



Equilibrium pricing sequence in a co-opetitive supply chain with the ODM as a downstream rival of its OEM[☆]



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ABSTRACT

We study three basic price competition games engaged in by an original equipment manufacturer (OEM) and its competitive original design manufacturer (ODM): a simultaneous pricing game, an OEM-pricing-early game, and an ODM-pricing-early game. The ODM provides contract manufacturing service to the OEM and competes with this OEM in the consumer market by selling self-branded products. We consider two market environments: the ODM market and the OEM market. For the ODM market, we show that a sequential pricing game arises as the outcome preferred by the OEM and its ODM. Moreover, the equilibrium that the OEM prices early risk-dominates the one that the ODM prices early. Nevertheless, for the OEM market, the simultaneous pricing game and the sequential pricing game can both arise and be sustained. We also demonstrate that it is in their mutual interest to be friends rather than foes.

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1. Introduction

In the manufacturing industry, original equipment manufacturers (OEMs) often outsource their manufacturing and even some design functions to original design manufacturers (ODMs), the contract manufacturers (CMs) that design and manufacture the specified products for OEMs [40,34]. For example, PalmOne worked with HTC, a Taiwan-based ODM, to design and manufacture its popular Treo 650 smartphones [23]. Apple outsourced its product manufacturing and partially, its innovation to notebook ODMs including Quanta, Asus, and Flextronics [39,23].

However, outsourcing production to ODMs can be a double-edged sword for OEMs [41]. On the one hand, by outsourcing production to ODMs, OEMs can minimize the risk of new product failure, shorten the introduction time of innovative products, speed up product life cycles, reduce design and production costs, and expand product portfolios [24]. On the other hand, according to Ozkan and Wu [42], ODMs are getting more likely to launch their own branded products that are similar to the OEMs' and, thus, become their downstream competitors. For instance, in the consumer electronics industry, HTC, the ODM for Google, produces its self-branded HTC Desire smartphone and the Google Nexus One smartphone, which have similar specifications [46].

The quality levels of the OEM products and self-branded ODM products can be very close, as they are produced by the same manufacturer using similar production technologies. In recent years, more and more OEMs are focusing on marketing activities (e.g., branding, advertising, and real-time customer interactions) while relying on their CMs to ensure the product quality [33]. Compared to OEMs, ODMs often lack the marketing skills necessary to achieve success in the markets such as the United States, Japan and some European countries [26]. The potential reasons are as follows: (1) ODMs are unfamiliar with the distributors in the countries that are likely to be the home markets of the OEMs, and, hence, face difficulty building efficient distribution channels and service networks; (2) they do not have sufficient knowledge about the consumer purchasing behaviors in those markets and have limited pricing skills; and (3) they invest little in branding and promoting their products. It is frequently reported that ODMs' products occupy much less market share in developed markets than in emerging markets. For example, Taiwan-based TPV Technology Limited (TPV) designs and produces computer monitors and LCD televisions not only for OEMs, such as Samsung, Philips, Sony, Vizio, and LG, but also for itself under its own brands, AOC

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and Envision. In 2009, AOC's market share in France and Germany was ranked 15th and 13th, respectively [2], but the company was officially ranked first in the Asia–Pacific region. AOC even achieved the largest market share (34.2%) in Philippines [31]. According to Ray Zhuo, the general manager in charge of AOC's operations in Asia–Pacific, Middle East Asia, and Central Asia, its success in these emerging markets was primarily due to its *local business network* advantage [20]. In another case, the ODM Asus produces and sells its self-branded Asus notebook. According to a report from RescueCom and IDOnly, in 2010 Asus captured around 3% of the American computer market, whereas Asus's OEMs Apple and Toshiba account for 9.7% and 10.2%, respectively [4]. However, Asus performs very well in its close-to-home emerging markets. For example, Asus enjoyed a market share of 12.5% in China and has been fighting for second place, targeting a 15% market share [67]. Actually, due to its *close-to-home* marketing strategy, Asus has “penetrated into China commercial business aggressively” and launched a “ferocious attack to gain more mind share and market share” in the Asia–Pacific region [44]. As a result, Asus has built a mature sales and service network in this region. These examples demonstrate that customers may prefer the self-branded products of competitive ODMs over those of OEMs in some local emerging markets due to their strong market position. However, the opposite may hold true in developed markets. To characterize the different market features, we refer to the market where the competitive ODM's (OEM's) product is preferred as the *ODM (OEM) market*, and we consider the price competition in both markets.

When an OEM contracts with a competitive ODM, the price competition is intriguing because the ODM is not only a downstream competitor of the OEM but also an upstream business partner. Will a firm's price be undercut by its competitor, and will the two firms engage in a price war? Indeed, in the traditional Bertrand competition game, the second-mover advantage exists because the firm that makes its pricing decision late can undercut the price of the firm that prices early so as to capture a larger market share [27,22]. In such a traditional setting, a Stackelberg equilibrium cannot be sustained because firms always try to undercut the prices of other firms. Nevertheless, this intuition need not hold in our setting because the OEM and the ODM are not only competitors but also partners. Recall that the ODM's revenue comes from both the contract manufacturing business and selling self-branded products. Undercutting the OEM's price can attract more customers to the ODM's self-branded products, but such behavior also reduces the wholesale price for the ODM's contract manufacturing service and thus the related revenue. Knowing that, the ODM may not have enough incentive to undercut the OEM's price. Anticipating the ODM's response and without worrying about the price being undercut, the OEM may prefer to price early rather than late. Thus, the following questions arise: Could a sequential pricing game be sustained between the OEM and its competitive ODM? If it could, under which conditions?

To study this issue, we investigate an endogenous pricing game that was first introduced in Gal-Or [27]. There are two stages in this game. At the first stage, two players independently decide when to price their products, early or late. Their pricing timing choices are revealed at the beginning of the second stage: a *simultaneous game* is played if both players make the same pricing timing decisions; an *OEM-pricing-early game* is played if the OEM prefers pricing early while the ODM prefers pricing late, and an *ODM-pricing-early game* is played otherwise. Note that the first stage of this game is artificially constructed to enable examination of firms' incentives for choosing a particular pricing sequence [1]. The players' endogenized pricing timing choice will then be revealed by the subgame perfect Nash equilibrium (SPNE) of the endogenous timing game.

We show that the answer to the first question is positive: a Stackelberg equilibrium can indeed be sustained in the pricing game between an OEM and its ODM. Therefore, the conventional wisdom generated from the traditional Bertrand pricing game (i.e., two firms will frequently change their prices to compete for customers) does not hold in a situation where one firm's end-market competitor also serves as its upstream partner. We further find that the equilibrium of the endogenous pricing game is heavily affected by the market type.

In the ODM market, both the OEM-pricing-early sequential game and the ODM-pricing-early sequential game can be the equilibrium. In this market, neither party has a large incentive to undercut the other's price: The OEM has little incentive because customers prefer the ODM's products, and it is difficult to attract customers by undercutting the price; the ODM has even less incentive because it has revenues from the OEM via contract manufacturing. Consequently, a sequential pricing game can be sustained. Furthermore, we find that the player that prices late may even charge a higher price than the one that prices early. We also show that, between the two sequential games, the OEM-pricing-early game risk-dominates the ODM-pricing-early game. That is, the more uncertain the OEM and ODM are about each other's choice of pricing early or late, the more likely a sequential pricing game with the OEM pricing early becomes.

In the OEM market, either a sequential pricing game or a simultaneous pricing game can be the equilibrium. Their decisions on pricing early or late depend on the OEM's outside option (i.e., the non-competitive ODM's wholesale price) because this outside option determines the allocation of the profit margin between the OEM and its competitive ODM. If this outside option is favorable for the OEM (i.e., if the non-competitive ODM's wholesale price is low), the two parties will choose the sequential pricing game; otherwise, the competition will become fierce, and a simultaneous game will ensue. We also show that the OEM is more likely to prefer pricing early in the OEM market. This helps explain why the OEM usually announces price information earlier than the competitive ODM does in some developed countries/regions (i.e., where the OEM has a large market share).

Besides addressing the two aforementioned main questions, we consider two further questions: Does the competitive ODM have the incentive to reject performing the contract manufacturing service for the OEM? Should the OEM avoid doing business with the competitive ODM and, instead, outsource from non-competitive ODMs? We find that, if the wholesale price of the non-competitive ODMs is sufficiently low, then the OEM always stays in the market. Under this condition, engaging in both self-branded business and contract manufacturing is more beneficial to the competitive ODM than is doing only self-branded business. We also show that the OEM should outsource solely from its competitive ODM even if the competitive ODM charges the same wholesale price as that of the non-competitive ODMs. The underlying reason is that revenue from the upstream CM business tames the competitive ODM and mitigates the competition between the OEM and its competitive ODM in the consumer market. Or, to put it simply, a non-hungry ODM has less incentive to bite the hand that feeds it. In summary, as long as an attractive outside option exists for the OEM (i.e., when the non-competitive ODMs' wholesale price is sufficiently low), the OEM and the competitive ODM should choose to be friends rather than foes.

We organize the remainder of this paper as follows. The literature is reviewed in Section 2. Section 3 introduces the model settings. Sections 4 and 5 analyze the pricing sequence preference of the OEM and its competitive ODM in the ODM market and the OEM market, respectively. We discuss the impacts of market environments, wholesale price negotiation, the competitive ODM's limited capacity, and the outcomes with a general demand model in Section 6. Lastly, Section 7 provides the concluding remarks and suggestions for future research. We relegate the technical details and proofs to the appendix.

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