A Dynamic Transaction Cost Model of Firm Boundaries: Why Do Firm Boundaries Waver?

MORI, Yusuke

Abstract

This study analyzes dynamic changes in firm boundaries through the lens of transaction cost economics. We present a multi-generational model in which each generation can either make (i.e., non-integration) or buy (i.e., integration) an intermediate good and show that if relationship-specificity is intermediate, vacillation between non-integration and integration occurs in equilibrium. This result implies that such a vacillation can be interpreted as each generation's experimentation to determine the optimal governance structure.

Keywords: Transaction cost, organizational vacillation, firm boundaries, haggling

I. Introduction

Whether a transaction should be undertaken between or within firms is known as a make-or-buy decision or boundary of the firm and is regarded as one of the main topics of organizational economics. Coase (1937), which is the seminal paper on the topic, points out that "there is a cost of using the price mechanism" (p. 390) and asserts that firms are established to economize such a cost. Coase's approach has been extended and developed into transaction cost economics (TCE) by his followers, including Oliver Williamson.

TCE (e.g., Williamson [1975] and [1985]) states that the primary sources of market transaction cost include haggling (i.e., costly *ex post* renegotiation over terms of transaction) and that such haggling can be reduced if the trading parties are integrated into a single firm. It follows because internal organizations can use fiat to settle haggling. TCE then asserts that higher relationship-specificity makes integration more likely to be chosen. High relationship-specificity results in a bilateral monopoly between trading parties, which provides each party high bargaining power to pursue his/her favorable terms, thus making *ex post* renegotiation more costly. This assertion is strongly supported by a number of empirical studies (see Lafontaine and Slade [2007] for a review of those studies). However, TCE also states that hierarchies suffer from bureaucracy costs, and hence more integration cannot always be better than less.

Despite TCE's empirical success, some studies (e.g., Dow [1987] and Langlois and Robertson

[1995]) specify that it is unsuited for analyzing dynamic structural changes, including vacillation in firm boundaries: swing between non-integration and integration. This study thus aims to extend the TCE approach to analyze such a vacillation.

To analyze dynamic changes in firm boundaries, we employ a multi-generational model in which each generation tries to minimize governance costs by governance choice (i.e., either non-integration or integration).[1)] Following TCE, market governance cost is haggling cost and integration suffers from bureaucracy costs. While costs of using hierarchy (i.e., bureaucracy costs) cannot be avoided under integration, haggling does not necessarily occur under non-integration (market governance cost might be zero). The problem is that generation t might be uncertain about which structure to choose for the following two assumptions. First, each generation can observe $t-1$'s governance cost but not l's ($l \leq t-2$), and hence, if $t-1$ chooses integration, observing $t-1$'s governance cost does not tell t anything about whether non-integration triggers haggling. Second, each generation is uncertain about whether his/her predecessors are rational (i.e., some generation might have chosen governance structure irrationally). Each generation then has to infer the structure that is optimal from available information, including history of governance choices and the level of relationship-specificity (higher relationship-specificity makes a prior belief that market transaction suffers from haggling higher).

We show that vacillation between the governance structures occurs in equilibrium when relationship-specificity is intermediate. This result implies that the vacillation can be interpreted as each generation's effort to determine the governance structure that is optimal. When relationship-specificity is high (resp. low) enough, non-integration is likely to be more (resp. less) costly than integration, and then, no vacillation occurs. When relationship-specificity is intermediate, it is difficult for each generation to infer the optimal structure (i.e., whether market transaction suffers from haggling), and thus, he/she undertakes experimentation to figure it out.

There are few studies on organizational vacillation. Nickerson and Zenger (2002) and Boumgarden, Nickerson, and Zenger (2012) specify that vacillation between centralization and decentralization can be considered as an effort to balance between exploration (i.e., search for new ideas) and exploitation (i.e., pursue efficient utilization of existing ideas). Since exploration and exploitation require opposite organizational designs (i.e., while centralization promotes exploitation, decentralization promotes exploration), firms can dynamically achieve "high levels of both exploration and exploitation by temporally and sequentially alternating between organizational structures that promote either exploration or exploitation, respectively" (Boumgarden, Nickerson, and Zenger, 2012, p. 588). While the abovementioned studies focus on the situation in which "the desired functionality lies in-between the steady-state functionality delivered by two discrete choices" (p. 547), ours deals with the one in which either of the two polar choices (i.e., either non-integration or integration) is optimal. Furthermore, their result does not explain why organizational changes are often followed by managerial changes.

The rest of the paper is organized as follows. Sections 2 and 3 present our model and analysis, respectively. Section 4 includes the extension of the model. Section 5 concludes.

II. The Model

There is a firm that demands one unit of an intermediate good to produce a final product in each period of time. The intermediate good can be procured through either market transaction/non-integration (denoted by NI) or intra-firm transaction/integration (denoted by I).

Our multi-generational model proceeds as follows: let G_t represent generation t.

Period 1: The level of relationship-specificity $k \in \mathbb{R}_+$ is exogenously determined.

Period 2: Given NI, G_1 receives his/her payoff and exits. Given G_1's payoff and relationship-specificity k, G_2 chooses either NI or I.[2)]

⋮

Period t: G_{t-1} receives his/her payoff and exits. Given G_{t-1}'s payoff, the history of the governance choices, and relationship-specificity k, G_t chooses either NI or I.

⋮

Each generation's payoff is given by governance costs, which depend on the choice of governance structure (i.e., either NI or I). As mentioned in Introduction, the primary source of market governance cost includes haggling. Hierarchy, on the other hand, can economize haggling cost but suffers from bureaucracy costs. Let $M(k)$ (resp. $B(k)$) denote the haggling costs (resp. bureaucracy costs) where $B(0) > M(0)$ and $M'(k) > B'(k) > 0$. While integration always suffers from $B(k)$, non-integration may not lead to haggling. Given the relationship-specificity k, $p(k)$ represents prior belief that market transaction suffers from haggling where $p'(k) > 0$. Throughout, we use $p \equiv p(k)$ for notational convenience.

We now introduce a key assumption: each generation may be of appeal type (resp. rational type) with probability q (resp. $1-q$), which is common knowledge. While the rational type maximizes his/her (expected) payoff, the appeal type G_t never chooses the same governance structure as G_{t-1} does (i.e., if G_{t-1} chooses NI, G_t chooses I, and vice versa).[3)] Intuitively, this assumption reflects that "[organizational] vacillation may reflect management turnover–new managers seeking to leave their distinctive mark by initiating organizational change" (Nickerson and Zenger, 2002, p. 548).

The following information is available to $G_t (t \geq 2)$: (a) the level of relationship-specificity k, (b) $M(k)$ and $B(k)$, (c) the history of governance choice, (d) G_{t-1}'s payoff, (e) the probability with which each generation becomes appeal type, q, and (f) the common prior belief about whether haggling occurs under NI, p. The information that is available to each generation is common knowledge. Since G_{t-1}'s payoff is observable to G_t, if G_{t-1} chooses NI, G_t can infer whether haggling occurs under NI: G_{t-1}'s payoff $-M(k)$ (resp. zero) implies that market transaction triggers haggling (resp. no haggling). If G_{t-1} chooses I, on the other hand, G_{t-1}'s payoff does not tell G_t anything about haggling because the governance cost of I is always $-B(k)$. Given the type uncertainty, this also implies that if G_{t-1} chooses I, G_t observing G_{m-1} chooses NI and G_m chooses I cannot infer whether G_m chooses I rationally ($m \leq t-1$).[4)] G_t's posterior belief about whether non-integration leads to haggling is denoted by μ_t and determined by Bayes' rule.

III. Analysis

G_{t-1}'s governance choice affects G_t's behavior. We thus begin by focusing on the case in which G_{t-1} chose *NI* and then proceed to the case in which G_{t-1} chose *I*. Since the behavior of the appeal type is mechanical, we focus on the behavior of the rational G_t.

III-1 G_{t-1} Chose Non-Integration

Suppose G_{t-1} chose *NI*. G_t can then infer whether haggling occurs under *NI* by observing G_{t-1}'s payoff: observing $-M(k)$ (resp. zero) implies that haggling (resp. no haggling) occurs. Thus, the optimal choice of G_t (if rational) is as follows:

$$\begin{cases} NI & \text{if } -M(k) \geq -B(k) \text{ or } G_{t-1}\text{'s payoff is zero,} \\ I & \text{if } -M(k) < -B(k). \end{cases}$$

III-2 G_{t-1} Chose Integration

If G_{t-1} chose *I*, G_{t-1}'s payoff is $-B(k)$, which does not tell G_t anything about whether market transaction suffers from haggling. This case includes two subcases: whether *NI* was chosen for several generations in a row before G_t or not.

III-2-i G_{j-1} and G_j chose non-integration for some $j = \{2, 3, \ldots, t-2\}$

Consider the situation in which G_{j-1} and G_j chose *NI* for some $j = \{2, 3, \ldots, t-2\}$. Since the appeal type always changes governance structure, G_t can infer that G_j is rational and either of the following conditions hold:

$$\begin{cases} G_{j-1}\text{'s payoff is zero (i.e., no haggling occurs), or} \\ -M(k) \geq -B(k) \text{ holds.} \end{cases}$$

In either case, it is optimal for G_t (if rational) to choose *NI*.

III-2-ii There is no $j = \{2, 3, \ldots, t-2\}$ such that G_{j-1} and G_j chose non-integration

In this case, G_t (if rational) cannot perfectly infer whether haggling matters under non-integration and thus chooses the governance structure as follows: if governance changes from *NI* to *I* are observed n times before G_t, G_t chooses

$$\begin{cases} NI & \text{if } -\mu_t M(k) \geq -B(k), \\ I & \text{otherwise,} \end{cases}$$

where

$$\mu_t = \frac{p}{p + (1-p)q^n}.$$

μ_t implies that G_t does not have to care about how many governance changes from I to NI are observed. Suppose G_j ($j \leq t-2$) made such a governance change, then there are two possible reasons. First, G_j is rational and $-\mu_j M(k) \geq -B(k)$. Second, G_j is of the appeal type. In either case, G_j does not actually observe whether haggling occurs under NI, and hence G_j's governance change includes no additional information to update G_t's belief.

From the discussions above, G_t's (if rational) optimal choice is summarized as follows:

PROPOSITION 1

(*a*) *If* G_{t-1} *chose NI,* G_t *(if rational) chooses*

$$\begin{cases} NI & \text{if } -M(k) \geq -B(k) \text{ or } G_{t-1}\text{'s payoff is zero,} \\ I & \text{otherwise.} \end{cases}$$

(*b*) *If* G_{t-1} *chose I, and* G_{j-1} *and* G_j *chose NI for some* $j \leq t-2$, G_t *(if rational) chooses NI.*

(*c*) *If* G_{t-1} *chose I and there is no* $j \leq t-2$ *such that* G_{j-1} *and* G_j *chose NI,* G_t *(if rational) chooses*

$$\begin{cases} NI & \text{if } -\mu_t M(k) \geq -B(k), \\ I & \text{otherwise,} \end{cases}$$

where

$$\mu_t = \frac{p}{p + (1-p)q^n}$$

and n denotes the number of governance changes from NI to I that have been observed before G_t.

This proposition suggests that if k is intermediate, vacillation between NI and I occurs in equilibrium. Suppose that $-M(k) < -B(k)$ and haggling occurs under NI. Then, G_2, who observes G_1's governance cost $M(k)$, chooses I since $-M(k) < -B(k)$. If $-\mu_3 M(k) \geq -B(k)$ holds, NI is chosen by G_3. G_4, who observes G_3's governance cost $M(k)$, then chooses I because $-M(k) < -B(k)$ holds. This cycle continues until G_l such that $-\mu_{l-1} M(k) \geq -B(k)$ and $-\mu_l M(k) < -B(k)$.[5)]

This vacillation is caused by each generation's experimentation: an effort to figure out whether haggling occurs under NI. Such an effort is caused by the uncertainty about preceeding generations' rationality. This formally explains why organizational changes often follow the changes in top managements: new top management might not be able to fully understand the intention of his/her predecessors' governance choices.

Our result also implies that generation changes triggered by poor performance might make the vacillation last longer. Suppose the transition from G_{t-1} to G_t occurs due to G_{t-1}'s poor performance. G_t is then likely to doubt G_{t-1}'s rationality (i.e., q becomes high). Higher q makes t^* longer where t^* satisfies $-\mu_{t^*-1} M(k) \geq -B(k)$ and $-\mu_{t^*} M(k) < -B(k)$.

Furthermore, we find that even if I is not optimal, it might rationally continue to be chosen. Suppose that relationship-specificity k satisfies $-\mu_3 M(k) < -B(k)$ but haggling does not occur under NI. G_2 (if the appeal type) chooses I, and then rational G_t ($t \geq 3$) chooses I because $-\mu_t M(k) < -B(k)$ holds, which continues until the next appeal type appears. This explains why it is hard for some integrated firms to disintegrate even if the integration is not optimal.

IV. Extension: Relationship-Specificity Changes

The previous section focused on the situation where relationship-specificity is constant. However, in reality, unforeseen changes in relationship-specificity may occur.

For example, in Klein, Crawford, and Alchian's (1978) famous case of General Motors–Fisher Body relationship, a dramatic decline in relationship-specificity is observed. They report that "in 1919 General Motors entered a ten-year contractual agreement with Fisher Body for the supply of closed auto bodies" (p. 308) to encourage Fisher Body's investment in specific stamping machines. Such a contractual arrangement was required because "[T]he original production process for automobiles consisted of individually constructed open, largely wooden, bodies" (p. 308). However, "[T]he demand conditions facing General Motors and Fisher Body changed dramatically over the next few years. There was a large increase in the demand for automobiles and a significant shift away from open bodies to the closed body styles supplied by Fisher" (p. 309). This section thus examines the situation where relationship-specificity changes and extends Proposition 1.

We assume that the level of relationship-specificity may change between periods. The timing of the game then changes as follows: suppose the change in relationship-specificity from k to k' occurs between periods n and $n + 1$,

> Period n: G_{n-1} receives his/her payoff and exits. Given G_{n-1}'s payoff, the history of governance choice and relationship-specificity k, G_n chooses either *NI* or *I*.
>
> ——— Change in Relationship-Specificity $k \rightarrow k'$ occurs ———
>
> Period $n + 1$: G_n receives his payoff under relationship-specificity k' and exits. Given G_n's payoff, the history of governance choice, and relationship-specificity k', G_{n+1} chooses either *NI* or *I*.
>
> ⋮

For simplicity, we assume that whether haggling occurs under relationship-specificity k does not affect whether it occurs under k': G_{n+1}'s belief about whether haggling occurs is $p(k')$.[6)]

Since the changes in the setting does not affect our analysis significantly, we can extend Proposition 1 with slight modification:

Proposition 2 *Suppose relationship-specificity changes from k to k′ between periods i* – 1 *and i. G_t's ($t > i$) rational governance choice is defined similarly as in Proposition 1 by exchanging k for k′.*

V. Conclusion

This study analyzes dynamic changes in firm boundaries through the lens of TCE. We present a multi-generational model in which each generation chooses governance structure without knowing the reasons for the predecessors' governance choices. We show that if relationship-specificity is intermediate, vacillation between non-integration and integration occurs in equilibrium. This result implies that such

a vacillation can be interpreted as each generation's experimentation to determine the governance structure that is optimal. Our model also provides a formal explanation for why organizational changes often follow management turnovers.

There are some extensions to be done, including endogenizing the level of relationship-specificity, introducing a single decision maker with imperfect recall of the reason for his/her previous choices instead of employing multi-generational framework, and extending the case in which haggling occurs probabilistically in each period. Since these are beyond the scope of this study, we leave further analysis for future research.

Acknowledgements

I am grateful to two anonymous referees and the participants at Contract Theory Workshop East for their beneficial comments and suggestions. All errors are my own.

Notes

1) Our framework can also be applied to the choice between spin-off and spin-in.
2) Following TCE's classic assumption that "in the beginning there were markets" (Williamson, 1975, p. 20), we assume that the game starts with *NI*, which does not affect our result qualitatively.
3) What is crucial to our result is that the changes from non-integration to integration do not necessarily take place for rational reasons. Thus, our result continues to hold if we introduce empire builder, who always chooses integration, instead of the appeal type.
4) Some public information made by predecessors, such as annual reports, might be available to successors and help them infer the reason for predecessors' choice of governance structures. However, such information is not necessarily reliable: "Particular care must be exercised in the interpretation of annual reports that are biased in presentation" (Boumgarden, Nickerson, and Zenger, 2012, p. 607).
5) Each G_i $(i \geq l)$ (if rational) then chooses I.
6) Our result does not change if G_{n+1}'s belief is given by $p(k', \mu_n)$ where μ_n denotes posterior belief immediately before the change in relationship-specificity.

Reference

Boumgarden, Peter, Jackson Nickerson, and Todd R. Zenger. 2012. "Sailing into the Wind: Exploring the Relationships among Ambidexterity, Vacillation, and Organizational Performance." *Strategic Management Journal*, 33(6): 587–610.

Coase, Ronald. 1937. "The Nature of the Firm." *Economica*, 4(16): 386–405.

Dow, Gregory K. 1987. "The Function of Authority in Transaction Cost Economics." *Journal of Economic Behavior & Organization*, 8(1): 13–38.

Klein, Benjamin, Robert Crawford, and Armen Alchian. 1978. "Vertical Integration, Appropriable Rents and the Competitive Contracting Process." *Journal of Law and Economics*, 21(2): 297–326.

Lafontaine, Francine, and Margaret Slade. 2007. "Vertical Integration and Firm Boundaries: The Evidence." *Journal of Economic Literature*, 45(3): 629–685.

Langlois, Richard N., and Paul L. Robertson. 1995. *Firms, Markets, and Economic Change: A Dynamic Theory of Business Institutions*. Routledge.

Nickerson, Jack A., and Todd R. Zenger. 2002. "Being Efficiently Fickle: A Dynamic Theory of Organizational Choice." *Organizational Science*, 13(5): 547–566.

Williamson, Oliver E. 1975. *Markets and Hierarchies: Analysis and Antitrust Implications*. New York: Free Press.

Williamson, Oliver E. 1985. *The Economic Institutions of Capitalism*. New York: Free Press.