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Auditing internal transfer prices in multinationals under monopolistic competition

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Abstract

This paper derives an appropriate standard price that can be used by the tax authorities of a country for auditing transfer prices in multinational firms (MNFs) for the purpose of social welfare maximization of the country. We assume that the corporate tax rate in the host country, where MNFs undertake foreign direct investment to locate their manufacturing divisions, is lower than that in the home country. Our conclusion is that the tax authorities of the home country should not always force MNFs to hold down the transfer price through a too strict audit standard if it aims to maximize social welfare of the country in the long-run equilibrium. This result implies that tax authorities face a trade-off between consumer welfare and tax revenue when determining the standard price used for auditing. One notable implication is that the tax authorities should raise the upper-limit price allowed for internal transfers as the elasticity of substitution between brands for consumers decreases.

Keywords Transfer pricing, International taxation, Multinationals, Monopolistic competition, Social welfare

JEL Classification F23, H26

1 Introduction

Tax authorities in free-economy countries usually encounter difficulties when auditing internal transfer prices in large divisionalized firms. Particularly, the auditing on multinational firms (MNFs) operating across differing tax and tariff schedules is difficult, because they have a strong incentive for tax evasion, attempting to retain as much profit as possible in a division located in a low tax jurisdiction by altering transfer prices (e.g., Copithorne 1971; Horst 1971).¹ To cope with the problem, OECD countries audit multinational transfer prices to determine whether each transfer price meets the arm's-length standard: the transfer price equals the price that two arm's-length or independent firms, firms not controlled by the same MNF, would trade. Specifically, the tax authorities in each country compare data from the audited firm with those from comparable transactions between independent buying and selling firms. However, §482 of the Internal Revenue Code (1994) in the United States, for example, offers no practical guidance for dealing with industries in which no comparable uncontrolled transactions exist, although it repeatedly mandates the need to "locate two unrelated parties that are each comparable to one of the controlled taxpayers". Moreover, OECD guidelines state that "evidence from enterprises engaged in controlled transactions with associated enterprises may be useful" but do not provide any specific guidance on how best to use such information (OECD 2001).

Given this practical problem, this paper proposes an alternative method to calculate an appropriate "standard" price for auditing transfer prices within MNFs to maximize the social

¹ Gresik (2001) gives a comprehensive perspective on practical multinational transfer-pricing behavior. A series of survey studies by Tang (1979, 1992, 1993, 2002) provides empirical evidence regarding transfer pricing based on surveys of Fortune 500 firms. In particular, Tang quantifies the importance of the environmental factors affecting the transfer price. For instance, in 1977, "overall profit to the company" ranks first, whereas "differentials in income tax rates and income tax legislation among countries" ranks fourth (Tang 1979). However, by the 1990 survey, the latter factor is ranked second (Tang 1993). Tang (2002) involves similar surveys conducted in 1997 and 1998, where "transfer pricing and other tax regulations in the United States" ranks first, and "overall profit to the company" ranks second. Notably, "overall profit to the company", which is ranked first in the 1979 and 1990 surveys, falls to second rank in the 1997 and 1998 surveys, and is replaced by "transfer pricing and other tax regulations in the United States". This evidence suggests that MNFs are tending to pay increasingly more attention to the risk of additional tax imposition by national tax authorities.

welfare of the country, even when the authority cannot observe the arm's-length price of a good. Specifically, our model considers the following typical situation where transfer pricing problem occurs in an MNF. There are MNFs, which are composed of two divisions located in two separate countries: (1) an upstream manufacturing division that locates in the host country and produces a good; and (2) a downstream selling division that locates in the home country and sells the good to final consumers. The MNFs are engaged in monopolistic competition. Additionally, we assume that there is a tax differential between the two countries; the tax rate in the host country is lower than that in the home country. Given the difference in tax rate, we expect that each MNF desires to leave as much profit as possible in the host country to evade the higher tax rate in the home country by raising the internal transfer price to an upper limit allowed by the tax authorities.

A major contribution from our analysis is that we derive an optimal standard price that the tax authorities of the home country can use to audit internal transfer prices in an MNF for the purpose of social welfare maximization. Specifically, if the home country government aims to maximize the social welfare of the country, the tax authorities should not always force MNFs to hold down the transfer price equal to, say, the average production cost through a strict audit standard. Even though auditing based on a strict standard increases tax revenue for the home country and prevents rents from outflowing to the host country, it simultaneously deteriorates consumer welfare because the final price for each variety of the good rises and the supply quantity decreases in the long-run equilibrium under monopolistic competition. If the latter effect dominates the former, a strict transfer pricing standard worsens social welfare. In summary, tax authorities face a trade-off between consumer welfare and tax revenue by controlling the audit standard.

One notable implication is that the tax authorities should relax the price standard, i.e., raise the threshold price for auditing transfers, as the elasticity of substitution between brands for consumers decreases. Consumers' relatively low elasticity of interbrand substitution means that each brand of the good is established and captures a certain share of demand irrespective of its price. If the degree of substitution between varieties of the good is low, typical monopolistic competition models demonstrate that firms may enjoy high profits in the

short run without entry of other entities. However, entry of other firms into the market in the long run induces all firms to earn no excess profit, and all rents are passed on to consumers as their welfare. Therefore, we reach the conclusion that tax authorities should relax standards for auditing; namely, raise the standard price to help firms to supply large quantities at a low price to increase consumer welfare rather than tax revenue when the degree of substitution across brands is relatively low.

To formulate our model, we introduce the monopolistic competition framework in Dixit and Stiglitz (1977). Although the monopolistic competition model is frequently used to analyze trade in the international economic literature (e.g., Ottaviano et al. 2002), no previous study has introduced the model to investigate the transfer pricing problem, where the tax authorities cannot calculate a precise arm's-length price to audit transfers within vertically integrated firms.² Our primary reason for considering monopolistic competition rather than oligopoly is that our focus lies not on strategic interactions between the MNFs, but rather on the response of social welfare to the standard price used for auditing under a fixed number of firms.³ As shown later, the demand curve for each variety of the good under monopolistic competition does not shift according to variation in the standard price for auditing, contrary to the Cournot and Bertrand-type competition models. Furthermore, the number of firms after considering free entry of other firms is not affected by the standard price used for auditing. These properties enable us to concentrate exclusively on social welfare, which is the major

² Among studies on international taxation, Dröge and Schröder (2009) introduce Dixit–Stiglitz-type monopolistic competition to compare economic impacts between ad valorem tax and unit tax. They demonstrate that unit taxes lead to more firms in the industry, less output per firm, and less tax revenue, but higher welfare compared with ad valorem taxes. As can be seen, our model framework for welfare analysis is somewhat analogous with theirs.

³ Contrary to monopolistic competition, the Cournot and Bertrand models involve strategic effects between firms. In this research area, many studies have been published on the strategic benefits of decentralization-induced transfer pricing (e.g., Alles and Datar 1998; Arya and Mittendorf 2007; Baldenius and Reichelstein 2006; Baldenius et al. 2004; Göx 2000; Hirshleifer 1956; Hughes and Kao 1998; Matsui 2011; Narayanan and Smith 2000; Schjelderup and Sørsgard 1997; Zhao 2000). With the presence of strategic interactions, the number of firms in the long-run equilibrium will depend on the standard price for auditing, and the demand curve of each variety shifts according to the number of firms. Therefore, it would be more complicated to analyze the influence of the standard price on social welfare under oligopoly than under monopolistic competition.

merit of incorporating monopolistic competition into a transfer pricing model.

The study of transfer pricing behavior in the international taxation literature dates back at least to Copithorne (1971) and Horst (1971). Since then, the influence of tax-induced transfer pricing has been considered on the effect of transfer pricing on a government's choice of tax base (Haufler and Schjelderup 2000) and double tax rule (Weichenrieder 1996), on the interaction between trade policies and corporate tax policies (e.g., Bond 1980; Levinsohn and Slemrod 1993; Schjelderup and Weichenrieder 1999), and on the efficacy of transfer price regulation when firms have private cost information (Bond and Gresik 1996; Calzolari 2004; Elitzur and Mintz 1996; Gresik 2010; Gresik and Nelson 1994; Prusa 1990). Gresik (1999) shows that a policy that seeks to attain arm's-length transfer prices is consistent with broader welfare objectives when the multinational's home country adopts a commensurate-with-income standard. Gresik and Osmundsen (2008) point out the possibility that standard arm's-length methods cannot perform well in vertically integrated industries because the comparability rules may encourage the integrated firms to collude tacitly on transfer prices.⁴

Although a fair transfer that meets the arm's-length standard in an MNF is important, tax authorities should not overlook yet another critical goal: the improvement of social welfare in the country. In this respect, Gresik and Nelson (1994) and Gresik and Osmundsen (2008) are the two representative studies from the above literature particularly related to the current analysis. The former study shows that the use of a standard that deviates from arm's-length pricing by the authorities can be socially optimal, while the latter shows that standard audit methods may not perform well in vertically integrated industries. However, studies drawing on a monopolistically competitive setting to address the tax-induced transfer pricing problem are absent from the literature. By employing this setting, the present study proposes an alternative method to calculate a relevant price for auditing that maximizes social welfare, providing additional insights into international taxation. Put plainly, the model in this study is an extension of the findings in Gresik and Nelson (1994) and Gresik and Osmundsen (2008)

⁴ A research strand that compares two major current tax accounting regimes, i.e., separate accounting and formula apportionment, also appears in the literature (e.g., Gresik 2010; Riedel 2010; Riedel and Runkel 2007).

to the case of monopolistic competition.

The remainder of the paper is structured as follows. Section 2 outlines the assumptions and settings of our model. In Section 3, we construct a monopolistic competition model and derive a desirable standard price for auditing internal transfers based on the optimization behavior of firms and consumers. Section 4 discusses the results further and explores some possible extensions of our basic model. The final section includes concluding remarks.

2 Assumptions and settings

We initially assume that MNFs are composed of two divisions: (1) an upstream manufacturing division that locates in the host country and produces a good; and (2) a downstream selling division that locates in the home country and sells the good to final consumers. There is a tax differential between the two countries; the tax rate in the host country, t_U , is lower than in the home country, t_D . The host country which we assume can provide firms engaging in this business with the lowest production costs (including corporate tax payments) due to a relatively low production factor price such as the wage rate among the countries, which are candidates to undertake foreign direct investment (FDI). Hence, all MNFs operating in this industry have the same production structure and so locate the manufacturing division in the host country. These divisions then face the same tax rate.⁵ The MNFs produce and sell a same product, but the good is differentiated across the MNFs. Each MNF produces and sells only one variety of the good. The MNFs are assumed to be continuously distributed along the interval of product variety space $[0, n]$, indicating that they are engaged in monopolistic competition. Note that there are no transactions of the good between independent firms, meaning that a comparable arm's-length price does not exist. Therefore, the tax authorities face the difficulty of calculating a standard price for auditing

⁵ If we incorporated differences in production process or technology into our model, the model would become far more complicated because the Dixit–Stiglitz-type monopolistic competition framework is by nature constructed on the assumption of a symmetric production technology among firms.

internal transfers.

As an empirical example of this model, we may typically presume primary products, such as coffee beans, produced in developing countries and subsequently sold in developed countries. Coffee is also relatively differentiated and includes a wide variety of brands such as Blue Mountain, Kilimanjaro, Mocha, Kona, etc., which have been well acknowledged by consumers and hold substantial customer loyalty. Hence, each firm is expected to have a degree of ability to control price in this product category.

Because no strategic interactions between firms arise in the monopolistic competition framework, we may conjecture that the optimal transfer price for an MNF is the upper limit; i.e., the final retail price that enables the firm to leave all profits in the upstream manufacturing division if the tax authorities do not audit the MNF. To prevent such surplus shifting to the host country, the tax authorities of the home country audit the transfer price, r_i , and determine whether the price is below the "standard" price, $\bar{r}_i$, that the authorities sets. We assume that the authority perfectly detects the internal transfer price.⁶ If the audited MNF has transferred the product from the upstream division to the downstream division at a price above the standard price, the tax authorities forcibly modify the transfer price to another price below the standard price. As will be shown later, the MNF sets the transfer price, r_i , equal to the upper limit, $\bar{r}_i$, set by the tax authorities in equilibrium. Moreover, because no strategic interactions between MNFs take place under monopolistic competition, no implicit collusion among them arises, indicating that the equilibrium is stable. Consequently, our model effectively assumes that the tax authorities can directly control the chosen transfer price, at no cost. In addition, we assume that the tax authorities impose a commensurate-with-income provision on MNFs. Throughout this paper, the commensurate-with-income standard signifies that neither upstream nor downstream divisional taxable profits are negative, following Gresik (1999). That is, MNF i must set the transfer price between the marginal

⁶ In our model, the marginal cost, retail price, and quantity are all observable to the tax authorities. Given that the equilibrium values are the outcomes of the optimal behaviors of MNFs, the authority can then correctly estimate the actual internal transfer price set by each MNF. Therefore, perfect detection of the actual transfer price is a rational assumption.

production cost and the retail price to retain nonnegative profits in either of its divisions.

The timeline of events is described as follows. Initially, the tax authorities of the home country select the standard price, $\bar{r}_i$, for auditing internal transfers in MNF i , to maximize the social welfare of the home country at Date 1, taking the corporate tax rates in the home country, t_D , and in the host country, t_U , as given. Subsequently, an entrepreneur decides whether to enter the business by incurring sunk costs, F , to undertake FDI and set up an MNF at Date 2. If she/he may earn nonnegative after-tax profits, she/he enters the market. At Date 3, MNF i chooses the transfer price, r_i , and sells variety i of the differentiated good at the retail price, p_i , given the standard price and the tax rates. If MNF i has transferred the good at a price above $\bar{r}_i$, the authorities force the MNF to modify the transfer price to another price between the marginal cost, c , and $\bar{r}_i$, as a result of the audit and the commensurate-with-income standard. Finally, the long-run equilibrium social welfare and tax revenues are realized at Date 4. Given these assumptions, we identify the relevant subgame perfect equilibrium by solving backwards the above economic model in the next section.

3 Analysis of monopolistic competition

3.1 Consumer and multinational behavior

Following Dixit and Stiglitz (1977), we assume that firms are continuously distributed in the interval $[0, n]$ with measure zero, implying that the number of firms is infinite. Moreover, assume that the following inequality is met:

$$t_D / t_U \leq \sigma \leq t_D (1 - t_U) / (t_U (1 - t_D)), \quad (1)$$

where σ is the constant elasticity of substitution between varieties for consumers, which is greater than one. As shown later, Inequality (1) ensures that the equilibrium transfer price is greater than or equal to the marginal production cost and less than or equal to the retail price. Put differently, the equilibrium transfer price is consistent with the commensurate-with-income provision imposed on MNFs by the tax authorities.

The utility maximization problem for a representative consumer is given by:

$$\begin{aligned} \max \quad & u = \left(\int_0^n x_i^{(\sigma-1)/\sigma} di \right)^{\sigma/(\sigma-1)} \\ \text{s.t.} \quad & \int_0^n p_i x_i di = m, \end{aligned} \quad (2)$$

where u denotes utility that takes the CES form, p_i is the retail price, x_i is quantity, m is consumer income, and subscript i indexes the variety. Because infinite varieties of the good are continuously distributed in the interval $[0, n]$, demand for each variety resulting from the optimization of the utility is drawn as:

$$\ln x_i = \ln m - \sigma \ln p_i + (\sigma - 1) \ln P, \quad (3)$$

where:

$$P \equiv \left(\int_0^n p_i^{-(\sigma-1)} di \right)^{\frac{1}{1-\sigma}}. \quad (4)$$

Because the number of varieties is infinite, each firm's pricing behavior has no influence on the price index, P ; i.e.:

$$\frac{\partial \ln P}{\partial \ln p_i} = 0. \quad (5)$$

By using Equations (3) and (5), we obtain the own elasticity of variety i on its demand, η_{ii} , and the cross elasticity, η_{ij} , as:

$$\eta_{ii} \equiv -\frac{\partial \ln x_i}{\partial \ln p_i} = \sigma, \quad (6)$$

$$\eta_{ij} \equiv -\frac{\partial \ln x_i}{\partial \ln p_j} = 0. \quad (7)$$

In the symmetric equilibrium, $p_i = p$ and $x_i = x$ hold, where p and x are the respective price and quantity for each variety in the equilibrium. Substituting $p_i = p$ into Equation (4) yields $P = n^{1/(1-\sigma)} p$. Therefore, the following equation holds in the symmetric equilibrium:

$$x = m/(n p). \quad (8)$$

Given the consumer behavior, we next solve the optimization problem for an MNF. Suppose that each MNF employs an identical production technology, and the upstream division of an MNF incurs marginal cost, c . Moreover, an MNF must pay sunk costs, F , to set up a multinational when entering the industry.⁷ MNF i 's profit is then:

$$\pi_i = (1 - t_D)(p_i - r_i)x_i + (1 - t_U)(r_i - c)x_i - F, \quad (9)$$

where the first and second terms are the after-tax profit for the downstream and upstream divisions, respectively. Equation (9) indicates that profits are taxed where generated, that is, the source principle of international corporate taxation is presumed. Let $\bar{r}_i$ denote the standard price used for auditing transfers within MNF i . Because the tax authorities will force an MNF to modify r_i as equal or less than $\bar{r}_i$ if r_i exceeds $\bar{r}_i$, $r_i \leq \bar{r}_i$ is a constraint for the MNF when it selects the transfer price, r_i . Hence, the optimization problem for MNF i at Date 3 is:

⁷ Following the international taxation model in Auriol and Warlters (2005), we assume that the sunk costs for entry, F , are not tax deductible. Taking thin capitalization rules as an example, Amerighi and Peralta (2010) also point out that startup costs for a firm tend to become non-tax deductible under current corporate tax systems, incorporating this tendency into their taxation model.

$$\begin{aligned} & \underset{\{p_i, r_i\}}{\text{Max}} \pi_i \\ & \text{s.t. } r_i \leq \bar{r}_i \end{aligned} \quad (10)$$

Derivatives of π_i with respect to r_i are calculated as $\partial \pi_i / \partial r_i = (t_D - t_U)x_i > 0$, $\partial^2 \pi_i / \partial r_i^2 = 0$, indicating that the MNF automatically sets the transfer price, r_i , equal to the upper limit, $\bar{r}_i$, which is set by the tax authorities. Next, we maximize π_i with respect to the retail price, p_i . The first-order condition is:

$$\frac{\partial \pi_i}{\partial p_i} = (1 - t_D)x_i + (p_i(1 - t_D) + (t_D - t_U)\bar{r}_i - c(1 - t_U)) \frac{\partial x_i}{\partial p_i} = 0. \quad (11)$$

Equation (11) is then rearranged as:

$$p_i + \left(p_i + \frac{(t_D - t_U)\bar{r}_i - c(1 - t_U)}{1 - t_D} \right) \frac{p_i}{x_i} \frac{\partial x_i}{\partial p_i} = 0. \quad (12)$$

Because Equation (6) suggests that the own-price elasticity of demand is equal to the elasticity of substitution, i.e., $\eta_{ii} = - (p_i/x_i) (\partial x_i / \partial p_i) = \sigma$, Equation (12) is rewritten as:

$$p_i = \frac{((1 - t_U)c - (t_D - t_U)\bar{r}_i)\sigma}{(1 - t_D)(\sigma - 1)}. \quad (13)$$

In the long-run equilibrium, each firm earns zero profit because of free entry.

$$\pi_i = (1 - t_D)(p_i - \bar{r}_i)x_i + (1 - t_U)(\bar{r}_i - c)x_i - F = 0 \quad (14)$$

Substituting Equation (13) into (14) gives the long-run equilibrium quantity as:

$$x_i = \frac{(\sigma - 1)F}{(1 - t_U)c - (t_D - t_U)\bar{r}_i}. \quad (15)$$

Substituting Equations (13) and (15) into (8) yields the number of firms (or varieties) in the long-run equilibrium as:

$$n = \frac{(1 - t_D)m}{\sigma F}. \quad (16)$$

The above results are summarized as the following proposition.

Proposition 1 *Given the standard price for auditing, $\bar{r}_p$, set by the tax authorities, the quantity, price and the number of firms that result from the optimization behavior of consumers and MNFs in the long run are summarized as follows:⁸*

$$x_i = \frac{(\sigma - 1)F}{(1 - t_U)c - (t_D - t_U)\bar{r}_i}, p_i = \frac{((1 - t_U)c - (t_D - t_U)\bar{r}_i)\sigma}{(1 - t_D)(\sigma - 1)}, n = \frac{(1 - t_D)m}{\sigma F}. \quad (P1)$$

The following corollary summarizes several properties of the number of firms, n , derived from Proposition 1 (all proofs are provided in the Appendix).

Corollary 1 *The number of firms (or varieties) in the long-run equilibrium satisfies the following properties:*

- (i) *n is not influenced by the standard price for auditing, $\bar{r}_p$, set by the tax authorities;*
- (ii) *n decreases as the tax rate of the home country, t_D , increases.*

We note that property (i) in the corollary helps us to proceed to welfare analysis. Proposition

⁸ Because x_i and p_i are non-negative, we should confirm that $(1 - t_U)c - (t_D - t_U)\bar{r}_i \geq 0$ holds. However, Proposition 3 later suggests that both x_i and p_i take positive values in equilibrium, where $\bar{r}_i$ has already been set by the tax authorities, implying that the inequality is met.

1 suggests that the revenue of each MNF in the home country is calculated as $p x = \sigma F / (1 - t_D)$. That is, the revenue is independent of the transfer price standard, $\bar{r}_i$, the home government adopts. This is the reason for the result that the equilibrium measure of varieties, n , is independent of the transfer price standard.

Corollary 2 *As the tax authorities of the home country relaxes the standard, i.e., raises $\bar{r}_i$, the retail price, p_i , decreases and the quantity, x_i , increases.*

The intuition behind Corollary 2 is summarized as follows. As the authority raises the standard price, more profits will accumulate in each MNF in the short run. In the long run, however, all accumulated profits will be passed on to consumers as a welfare improvement because of the free entry of other entities into the market, leading to a higher quantity supplied at a lower price.

3.2 Welfare maximization by the authorities

Working through the problem backward, we next determine the optimal standard price, $\bar{r}_i$, set by the tax authorities at Date 1. Let TS_i , CS_i , and TX_i denote the total social surplus, consumer surplus, and tax revenue, respectively. First, notice that we cannot calculate the consumer surplus of variety i , CS_i . Looking at Figure 1, we can see that the demand curve does not intersect with the vertical axis, meaning that consumer welfare at any combination of price and quantity diverges to positive infinity. This property of the demand curve is attributable to the assumption of the CES utility function. Nonetheless, we may calculate the optimal standard price for auditing by following the logic shown in the Appendix. As a consequence, we obtain the following proposition.

[Insert Figure 1 around here]

Proposition 2 *The optimal standard price for auditing internal transfers that maximizes social welfare for the home country is:*

$$\bar{r}_i^* = \frac{c(1-t_U)(t_D(1+t_D(\sigma-1))-t_U\sigma)}{(t_D-t_U)^2\sigma}. \quad (P2)$$

Using Proposition 2, we may derive the retail price and quantity after $\bar{r}_i$ is set by reevaluating the results in Proposition 1 at $\bar{r}_i = \bar{r}_i^*$.⁹

Proposition 3 *When the standard price for auditing, $\bar{r}_i$, is set equal to the optimal level, $\bar{r}_i^*$, by the authority, the quantity, price, and number of varieties in the equilibrium are restated as follows:*

$$x = x_i = \frac{(t_D - t_U)\sigma F}{t_D(1-t_D)(1-t_U)c}, \quad p = p_i = \frac{t_D(1-t_U)c}{t_D - t_U}, \quad n = \frac{(1-t_D)m}{\sigma F}. \quad (P3)$$

Proposition 4 *In the equilibrium identified in Proposition 3, MNF behavior meets the commensurate-with-income standard, i.e., $c \leq r_i (= \bar{r}_i^*) \leq p$. In particular, the authorities should require r_i (and $\bar{r}_i^*$) to be strictly greater than c as long as σ does not take the upper limit of the commensurate-with-income standard in Inequality (1), i.e., when $t_D/t_U \leq \sigma < t_D(1-t_U)/(t_U(1-t_D))$.*

The next corollary also follows from Proposition 2.

Corollary 3 *As σ decreases, the tax authorities should relax the auditing standard: i.e., raise $\bar{r}_i$ to allow the MNF to transfer the product at a higher price.*

⁹ Whereas our model treats a unit of tax revenue as equal to a unit of consumer surplus, previous taxation models frequently assume that tax revenue has a higher marginal social value than private income. If we added this assumption by multiplying TX_i of Equation (A2) by $\beta (> 1)$ to maximize $TS_i = CS_i + \beta TX_i$, Equation (P2) would become as follows: $\bar{r}_i^* = c(1-t_U)(t_D((\sigma - \beta(\sigma - 1)) + t_D\beta(\sigma - 1)) - t_U\sigma)/((t_D - t_U)^2\sigma)$. Because simple calculation shows that this value is smaller than Equation (P2), a higher marginal valuation of tax (β) would induce the authorities to tighten the standard. One may easily confirm that x accordingly decreases, p rises, and n remains unchanged by substituting this value, $\bar{r}_i^*$, into Equation (P1).

Corollary 3 is very important because it implies that the tax authorities should raise the upper limit price allowed for transfers as the consumer elasticity of substitution between varieties decreases. When consumers' elasticity of substitution between brands is relatively low, we expect that each brand of the good is well established and captures a certain share of demand. Typical monopolistic competition models demonstrate that a low elasticity of substitution enables firms to enjoy high profits in the short run without fear of the entry of other firms. However, entry of other firms into the market in the long run induces all the firms to earn no profit, and all rents are passed on to consumers as their welfare. Even though tax revenue for the home country increases when the authority tightens the audit standard by reducing $\bar{r}_i$, the final price for each variety of the good rises and the supply quantity decreases through the strict standard in the long-run equilibrium. Therefore, the tax authorities should relax standards for auditing; namely, raise the standard price to assist firms to supply large quantities at a low price so as to increase consumer welfare rather than tax revenue when the degree of substitution across brands is relatively low. By contrast, the authority should extract large corporate tax through a relatively strict audit standard when the product is substitutable. As Proposition 1 indicates, an MNF supplies a large quantity if σ takes a high value, holding other variables constant. Therefore, the authority may extract large tax revenue through a strict standard in this situation without serious negative impact on consumer welfare.¹⁰

The next two corollaries regarding the relationship between the optimal standard price and the tax rates are drawn from Proposition 2.

¹⁰ Because we do not consider the allocation of tax revenue collected, our setting can be interpreted as indicating that the tax revenue is spent on public goods that have the same constant marginal benefit as private income. An alternative setup would be to return the revenue to the consumer, in which case it would enter the consumer budget constraint given by Equation (2). If we employed such an alternative setting, Equation (8) would become as follows: $x_i = (m + TX_i)/(n p_i) = (m + t_d(p_i - \bar{r}_i)x_i)/(n p_i)$. Replacing p_i and x_i in this budget equation with Equations (13) and (15) would show that n satisfying the equation depends on $\bar{r}_i$, which is a different result from Equation (P1). Accordingly, ΔCS_i , shown in the Appendix, would not be derived because n varies with $\bar{r}_i$. Therefore, our conclusion would substantially change and become more complicated.

Corollary 4 *If the tax rate in the host country, t_U , is fixed, variation of the optimal standard price in response to the tax rate in the home country, t_D , is summarized as follows:*

$$(1) \frac{d\bar{r}_i^*}{dt_D} < 0 \text{ when } \sigma < \frac{t_D + t_U - 2t_D t_U}{2(1-t_D)t_U}, \text{ meaning that the authority should increase the}$$

standard price as the tax rate of the home country decreases; and

$$(2) \frac{d\bar{r}_i^*}{dt_D} > 0 \text{ when } \sigma > \frac{t_D + t_U - 2t_D t_U}{2(1-t_D)t_U}, \text{ meaning that the authority should increase the}$$

standard price as the tax rate of the home country increases.

Corollary 5 *If the tax rate in the home country, t_D , is fixed, variation of the optimal standard price in response to the tax rate in the host country, t_U , is summarized as follows:*

$$(1) \frac{d\bar{r}_i^*}{dt_U} > 0 \text{ when } \sigma < \frac{t_D(2-t_D-t_U)}{(1-t_D)(t_D+t_U)}, \text{ indicating that the authority should increase the}$$

standard price as the tax rate of the host country increases; and

$$(2) \frac{d\bar{r}_i^*}{dt_U} < 0 \text{ when } \sigma > \frac{t_D(2-t_D-t_U)}{(1-t_D)(t_D+t_U)}, \text{ indicating that the authority should increase the}$$

standard price as the tax rate of the host country decreases.

Corollaries 4 and 5 imply that the tax authorities should control the standard price, as in the next remark.

Remark 1 *The tax authorities should control the standard price as follows, as the difference in the tax rate of the two tax jurisdictions, namely, the deviation between t_D and t_U , increases.*

(1) *The authority should lower $\bar{r}_i$ according to the deviation of the tax rate, if the degree of substitution between the varieties, σ , is relatively small.*

(2) *The authority should raise $\bar{r}_i$ according to the deviation of the tax rate, if the degree of substitution between the varieties, σ , is relatively large.*

If the product is less substitutable between varieties, firms have a stronger incentive to shift their large profits to the host country in the short term as the difference in the tax rate increases. Under such a situation, the tax authorities of the home country should tighten the audit standard so as to preclude surplus shifting out in the form of an improvement in the social welfare of the host country. Conversely, if the product is substitutable, the authority should relax the standard as the tax rate difference increases, thereby aiming to increase tax revenue rather than consumer welfare.

4 Discussion and extension

4.1 Tax rate differences

In the previous section, we established a basic transfer-pricing model with desirable audit system under monopolistic competition. This section further examines how the above results change if we alter the earlier settings so we encompass more general circumstances. First, we consider the situation when the corporate tax rate in the host country is higher than in the home country, i.e., $t_U > t_D$. Because an MNF wishes to set the transfer price as low as possible, in contrast to the previous setting, one leaves zero profit in the upstream division given the commensurate-with-income standard. Accordingly, all tax bases are shifted to the home country and the tax authorities thus have no more incentive to regulate the transfer price.

Let us examine this outcome formally. Recall that Equation (9) represents the profit of MNF i , π_i . Because $\partial \pi_i / \partial r_i = (t_D - t_U)x_i < 0$, the solution of r_i that maximizes π_i and meets the commensurate-with-income standard ($c \leq r_i \leq p_i$) is c . Plugging $r_i = c$ into Equation (9) restates π_i as:

$$\pi_i = (1 - t_D)(p_i - c)x_i - F. \quad (17)$$

Consequently, the standard transfer price, $\bar{r}_i$, set by the authorities has no influence on the profit, because π_i does not depend on r_i as Equation (17) shows. Further, the problem reduces

to a typical industrial long-run equilibrium problem where firms freely enter the domestic market to the extent that Equation (17) becomes zero, because features of the host country environment, such as t_U , no longer affect profit. That is, the international tax difference and audit system, which are central to the current study, play no role in determining the long-run equilibrium if the tax differential between the two countries is reversed.

4.2 Welfare in the two countries

Because we have thus far concentrated exclusively on home country welfare, we consider here how auditing by the tax authorities influences host country welfare and the total welfare of the world economy. Taking the conclusions in advance, we find that the equilibrium audit standard price in Proposition 2, $\bar{r}_i^*$, is too low, that is, the standard is set too severely in terms of either host country's welfare or total world welfare. Stated differently, the welfare of both can increase by increasing $\bar{r}_i$ above $\bar{r}_i^*$.

To illustrate this consequence, let FTX_i and WS_i denote the host country' tax revenue and total world welfare, respectively. Note that FTX_i also signifies social welfare in the host country because the goods are not sold there. Using Proposition 1, FTX_i is calculated as:

$$FTX_i = t_U (\bar{r}_i - c) x_i = \frac{t_U (\bar{r}_i - c) (\sigma - 1) F}{c(1 - t_U) - \bar{r}_i (t_D - t_U)}. \quad (18)$$

Because $WS_i = CS_i + TX_i + FTX_i$, the following equation holds.

$$\frac{\partial WS_i}{\partial \bar{r}_i} = \frac{\partial CS_i}{\partial \bar{r}_i} + \frac{\partial TX_i}{\partial \bar{r}_i} + \frac{\partial FTX_i}{\partial \bar{r}_i} \quad (19)$$

When we evaluate Equation (19) using $\bar{r}_i^*$ in Proposition 2, $\partial CS_i / \partial \bar{r}_i + \partial TX_i / \partial \bar{r}_i = 0$ holds because $\bar{r}_i^*$ is the solution that maximizes $CS_i + TX_i$. However, the third term in Equation (19) becomes positive because

$$\partial FTX_i / \partial \bar{r}_i \Big|_{\bar{r}_i = \bar{r}_i^*} = t_U (\sigma - 1) (1 - t_D) cF / \left(c(1 - t_U) - \bar{r}_i^* (t_D - t_U) \right)^2 > 0, \text{ meaning that the standard}$$

price for audit that the home country selects does not maximize not only host country welfare but also total world welfare. Furthermore, the inequality suggests that $\bar{r}_i^*$ is smaller than the level that maximizes world welfare, because WS_i would increase by raising $\bar{r}_i$ marginally. This consequence is congruent with economic intuition in that the home country wishes to hold down the standard price as low as possible, namely, a too tight a level, to secure the tax base only for the country.

4.3 Host country response

Lastly, we consider the responses of the authorities in the host country to counter the home country authorities. Recall that in our model the home country sets the upper limit of the transfer price, $\bar{r}_i^*$, to prevent the outflow of surplus. By contrast, the host country has an incentive to set a lower limit of the transfer price in reply because it wants MNFs to transfer goods at as high a price as possible, leading to greater taxable income in the upstream division. Let $\underline{r}_i$ denote the lower limit that the host country authorities set. Suppose that the host country authorities set $\underline{r}_i$ immediately after observing $\bar{r}_i^*$ set by the home country authorities at Date 1.

To derive an equilibrium in the presence of this host country response, first consider the case when $\underline{r}_i \leq \bar{r}_i^*$. Then, the optimal transfer price for MNF i is obviously $\bar{r}_i^*$, as shown in Section 3, because the MNF can choose any price between $\underline{r}_i$ and $\bar{r}_i^*$. As a result, in this case MNF i sets the transfer price (r_i) equal to $\bar{r}_i^*$. Conversely, if $\underline{r}_i > \bar{r}_i^*$, MNF i has no transfer price to choose because the lower limit is higher than the upper limit according to the regulations set in both countries. That is, each MNF cannot transfer the goods and ceases to operate because of regulation, and social welfare in the host country falls to zero. Obviously, the latter case ($\underline{r}_i > \bar{r}_i^*$) is not a subgame perfect Nash equilibrium, because the host country can realize positive welfare by choosing the former case ($\underline{r}_i \leq \bar{r}_i^*$). Consequently, in equilibrium the host country sets $\underline{r}_i$ less than or equal to $\bar{r}_i^*$ and MNF i sets r_i equal to $\bar{r}_i^*$, meaning that the host country's regulation becomes nonbinding. In this equilibrium, all

taxable income of the MNF remains in the upstream division. Because consumer surplus does not arise in the host country, social welfare in the country equal to its tax revenue is automatically maximized, even if the host country does not impose any other transfer-pricing regulation. In sum, the economic consequences in the previous section hold, even if we incorporate responses by the host country in our model.

5 Conclusion

To audit the internal transfer prices selected by MNFs, tax authorities frequently face difficulty, especially when an MNF transacts a product with no other independent firm and, consequently, the relevant price for auditing that meets the arm's-length standard is hardly obtainable. Given this problem, this paper proposes an alternative method to calculate the standard price for auditing transfer prices within divisionalized firms apart from the arm's-length standard. In our model, even when the tax authorities cannot obtain the precise arm's-length price, it may calculate the standard price for auditing by referring to the degree of substitution between brands in the product category that an audited MNF handles. This process enables the authorities to achieve another critical goal; the improvement of social welfare in the country, which is equally or, sometimes, more important than simply mandating a fair transfer price.

Because the major objective of our paper is to establish a benchmark model of transfer pricing with desirable audit standards under monopolistic competition that has not appeared in the literature, we expect this basic model can be extended in a variety of ways. To start with, even though empirical studies investigating transfer-pricing practice are quite rare in the literature, Dischinger and Riedel (2010) recently provided notable empirical evidence that multinationals are reluctant to shift profits from their headquarters. In our present model, the jurisdiction where the headquarters is located does not matter for deriving the economic outcomes because we assume the source principle of international corporate taxation, that is, each subordinate division bears separate tax payment, as in Equation (9). Given the empirical findings, however, we could incorporate the preference of central management regarding

where to locate its headquarters into the constructed model by, for example, altering the assumption of the source principle of taxation to the residence principle. Moreover, while our primary purpose is to investigate desirable transfer-pricing regulation, we could also explore other policy instruments or regulations that directly affect the output of firms. We identify these important issues, which are beyond the scope of the present paper, as promising directions for future research.

Appendix

Proof of Corollary 1 Derivatives of n in Equation (P1) with respect to $\bar{r}_i$ and t_D immediately show that the two listed properties are met. $\square$

Proof of Corollary 2 Derivatives of p_i and x_i on $\bar{r}_i$ are $\partial p_i / \partial \bar{r}_i = -(t_D - t_U)\sigma / ((1 - t_D)(\sigma - 1)) < 0$ and $\partial x_i / \partial \bar{r}_i = (t_D - t_U)(\sigma - 1)F / ((1 - t_U)c - (t_D - t_U)\bar{r}_i)^2 > 0$, suggesting that the corollary holds. $\square$

Proof of Proposition 2 Social welfare, TS_i , is composed of three factors: consumer surplus CS_i , firm profits π_i , and tax revenue TX_i . In the long-run equilibrium under monopolistic competition, however, no excess profit for firms is generated, meaning that $\pi_i = 0$ as shown in Equation (14). Hence, $TS_i = CS_i + TX_i$. A necessary condition to maximize TS_i is:

$$\frac{\partial TS_i}{\partial \bar{r}_i} = \frac{\partial CS_i}{\partial \bar{r}_i} + \frac{\partial TX_i}{\partial \bar{r}_i} = 0. \quad (\text{A1})$$

Accordingly, we may use Equation (A1) to find the standard price that maximizes total social welfare. More precisely, we should maximize nTS_i because there are n varieties of the good. Fortunately, however, maximization of TS_i and that of nTS_i yields the equivalent value of $\bar{r}_i$ because Proposition 1 indicates that n is independent of $\bar{r}_i$. The tax revenue, TX_i , for the home country is defined as:

$$TX_i \equiv t_D(p_i - \bar{r}_i)x_i. \quad (\text{A2})$$

Using Equations (13) and (15), we restate Equation (A2) as:

$$TX_i = \frac{t_D(c(1-t_U)\sigma + \bar{r}_i(1-t_D-(1-t_U)\sigma))F}{(1-t_D)(c(1-t_U)-\bar{r}_i(t_D-t_U))}. \quad (A3)$$

The first-order derivative of TX_i on $\bar{r}_i$ is:

$$\frac{\partial TX_i}{\partial \bar{r}_i} = -\frac{t_D(1-t_U)(\sigma-1)cF}{(c(1-t_U)-\bar{r}_i(t_D-t_U))^2}. \quad (A4)$$

Next, we calculate $\frac{\partial CS_i}{\partial \bar{r}_i}$. To derive the partial derivative, we first write the increment of

consumer surplus, ΔCS_i , in response to the increase in the standard price, $\Delta \bar{r}_i$, as follows:

$$\begin{aligned} \Delta CS_i = & \left(\frac{((1-t_U)c - (t_D-t_U)\bar{r}_i)\sigma}{(1-t_D)(\sigma-1)} - \frac{((1-t_U)c - (t_D-t_U)(\bar{r}_i + \Delta \bar{r}_i))\sigma}{(1-t_D)(\sigma-1)} \right) \frac{(\sigma-1)F}{(1-t_U)c - (t_D-t_U)\bar{r}_i} \\ & + \int \frac{(\sigma-1)F}{(1-t_U)c - (t_D-t_U)\bar{r}_i} \left(\frac{m}{nx} - \frac{((1-t_U)c - (t_D-t_U)(\bar{r}_i + \Delta \bar{r}_i))\sigma}{(1-t_D)(\sigma-1)} \right) dx \end{aligned} \quad (A5)$$

See Figure 1 for an intuitive illustration on how to calculate ΔCS_i as in Equation (A5). As Equation (P1) indicates, $\bar{r}_i$ does not affect n and, thus, the increment of consumer surplus can be written as Equation (A5). Substituting $n = (1-t_D)m/(\sigma F)$, presented in Proposition 1, into Equation (A5) and calculating the integration yields:

$$\Delta CS_i = \frac{1}{1-t_D} \sigma F \left(\ln \frac{(\sigma-1)F}{c(1-t_U) - (t_D-t_U)(\bar{r}_i + \Delta \bar{r}_i)} - \ln \frac{(\sigma-1)F}{c(1-t_U) - (t_D-t_U)\bar{r}_i} \right). \quad (A6)$$

Dividing both sides of Equation (A6) by $\Delta \bar{r}_i$ gives:

$$\frac{\Delta CS_i}{\Delta \bar{r}_i} = \frac{1}{1-t_D} \sigma F \left(\ln \frac{(\sigma-1)F}{c(1-t_U) - (t_D-t_U)(\bar{r}_i + \Delta \bar{r}_i)} - \ln \frac{(\sigma-1)F}{c(1-t_U) - (t_D-t_U)\bar{r}_i} \right) / \Delta \bar{r}_i. \quad (A7)$$

Finally, taking the limit as $\Delta \bar{r}_i$ goes to 0 yields the derivative of CS_i with respect to $\bar{r}_i$ as follows:

$$\frac{\partial CS_i}{\partial \bar{r}_i} = \frac{(t_D-t_U)\sigma F}{(1-t_D)(c(1-t_U) - (t_D-t_U)\bar{r}_i)}. \quad (A8)$$

Substituting Equations (A4) and (A8) into Equation (A1) and solving the equation with respect to $\bar{r}_i$ yields:

$$\bar{r}_i = \frac{c(1-t_U)(t_D(1+t_D(\sigma-1))-t_U\sigma)}{(t_D-t_U)^2\sigma}. \quad (\text{A9})$$

Lastly, we prove that $\bar{r}_i$ given in Equation (A9) satisfies the second-order condition for maximization. The second-order derivative of TS_i on $\bar{r}_i$ is:

$$\begin{aligned} \frac{\partial^2 TS_i}{\partial \bar{r}_i^2} &= \frac{\partial^2 CS_i}{\partial \bar{r}_i^2} + \frac{\partial^2 TX_i}{\partial \bar{r}_i^2} \\ &= \frac{(t_D-t_U)^2\sigma F}{(1-t_D)(c(1-t_U)-\bar{r}_i(t_D-t_U))^2} - \frac{2t_D(1-t_U)(t_D-t_U)(\sigma-1)cF}{(c(1-t_U)-\bar{r}_i(t_D-t_U))^3}. \end{aligned} \quad (\text{A10})$$

Replacing $\bar{r}_i$ in Equation (A10) with Equation (A9) yields:

$$\frac{\partial^2 TS_i}{\partial \bar{r}_i^2} = -\frac{(t_D-t_U)^4\sigma^3 F}{t_D^2(1-t_U)^2(1-t_D)^3(\sigma-1)^2 c^2} < 0, \quad (\text{A11})$$

which ensures the maximization of TS_i . $\square$

Proof of Proposition 3 Substituting Equation (P2) into the result in Proposition 1 derives the equilibrium outcome.

Next, we prove that the equilibrium transfer price meets the commensurate-with-income standard. Using Propositions 2 and 3, the following inequality holds.

$$p_i - r_i = (1-t_U)(1-t_D)(t_U\sigma - t_D)c / ((t_D-t_U)^2\sigma) \quad (\text{A12})$$

Because $r_i \leq p_i$ is necessary for the commensurate-with-income standard, Equation (A12) suggests that $\sigma \geq t_D/t_U$. Additionally, $r_i \geq c$ is another necessary condition for the standard. From Proposition 2, we can transform this inequality as $\sigma \leq t_D(1-t_U)/(t_U(1-t_D))$. Consequently, Inequality (1) satisfies the commensurate-with-income standard in equilibrium.

Finally, we present a numerical example of a set of exogenous variables that satisfy both the commensurate-with-income standard ($c \leq r_i \leq p_i$) and the regulation by the authorities ($r_i \leq \bar{r}_i^*$) in equilibrium so as to verify that such a parameter region actually exists. Suppose the exogenous variables take the following values.

$$(\sigma, t_U, t_D, c, F, m) = (1.5, 0.3, 0.4, 0.2, 1, 100) \quad (\text{A13})$$

Using Proposition 2, the equilibrium endogenous variables and functions are calculated as:

$$(p, \bar{r}_i^*, r_i, n, x, TX) = (0.56, 0.28, 0.28, 40, 4.464, 0.5). \quad (\text{A14})$$

One may confirm that this outcome satisfies both the commensurate-with-income standard and the regulation by the authorities. $\square$

Proof of Proposition 4 One may confirm that $r_i (= \bar{r}_i^*)$ equals c if and only if $\sigma = t_D(1-t_U)/(t_U(1-t_D))$ by replacing σ in Equation (P2) with this value. $\square$

Proof of Corollary 3 Differentiation of $\bar{r}_i^*$ on σ yields $\partial \bar{r}_i^* / \partial \sigma = -t_D(1-t_D)(1-t_U)c / ((t_D-t_U)^2 \sigma^2) < 0$, indicating that the authority should reduce $\bar{r}_i$ as σ grows. $\square$

Proof of Corollary 4 From Proposition 2: $\partial \bar{r}_i^* / \partial t_D = (1-t_U)(t_U(2\sigma-1)-t_D(1+2(\sigma-1)t_U))c / ((t_D-t_U)^3 \sigma)$. Solving the equation equal to 0 yields $\sigma = t_D + t_U - 2t_D t_U / (2(1-t_D)t_U)$, which is the threshold for $d\bar{r}_i^* / dt_D$ to be positive or negative. $\square$

Proof of Corollary 5 From Proposition 2: $\partial \bar{r}_i^* / \partial t_U = c(1-t_D)(t_D^2(\sigma-1)+t_D(t_U(\sigma-1)+2-\sigma)-t_U\sigma) / ((t_D-t_U)^3 \sigma)$. Solving the equation equal to 0 yields $\sigma = t_D(2-t_D-t_U) / ((1-t_D)(t_D+t_U))$, which is the threshold for $d\bar{r}_i^* / dt_U$ to be positive or negative. $\square$

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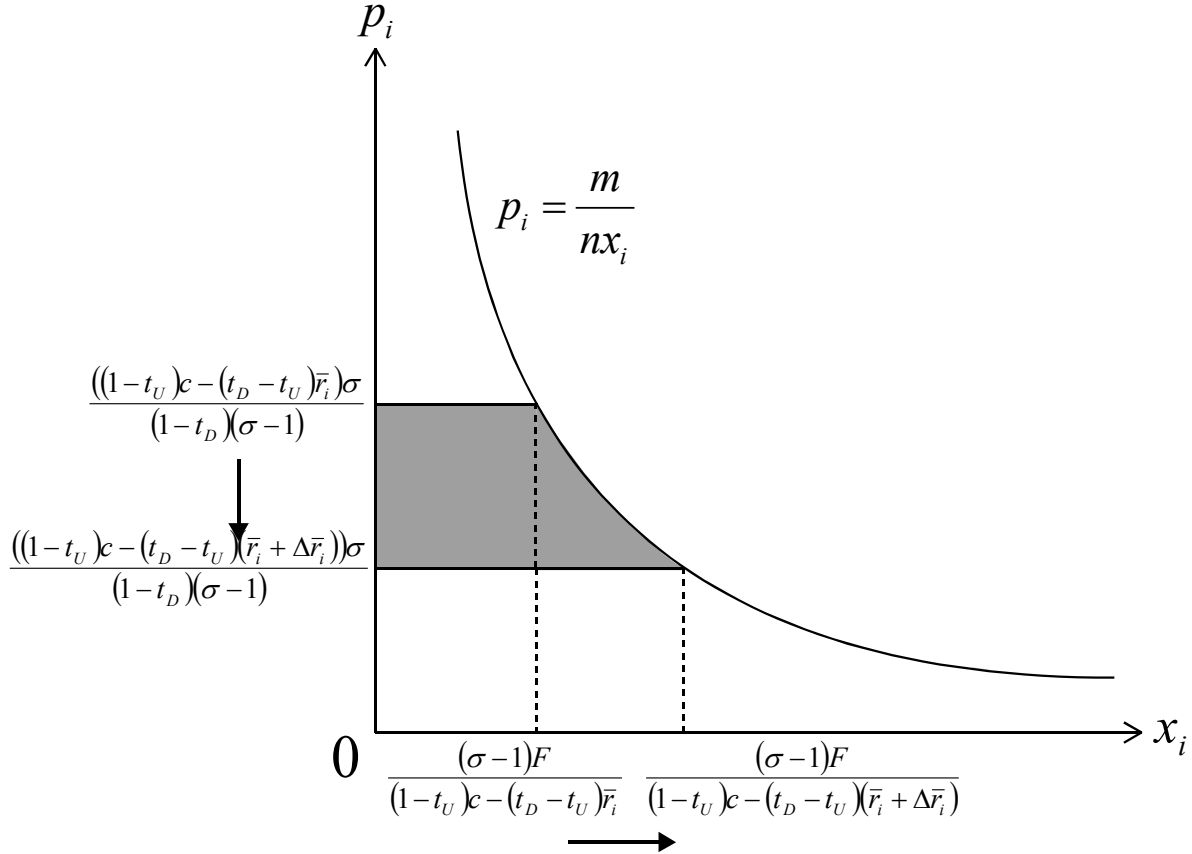
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Fig. 1 Increase in consumer welfare when the authority raises the standard price for auditing, $\bar{r}_i$, by $\Delta\bar{r}_i$



Because n is independent of the standard price for auditing transfers, $\bar{r}_i$, and the demand curve for a variety thus does not shift in response to $\bar{r}_i$, the increment in consumer welfare when the standard price is increased by $\Delta\bar{r}_i$ is represented by the gray area.