

# Control Rights over Intellectual Property and Corporate Venturing

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# Motivation

In the context of licensing of Intellectual Property

- What is the role of patents?
- What is the role of equity participation in post-invention revenues?
- What, if any, is the role of ex ante control rights across transacting parties?

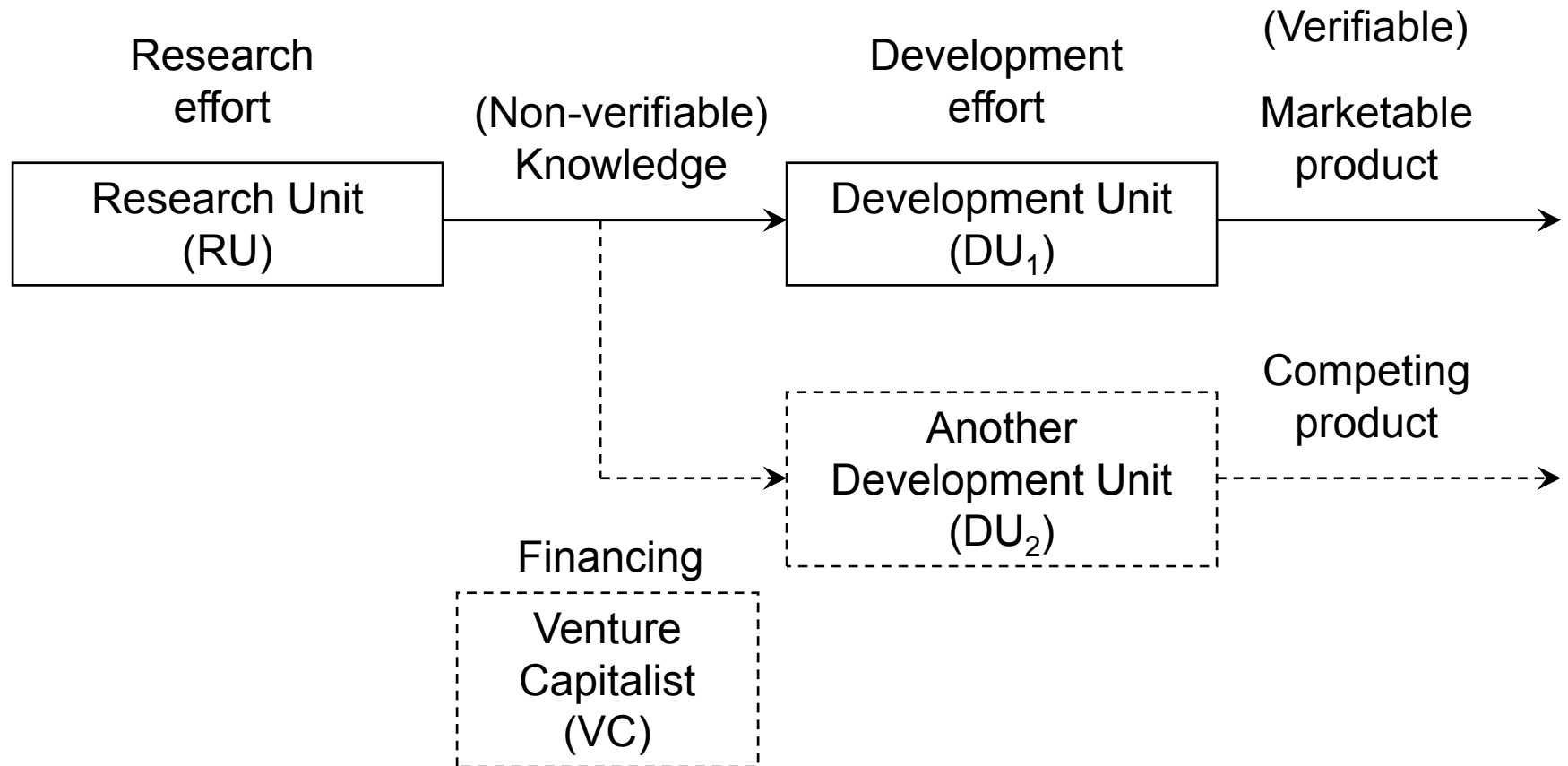
# Context: Cumulative R&D with Licensing of Interim Knowledge

- GlaxoSmithKline (GSK): 40% of sales due to outsourced drug ideas vs Pfizer, without such a pipeline
- GSK participated to a greater extent in corporate venturing, of biotech start-ups, assigning GSK first right of refusal on licensing their innovation
- If so, through what are the specific control rights?
  - Given inalienability of human capital?
- We assume that Corporate Venturing allows restricting coalitions with third parties
  - Hence can affect the patents vs trade secrets choice
  - Which in turn can influence research investment

# Contribution

- We explicitly model the patents vs. trade secrets choice
- Show that innovator's financial constraint is binding for less valuable innovation
- In which case control rights (restricting access to outside financing partners) are important
- Hence innovators has incentives to produce more valuable ideas to avoid such contingencies

# The setting



# Incentives and property rights

- Incomplete contract theory with sequential investments:
  - Even though interim knowledge is not verifiable, incentives can be provided via
    - giving RU property/control rights first,
    - then making DU owner/residual claimant
    - E.g. via options-to-own
- But knowledge is not a widget
  - Intellectual property rights are not only about ability to protect RU from theft/imitation by DU (excludability)
  - But also about making sure that the sale is exclusive
  - Non-rival nature of knowledge results in a risk of opportunistic disclosure by RU to another DU
- Although RU does not invest ex interim or after, needs incentives during the development stage (to prevent opportunistic disclosure)
- Hence cannot easily make DU a 100% residual claimant, even if ex post revenues are verifiable

# Committing to exclusive sale of knowledge

- Without commitment to exclusive sale, RU's licensing fee is too low
  - Even if RU cannot develop the idea herself, she can sell to a competing DU
  - After selling a license to  $DU_1$ , RU has incentives to disclose to  $DU_2$
  - If RU cannot commit not to disclose to  $DU_2$ , then  $DU_1$  will expect competition and will pay less for the license
- Patents provide a commitment device
  - Patents assure that if RU sells to  $DU_2$ , the original licensee can litigate
- BUT
  - Patents are not always enforceable
  - Patents involve a certain amount of leakage to public
- Hence parties may prefer a private transfer of knowledge without registering a patent
  - In order to provide incentives for RU not to disclose to a competitor, give RU a share in DU's post invention revenues
  - Hence RU cares about DU's market share
  - But if this share becomes too high, DU's own incentives are weakened
- Trade-off between the modes of disclosure

# Our research agenda

- How does the trade-off between patent-based and private sales and the optimal choice of the mode of disclosure depends on
  - The level of ex interim knowledge,
  - Degree of IPR protection (driven by codifiability or enforcement)
- How does Overall R&D activity depend on the degree of IPR protection, inversely related to pre-licensing leakage
  - Monotonic? U-shaped? Inverted-U-shape?
- Control rights and corporate venturing:
  - What are control rights in this setting?
  - How do control rights affect RU's and DUs' incentives?



# Some related literature

- Incomplete contracts: Surplus Appropriation by and Incentives of R&D and DUs
  - Aghion and Tirole (1994)
  - Anton and Yao (1994), (2004)
  - Rosenkranz and Schmitz (1999, 2002)
  - Baccara and Razin (2003)
- Nature of knowledge (tacit/ codifiable) and the choice of modes of disclosure
  - Teece (2000), Pisano (1989)
- Patents and R&D activity
  - Scotchmer and Green (1990)
  - Kortum and Lerner (1998)
  - Gallini (2002)
  - Lerner (2002)
- Corporate venturing
  - Gompers and Lerner (2000)
  - Anand and Galetovic (2000), Hellmann (2002)

# Model

- RU vs  $DU_1$  and  $DU_2$ , all risk neutral, RU financially constrained
- Technology:
  - RU's effort  $e$  affects c.d.f. of knowledge  $K \in [0,1]$
  - DU's effort  $E$  and DU's knowledge  $K$  are complements in development a marketable product
  - Probability of successful development: Cobb-Douglas

$$P = p(K, E) = \sqrt{2KE}$$

- equivalent to quadratic cost of effort:  $E = P^2/(2K)$
  - If there were no distortions,  $E = \operatorname{argmax} (2KE)^{1/2} - E = K/2$ ,  $P = K$
  - Knowledge is metrized in terms of probability of invention
- Product market competition: Bertrand
  - If only one DU invents successfully, he gets monopoly rent  $V = 1$
  - If two DUs invent successfully, they compete a la Bertrand, each gets 0
- $DU_1$ 's payoff:

$$(1 - P_2)P_1 - P_1^2/(2K) - F$$

where  $F$  is the licensing fee

# Timing

**Ex ante**

RU exerts effort  $e$

**Ex interim**

Realization of knowledge  $K$

Each  $DU_i$  exerts effort  $E_i$

**Ex post**

Realization of product value  $V$

Bargaining about licensing fee, mode of disclosure, opportunistic disclosure

Product market competition, rents and royalties

# Ex interim bargaining

- RU and DU(s) bargain about licensing and licensing fees
  - Alternating offer game similar to Bolton and Whinston (1993)
  - Symmetric bargaining power
    - No multiple licensing in equilibrium
- Registering a patent is an outside option
  - Once patent is registered, no return to closed mode
- The level of knowledge  $K$  is observed
- But its content must be described, and description results in leakage of  $LK$ ,  $L \in [0,1]$ 
  - In the open mode,  $LK$  is leaked to public once the patent is registered
  - In the closed mode,  $LK$  is leaked to DU in the process of negotiations between RU and DU
    - Hence the value of opportunistic disclosure is *lower* if  $L$  is high

# “Open” mode

- RU registers a patent, and sells  $K$  exclusively to  $DU_1$
- Licensing fee  $F$  is lump sum and not contingent on ex post revenue of the licensed DU
- Patent application provides  $DU_2$  with leaked knowledge  $LK$
- $DU_1$  chooses probability of invention  $P_o$ ,  $DU_2$  chooses  $Q_o$

$$P_o = \arg \max_p [(1 - Q_o)p - p^2/(2K)] = K(1 - Q_o)$$

Similarly,

$$Q_o = \arg \max_q [(1 - P_o)q - q^2/(2LK)] = LK(1 - P_o)$$

# Open mode: joint surplus and bargaining outcome

- Joint RU-DU<sub>1</sub> surplus

$$T_o = \frac{K(1 - LK)^2}{2(1 - LK^2)^2}$$

Decreases in L and increases in K

- Bargaining outcome: effectively Bertrand competition

F<sub>o</sub> sets licensee DU to his disagreement payoff

$$F_o = \frac{K(1 - L)}{2(1 - LK^2)}$$

... equal to what non-licensee gets from developing on the basis of leaked knowledge LK

... like in Bolton-Whinston (1993)

# “Closed” mode

- No patent,  $DU_1$  gives RU share  $s$  of his post invention revenues
- Incentive compatibility constraint:  
the value of the stake in the case of monopoly  $\geq$   
the value of the stake in the case of competition +  
maximum fee RU can collect from the competing DU

$$sK(1 - s) \geq (1 - K(1 - s))(1 - L)/2;$$

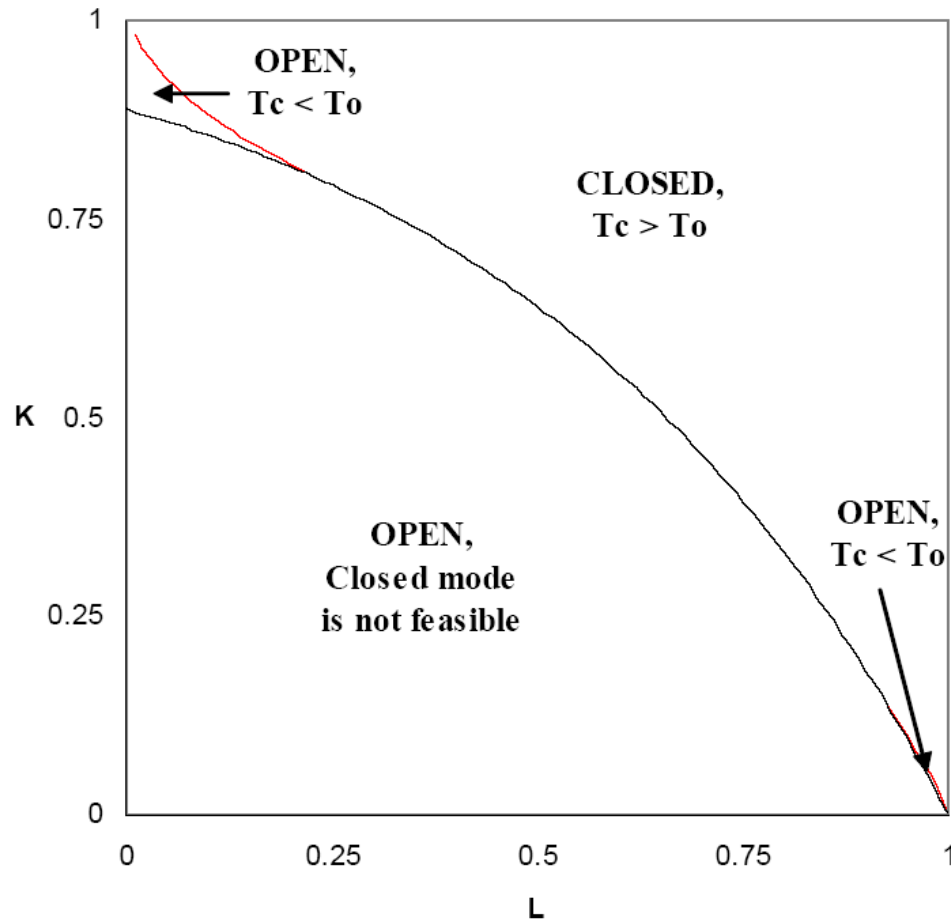
- Closed mode is more likely to exist and is more efficient
  - when  $K$  is high and
  - when  $L$  is high

# Implications

- Analysis of effect of stronger IPR protection on R&D and social welfare: Bhattacharya-Guriev JEEA (2006)
- Analysis of control rights: this paper
  - Important feature of the model:
    - In the closed mode, the RU-DU contract includes a royalty stake and a lump-sum payment
    - If value of the idea  $K$  is low then lump-sum payment is *negative*, hence RU's financial constraint is binding



# The equilibrium choice of the mode of disclosure



# Control rights

- How to define control rights?
  - Do not assume alienability of human capital (“brain transplants”), nor memory erasure
  - Control rights of DU over RU: Rule Out RU’s coalitions with 3<sup>rd</sup> parties, who might be part of her coalition in bargaining with DU
  - Such coalitions may be ex interim efficient whenever RU needs to overcome financial constraints, to sell a Closed mode license
- Ex ante transfer of control rights to DU by RU (corporate venturing) may be inefficient ex interim
  - But efficient ex ante, generating better incentives for research effort by RU, leading to greater likelihood of higher Knowledge
  - Related to Hart and Moore (2004): “Ruling Out but Not Ruling In”

# Financial constraints

- Suppose that
  - Joint surplus  $T$  is higher in the closed mode of knowledge sale, but
  - Value of the required incentive-compatible royalty stake is so high that RU has to pay cash ex interim to DU for agreeing to it
- Thus, if RU is financially constrained, DU prefers an open mode sale
  - If RU can join forces with a Venture Capitalist to obtain the cash needed for stake in RU's share of DU's revenue, ex interim efficiency is restored
- These situations are more likely to arise when  $K$  is low, since
  - The value of royalty stake  $sP_c$  decreases, and  $\{T_c/2, F_o\}$  increase in  $K$
  - Monopolistic rent is low, so need a very high  $s$  to preserve incentives of RU to not disclose  $K$  to second DU, in a clandestine cash sale

# Venture capitalist

- Must be a specialized intermediary with reputational concerns and funds who can:
  - Pay  $I = (T_o - F_o) - (T_c - sP_c)$  to DU ex interim, in return for  $I/P_c$  share of ex post DU revenues
  - Monitor/ discipline RU to prevent opportunistic knowledge disclosure to another DU, even though RU has only  $s \cdot I/P_c$  revenue share, i.e, force RU to act in the interest of their coalition

# Why Rule Out an ex interim efficient arrangement?

- RU-VC coalition improves RU's payoff if  $K$  is low
- If RU is not independent, such low  $K$  states may result in lower payoffs for her than otherwise
- Hence, if RU is controlled ex ante by a DU, then RU has incentives to reduce the probability of such low  $K$  states, by incurring additional costly research effort, which helps raise expected  $K$  and ex ante joint surplus  
....Despite the costs of ex interim inefficiency for low  $K$

# Numerical example

	$K = K^L$	$K = K^H$
$K$	0.33	0.5
$L$	0.8	0.8
$T_o$	0.108	0.141
$T_c$	0.140	0.246
$F_o$	0.037	0.063
$T_o - F_o$	0.071	0.078
$T_c/2$	0.070	0.123
$s$	0.4	0.130
$sP_c$	0.08	0.056
$T_c - sP_c$	0.06	0.189
$I$	0.011	—
$sP_c - I$	0.069	—

(Relative to  $K^L$ )  $K^H$  costs RU additional effort  
 $e \in (0.054, 0.086)$

Low effort under RU independence:  
 $0.069 > 0.123 - e$

Corporate venturing encourages high effort:  
 $0.037 < 0.123 - e$

Corporate venturing is ex ante efficient:  
 $0.246 - 0.140 > e$

# Conclusions

- An incomplete contract model of sale of interim knowledge given potential leakage(s) via its description, in alternative modes of licensed disclosure
- Trade-off between the costs of open mode (greater leakage to rivals) and closed mode (revenue sharing post-development) sales of knowledge  $K$ 
  - Closed mode is more likely choice for high levels of  $K$  and leakage coefficient  $L$
- Rationale for control rights (over RU) transfer to DU
  - Incentive constraints costlier at lower  $K$ ; RU's financial constraint may be binding
  - If RU is independent, resulting inefficiencies may be mitigated by an intermediary
  - Corporate venturing: ex interim inefficient but may improve RU's incentives for costly ex ante research, and enhance joint surplus of RU cum her controlling DU

# Other implications

- Should observe more patenting in Corporate Venture vs. VC (other things equal)
- Bankruptcy law: “new” vs “old” industries