Economics Bulletin

Volume 30, Issue 3

# Ownership Structure as a Continuous Variable: A Note on Joint Ownership in the Grossman-Hart-Moore Theory of the Firm

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## Abstract

This study considers the choice of ownership as a continuous variable, thereby adapting the Grossman-Hart-Moore (GHM) theory of the firm. To do so, it is assumed that parties sign a contract that enables them to divide and use assets even after the negotiation over gains of trade fails. I show sufficient conditions for non-integration to dominate joint ownership, which is not taken into account in the original GHM model.

I am grateful to the Associate Editor Quan Wen, an anonymous referee, Katsuhito Iwai and Hitoshi Matsushima for their helpful comments. This research is partially supported by the Ministry of Education, Science, Sports and Culture, Grant-in-Aid for Young Scientists (B), 21730184, 2009. Any errors are my own.

**Citation:** Takanori Adachi, (2010) "Ownership Structure as a Continuous Variable: A Note on Joint Ownership in the Grossman-Hart-Moore Theory of the Firm", *Economics Bulletin*, Vol. 30 no.3 pp. 2112-2118.

**Submitted:** Jun 16 2010. **Published:** August 12, 2010.

## 1. Introduction

The model developed by Grossman and Hart (1986) and Hart and Moore (1990) (hereafter, the GHM model) is lucid and consistent enough to help us understand efficient ownership patterns ("boundaries") of the firm.[1] This study reconsiders the notion of joint ownership (i.e., cross ownership of an asset by multiple parties)[2] by adapting the GHM model and regards the choice of ownership as a continuous variable.

In the original GHM model, joint ownership is excluded from analysis, although Hart (1995, p.48) provides a brief explanation of why joint ownership is dominated by integration. To understand this, I consider the following joint ownership depicted in Figure 1. Suppose that in this ownership, negotiation after investments fails. Neither party can then access the asset $A_S$ "independently," since any asset usage must be agreed upon by both parties. This is due to the power derived from residual rights of control. It is clear that such an outcome is dominated by the ownership structure where asset $A_S$ is assigned to either party, as the ownership structure provides one party with an incentive to invest anyway. Therefore, joint ownership is always dominated by non-integration in the GHM model.

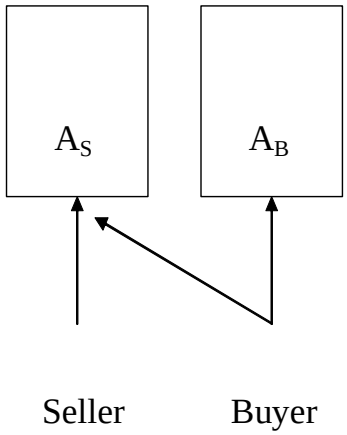


Figure 1: An Example of Joint Ownership

This conclusion depends crucially upon the operating terms of the contract: if a trade negotiation fails, joint ownership deprives both parties of the right of access to assets. However, this explanation does not clarify whether joint ownership becomes optimal if at the time of failure of negotiation the jointly owned asset can be accessed independently, and if the fragments of the asset are not complementary.

Thus, this study aims to understand what conditions make joint ownership a dominated structure even if fragments of an asset are not complementary. I do this by explicitly introducing joint ownership in the analysis so that several types of joint ownership can be compared with other forms of ownership, under the assumption that parities can sign a contract that allows them to divide and use assets if negotiation over gains of trade after

[1] Chapter 2 of Hart (1995) is a concise exoposition of the GHM model.

[2] The usual definition of joint ownership explains the situation where more than one party "owns" or "has residual rights of control" over assets that are necessary for economic activities. Note that the definition employed in this study is slightly different; it is similar to the definition of "split" property rights for a patent analyzed by Aghion and Tirole (1994).

the investment. I discover sufficient conditions for non-integration to always dominate joint ownership.

This study aims to complement the literature on joint ownership in the GHM framework by allowing the usage of split assets in the original GHM model. To the best of my knowledge, the first study that considers joint ownership in the GHM framework was by Maskin and Tirole (1999). By interpreting joint ownership as stochastic ownership, they showed that the first-best level of investment is achieved with joint ownership *and* an "option-to-sell" contract. They emphasized that the form of contract allowed in the GHM framework is limited, whereas stochastic ownership would be difficult to implement in reality. On the other hand, Cai (2003) incorporated endogenous choice of the degree of specificity associated with contracting parties' investments to show that joint ownership is optimal when specific and general investments are *substitutes* for each other.

The optimality of joint ownership is also shown by Halonen (2002), who showed that joint ownership works well as a credible threat point in a repeated relationship between a buyer and a seller. Rosenkranz and Schmitz (2003) found that joint ownership can be optimal by considering another dynamic setting of R&D alliances where joint surplus is realized repeatedly each time a know-how disclosure is made. Recently, Annen (2009) claimed that keeping ex-ante ownership "vague" (such as the 50-50 rule) provides each party stronger incentives to invest if they are rewarded for investment, as in a contest.[3] Note that the optimality of joint ownership shown in the studies above does not contradict the main claim in the present study: while these authors extend the economic environment of the GHM framework, while the present study only allows the continuum of owner structures.

The next section presents a model that relaxes the assumption in the GHM model that ownership structure is as a discrete value. It shows that at the negotiation failure stage, if the buyer's and seller's marginal returns of investment from any fragment of one party's initial physical capital is higher than that from any fragment of the other party's initial physical capital, then non-integration of assets dominates joint ownership. This sufficient condition seems to be satisfied in the general economic environment: therefore, joint ownership is seldom chosen, even though fragments of an asset are not complementary.

## 2. The Model

In this section, I present the model in which ownership can be chosen as a continuous variable. Throughout the discussion of this model, I assume the divisibility of assets in the renegotiation failure subgame, and that each investment is in human capital: one party's investment cannot be taken over by the other party because of the prohibition of slavery.

Consider two owner-manager firms: a risk-neutral seller, who produces a single unit of input and a risk-neutral buyer, who uses this unit to produce output. The seller initially possesses $A_S$ and the buyer $A_B$. The game proceeds as follows:[4]

Date 0: Contract of ownership,
Date 1: Choice of investment ($i \in R_+$ for the buyer and $e \in R_+$ for the seller),
Date 2: Bargaining over surplus of trade,

[3] See also Roider (2004), Wang and Zhu (2005) and Schmitz (2006) for other explanations of joint ownership in the GHM theory.

[4] As in the GHM model, we assume that the parties have symmetric information and that there is no time discounting.

Date 3: Trade if both agree to trade, else no trade.

Ownership patterns are defined as the ratio of asset that each party can claim if negotiation at Date 2 fails and if each party has to trade with other agent. The right to claim a specific ratio of asset is assumed to be verified by the court. Let $n_B \in [0,1]$ denote the ratio of $A_B$ on which the buyer has a claim and $n_S \in [0,1]$ denote the ratio of $A_S$ on which the seller has a claim. If negotiation fails and trade between the two parties does not occur, the buyer gains reservation revenue, $r : R_+ \times [0,1]^2 \to R_+$, minus the market price of the good, $\overline{p}$;

$$r(i; n_B, n_S) - \overline{p}$$

and the seller gains the market price of the good minus reservation cost, $c : R_+ \times [0,1]^2 \to R_+$;

$$\overline{p} - c(e; n_B, n_S).$$

There are following categories of ownership:

(a) Buyer-integration: $n_B = 1$ and $n_S = 1$,
(b) Seller-integration: $n_B = 0$ and $n_S = 0$,
(c) Non-integration: $n_B = 1$ and $n_S = 0$,
(c') Reverse non-integration: $n_B = 0$ and $n_S = 1$ and
(d) Joint ownership: $n_B \in (0,1)$ and $n_S \in (0,1)$.

Further, I suppose that the ex post gains are equally divided through Nash bargaining. Thus, buyer's and seller's ex ante payoffs are

$$\begin{aligned} \pi_B - i &= R - p - i = r - \overline{p} + \frac{1}{2}\{[R-C] - [r-c]\} - i \\ &= -\overline{p} + \frac{1}{2}\{R(i) + r(i; n_B, n_S) - C(e) + c(e; n_B, n_S)\} - i, \end{aligned}$$

and

$$\begin{aligned} \pi_S - e &= p - C - e = \overline{p} - c + \frac{1}{2}\{[R-C] - [r-c]\} - e \\ &= \overline{p} + \frac{1}{2}\{R(i) - r(i; n_B, n_S) - C(e) - c(e; n_B, n_S)\} - e, \end{aligned}$$

respectively, where $R : R_+ \to R_+$ denotes the revenue for the buyer, $C : R_+ \to R_+$ is the cost for the seller, and $p$ is the price of the good when trade occurs. I then set up the following assumption to obtain clearer results.[5]

**Assumption 1.** Reservation revenue and cost have an additively separable form in $n_B$ and $n_S$:

$$r(i; n_B, n_S) \equiv n_B r_1(i) + n_S r_2(i)$$

and

$$c(e; n_B, n_S) \equiv (1 - n_S)c_1(e) + (1 - n_B)c_2(e).$$

This assumption implies that fragments of each asset are not complementary and can work independently to produce gains for the parties. Figure 2 illustrates this situation.

[5] To guarantee a reasonable solution, the following inequalities are assumed to hold: $R' > 0$, $R'' < 0$, $C' < 0$, $C'' > 0$, $r' \geq 0$, $r'' \leq 0$, $c' \leq 0$, $c'' \geq 0$. Furthermore, $R'(0) > 2$, $\lim_{i \to \infty} R'(i) < 1$, $C'(0) < -2$, $\lim_{i \to \infty} C'(e) > -1$.

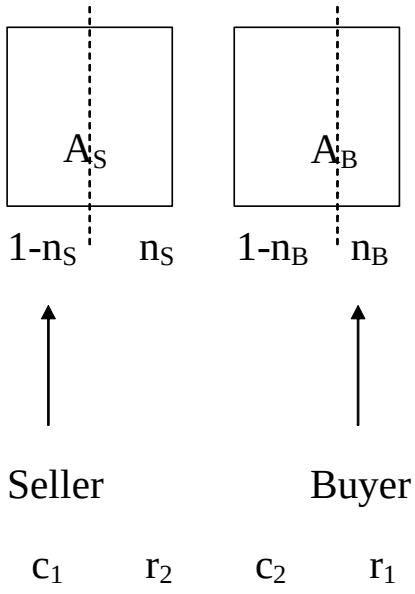


Figure 2: Assumption 1

Each party maximizes its ex ante surplus with respect to its investment at Date 1. I then obtain the following first order conditions:

$$\frac{R'(i) + n_B r_1'(i) + n_S r_2'(i)}{2} = 1$$

and

$$-\frac{C'(e) + (1 - n_S)c_1'(e) + (1 - n_B)c_2'(e)}{2} = 1.$$

I denote the chosen investment levels as $i(n_B, n_S)$ and $e(n_B, n_S)$. Before examining the choice of ownership, I briefly mention the first-best investment levels. If investment levels could be specified in the initial contract, it is clear that the maximum total surplus would not be related to patterns of integration: first-best investment levels are decided by $R'(i) = 1$ and $-C'(e) = 1$.

I proceed to study the second-best situation where investment levels cannot be specified in the initial contract. To do so, we define the following total surplus of trade:

$$S(n_B, n_S) = R(i(n_B, n_S)) - C(e(n_B, n_S)) - i(n_B, n_S) - e(n_B, n_S).$$

As explained above, specific patterns are established in favor of the ownership structure that bears the largest ex ante total surplus.

**Assumption 2.** The parties can sign a contract that allows them to divide and use assets if negotiation over gains of trade after investment fails.

Because assets generally involve various types of entities, this assumption seems realistic for all assets (e.g., factories), except of "hard" assets that cannot be divided. It is also possible to extend each party's residual rights of control to various entities.

I then suppose that marginal gains from investment when negotiation succeeds are always higher than those when it fails.

**Assumption 3.** $\forall i \in R_+$, $\forall e \in R_+$, $\forall n_B \in [0,1]$ and $\forall n_S \in [0,1]$, $R'(i) > n_B r_1'(i) + n_S r_2'(i)$ and $|C'(e)| > |(1-n_S)c_1'(e) + (1-n_S)c_2'(e)|$.

Under this assumption, the investment levels in the second-best situation are always lower than the first-best levels. This guarantees that if investment levels are lower, the total surplus is also lower. Thus, it becomes easy to rank ownership structures. The problem at the contracting date is summarized as: $\max_{n_B \in [0,1],\ n_S \in [0,1]} S(n_B, n_S)$.

The interior solution of this problem is joint ownership. However, we next explore sub-optimality of joint ownership in this model.

**Proposition.** If $r_1'/r_2' \geq \alpha$ and $c_1'/c_2' \geq \beta$, where $\alpha$ and $\beta$ are positive real numbers that satisfy $\alpha \cdot \beta \geq 1$, then non-integration dominates joint ownership.

**Proof.** If $r_1'/r_2' \geq \alpha$ and $c_1'/c_2' \geq \beta$ are satisfied, then, $\alpha \cdot \beta \geq 1$, $r_1'/r_2' \geq n_S/(1-n_B)$ and $c_1'/c_2' \geq (1-n_B)/n_S$ for any $n_B \in [0,1]$ and $n_S \in [0,1]$. This is equivalent to $r_1'(i) \geq n_B r_1'(i) + n_S r_2'(i)$ and $-c_1'(e) \geq -[(1-n_S)c_1'(e) + (1-n_S)c_2'(e)]$. When these inequalities hold, it is clear that investment levels are higher when there is non-integration than when there is joint ownership. With Assumption 3, this implies that the total surplus from non-integration is always higher than that from joint ownership: the latter is dominated by the former and is never selected. ■

The intuitive meaning of this proposition is that if the buyer's or seller's marginal returns of investment from a fragment of one party's initial physical capital at the negotiation failure stage is much higher than that from fragments of the other party's initial physical capital, dividing the initial asset divests the buyer's and/or the seller's incentive to invest: therefore, it should be owned by one party. The following corollary is a stronger sufficient condition with an economic meaning.

**Corollary.** If $r_1'/r_2' \geq 1$ and $c_1'/c_2' \geq 1$, then non-integration dominates joint ownership.

This means that if at the negotiation failure stage, the buyer's and seller's marginal returns of investment from fragment of one party's initial physical capital is higher than that from fragment of the other party's initial physical capital, then non-integration of assets dominates joint ownership. This statement seems to be satisfied under the usual economic environment. Thus, under relatively broader conditions, joint ownership is dominated by non-integration.

Throughout this discussion, I have assumed the contractibility of dividing the assets; that is, parts of assets that are prespecified at the initial contract can be independently accessed by the parties. This assumption at first seems slightly awkward, but is quite plausible because assets generally involve various types of entities. Moreover, except for the "hard" assets, it is not unnatural to suppose that assets can be used separately.

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