(x) = K_1 T g(x)^{-1/\gamma_E} + \alpha N \left( \frac{\ln(B/\alpha) - \ln g(x) - K_{2T}}{K_{3T}} \right)$$

$$+ (\bar{u}_F(1 - \gamma_F))^{-1/(\gamma_F-1)} e^{-\mu^2/(2\gamma_F^2\sigma^2)} x^{-1/\gamma_F}$$

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

$$K_1 T K_{3T} g(x)^{(\gamma_E^{-1})/\gamma_E} + \gamma_E B \left( \frac{\ln(B/\alpha) - \ln g(x) + K_{2T}}{K_{3T}} \right) = z x.$$

(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

Project value \( V_T \)
Financier’s payoff \( W^*_F \)

more risk averse entrepreneur (high \( \gamma_E \))
less risk averse entrepreneur (low \( \gamma_E \))

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

\[ \text{Financier's payoff } W^*_F \]

\[ \text{Project value } V_T \]

Status level

Financier's reservation utility

\[ \text{high status level } L \]

\[ \text{low status level } L \]

more demanding financier (high \( \bar{u}_F \))

less demanding financier (low \( \bar{u}_F \))
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