Impact of a direct channel on the choice of absorption versus direct costing using cost-based transfer price

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Abstract

This study analytically investigates the choice of a cost accounting system based on the cost-based transfer price by a divisionalized firm that has a direct channel through electronic commerce (EC). The findings show that the optimal choice between direct and absorption costing affects the increase of overhead allocation for the retail division through the cost-based transfer price. While traditional strategic transfer pricing literature shows that absorption costing is optimal in specific economic environments, this study demonstrates that direct costing is also optimal in a specific economic environment by considering dual channel competition. This research thus contributes to the extant strategic transfer pricing literature, which considers the choice of a cost accounting system in management accounting.

Keywords

Economics; Game theory; Cost-based transfer pricing; Cost accounting; Direct channel

I INTRODUCTION[1]

The significance of transfer prices in operational decisions has increased because large firms, such as multinationals, comprise multiple divisions. For example, General Motors Company and Panasonic use transfer prices to optimize the profits of their divisional operations. Additionally, a multinational enterprise (e.g., Starbucks Corporation) can use transfer pricing to avoid profit taxes. To counter such tax avoidance, the OECD provides a guideline for multinational transfer pricing. Hence, the transfer price is an essential factor to be considered in contemporary management accounting practice.

Management accounting research analyzes optimal internal transfer prices. The economic analysis of transfer pricing under price competition from a managerial viewpoint dates to Hirshleifer (1956), who argues that an internal transfer price equal to the marginal cost alleviates any double marginalization problems. Following Hirshleifer (1956), other studies in management accounting analyze the optimal transfer price using market competition models (e.g., Alles and Datar, 1998; Arya and Mittendorf, 2007; Autrey and Bova, 2012; Fjell and Foros, 2008; Göx, 2000; Hamamura, 2018; Matsui, 2011, 2012, 2013; Narayanan and Smith, 2000; Schjelderup and Sørgard, 1997; Shor and Chen, 2009). Most of these studies examine optimal transfer pricing by comparing marginal costs and discussing cost-based transfer pricing (e.g., Alles and Datar, 1998; Göx, 2000; Matsui, 2011, 2012).

Tang (1992) provides an important empirical contribution to the literature on transfer pricing by examining the relationships between the practical transfer prices and the cost accounting system. Specifically, he examines 143 Fortune 500 firms and finds that 46.2% of them are cost-based. Further, 7.7% use variable costs of production, 53.8% use full production costs, and 38.5% use full production costs plus a markup. Accordingly, Tang (1992) concludes that, in practice, many firms set transfer prices by using absorption costing.

[1] Abbreviations: Electronic commerce (EC), Organization for Economic Co-operation and Development (OECD), First-order condition (F.O.C.).

Given the increased attention paid to transfer prices by both academics and business practitioners, this study investigates the optimal choice of a cost accounting system when the firm adopts cost-based transfer prices. For instance, Göx (2000) shows that the optimal unobservable internal transfer price exceeds the marginal cost because firms use absorption costing to determine the internal transfer price as a commitment device that allows them to commit to softer competition.

Matsui (2012, 2013) demonstrates contrary results to those of Göx (2000) by considering an entry game or risk-averse manager. Specifically, Matsui (2012) considers that a risk-averse production division manager faces uncertainty on the outcomes from R&D investments, which affects fixed costs. When the manager is highly risk-averse, direct cost pricing becomes profitable because absorption costing is risky as it is affected by R&D investment. Additionally, Matsui (2013) considers the entry threat and shows that the incumbent credibly commits to an observable transfer price. The commitment to direct costing enables the incumbent to deter the entry of potential competitors.

This study provides additional findings and implications on the choice of a cost accounting system to strategic transfer pricing research in management accounting based on Tang (1992), who investigates the choice of a cost accounting system that affects internal transfer pricing.

The present study considers a direct channel of EC, which is not considered in prior transfer pricing research, in the choice of a cost accounting system. However, a direct channel by EC is frequently investigated in operations research or marketing, and such studies simultaneously consider the level of transfer price (e.g., Cattani et al., 2006; Chen et al., 2017; Dumrongsiri et al., 2008; Matsui, 2017). A direct channel of EC can be observed in practice. For example, Apple Inc. has channels that consist of online and retail stores. In the online store, consumers can buy, for example, a MacBook by using the internet, and the product is delivered by a delivery company. Additionally, Suntory Beverage & Food Limited, a Japanese company, sells beverages in both retail and online stores. Hence, in practice, there are many examples of the dual channels of a direct channel and a retail division or store. These examples suggest competition exists between the direct channel and retail division.

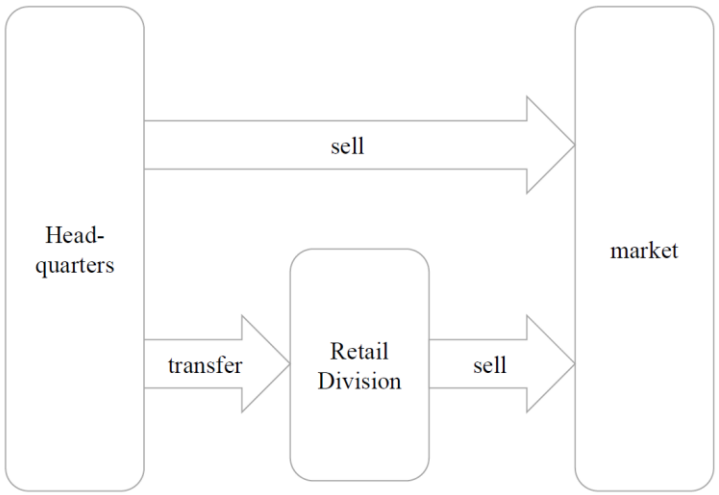
There is an important relationship between transfer pricing and direct channel research because a downstream division is managed using transfer pricing when the firm is divisionalized on the existing direct channel. While transfer pricing and the direct channel have an important relationship, the choice of a cost accounting system when adopting a cost-based transfer price has not yet been considered in the literature. Hence, this study considers the choice of a cost accounting system between absorption and direct costing through a direct channel, namely EC.

The findings show that direct costing is more profitable than absorption costing when there is a high overhead allocation to the retail division, contrary to Göx (2000). When the overhead allocation to the retail division facing absorption costing increases, the profit of the retail division decreases through the increase in the retail division's marginal cost. As a result, firm-wide profit decreases by decreasing the retail division's profit under specific conditions. However, absorption costing has a positive effect on firm-wide profit. When the marginal cost of the retail division increases through increasing the overhead allocation, the sales quantities of both channels decrease and market prices increase. This positive effect is important because it is a counterintuitive outcome that increasing marginal cost is profitable for firm-wide profit. An optimal choice between absorption or direct costing influences the effects of the increasing marginal cost, that is, increasing market prices and decreasing retail divisional profit.

II BASIC MODEL

Assume that the divisionalized firm is composed of headquarters (denoted as H) and a retail division (denoted as R). H produces the final product sold on a product market and transfers the product to R, which sells it on the market. This study assumes that products are produced at marginal cost c (> 0), transferred with transfer price t to R, and sold by H on the same market using EC. The market price decided by R is denoted p_R, and the market price decided by H is p_H. This study also assumes competition exists between the direct channel and the retail division. In practice, consumers can choose the purchasing channel by comparing factors such as price or trip cost. The situation in this study is represented in Figure 1.

Figure 1. Scenario analyzed in this study



Players H and R engage in quantity competition in a product market, following prior strategic transfer pricing literature (e.g., Arya and Mittendorf, 2007; Autrey and Bova, 2012). This paper assumes the following demand function:

$$p_i = a - q_i - \theta q_j, \qquad (i,j) = (R,H),(H,R). \tag{1}$$

The degree of substitution between channels is denoted as $\theta \in (0,1)$. When θ approaches 0, division i operates a monopoly. Here, a $(> c)$ is a positive constant.

This study assumes that the firm sets the cost-based internal transfer price used to transfer product from H to R. When the firm uses the cost-based transfer price, it presumably chooses a cost accounting system under either absorption or direct costing. When the firm adopts direct costing, the cost-based transfer price t is equal to c $(t = c)$. When the firm adopts absorption costing, the cost-based transfer price t is equal to $c + r$ $(t = c + r)$. Here, r (> 0) is the overhead allocation to the retail division of the firm. Hence, under absorption costing, the cost-based transfer price corresponds to the marginal cost-plus the overhead allocation. This assumption is considered in prior studies (Matsui 2013). If I assume endogenous overhead allocation, it is difficult to analyze this model. Additionally, it is not important to identify the overhead allocation. However, the difference in outcomes between $r = 0$ and $r > 0$ is important here. Further, this

study assumes $a > c + r$, which is the incentive of the retail division to sell the product. This study compares the profit between absorption and direct costing.

H manages firm-wide profit and R divisional profit π_R as follows:

$$\Pi = (p_H - c)q_H + (p_R - t)q_R + (t - c)q_R + V - F, \tag{2}$$

$$\pi_R = (p_R - t)q_R. \tag{3}$$

This study assumes $V > 0$ is the profit from other businesses (products) of the firm and $F > r$ is firm-wide overhead; this study assumes $V > F$ to simplify the model. Additionally, for simplicity, this study assumes r does not affect the level of V ($dV/dr = 0$). Section 4 relaxes this assumption and analyzes the impact of altering r on V in an additional analysis. The first term in Eq. (2) is the profit from the direct channel of EC, the second term is the profit of the retail division, and the third term is profit from transferring the product to R. This study also assumes H maximizes Eq. (2) and R maximizes Eq. (3).

Moreover, from Eq. (2), the marginal cost of H is equal to c for the direct channel. Consequently, the manufacturing cost of H is always calculated using direct costing. While R must commit to internal cost-based transfer pricing by choosing the cost accounting system, H is not required to commit to the chosen cost accounting system. Hence, R must determine the strategies corresponding to the cost accounting system chosen by H. However, as previously mentioned, H is not required to commit to the cost accounting system, which affects the internal cost-based transfer price.

In sum, this paper considers the following timeline. First, H produces products at marginal cost c and transfers products to R. Next, H and R choose sales quantities for a product market. Finally, profits are realized. This research does not consider the endogenous choice of the cost accounting system and compares the profits of both cost accounting systems at equilibrium. Additionally, variables cannot change after the decision and can be mutually observed.

III ANALYSIS

This study analyzes the model proposed in the prior section using backward induction. As previously mentioned, this paper considers the equilibrium in two cases - direct and absorption costing.

Direct costing

First, consider that H chooses direct costing, $t = c$. H chooses q_H to maximize Eq. (2), and R chooses q_R to maximize Eq. (3), which leads to the following F.O.C. of each player:

$$a - c - 2\theta q_R - 2q_H = 0, \tag{4}$$

$$a - c - 2q_R - \theta q_H = 0. \tag{5}$$

From Eqs. (4) and (5), this paper obtains the following strategies of each player:

$$q_H^{DC} = \frac{(1-\theta)(a-c)}{2-\theta^2}, \tag{6}$$

$$q_R^{DC} = \frac{(2-\theta)(a-c)}{2(2-\theta^2)}, \tag{7}$$

where the superscript DC denotes direct costing. In this outcome, $q_H^{DC} < q_R^{DC}$ holds because H selects strategies to maximize firm-wide profit, which includes the profit of R. In practice, the EC direct channel quantity is smaller than that of the retail channel. Hence, this outcome is consistent with management accounting practice in the real world.

Additionally, the firm-wide profit is as follows:

$$\Pi^{DC} = \frac{(8 - 8\theta - \theta^2 + 2\theta^3)(a-c)^2}{4(2-\theta^2)^2} + V - F. \tag{8}$$

Because this outcome corresponds to a well-known result regarding the dual channel of a direct channel and a retailer, it is not a unique outcome of this paper. Thus, this study compares this outcome with the outcome of the next subsection.

Absorption costing

Next, consider that H chooses absorption costing $t = c + r$. The difference between the best response function of this subsection and that of the prior section is the overhead allocation, r. Hence, the following best response function of R is as follows:

$$a - (c + r) - 2q_R - \theta q_H = 0. \tag{9}$$

While the best response function of R is as described above, the best response function of H is similar to Eq. (4). This is because this paper adopts the cost-based transfer price, which is affected by the cost accounting system, while the transfer price through the cost accounting system does not apply in calculating H's performance. While it seems that the third term of Eq. (2) may affect the performance of H, q_H, which is decided by H, does not affect H's performance. Hence, upon identifying the F.O.C. of H, there is no difference between the best response function of H in the prior subsection and that in this subsection. Therefore, the best response function of H corresponds to Eq. (4). From the best response functions, I identify the optimal strategies as follows:

$$q_H^{AC} = \frac{(1-\theta)(a-c) + r\theta}{2-\theta^2}, \tag{10}$$

$$q_R^{AC} = \frac{(2-\theta)(a-c) - 2r}{2(2-\theta^2)}, \tag{11}$$

where superscript AC denotes absorption costing.

In addition, the firm-wide profit is as follows:

$$\Pi^{AC} = \frac{(8 - 8\theta - \theta^2 + 2\theta^3)(a-c)^2 + 4r(1-\theta)(\theta(a-c) - (1+\theta)r)}{4(2-\theta^2)^2} + V - F. \tag{12}$$

Following proposition summarizes the outcome of absorption costing:

Proposition 1. When the firm adopts a direct channel by EC, optimal strategies and firm wide-profit are as follows:

$$q_H^{AC} = \frac{(1-\theta)(a-c)+r\theta}{2-\theta^2},$$

$$q_R^{AC} = \frac{(2-\theta)(a-c)-2r}{2(2-\theta^2)},$$

$$\Pi^{AC} = \frac{(8-8\theta\ -\theta^2+2\theta^3)(a-c)^2+4r(1-\theta)(\theta(a-c)-(1+\theta)r)}{4(2-\theta^2)^2}+V-F.$$

The next proposition considers the property of firm-wide profit at equilibrium:

Proposition 2. When overhead allocation r satisfies the following condition:

$$r < \frac{\theta(a-c)}{2(1+\theta)},$$

firm-wide profit Π^{AC} increases by increasing r.

Proof. Consider the first derivative of firm-wide profit with respect to r to obtain following result:

$$\frac{\partial \Pi^{AC}}{\partial \mathrm{r}} = \frac{4(1-\theta)\big(\theta(a-c)-2r(1+\theta)\big)}{4(2-\theta^2)^2}. \tag{13}$$

Equation (13) is positive when

$$r < \frac{\theta(a-c)}{2(1+\theta)}, \tag{14}$$

holds. In this case, the firm-wide profit increases by increasing the overhead allocation r. (Q.E.D.)

From Proposition 2, when r is small, the firm-wide profit increases by increasing r. When H chooses absorption costing, the cost-based transfer price increases the marginal cost of R as the firm

engages in softer competition in a product market compared to direct costing. This increases firm-wide profit. However, the cost of R increases and R's profit decreases by increasing r under absorption costing. As a result, Proposition 2 is obtained when the impact of engaging in softer competition exceeds the impact of decreasing R's profit. This result is counterintuitive.

When the direct channel is EC, the increase in the retail division's costs is not necessarily affected. The practical implication is that it is necessary to successfully control market prices through sales quantities. Hence, companies will need to concentrate on subsequent decisions without being hampered by the increasing costs.

Absorption versus direct costing

Next, this study compares the strategies and firm-wide profit between absorption and direct costing, rewriting Eqs. (10), (11), and (12) as follows:

$$q_H^{AC} = \frac{(1-\theta)(a-c)}{2-\theta^2} + \frac{r\theta}{2-\theta^2}, \tag{15}$$

$$q_R^{AC} = \frac{(2-\theta)(a-c)}{2(2-\theta^2)} - \frac{r}{2-\theta^2}, \tag{16}$$

$$\Pi^{AC} = \frac{(8-8\theta-\theta^2+2\theta^3)(a-c)^2}{4(2-\theta^2)^2} + V - F + \frac{r(1-\theta)(\theta(a-c)-(1+\theta)r)}{(2-\theta^2)^2}. \tag{17}$$

The results can be represented as follows:

$$q_H^{AC} = q_H^{DC} + \frac{r\theta}{2-\theta^2}, \tag{18}$$

$$q_R^{AC} = q_R^{DC} - \frac{r}{2-\theta^2}, \tag{19}$$

$$\Pi^{AC} = \Pi^{DC} + V - F + \frac{r(1-\theta)(\theta(a-c)-(1+\theta)r)}{(2-\theta^2)^2}. \tag{20}$$

From Eq. (18), $q_H^{AC} > q_H^{DC}$ is obvious, as is $q_R^{AC} < q_R^{DC}$ from Eq. (19). When H adopts absorption costing, the cost-based transfer price is higher than when direct costing is adopted. In this model, because

H and R face quantity competition on a product market, H can supply a larger quantity by decreasing R's quantity and can prevent a collapse from an excess supply.

Next, this study considers firm-wide profit. From Eq. (20), firm-wide profit with absorption costing is equal to firm-wide profit with direct costing plus $r(1-\theta)(\theta(a-c)-(1+\theta)r)/(2-\theta^2)^2$. The relationship between firm-wide profit and absorption and direct costing is thus affected by the sign of $r(1-\theta)(\theta(a-c)-(1+\theta)r)/(2-\theta^2)^2$. When this term is positive, firm-wide profit exceeds the profit with direct costing and does not exceed the profit with direct costing when this term is negative. The following proposition summarizes this outcome:

Proposition 3. Firm-wide profit with direct costing exceeds profit with absorption costing when $r > \theta\,(a-c)/(1+\theta)$ holds.

Proof. Proposition 3 is obtained by considering the condition of $r(1-\theta)(\theta(a-c)-(1+\theta)r)/(2-\theta^2)^2 < 0$. (Q.E.D.)

Proposition 3 shows that the optimal choice of a cost accounting system is affected by the economic environment. When overhead allocation r is small, firm-wide profit is increased with absorption costing. This is because absorption costing has a positive effect on firm-wide profit, as shown in Proposition 2, and a negative effect on the profit of R through the cost-based transfer price. The trade-off between both effects depends on the optimality of the cost accounting system. When r is large, the negative effect exceeds the positive effect of absorption costing, and direct costing is the optimal choice of H in this case.

This study defines $\tilde{r} \equiv \theta(a-c)/(1+\theta)$ to consider the threshold of overhead allocation r in Proposition 3. It is intuitive that threshold $\tilde{r}$ is increasing in a and decreasing in c because increasing the intercept of the demand function positively affects profit and increasing the marginal production cost

negatively affects profit. Additionally, differentiating the threshold with respect to θ yields the impact of increasing θ:

$$\frac{\partial \tilde{r}}{\partial \theta} = \frac{a-c}{(1+\theta)^2} > 0. \tag{21}$$

Therefore, increasing the degree of product differentiation θ decreases threshold $\tilde{r}$. When $\tilde{r}$ increases, the condition where firm-wide profit with direct costing is larger than with absorption costing becomes less important. Hence, the benefit of the price increasing with adopting absorption costing increases. Consequently, the following proposition is obtained:

Proposition 4. The threshold $\tilde{r}$ increases when

$$\frac{\partial \tilde{r}}{\partial \theta} = \frac{a-c}{(1+\theta)^2} > 0,$$

holds.

Proposition 4 shows that r increases due to more intense competition in specific economic environments. When competition becomes intense, tacit collusion using absorption costing is effective because H and R obtain lower profits under intense quantity competition with cannibalism. In this situation, when H adopts absorption costing and increases the marginal cost of R, $H$and R need not engage in intense competition by overproduction because they can face softer competition as the marginal cost of R increases. Hence, is difficult to consider direct costing as an advantage by increasing the degree of product differentiation, θ.

The outcome shows that the degree of overhead allocation r has a significant impact on the choice of a cost accounting system. Prior research, such as Göx (2000) and Matsui (2013), does not analyze the direct channel and choice of cost-based transfer price.

Numerical example

Here, we consider a numerical example of the main model analysis to demonstrate the effect of increasing the overhead allocation r. We consider the situation when $(a, c, \theta, F, V) = (1, 0.5, 0.5, 10, 15)$ holds. The combination of exogenous variables in this example satisfies $a > c + r$, $0 < \theta < 1$, and $F < V$. We represent the outcome of optimal strategies and firm-wide profit by increasing overhead allocation r in Table 1.

Table 1. Optimal strategies by increasing r, when $(a, c, \theta, F, V) = (1, 0.5, 0.5, 10, 15)$

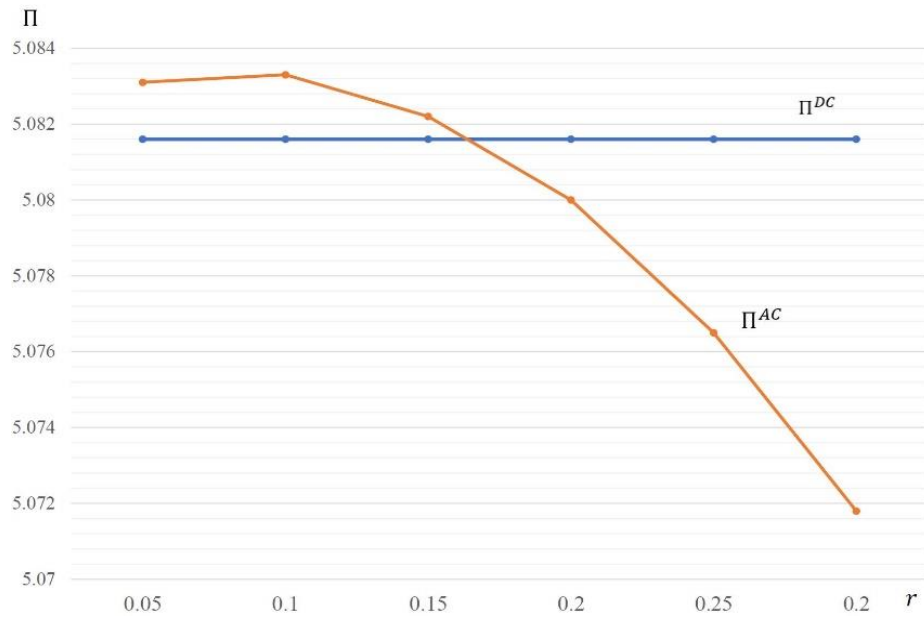
Cost accounting	r	Π^{DC}	Π^{AC}	q_H^{DC}	q_R^{DC}	q_H^{AC}	q_R^{AC}
Absorption costing	0.05	5.0816	5.0831	0.1429	0.2143	0.1571	0.1857
	0.1		5.0833			0.1714	0.1571
	0.15		5.8022			0.1857	0.1286
Direct costing	0.2		5.08			0.2	0.1
	0.25		5.0765			0.2143	0.0714
	0.3		5.0718			0.2286	0.0429

We round to the fifth decimal place or less.

When r increases by 0.05 from 0.05, Π^{AC} changes by increasing r, while Π^{DC} does not change. This is because Eq. (8) is not affected by r, while Eq. (12) is affected by r. Now, considering the change in Π^{AC}, when r changes to 0.1 from 0.05 (r is sufficiently small), Π^{AC} increases by increasing r. This fact is consistent with the outcome of Proposition 2. After that, Π^{AC} decreases by increasing r. Finally, when $\Pi^{AC} < \Pi^{DC}$ holds, direct costing is superior to absorption costing. This is shown in Figure 2.

In addition, while q_H^{DC} is always smaller than q_R^{DC}, q_H^{AC} is smaller than q_R^{AC} only when $r = 0.05$. When $r > 0.05$, $q_H^{AC} > q_R^{AC}$ always holds. When the firm chooses direct costing, the H that maximizes firm-wide profit chooses a low quantity to engage softer competition in a product market. When the firm chooses absorption costing, H tries to improve firm-wide profit by increasing the quantity sold on the direct channel of EC because the retail division's profit decreases by increasing overhead allocation r. As a result, the quantity sold by H exceeds that of R.

Figure 2. Relationship between Π^{DC} and Π^{AC} by increasing r



IV Additional analysis

Relaxing the assumption of V

Here, this study expands the basic model using the assumption of V. While this paper assumes that V does not change by altering r in the basic model, this subsection considers how altering r impacts profit from another product, V. When the overhead allocation for R increases, overhead allocations for other divisions decrease. Hence, other divisions' marginal costs will decrease, and their total profit will increase. Therefore, this paper assumes $dV/dr > 0$.

It is important that the profits from producing V differ between absorption and direct costing. This is because overhead allocation for R increases with absorption costing, compared with direct costing. Profit from other production with absorption costing is denoted as V_{AC} and with direct costing as V_{DC}. From the assumption of $dV/dr > 0$, it is obvious that $V_{AC} > V_{DC}$ $(> F)$.

From this assumption, this study rewrites Eqs. (12) and (8) as follows:

$$\Pi^{AC} = \frac{(8 - 8\theta - \theta^2 + 2\theta^3)(a - c)^2}{4(2 - \theta^2)^2} + \frac{r(1 - \theta)(\theta(a - c) - (1 + \theta)r)}{(2 - \theta^2)^2} + V_{AC} - F, \tag{22}$$

$$\Pi^{DC} = \frac{(8 - 8\theta - \theta^2 + 2\theta^3)(a - c)^2}{4(2 - \theta^2)^2} + V_{DC} - F. \tag{23}$$

In addition, rewrite Eq. (22) as:

$$\Pi^{AC} = \Pi^{DC} + \frac{r(1 - \theta)(\theta(a - c) - (1 + \theta)r)}{(2 - \theta^2)^2} + V_{AC} - V_{DC}. \tag{24}$$

The difference between Eqs. (20) and (24) is the additional term $V_{AC} - V_{DC}$ in Eq. (24). Hence, the threshold, where the profit Π^{AC} with absorption costing exceeds the profit with direct costing, is different between the basic model and the additional analysis.

Consider the threshold where the profit with direct costing exceeds the profit with absorption costing, as follows:

$$\frac{r(1 - \theta)(\theta(a - c) - (1 + \theta)r)}{(2 - \theta^2)^2} + V_{AC} - V_{DC} > 0. \tag{25}$$

Note that the profit with direct costing exceeds the profit with absorption costing in Eq. (25) as follows:

$$r > \frac{\theta(a - c) - \sqrt{\theta^2(a - c)^2 + \frac{4(1 + \theta)(2 - \theta^2)^2(V_{AC} - V_{DC})}{1 - \theta}}}{2(1 + \theta)}, \tag{26}$$

$$r < \frac{\theta(a - c) + \sqrt{\theta^2(a - c)^2 + \frac{4(1 + \theta)(2 - \theta^2)^2(V_{AC} - V_{DC})}{1 - \theta}}}{2(1 + \theta)}. \tag{27}$$

However, Eq. (26) is not binding because $r > 0$. Hence, Eq. (27) is the threshold that represents that the profit with absorption costing is greater than the profit with direct costing. Additionally, in Eq. (27), I consider $V_{AC} = V_{DC} = V$, and this threshold is equal to $\theta(a - c)/(1 + \theta)$, which corresponds to $\tilde{r}$. This result is summarized in the following proposition:

Proposition 5. Assuming increasing r affects V, the firm-wide profit with direct costing exceeds the profit with absorption costing when

$$r < \frac{\theta(a-c) + \sqrt{\theta^2(a-c)^2 + \frac{4(1+\theta)(2-\theta^2)^2(V_{AC}-V_{DC})}{1-\theta}}}{2(1+\theta)}$$

holds.

This proposition shows that direct costing is efficient in a specific economic environment. This study defines this threshold as follows:

$$\hat{r} \equiv \frac{\theta(a-c) + \sqrt{\theta^2(a-c)^2 + \frac{4(1+\theta)(2-\theta^2)^2(V_{AC}-V_{DC})}{1-\theta}}}{2(1+\theta)}, \tag{28}$$

and compares $\tilde{r}$ with $\hat{r}$. As a result, $\tilde{r} < \hat{r}$ from the assumption of $V_{AC} > V_{DC}$. This is because absorption costing has the advantage from the additional term $V_{AC} > V_{DC}$. While this result is intuitive, this paper summarizes it in the following corollary.

Corollary 1. When increasing r affects V and the firm uses cost-based transfer prices, the threshold that represents that firm-wide profit with direct costing that is greater than the profit with absorption costing, $\hat{r}$, is larger than $\tilde{r}$.

In sum, the model's result of the effectiveness of direct costing being greater than that of absorption costing is robust.

V CONCLUSIONS

This study shows that direct costing is optimal in specific economic environments with cost based-transfer prices, a result different from that of Göx (2000). The optimality of the choice of a cost accounting system based on a cost-based transfer price with a direct channel is affected by the level of the overhead allocation for the retail division in the proposed model. This paper shows that this result emerges in a specific economic environment when the assumption of the basic model is relaxed.

In the strategic transfer pricing literature, which considers the choice of a cost accounting system, a direct channel of EC is not assumed. Hence, this paper has significant implications for management accounting practice, as when firms decide on a cost accounting system that affects the cost-based transfer price, they must consider the channel.

This study has the following limitations. First, it considers an exogenously given overhead allocation, while many firms endogenously choose overhead allocation between divisions in practice. Additionally, when a firm uses absorption costing, the marginal cost of production declines by increasing product quantities. However, this is difficult to solve explicitly, and Matsui (2013) considers the same setting as this study. Hence, the assumption of this paper, which is relative to overhead allocation, is observed in prior strategic transfer pricing literature. Additionally, this paper does not discuss whether the direct channel is optimal. In other words, it analyzes the optimality of the cost accounting system when a direct channel is given by headquarters. Therefore, this study does not address the choice of channel. In addition, this paper assumes that the firm faces a monopoly market; however, in the real world, many firms face competition with other firms. Hence, we can consider competition with other firms as a future expansion of this model. While this paper has limitations, it contributes significantly to the strategic transfer pricing literature, which considers the optimal choice of the cost accounting system in terms of the cost-based transfer price.

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