Endogenous Product Differentiation and Profit Shifting*

Hirofumi Okoshi†

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Abstract

High product differentiation enhances consumers’ utility and firms’ profits but at the same time makes it difficult for tax authorities to audit MNEs’ tax avoidance strategies, as the arm’s length principle is difficult to apply. This paper combines these two aspects of product differentiation and studies the interrelation between profit shifting and product differentiation. The model shows that MNEs engage in more investment in product differentiation in the presence of profit shifting opportunities and financial economic integration accelerates the investment.

Keywords: Tax avoidance; Product differentiation; Financial economic integration

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†University of Munich, Munich Graduate School of Economics, Seminar for Economic Policy, Akademiestr. 1/II, D-80799 Munich, Germany; E-mail: hirofumi.okoshi1@gmail.com
1 Introduction

Investment in research and development (R&D) has been growing over years. According to the National Science Foundation, worldwide R&D expenditure rose from $336,571 million in 2009 and to $451,831 million in 2016. Although these numbers do not distinguish between R&D types, empirical evidence suggests that product differentiation is a core reason for R&D. According to Scherer and Ross (1990), three quarter of R&D expenditures by U.S. firms' were used for product R&D. Bagwell (2007) also reports examples of large spendings on advertisement by U.S. firms which serve to increase product differentiation. In 2003, $3.43 billion was spent by General Motors for cars and trucks, $3.32 billion was used for detergents and cosmetics manufactured by Protecter and Gamble, and Pfizer devoted $2.84 billion to advertise its drugs. Such an investment in product differentiation is one of the most important strategies of firms because competition among firms gets less fierce and firms are able to enjoy more market power by differentiating their products from those of rival firms.

The increase in market power due to product differentiation is not always harmful for consumers, once individuals’ preference over varieties are considered.\(^1\) One classical theory which introduces heterogeneous preference on goods is Hotelling (1929). In his model, consumers’ preferences are uniformly distributed along an interval and the socially optimal level of duopolists’ product differentiation is positive. Therefore, higher degrees of product differentiation can benefit both firms and consumers so that product differentiation can be beneficial for the whole economy.

From the viewpoint of global taxation, however, product differentiation exacerbates the difficulties of collecting corporate tax revenue, because of the tax avoidance behaviour of multinational enterprises (MNEs). MNEs exploit tax rate differentials between countries by shifting their profits to low-tax environments by means such as transfer pricing. The transfer price is the price used in intra-firm transactions, on intermediate products and/or intangible assets such as trademarks.\(^2\) As OECD guidelines stipulate, such a price used in intra-firm transactions should be the one used in inter-firm transaction, or arm’s length (AL) price. Tax authorities compare the transfer price used by an MNE to the AL price from comparable uncontrolled transactions. However, product differentiation makes it difficult to find comparable transactions,

\(^{1}\)This is also supported by “love of variety” pioneered by Dixit and Stiglitz (1977) and Krugman (1980). For evidence on the love of variety, see, for example, Ardelean (2006) who estimates the parameter of love of variety.

\(^{2}\)In a last few decades, the global economy has been substantially influenced by small number of but usually quite large MNEs. For empirical evidence on the importance of intra-firm transactions, see Bernard et al. (2010) and Lanz and Miroudot (2011) which report over 46% and around 50% of U.S. imports were done between related companies in 2000 and 2009, respectively. In addition, Bernard et al. (2005) shows that, in 2000, the number of MNEs are around 1% of total number of firms in U.S. while 29.1 % of worker were hired by MNEs and approximately 90% of U.S. trade were involved with MNEs.
since characteristics of the comparable products in inter-firm transaction should be similar to the ones of the good traded in the intra-firm transaction. In practice, both consultant companies and tax authorities frequently rely on a range of transfer prices, or AL range, which provides MNEs with room to manipulate their transfer prices for the purpose of profit shifting.

This link between product differentiation and profit shifting is empirically supported by academic literature as well. Bernard et al. (2006), Cristea and Nguyen (2016), and Davies et al. (2018) used export price data in the U.S., Denmark, and France and showed the significant difference between transfer prices and AL prices. Moreover, they categorized industry into homogeneous and differentiated sectors and conclude that transfer prices are more sensitive to tax changes when the goods category is differentiated (e.g. Davies et al. (2018), Table 2). Even though the empirical evidence points to a link between product differentiation and MNEs’ profit shifting, a theoretical approach that combines these two aspects has not been developed so far. To the best of my knowledge, this is the first paper that studies this link and analyzes its welfare effects.

Tax avoidance by MNEs has attracted global attention because of its sizable impact on tax revenue losses. OECD stated that annual revenue losses from MNEs’ tax avoidance are estimated $100 billion to $240 billion. Zucman (2014) shows that the share of U.S. corporate profits made in tax havens has risen from 2% in 1983 to 17% in 2013. Tørsløv et al. (2018) also estimate that more than $600 billion were shifted to tax havens. As the magnitude of MNEs’ tax avoidance is large, understanding the MNEs’ incentive to conduct tax avoidance and its welfare effects is essential.

This paper incorporates tax avoidance behaviour into a model with endogenous product differentiation, proposed by Lin and Saggi (2002). To reflect the above argument, this paper introduces a link between product differentiation and the ease of profit shifting. When profit shifting is possible, MNEs benefit more from product differentiation because higher product differentiation makes shifting profits easier. Due to this additional incentive, we find that the optimal investment in product differentiation in the presence of profit shifting is higher than in the absence of profit shifting. We also analyze the impact of financial economic integration which is characterized as an increase in the mobility of tax bases. We find that economic integration results in greater post-tax profits of MNEs, higher consumer surplus from the differentiated products, and lower tax revenues in a high tax country. Irrespective of the two positive impacts, our numerical analysis shows economic integration decreases welfare in the high tax country due to an under-provision of a public good.

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The above results are robust even if we endogenize the tax rate in the high tax country. As economic integration proceeds, the MNEs’ incentive to shift profit gets stronger so that the government in the high tax country needs to lower the tax rate to avoid an outflow of its tax base.\(^4\) Although this reduction in the tax rate narrows the tax gap and mitigates the MNEs’ incentive to investment in product differentiation, the impact of economic integration is the first order effect so that economic integration results in more product differentiation. Thus, our numerical example shows effective tax rate for the MNEs declines due to economic integration.

This paper contributes to several fields of research. The first strand of literature studies endogenous product differentiation. Lin and Saggi (2002) show a stronger incentive to engage in more product differentiation in the presence of process R&D, because innovation increases the benefit from product differentiation. A few papers study endogenous product differentiation in the open economy. Beladi et al. (2012) incorporate an outsourcing firm in their analysis, but the focus is on differences in technology and wages across firms and countries. Ferguson (2015) analyzed the impact of trade liberalization in a monopolistically competitive model with a constant elasticity of substitution in consumption. For the papers closer to ours, Braun (2008) explored the impact of economic integration on product R&D and shows that economic integration increases operating profits from the export market and thus results in more product differentiation. Bastos and Straume (2012) also consider a two-country model and introduce per-unit tariffs on firms’ exports and. They conclude that economic integration leads to a stronger incentive to invest in product differentiation in order to mitigate market competition due to a intensified international competition driven by economic integration. Therefore, their analysis does not allow to draw any conclusions for product differentiation due to a tax motive, which is the focus of our paper.

Second, our model also contributes to the research on tax avoidance by MNEs. After Copithorne (1971) and Horst (1971), a number of authors have studied transfer pricing and profit shifting. Kant (1988) first introduces legal or other costs of profit shifting to obtain an interior solution. Traditionally, this field has been analyzed in a perfect competition setup but a few recent works also incorporated market imperfection in their analysis. Some papers study AL regulation with taking MNEs’ strategies into account. Among them, Choi et al. (2018) and Choi et al. (2019) study the impact of AL principle on an MNE’s sourcing and licensing strategies, respectively. As AL regulation does not allow MNEs to discriminate input prices/royalty on patent between related affiliate and independent firms, they show AL regulation distort an MNE’s strategies (dual

\(^4\)This result is also in line with a stylized fact of a reduction in corporate tax rates over time. According to OECD stat, the average statutory corporate tax rate in OECD countries dropped from 32% in 2000 to 23.51% in 2019. See https://stats.oecd.org/index.aspx?DataSetCode=TABLE_I11.
sourcing vs single sourcing and licensing to an unrelated firm or not, respectively). However, they do not consider the similarity of transactions whereas our paper considers the link between product differentiation and profit shifting.

A few papers saw the link. Yao (2013) considers a spatial product differentiation model with profit shifting in a Hotelling fashion and shows that the opportunity of manipulating transfer price induces a wider distance of two MNEs’ location. Kato and Okoshi (2019) incorporate the link between product differentiation and the ease of profit shifting in their robustness analysis. In their analysis, an MNE sells differentiated inputs to a related affiliate and an independent firm so that transfer price manipulation is still possible with a limited degree under AL regulation. However, they fixed the possible degree of transfer price manipulation so that they ignore the incentive to differentiate product for tax avoidance purpose. Therefore, the contribution of this paper is to incorporate characteristics of products into the cost function of profit shifting, which plays a significant role in practice and provides policy implications.

The rest of the paper is organized as follow. The next section explains the basic model and derives the equilibrium in financial autarky. Section 3 introduces profit shifting by incorporating a tax haven. Section 3.4 argues the effects of marginal economic integration while section ?? discuss some extensions. The last section concludes.

2 The benchmark model

Our benchmark model abstracts from profit shifting. Consider a domestic country (country $D$) where both consumption and production take place. In the economy, there exist three sectors: an imperfect competition sector (sector $X$), a homogeneous sector (sector $Y$) and a public sector. In the $Y$ sector, we assume perfect competition so that no positive profits accrue to every firm in the sector. The $X$ sector is characterized by an oligopolistic market structure and has only two operating firms because of high entry cost. We refer to these firms as MNEs, labelled 1 and 2, since they have a subsidiary in a tax haven (country $H$), which is introduced in the next section.

** Consumers** Individuals in country $D$ are identical and share the same preferences over consumption of the three types of goods provided by the MNEs, perfectly competitive firms and the government in country $D$,

$$ u(x_i, x_j, y, G) = a(x_i + x_j) - \frac{x_i^2 + x_j^2}{2} - sx_i x_j + y + \beta G, \quad i \in \{1, 2\}, \quad j \neq i $$

(1)
where $x_i$ is the consumption level of the product manufactured by the MNE $i$, $y$ is the consumption of the homogeneous good, and $G$ is the quantity of the public good. $a$ and $\beta$ are parameters and exogenously given. $\beta$ represents the marginal utility from the public good and assumed to be greater than unity $\beta > 1$, which assures that the government has an incentive to provide the public good.

The parameter $s \in [0,1]$ represents the degree of substitutability between the two products manufactured by the MNEs. The degree of substitutability is endogenously determined by MNEs’ investments described below and the products are more differentiated as $s$ approaches zero. At the other extreme case, the MNEs’ goods are homogeneous if $s$ is 1.

The utility function yields the following inverse demand function,

$$p_i = a - x_i - sx_j. \tag{2}$$

Note that our utility function has a property of “love of variety” and the inverse demand function shifts outward as the degree of substitutability gets smaller.\(^5\) This is because the more differentiated products increase the individuals’ willingness to pay for each product.

Individuals own the MNEs and thus their income $I$ consists of post-tax profits of the MNEs. Therefore, utility maximization yields the optimal consumption level of the homogeneous good as $\hat{y} = I - \sum_{i=1}^{2} p_i x_j$.

**Government** The government has only one tax instrument in order to finance the provision of the public good: a proportional corporate tax rate on the reported profits of the MNEs in country $D$. As the marginal utility from the public good is higher than that of the numeraire good, the government imposes a positive tax rate on firms’ profits ($t_D$). Since sector $Y$ is perfectly competitive and makes zero profits, tax revenue can be generated only from sector $X$. In our benchmark model, we assume that the tax rate is exogenously given. Later, we also argue the optimal tax rate and the effect of financial economic integration on the tax rate.

The government can transform one unit of the numeraire good into one unit of the public good, which means $G = TR$ holds.

**Firms** Our focus is on the differentiated sector. The MNEs produce their goods with constant marginal cost $c$ and compete over quantity. Before the MNEs produce the goods, they also have a

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\(^5\)If the two goods are perfect substitute $s = 1$, the inverse demand function is linear, which is the case that the elasticity of substitute is approaching to infinity, and love of variety effect vanishes. As the degree of product differentiation or the elasticity of substitute get smaller, indifference curves become more convex with respect to origin.
chance to invest in product differentiation. Following Lin and Saggi (2002), at the first stage, they engage in investment to differentiate their goods from the one made by the rival MNE. Let $d_i \in \left[0, \frac{1}{2}\right]$ be the investment level by MNE $i$. Then, the degree of substitutability is given by $s = 1 - (d_1 + d_2)$. The investment cost is assumed to be $F(d_i)$ with $F'(d_i) > 0$ and $F''(d_i) > 0$. To secure interior levels of $d_i$, we assume that $F'(0) = 0$ and $F'(\frac{1}{2})$ is sufficiently large. Throughout the analysis, we assume that second order condition is satisfied.

The sequence of the game is as follow. At the first stage, both MNEs decide the investment level. Given the investment level, and hence the degree of product differentiation, the MNEs compete in a Cournot fashion and make operating profits. At each stage, their decisions are made simultaneously. We solve the three stage game by backward induction.

2.1 2nd stage: Market outcome

We denote the operating profits of MNE $i$ by $\pi_i = (p_i - c)x_i$ and the post-tax profits by $\Pi_i$. As in standard Cournot competition, the equilibrium output and price level by MNE $i$ are

$$\hat{x}_i = \left(\frac{a - c}{2 + s}\right) = \left(\frac{a - c}{3 - d_i - d_j}\right), \quad \text{and,} \quad \hat{p}_i = \frac{a + (2 - d_i - d_j)c}{3 - d_i - d_j}. \quad (3)$$

Intuitively, more product differentiation leads to more output by the MNEs because market competition between them gets less fierce. As prices are higher when the goods are more differentiated, investment in product differentiation plays a role in market expansion. We can see this from the best response function of MNE $i$. Let $x_i^R$ be the best response function, which is $x_i^R = \frac{a - c - sx_j}{2}$. Lower $s$, meaning their goods are more differentiated, leads to a reduction in outputs because MNE $i$ reduces its own output levels for any given output of its rival.

Due to the feature of market expansion, more outputs by MNEs do not mean a reduction in prices in this setup. Remember that the inverse demand function shifts outward because of more product differentiation, which makes consumers’ willingness to pay higher and creates more demands. Formally, we can easily confirm the effect of product differentiation on the price,

$$\frac{\partial \hat{p}_i}{\partial d_i} = \frac{a - c}{(3 - d_i - d_j)^2} > 0, \quad (4)$$

so that more product differentiation always results in a higher price. As more product differentiation increases both supplies and prices, it obviously increases the operating profits of MNEs.
2.2 1st stage: Investment decision

As more product differentiation results in greater operating profits, each MNE has an incentive to differentiate their product from the rival’s. For the purpose of identifying variables, we use a superscript “O” for variables without profit shifting.

The MNEs maximize the following post-tax profits,

\[ \Pi^O_i = \left(1 - t_D\right) \left(\frac{a - c}{3 - d_i - d_j}\right)^2 - F(d_i). \tag{5} \]

Thus, the optimal investment level \( \hat{d}_O \) is characterized in symmetric equilibrium,

\[ \frac{\partial \Pi^O_i}{\partial d_i} \bigg|_{d_i = d_j = \hat{d}_O} = \frac{2(1 - t_D)(a - c)^2}{(3 - 2\hat{d}_O)^3} - F'(\hat{d}_O) = 0. \tag{6} \]

The first term is the (tax adjusted) marginal benefit from differentiation via market expansion while the second term is marginal cost of the investment. Therefore, the optimal investment level is the one which equates the marginal benefit and marginal cost of investment.

3 Financial integration

Next, we consider the case where the MNEs have a possibility to shift profit into country H by some means such as transfer pricing on tangible/intangible assets. We assume that country H is very small and there are no consumption in country H. This is a standard assumption in literature of tax havens because tax havens such as Caribbean islands frequently have a relatively small county size but provide opportunities of tax planning via non-production transaction such as patent royalty or internal debt.\(^6\) We modify the game by introducing profit shifting stage after the second stage.

3.1 Cost of profit shifting

In general, engaging in tax avoidance is costly. For example, MNEs need to hire specialists on accounting such as accountants or lawyers to justify shifted profits between related companies. This cost is known as concealment cost in the literature. Therefore, irrespective of means of profit shifting such as transfer pricing or a licensing fee, the MNEs have to incur the cost as well. In the literature of tax avoidance, the cost is assumed to increase as more profits are shifted because experts in accounting branch or consulting firms have to exert much effort to save tax and MNEs may need to

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\(^6\)Even if we introduce consumption in country H, the results are qualitatively robust.
pay more rewards to them so as to shift more profits.

Following Amerighi and Peralta (2010), we assume that the cost is formulated as

\[
C(\eta, \pi_S^i) = \frac{\eta(\pi_S^i)^2}{2\pi_i}
\]

(7)

where \( \pi_S^i \) represents the amount of shifted profits to country \( H \) and \( \eta \) is a measure of difficulty of profit shifting.\(^7\) This specification implies that a given amount of profit shifting is easier to hide when total profits are large. Therefore, the marginal cost of profit shifting is less as MNEs makes larger operating profits.

This traditional formulation of the cost function has one caveat that it does not reflect comparability of an intra-firm transaction with another. In this model, it is straightforward to assume that the cost of profit shifting gets lower as the products are more differentiated. To capture this aspect, we decompose \( \eta \) into two elements. First part of \( \eta \) is factors that MNEs cannot change, which is denoted by \( \theta \). One example of the factors is the prevalence of knowledge or information of using tax havens, which makes it easy to shift profits into tax havens. In this paper, we interpret \( \theta \) as a term of financial economic integration.\(^8\) Second, the difficulty of profit shifting also depends on the degree of product differentiation between the MNEs. In any forms of intra-firm transactions, tax authorities need to find appropriate comparable price so-called comparable uncontrolled price (CUP). If the intra-firm traded assets either tangible or intangible are differentiated, finding CUP is difficult for tax authorities. Thus, shifting profits gets easier as products are more differentiated. To incorporate these two properties, we assume \( \eta = \theta s \).\(^9\)

We use a superscript “P” for the case with profit shifting.

### 3.2 Profit shifting

When profit shifting is possible, MNE \( i \) maximizes the following post-tax global profits,

\[
\Pi_i^P = (1 - t_D)(\pi_i - \pi_S^i) + \pi_S^i - F(d_i) - \frac{\theta s(\pi_S^i)^2}{2\pi_i},
\]

(8)

\(^7\)This specification is also used in some empirical papers. See, for example, Hines Jr and Rice (1994), Huizinga and Laeven (2008), and Gumpert et al. (2016).

\(^8\)The existing literature also interprets this term as the degree of government’s attention to auditing profit shifting. In this case, higher \( \theta \) can be interpreted as stricter policy or regulation such as worldwide cooperation, e.g. BEPS project or AL principle.

\(^9\)This specification of \( \eta \) is not critical to derive our results. See appendix for derivation of generalized form of \( \eta(\theta, s) \).
where the first term is post tax profits in country $D$ and the second term is those in country $H$. The first order condition provides the following optimal shifted profits,

$$\hat{\pi}_i^S = \frac{t_D}{\theta_S} \pi_i. \quad (9)$$

To secure positive reported profits in country $D$, we assume $\frac{t_D}{\theta_S} \in [0, 1]$.

The optimal amount of shifted profits is determined by balancing the marginal benefit with the marginal cost from profit shifting. Eq.(9) shows four determinants of profit shifting. The MNEs shift more profits when tax gap gets wider, which increases the benefit of saving tax payment, and when the world is financially well integrated, captured by lower $\theta$, which reduces the cost of profit shifting. Intuitively, the shifted profits are 0, which corresponds with the case of no profit shifting, when there is no tax gap, $t_D = 0$, or the world is financially segmented, $\theta \to \infty$.

On top of these two determinants which are argued in the existing literature, two more new channels caused by product differentiation appear in this model. First, as higher product differentiation, captured by higher $d_i$ or lower $s$, makes it difficult to find CUP, it decreases the marginal cost of profit shifting. Second, as more operating profits reduces the cost of shifting profits, the shifted profits is increasing in the operating profits.$^{10}$ As we saw above, product differentiation increases operating profits so that both of these new determinants positively affect the MNEs’ tax saving strategy.

Plugging in the optimal shifted profits, the maximized profits become,

$$\Pi_i^P = \left(1 - t_D + \frac{t_D^2}{2 \theta_S} \right) \pi_i - F(d_i). \quad (10)$$

The last term of the bracket appears in the presence of profit shifting, which captures the net gains from tax savings. From the equation, we can see the decision on profit shifting is independent from the quantity setting. Thus, the outcome in the second stage is the same as in the benchmark.

$^{10}$In the transfer pricing literature, the amount of shifted profits is product of transfer price and the amount of exports. Therefore, they also has a similar channel to ours that more exports (or more operating profits) leads to more shifted profits. Unlike our model, however, their channel is related to benefit side since MNEs are able to shift more profits when they conduct intra-firm trade more even if the same transfer price are set while our model indicates the channel through cost side. For example, see Choi et al. (2018).
3.3 Investment decision with profit shifting

In the presence of profit shifting, eq. (3) and (11) give the following post-tax profits of MNE $i$,

$$\Pi_i^p = \left(1 - t_D + \frac{t_D^2}{2\theta(1 - d_i - d_j)}\right) \left(\frac{a - c}{3 - d_i - d_j}\right)^2 - F(d_i).$$  \hspace{1cm} (11)

Similarly, the first order condition shows the condition that the optimal investment level $d^p$ satisfies as,

$$\left.\frac{\partial \Pi_i^p}{\partial d_i}\right|_{d_i = d_j = d^p} = \frac{2(1 - t_D)(a - c)^2}{(3 - 2d^p)^3} + \frac{t_D^2(a - c)^2}{\theta(1 - 2d^p)(3 - 2d^p)^3} + \frac{t_D^2}{2\theta(1 - 2d^p)^2 (3 - 2d^p)^2} - F'(d^p) = 0.$$  \hspace{1cm} (12)

The second and third terms appear as the additional incentives to capture marginal benefits from tax savings since the term of tax saving gains exists in eq.(10). The second term in eq.(12), we refer to this as “tax avoidance effect”, captures the marginal benefit from the existence of profit shifting. As the more product differentiation results in the higher operating profits and shifted profits, the opportunity to shift profits is more profitable as more product differentiation even with the fixed tax saving term in eq.(10). Furthermore, the third term in eq.(12) captures the link between product differentiation and the cost of profit shifting, we refer to this as “concealment cost effect”. More product differentiation benefits the MNEs via less cost of profit shifting so that it increases tax saving gains even with fixed operating profits. As the new terms are always positive, the chance to save tax payments provides a stronger incentive to invest in product differentiation with the MNEs.

Note that the concealment cost effect is a specific term in this model as the effect reflects the determinant that more product differentiation leads to lower cost of profit shifting. With a traditional concealment cost, product differentiation has no impacts on the cost structure so that the term disappears once we ignore the relation between product differentiation and the cost of profit shifting. To clarify this point, let $d^T$ be the investment level under the case of traditional concealment cost where the concealment cost is unrelated to product differentiation. Then, $\hat{d}^T < \hat{d}^P$ holds because of disappearance of the positive concealment cost effect. These arguments lead to the following proposition.

**Proposition 1.** The opportunity of profit shifting induces the MNEs to invest more in product R&D, $\hat{d}^P < \hat{d}^T$. This effect is reinforced when product differentiation reduces the costs of profit shifting, $\hat{d}^T < \hat{d}^P$. 
3.4 Economic integration

In the last subsection, we see the impact of financial economic integration on product differentiation but this is one extreme example of integration, that is, autarky to financially open economy. Although the above analysis provides several arguments, considering marginal economic integration is helpful to explain the reality since the recent world is featured by marginal integration. Thus, this section focuses on another type of economic integration, or a reduction in $\theta$.

By differentiating eq.(12) with respect to $\theta$, we obtain

$$\frac{\partial}{\partial \theta} \left( \frac{\partial \Pi_i^p}{\partial d_i} \right) \bigg|_{d_i=d_j=d^p} = - \left( \frac{t_D^2(a-c)^2}{\theta^2(1-2d^p)(3-2d^p)^2} \right) \left( \frac{1}{3-2d^p} + \frac{1}{2(1-2d^p)} \right) < 0. \quad (13)$$

Financial economic integration reduces the cost of profit shifting, increases tax saving gains, and thus increases the marginal benefit of the investment via both tax avoidance effect and concealment cost effect. As the optimal level of the investment is determined so as to balance the marginal benefit and the marginal cost of the investment, economic integration clearly induces the MNE to invest more in product differentiation. Thus, we have the following proposition.

Proposition 2. Financial economic integration induces the MNEs to invest more in product differentiation, $\frac{\partial d_i^p}{\partial \theta} < 0$.

4 Welfare effect

Economic integration has three effects on the post-tax global profits of the MNEs. Directly, economic integration magnifies the tax saving gains. On top of that, the more product differentiation via economic integration increases not only operating profits but also tax saving gains. Clearly, three effects augment the post-tax global profits. Formally, we can obtain the following inequality,

$$\frac{\partial \Pi_i^p}{\partial \theta} = - \frac{t_D^2}{2\theta^2(1-2d^p)} \left( \frac{a-c}{3-2d^p} \right)^2 < 0. \quad (14)$$

Next, we analyze the impact on a consumer surplus from the differentiated products. Let $CS_X$
be denoted as the consumer surplus,

\[ CS_X = a(\hat{x}^p + \hat{x}^p) - \frac{(\hat{x}^p)^2}{2} - \frac{(\hat{x}^p)^2}{2} - s(\hat{x}^p)^2 - \sum_{i \in \{1,2\}} \hat{p}_i^p \hat{x}_i^p = 2(1 - d^p) \left( \frac{a - c}{3 - 2d^p} \right)^2 \]  

(15)

As consumers love variety, there are two effects of more product differentiation on consumer surplus. First, the volume of consumption is a determinant which is captured by the second term of eq. (15). More product differentiation results in more consumption and thus obviously has a positive effect on the consumer surplus via the volume effect. On the other hand, product differentiation has a negative effect on the consumer surplus via price increases. Recall that product differentiation softens the market competition among the MNEs and thus increases the prices. This aspect is captured by the first term of eq.(15). Irrespective of the counteracting effects, the first derivative of the consumer surplus with respect to \( \theta \) is,

\[
\frac{\partial CS_X}{\partial \theta} = \frac{\partial CS_X}{\partial d_i} \frac{\partial d_i}{\partial \theta} = \frac{2(1 - 2d^p)(a - c)^2}{(3 - 2d^p)^3} \frac{\partial d_i}{\partial \theta} < 0. \tag{16}
\]

Therefore, the positive effect of product differentiation due to economic integration always exceeds the negative one.

Contrary to the positive effects on consumers and the MNEs, economic integration can have a negative impact on tax revenues in country \( D \) which is formulated as,

\[
TR_D^p = t_D \left( \sum_{i \in \{1,2\}} \pi_i^p - \pi_S^p \right) = 2t_D \left( 1 - \frac{t_D}{\theta(1 - 2d^p)} \right) \left( \frac{a - c}{3 - 2d^p} \right)^2, \tag{17}
\]

which yields,

\[
\frac{\partial TR_D^p}{\partial \theta} = 2t_D \left( \frac{a - c}{3 - 2d^p} \right)^2 \left\{ \frac{t_D^2}{\theta^2(1 - 2d^p)} + \frac{2}{3 - 2d^p} - \frac{t_D(5 - 6d^p)}{\theta(1 - 2d^p)^2(3 - 2d^p)} \right\} \frac{\partial d_i}{\partial \theta}. \tag{18}
\]

The direct effect is to induce outflows of tax base to country \( H \), which is the first term of the second parenthesis. The indirect effects via product differentiation, however, work in the opposite directions. On the one hand, more product differentiation also results in more outflows of tax bases as it increases tax saving gains. One the other hand, more product differentiation also increases the operating profits of the MNEs via less competition. Therefore, the overall impact of economic integration on tax revenues in country \( D \) is not obvious. As the direct effect is the first order, we can confirm the negative sign if the economic integration is highly developed and \( \theta \) approaches to the
lower bound $\frac{\partial TR^D}{\partial \theta} \bigg|_{\theta = \frac{t_D}{1-\frac{t_D}{2}}} > 0$. Our numerical example, seen in Fig.2 in appendix, also illustrates that economic integration results in a fall of tax revenues.

Given the counteracting effects on consumers, the MNEs and tax revenues, the overall effect on welfare in country $D$ is ambiguous so that we investigate the welfare impact of economic integration in the rest of this section. We assume that the government’s objective function is the welfare of consumers. Note that consumers own the MNEs so that MNEs’ post-tax profits accrue to consumers. Thus, we can compute the objective function of the government as,

$$u(\hat{x}^p, \hat{y}^p) = \hat{CS}^P_X + \sum_{i \in \{1,2\}} \hat{\Pi}^P_i + \beta \hat{TR}^P_D. \quad (19)$$

Figure 1 illustrate welfare in country $D$ without and with profit shifting cases at different value of $\beta$, $\beta = 2$ for the left figure and $\beta = 1.05$ for the right one.\footnote{This figure is derived using the following parameter values: $a = 2$, $t_D = 0.2$, and $F(d_i) = \frac{d_i^2}{2}$.}

In each figure, an upward sloping curve represents welfare in country $D$ for the case with profit shifting and a horizontal dashed line does for the one without profit shifting. These figures indicate that the tax revenue effect of economic integration dominates the sum of the other effects via consumers and the MNEs. As the marginal utility from the public good is greater than the homogeneous good, a reduction in tax revenues is the main impact.

4.1 Optimal tax rate

So far, we fixed the corporate tax rate in country $D$. Hereafter, we endogenize the tax rate.
In the absence of profit shifting, the first order condition for the tax rate is derived as,

\[
\frac{\partial u^O}{\partial t_D} = 2 \left( \frac{a - c}{3 - 2d^c} \right)^2 \left[ \beta - 1 + \left\{ \frac{1 - 2d^O}{3 - 2d^O} + \frac{\beta t_D}{3 - 2d^O} \right\} \frac{\partial d_i}{\partial t_D} \right]. \tag{20}
\]

The first two terms of the square bracket are the direct effect that an marginal utility from the public good and marginal (dis)utility from the homogeneous good. As we assume \( \beta > 1 \), the government has an incentive to collect greater tax revenue. On top of this, the rest terms of the bracket is indirect effects via change in product differentiation. Note that an increase in tax rate discourage MNEs to invest in product differentiation because a higher corporate tax rate reduces post tax operating profits and thus gains from product differentiation. Therefore, \( \frac{\partial d_i}{\partial t_D} < 0 \) holds, which means that a higher corporate tax results in less product differentiation, consumer surplus and tax revenue. Although it is possible that the optimal corporate tax rate is zero when \( \beta \) is close to unity, our focus is more on realistic case that the government impose a positive tax rate. Thus we assume \( \beta \) is large enough to make the square bracket positive so that equilibrium tax rate in the absence of profit shifting is unity.

With profit shifting, the first order condition is,

\[
\frac{\partial u^O}{\partial t_D} = 2 \left( \frac{a - c}{3 - 2d^c} \right)^2 \left[ \beta - 1 + \left\{ \frac{1 - 2d^P}{3 - 2d^P} + \frac{\beta t_D}{3 - 2d^P} \right\} \frac{\partial d_i}{\partial t_D} \right] + \left\{ \frac{1 - 2d^P}{3 - 2d^P} + \beta t_D \left( \frac{1}{3 - 2d^P} - \frac{t_D(5 - 6d^P)}{\theta(1 - 2d^P)^2(3 - 2d^P)} \right) \right\} \frac{\partial d_i}{\partial t_D} \right]. \tag{21}
\]

As an additional direct effect, an increase in tax rate gives the opportunity of profit shifting for tax savings. Even though such a tax avoidance contributes to an increase in consumption of homogeneous product, it reduces tax revenues and thus public good provision which is more valuable for the consumer. Moreover, since such a tax avoidance behaviour entails concealment costs, the net effect of the tax avoidance is negative. Due to this direct impact, the government’s incentive to impose a higher corporate tax rate is mitigated. Furthermore, there exist a new indirect effect as well. Since MNEs has a stronger incentive to invest in product differentiation for tax saving, they engage in more investment, which results in greater operating profits and thus tax revenue. In total, although we assume eq.20 is positive, the new impacts are opposite directions and the total impact is unequivocal.
Here, we again rely on numerical calculation as it is impossible to derive analytical results. In Table 1, the numerical results are provided with $\beta = 1.20$ which is in-between of the benchmark analysis.\(^{12}\)

<table>
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<th>$\theta$</th>
<th>0.5</th>
<th>1.0</th>
<th>1.5</th>
<th>2.0</th>
<th>2.5</th>
<th>3.0</th>
<th>3.5</th>
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<th>4.5</th>
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<td>0.06715</td>
<td>0.10056</td>
<td>0.13385</td>
<td>0.16699</td>
<td>0.19999</td>
<td>0.23282</td>
<td>0.2654</td>
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<td>1.0</td>
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<td>0.08252</td>
<td>0.07937</td>
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<td>0.07320</td>
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<td>0.06723</td>
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<td>0.06145</td>
<td>0</td>
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<tr>
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<td>0.01537</td>
<td>0.02293</td>
<td>0.03041</td>
<td>0.03781</td>
<td>0.04512</td>
<td>0.05235</td>
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<td>0.47276</td>
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<td>0.47348</td>
<td>0.47384</td>
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<td>0.47453</td>
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<td>$t_{ef}$</td>
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<td>0.92465</td>
<td>0.92532</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Optimal tax policy

The values of the closed economy case are shown in the right edge of the table. As we saw, the optimal tax rate is unity. In this financial autarky case, the optimal investment level is zero since the post-tax operating profits are zero.

Once we allow profit shifting, we can see a reduction in tax rate in country $D$. This implies that the new direct impact dominates the indirect effect. The table also show a negative monotone relationship between economic integration and optimal tax rate because the reduction in $\theta$ is the first order effect. In other words, Although the government wants to collect tax revenue as much as possible and to set the highest tax rate, such a wide tax gap highly incentivizes the MNEs to shift profit more as seen in eq. (9). Therefore, the optimal tax rate can lie in an interval $[0, 1)$ when the world is enough integrated and decreases as $\theta$ becomes lower.\(^{13}\) This result is in line with the current economy that “bottom to the race” is observed. As a results, we can also confirm that economic integration accelerates product differentiation and decreases welfare in country $D$. Thus, qualitatively the same results as the main analysis are obtained.

Note that the effect of economic integration on the investment level is the same as the main analysis but another determinants exist in this modified case. As a reduction in tax rate due to economic integration discourages the MNEs to shift profits to country $H$ so that there exists an indirect effect to brake more investment in product differentiation. Therefore, the result in Table 1 suggests the direct pro-product-differentiation effect via economic integration dominates the indirect anti-product-differentiation effect.

The last investigation of the model is whether product differentiation accelerates the efficiency of tax avoidance of MNEs. One of the standard way of measuring the efficiency of profit shifting is to compute effective tax rate, which is the ratio of tax payments to operating profits. In this model,\(^{12}\)The same parameter values are used as Figure 1.\(^{13}\)In our numerical example, the optimal tax rate is less than unity when $\theta \lesssim 16.35$
the effective tax rate is computed as,

\[ t^{eff} = \left( 1 - \frac{\ln \left( \frac{1}{\theta} \right)}{\pi_i} \right) \pi_i = 1 - \frac{t_D}{\theta(1 - 2d^P)}. \]  \hspace{1cm} (22)

From the table 1, the impact of economic integration is not obvious as economic integration makes tax rate lower, which increases effective tax rate, but product more differentiated as well as the direct impact of reduction in \( \theta \). However, the bottom row of the Table 1 shows that economic integration realizes efficient tax avoidance. This reduction in effective tax rate is also observed in reality.

5 Discussions and policy implications

Proposition 1 and 2 give a new rationale for current development of product differentiation from the tax avoidance angle. In the closed economy, the MNEs determine the optimal level of investigation to equate the marginal benefit and cost from the investment. In the open economy, however, the benefit also includes the gains from tax avoidance. As the benefit becomes greater in a well integrated world, the existence of profit shifting induces MNEs to invest more in product differentiation.

However, the more product differentiation is a driver to exacerbate the MNEs’ tax avoidance and thus welfare in country \( D \). Due to the negative aspect, an increase in process R&D does not necessarily lead to improvement of welfare once we incorporate a tax haven. Our numerical analysis on welfare supports the result of Slemrod and Wilson (2009) even if we take product differentiation into account.

Our model also casts a new possibility of the relation between product differentiation and market structure. As in introduction, one can expect that firms have a strong incentive to engage in product differentiation when a product market is highly competitive to mitigate competition on the one hand. On the other hand, one can also expect intensive product differentiation when the market is less competitive because finding comparable transaction is difficult. \( \theta \) may reflect the degree of difficulty of finding comparable transaction and it would be higher as the global market is oligopoly with a few firms due to smaller numbers of potential transactions. Eq.(12) immediately shows the two tax saving gains from product differentiation is larger as \( \theta \) is small, equivalently, the global market is less competitive.

Finally, as a contribution by incorporating product differentiation into the concealment cost function, the benchmark model also suggests the current trend of more product differentiation.
is magnified by the regulation system that tax authorities try to find a proper transaction price based on a similarity of products. If tax authorities estimated proper transfer prices based only on information on such as production cost or profit ratio and did not pay attention to characteristics of products with other firms, the concealment cost effect would disappear. One possibility of the examples is the world with FA instead of SA. FA allocates a weighted consolidated global profits to an affiliate in each country as tax bases for the affiliate in that country. The weight is based on a formula which is composed of information on sales, property and payroll so that tax authorities do not have to find CUP. Tax avoidance effect still exists since some proportion of profits are taxed in a tax haven based on the formula. However, FA clearly destroys the investment incentive to reduce cost of profit shifting. Thus, our model predicts more product differentiation under SA than under FA.

6 Concluding remarks

In this paper, we have analyzed MNEs’ incentive to invest more in product differentiation in the presence of profit shifting. Product differentiation reduces the similarity of MNEs’ products, which makes it difficult for tax authorities to find comparable or appropriate AL price and to audit MNEs’ tax avoidance behaviours. Based on this practical difficulty, our model has shown a new rationale that MNEs engage in higher product differentiation. We also have analyzed the impacts of financial economic integration. Economic integration reduces the cost of profit shifting and increase a marginal benefit from product differentiation. As a result, the further economic integration leads to the more product differentiation.

The more product differentiation has counteracting effects. On the positive side, consumers and MNEs benefit due to more product differentiation and less market competition. On the negative side, tax revenue in a high tax country becomes smaller and thus the provision of a public good is scarce. Our numerical example showed that the negative effect dominates the positive ones.

Our analysis can be extended in several ways. First of all, as briefly discussed in the text, MNEs’ incentive to invest in product differentiation can differ under FA although this paper implicitly assumed that the world adopt SA scheme. As we can expect that FA discourages investment in product differentiation but increases tax revenue, the effects of a change in international tax scheme is still in question. Furthermore, we postulated that product differentiation takes place in the final product market but product differentiation is also seen in intermediate industries. Thus, investigation of a vertically related industries is interesting. Finally, governments’ behaviours should
be analyzed more in detail in order to obtain richer policy implications. Especially, as globally cooperative actions such as BEPS project begins, interaction between countries in non-cooperative and cooperative way can be one of the interesting extensions.

Appendices

A Figure

Figure 2: Tax revenue

References


