

Vertical Learning Alliances and Parital Equity Ownership in the Presence of Performance Spillovers

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Presentation at 1st ATE Symposium

December 13, 2013

Introduction

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⇒ The transfer of knowledge between partner firms.
- Vertical alliances: Buyers often educate their partner suppliers on advanced production systems such as “lean production” and “just-in-time system”.
- Examples: Toyota and John Deere.

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- Performance spillovers can reduce a buyer's incentives to educate its partner supplier because the buyer's investment ends up increasing the supplier's outside option.
- This leads to the buyer's underinvestment in educating the supplier.
- How can the buyer's underinvestment problem be resolved?

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- However, knowledge is often tacit and non-verifiable, and contracting can play, at best, the limited role in the transfer of tacit knowledge.
- Partial equity ownership (PEO) can play a critical role in facilitating the transfer of tacit knowledge.
 - Mowery, Oxley and Silverman (1996).
 - Comes-Casseres, Hagedoorn and Jaffe (2006).

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- PEO between U and D_1 can mitigate the under-investment problem of D_1 's knowledge transfer.
- Welfare consequences: In contrast to the standard notion that PEO is anticompetitive, PEO can increase welfare.

Remainder of the talk

- Relationship to the literature.
- Model and analysis.
- Welfare consequences and policy implications.
- Endogenizing the rate of performance spillovers.
- Conclusion.

Relationship to the literature

- Bhattacharyya and Lafontaine (1995).
 - A double-sided moral hazard (a single principal-agent pair).
 - Both franchisor and franchisee exert costly efforts (not contractible) to increase the profit of the outlet.
 - The optimal sharing rule can be represented by a linear contract, $\beta \in (0, 1)$.

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- Lai, Riezman, and Wang (2009).
 - R&D outsourcing with possible leakage of trade secrets.
 - Under outsourcing, U learns D_1 's trade secret, and can leak it to D_2 .
 - Sales sharing contract prevents information leakage.
 - See Allain, Chambolle, and Rey (2011) for a related analysis.

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- PEO can increase welfare when the spillover rate is relatively high.

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- Each D_i ($i = 1, 2$) has zero fixed costs and a constant MC, and requires one unit of the machine to produce their downstream goods.

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- Levels of investment, x and e , are observable but not contractible.

Downstream firms' costs

- If U 's machine is used,

$$D_1\text{'s MC: } c_1 = c - \theta x - e,$$

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where $\theta > 0$ and $\beta \in [0, 1]$.

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 $c_i = c$ (for $i = 1, 2$).
- Each D_i 's profit: $\pi(c_i)$, where $\pi'(\cdot) < 0$ and $\pi''(\cdot) > 0$.

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- Stage 4 Profits realize.

Ownership of firms

- Suppose that there are three plants, plant u , plant d_1 , and plant d_2 .
- Initially, plants u , d_1 , and d_2 are owned, respectively, by U , D_1 , and D_2 . U and D_1 can engage in PEO, under which D_1 pays F to purchase ϕ of plant u 's shares from U .

Analysis: Stage 4

- If D_1 purchases the machine from U at the price p , the three firms' profits are:

$$\Pi_U = (1 - \phi)p + F - G(x),$$

$$\Pi_{D_1} = \pi(c - \theta x - e) - K(e) - (1 - \phi)p - F,$$

$$\Pi_{D_2} = \pi(c)$$

Stage 3

Lemma 1

In the equilibrium of Stage 3 subgames, D_1 purchases the machine from U at $p = \pi(c - \theta x - \beta e) - \pi(c)$.

Stage 2

Let $x(\phi)$ and $\theta(\phi)$ denote investment levels of U and D_1 , respectively, in the equilibrium of Stage 2 subgames.

Lemma 2

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 - $\phi \uparrow \Rightarrow U$ internalizes larger fraction of $p \Rightarrow D_1$'s incentive to transfer knowledge \uparrow .

Stage 2 (cont.)

Lemma 3

For any given $\phi < 1$, $\frac{\partial e(\phi)}{\partial \beta} < 0$.

- The rate of performance spillovers \uparrow
 - $\Rightarrow D_1$'s knowledge transfer increases p more quickly
 - $\Rightarrow D_1$'s incentive to transfer knowledge \downarrow .

Equilibrium PEO

- At stage 1, U and D_1 jointly choose ϕ to maximize their joint profit $\Pi(\phi) = \pi(c - \theta x - e) - G(x) - K(e)$, where $x = x(\phi)$ and $e = e(\phi)$.

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 - $\phi \uparrow$ mitigates D_1 's underinvestment in e , but worsens U 's underinvestment in x .
 - When β is large enough, the positive effect dominates the negative one $\Rightarrow \phi > 0$ in equilibrium.

Welfare consequences of PEO

- Suppose that each downstream firm D_i faces a representative consumer with utility function $U(q) + m$, where m is a numeraire good and $U(\cdot)$ satisfies standard properties.
 $\Rightarrow \pi(c_i)$ satisfies $\pi'(\cdot) < 0$ and $\pi''(\cdot) > 0$.

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- Compare ϕ^w and ϕ^* .

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- D_1 's equilibrium MC, $c_1^* = c - \theta x^* - e^*$, is higher than social optimum.

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- If $\beta > \bar{\beta}$, U and D_1 choose $\phi = \phi^* > 0$.
- D_1 's equilibrium MC, $c_1^* = c - \theta x^* - e^*$, is higher than social optimum.
- Suppose the planner increases ϕ from $\phi = \phi^*$. \Rightarrow
 - (i) $x \downarrow$ but this does not increase c_1 that much when θ is small.
 - (ii) when β is large, $\phi \uparrow$ more effectively increases e and reduces c_1 .

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- If $\phi^w > \phi^*$, the planner does not announce.
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- Three possibilities:
Permit, partially permit, or prohibit (when $\phi^w = 0$) PEO.

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- Through numerical simulations, we identify the following pattern:
 - $\theta \downarrow \Rightarrow \alpha \downarrow \Rightarrow$ performance spillovers \uparrow .
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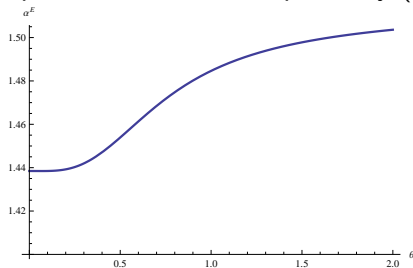
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- \Rightarrow Robustness of Proposition 2 in this extension.

Endogenizing the rate of performance spillovers (cont.)

- An example of numerical simulation.
- It is assumed that the downstream firms face a linear inverse demand function, $p = 1 - q$, and the innovative cost functions are quadratic, $G(t) = K(t) = \delta t^2/2$.

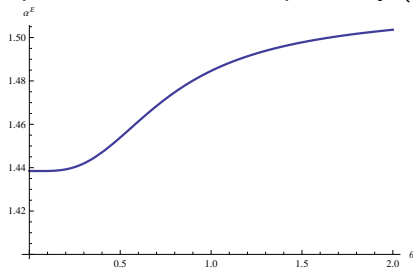
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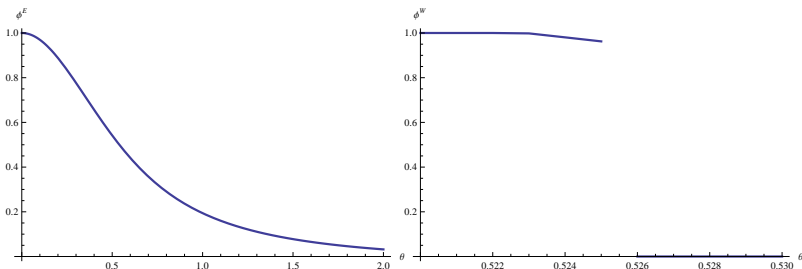
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- α^E is increasing in θ .

Endogenizing the rate of performance spillovers (cont.)

- The comparison between the equilibrium partial ownership level (ϕ^E) and the socially-optimal level (ϕ^W) is the following



- It can be seen that $\phi^W > \phi^E$ if and only if $\theta < 0.525$.

Concluding remarks

- We have studied the role of PEO in mitigating the buyer's underinvestment in vertical learning alliances with performance spillovers.
- We have shown that the equilibrium level of PEO can be strictly positive, where PEO mitigates D_1 's underinvestment problem due to performance spillovers.
- PEO increases welfare when the spillover rate is relatively high.
- The social planner may permit, partially permit, or prohibit PEO.