



Decision Support

Vertical separation as a defense against strong suppliers

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ABSTRACT

We provide a simple model to investigate decisions about vertical separation. The key feature of this model is that more than one input is required for the final product of the downstream monopolist. We show that as the bargaining powers of independent complementary input suppliers grow larger, the downstream monopolist tends to separate from its input units. The results are related to a visible difference between the vertical structures of Japanese and US auto assemblers.

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1. Introduction

Vertical separation has become a widespread phenomenon in the industrialized world. Examples of industries where vertical separation is a key feature of the organization of production abound: aircraft, cars, computers, audio/video systems, and so on. For example, in the automobile industry, suppliers have a significant role in US, European, and Japanese auto manufacturing and therefore in the quality of the final product (Richardson, 1993). Japanese assemblers, especially, often spin off parts development and manufacturing to independently managed yet closely linked suppliers (Ahmadjian and Lincoln, 2001). Moreover, automobiles are developed and manufactured by OEMs and their supplier networks, who produce as much as 70 percent of the value of a vehicle. Consequently, the cost and quality of a vehicle are functions of the productivity of a network of firms working in collaboration (Dyer and Nobeoka, 2000).

The degree of vertical separation (integration) varies between firms although vertical separation has become a widespread phenomenon. The automobile industry is a typical example. Japanese auto assemblers are known to be substantially less vertically integrated than their US counterparts (see, for instance, Cusumano and Takeishi (1991) and the references therein). Large Japanese auto assemblers such as Toyota and Nissan rely on suppliers for both design and manufacture of components traditionally produced

in-house by GM and Ford. As summarized in Dyer (1996), there are several explanations that a high (*resp.* low) degree of vertical integration emerged in the US (*resp.* Japan). One explanation is preference for vertical interactions among firms. The US auto companies tend to eliminate some negative effects from interactions with their trading partners. For instance, Perry (1989) and Scherer (1980) point out managements' desire to grow and reduce dependency on outside suppliers. Moreover, Emerson (1962) and Pfeffer and Salancik (1978) mention that firms lose power when they increase their dependency on outside suppliers. On the other hand, Japanese cultural norms and values result in a high level of "goodwill trust" in Japan, which translates into cooperative interfirm relationships (Dore, 1983; Sako, 1991; Hill, 1995). Another explanation of the differences between the US and Japanese in the degree of vertical integration is based on the lack of an open market for corporate control in Japan (Sheard, 1994) and the limitations of Japanese financial markets (Nishiguchi, 1994).

Although those explanations summarized by Dyer (1996) sound plausible, we provide a new strategic reason for the difference between the US and Japan. We think that a simple key feature to explain those differences is that more than one input is required for the final products of those manufacturers. In automobile product development, the degree of vertical separation (integration) for a single manufacturer is the consequence of hundreds of individual procurement choices, ranging from simple supply contracts for commodity components to complex arrangements for cutting-edge technology development (Novak and Stern, 2009).

We provide a simple model to investigate decisions of vertical separation and show several results that have not been explained in previous research (we mention the difference between this

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model and those in related previous studies later). The key feature of this model is that more than one input is required for the final product of the downstream monopolist.¹ This feature is consistent with the examples mentioned above. The model can be also applied to other industries. For instance, in the aircraft industry two major firms, Airbus and Boeing, rely heavily on firm-specific inputs (e.g., engines, wings, horizontal stabilizers) produced by independent manufacturers, and then sell their aircraft to airline companies, which are final customers (Beelaerts van Blokland et al., 2008).

The model structure is as follows. There is a downstream monopolist D that uses two inputs; A and B . The inputs are produced by an independent upstream supplier U_A and a production unit inside the downstream firm D respectively. The wholesale price of input A is determined by bargaining between the downstream firm and the supplier. Under this condition, we consider two cases: (1) the downstream firm produces units of input B , (2) the downstream firm separates from its input production unit. The separated unit (supplier U_B) supplies to the downstream firm D to maximize its own profit.² We show that as the bargaining power of the independent supplier U_A increases, the downstream monopolist tends to separate from its input unit. A corollary of the result is that when the bargaining power of the independent supplier U_A is large enough, vertical separation is always profitable for the downstream monopolist.

Our paper shows that when the number of high-quality input suppliers that tend to have stronger bargaining power is large, assemblers tend to withdraw from design and/or manufacture of other complementary components, as the Japanese assemblers did. Following the discussion in Clark and Fujimoto (1991) and Clark (1989), we now explain that Japanese suppliers indeed have strong bargaining power and/or provide high-quality product to auto assemblers. Clark and Fujimoto (1991), Clark (1989) examine the impact of “project scope” in the global auto industry. The impact is a measure of the uniqueness of the part played and the extent of development carried out by outside suppliers in project performance. The authors found that 67% of Japanese projects were “black box,” or developed by suppliers, compared with 16% of US vehicles. They argue that the black-box system is effective because the link between design and manufacturing is strong. They argue that the high percentage of unique parts and high supplier involvement contributes to an observed Japanese advantage in project lead time and cost.³ This fact is consistent with our result: As the number of high-quality independent input suppliers, which tend to have stronger bargaining power, increases the downstream monopolist tends to separate from its input production units.

Several researchers have investigated how the structure of vertical organizations is determined in competitive environments (Bonanno and Vickers, 1988; Gal-Or, 1999; Choi and Yi, 2000; Chen, 2001, 2005; Lin, 2006; Arya et al., 2008; Matsushima, 2009). Although these papers consider downstream competition to derive results for vertical separation, we show that vertical separation is profitable even with only one downstream firm. An exception is Laussel (2008) who explicitly incorporates complementary inputs in an attempt to examine why vertical integration

does not occur. Besides several differences in the setup (which we will mention later), the present paper differs from Laussel (2008) as our focus is primarily on the relation between the degree of vertical separation and procurement conditions.⁴

In the context of operations research, for two decades, there has been a growing interest in the issue of channel management in oligopoly.” is cited in the text but not listed. Kindly check. McGuire and Staelin (1983) is the pioneering work which discusses a bilateral duopoly market where each manufacturer sells a differentiated product through a single monopoly retailer. They find that the equilibrium distribution structure (vertically integrated or not) depends on the level of product differentiation. Following the seminal work of McGuire and Staelin, 1983, the issue of vertical integration has been extensively studied in the literature (Moorthy, 1988; Choi, 1991; Desai, 1996; Kumar et al., 2000; Atkins and Liang, 2010; Anderson and Bao, 2010; Edirisinghe et al., 2012; Matsui, 2012). Those papers mainly show that manufacturers may prefer vertically separated supply chains.⁵ These papers mainly consider bilateral oligopoly models although our paper mainly discusses how the number of suppliers and their bargaining positions affect vertical structure.⁶

In a broad sense, since the seminal work by Coase (1937), the problem of vertical integration/separation has long been discussed by many researchers in the transaction-cost-based approach. The related papers mainly deal with well-known hold-up problems that illustrate the underinvestment hypothesis (e.g., Grout, 1984; Tirole, 1988). Coase (1937) suggested that transaction costs might be avoided or reduced via other organizational structures, and Klein et al. (1978) and Williamson (1979) suggested vertical integration as an organizational response. The focus of this approach has been on comparing costs internal to a transaction, between organizing the transaction within a firm or through the market.⁷ Complementary to the transaction-cost based approach, this paper emphasizes the importance of incorporating multiple inputs into the standard models with vertical relations.

The model setup is somewhat similar to those in the literature on patent pools although the motivations of these papers are quite different from ours (Lerner and Tirole, 2004; Kim, 2004; Schmidt, 2008). These papers discuss how vertical integration and/or patent pools (alliances among patent holders) alter the prices of patented inputs. However, the incentives for vertical integration between upstream and downstream firms are not discussed.

The remainder of this paper is organized as follows. Section 2 formulates the model. Section 3 presents the results. Section 4 extends the basic model. Section 5 discusses the consistency of our

¹ Our model is also related to models with complementary suppliers (Economides and Salop, 1992; Nalebuff, 2000; Baldwin and Woodard, 2007; Casadesus-Masanell et al., 2007; Maruyama and Minamikawa, 2009). Those papers discuss how mergers among complementary suppliers occur and/or how these mergers change equilibrium outcomes. Such complementary suppliers provide their products directly to consumers. This setting differs greatly from ours in that our main concern is to investigate how the number of suppliers and their bargaining positions affect vertical structure.

² We assume that the downstream firm cannot merge with supplier U_A . A more detailed discussion of the assumption is provided in Section 2.

³ Many researchers also point out that Japanese suppliers have superior technology, which contributes to better performance by Japanese automakers (see Hemmert (1999) and the references therein).

⁴ Matsushima and Mizuno (forthcoming) is also related to this paper. In Matsushima and Mizuno (forthcoming), using multiple input models, we discuss how market structures affect decisions on vertical integration/separation. In Matsushima and Mizuno (forthcoming), we do not discuss how bargaining power affects decisions on vertical integration/separation. Laussel and Long (2012) extend the model in Laussel (2008). They analyze the dynamics of the separation process when the downstream firm cannot commit to a time path of asset sale.

⁵ Besanko et al. (1998), Kadiyali et al. (2000), and Sudhir (2001) empirically investigate channel management problems.

⁶ As employed in our paper, Baron et al. (2008) and Wu et al. (2009) incorporate Nash bargaining into channel management problems discussed in this literature although their main concerns are quite different from ours.

⁷ Using the property rights approach to address the question of whether vertical integration can escape the hold-up problem, Grossman and Hart (1986) and Hart and Moore (1990) considered how a particular ownership structure affects the parties' exposure to hold-ups. Che and Sákovic (2008) provided an excellent brief survey of the hold-up problem. The topic of vertical foreclosure is also related to the problem of vertical integration. The vertical foreclosure issue primarily concerns the relation between vertical integration and the competitiveness of downstream firms (e.g., Ordovery et al., 1990; Hart and Tirole, 1990). See also O'Brien and Shaffer (1992), McAfee and Schwartz (1994), Gaudet and Long (1996), Ma (1997), Riordan (1998), and Choi and Yi (2000). Rey and Tirole (2007) provide an excellent survey of the literature.

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