Profitable gray market with asymmetric costs

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November 2023

Discussion Paper No. 2319

GRADUATE SCHOOL OF ECONOMICS

KOBE UNIVERSITY

ROKKO, KOBE, JAPAN

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November 14, 2023

Abstract

When manufacturers sell their branded goods at different prices in different markets or channels, gray marketers buy goods in the low-priced market and resell them in the high-priced market to compete with the manufacturers' authorized sellers. Conventional wisdom suggests the lost sales in the high-priced market resulting from the gray market's diversion always make manufacturers worse off. However, by purely considering the marginal production cost in the high-priced market is higher than the low-priced market, we show that the manufacturer can gain from gray market, which contradicts to the conventional result. It happens when the marginal production cost in the high-priced market is sufficiently large (or the transaction cost for the gray marketer is sufficiently small in the linear demand case).

JEL codes: F12, F23, L13

Keywords: Gray market, parallel trade, cost asymmetry

*The second author gratefully acknowledges the financial support of the Japan Society for the Promotion of Science (JSPS), KAKENHI Grant Numbers JP22H00043 and JP23H00764. The usual disclaimer applies.

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1 Introduction

Gray market (also known as parallel trade) goods are genuine branded products sold by third parties ("gray marketers") through manufacturer-unauthorized channels. When manufacturers sell their branded goods at different prices in different markets or channels, gray marketers buy goods in the low-priced market and resell them in the high-priced market to compete with the manufacturers' authorized sellers. Conventional wisdom suggests that gray markets hurt manufacturers' profits by creating competition, which has also been shown in evidence in a wide variety of sectors. In the the survey of large high tech firms by KPMG (2008), it estimates that gray markets result in $58 billion of lost sales annually. And according to a 2009 analysis by Deloitte LLP, gray markets account for $63 billion (4.5% of sales) per year of lost U.S. sales in the consumer products sector (Wolf 2009). However, despite of the large impact of gray markets, firms do not always implement systems to control or monitor gray market distribution. For instance, in a survey conducted by KPMG (2008), it was found that 42% of the participants did not possess any system to detect or track gray market operations. Based on the above, one may have the following question: Why do some firms allow the existence of gray markets and do nothing to curb gray market activity? This study provides a possible reason for profitable gray market by introducing cost asymmetry of the manufacturer in different markets.

Specifically, we consider the marginal production cost in the high-priced market (e.g. developed countries with higher consumers' willingness to pay) is higher than the low-priced market (e.g. developing countries with lower consumers' willingness to pay). This cost asymmetry may be because the input cost is higher in the high-priced market, which is well-observed between developed countries and developing countries. Hence, it is natural to introduce such cost asymmetry into the discussion of gray market.

We find that a decrease in the transaction cost of the gray marketer, i.e., an increase of the transaction volume of the gray marketer, can benefit the manufacturer when the the marginal cost of the production for the domestic market is sufficiently large (or the transaction cost for the gray marketer is sufficiently small in the linear demand case). The intuition for this

result is as follows. In the presence of gray market, the manufacturer has two channels to supply its product to a domestic market. One is the direct channel, where the manufacturer supplies its product directly to the domestic market; the other is the indirect channel, where the manufacturer supplies its product to the foreign market and the gray marketer resells it to the domestic market. When the marginal cost of the production for the domestic market is large (or the transaction cost for the gray marketer is small in the linear demand case), the indirect channel becomes more efficient. In this case, the manufacturer can make more profit by using the indirect channel. As a result, the existence of gray marketer makes the manufacturer better off.

The conventional belief that gray markets hurt manufacturers' profits has been proved in many previous literature (Richardson 2002; Maskus and Chen 2004; Hur and Riyanto 2006, etc.). Our study is related to previous studies that tackle this well-known negative effect of gray market for manufacturers in various contexts (Ahmadi and Yang 2000; Knox and Richardson 2002; Li 2006; Raff and Schmitt 2007; Mukherjee and Zhao 2012; Autrey el al. 2015). These show that gray markets may benefit the manufacturers and provide the reasons why gray markets persist in the economy. However, no research among the above-mentioned studies proves that gray markets may benefit the manufacturers by purely considering the effect of cost asymmetry of the manufacturer in different markets.

The rest of this paper is organized as follows. Section 2 describes the model and Section 3 shows the conditions where a gray market benefits the manufacturer in both general and linear demand cases. Section 4 concludes.

2 Model

We consider a monopolist manufacturer M selling its products in a domestic market, market 1, and a foreign market, market 2 (where the market price is lower). The manufacturer has a plant in each of the country and offers products to both countries from the respective plant. We assume that the marginal production cost in the domestic market is $c_1 > 0$ and that for the foreign market is 0 (e.g. input cost in the domestic market).

In our analysis, we assume that there is a firm G, which we denote by the gray marketer, might divert the product of M from the foreign market to the domestic market.[1] There is a marginal transaction cost $c_G > 0$ for the gray marketer for trade between the two markets. Note that when c_G is sufficiently large, the gray marketer might not be able to survive in the market.

The production quantity in the domestic market and the foreign market are q_1 and q_2, respectively. We assume that the gray marketer G buys q_G units of the products in the foreign market and sells to the domestic market. Therefore, for the manufacturer M, by considering the consumption of the gray marketer, it faces a demand which equals to the total supply in the foreign market as $Q_2 = q_2 - q_G$ and in the domestic market as $Q_1 = q_1 + q_G$, where q_1 and q_2 are the production quantities in the domestic market and foreign market, respectively. We denote the inverse demand in the domestic market and the foreign market as $p_1(Q_1)$ and $p_2(Q_2)$, respectively. We assume that the first and second derivatives of the inverse demands are $p_i'(Q_i) < 0$ and $p_i''(Q_i) \leq 0$ $(i = 1, 2)$. Thus, the profit of the manufacturer M is $\pi_M \equiv [p_1(Q_1) - c_1]q_1 + p_2(Q_2)q_2$, while the profit of the gray marketer G is $\pi_G \equiv [p_1(Q_1) - p_2(Q_2) - c_G]q_G$.

The manufacturer M decides its production quantities q_1 and q_2, and the gray marketer G chooses the transaction volume q_G, simultaneously.[2] We employ Nash equilibrium as the equilibrium concept.

3 Analysis

In the constant-curvature demand model, for the simplicity of calculation, we assume that c_G is sufficiently large so that the transaction volume of the gray marketer is close to zero.[3]

[1] Our set-up of the gray market diversion also applies to a situation where a branded manufacturer attempts to price discriminate across different channels and leakage across the channels takes place.

[2] Even though some previous research assume that the gray marketer set the transaction volume as a Stackelberg follower after the output decisions of the manufacturer, for the simplicity of calculation in the general demand case, we assume all the players make the decisions simultaneously as Mukherjee and Zhao (2012).

[3] From the profit function of the gray marketer, q_G is negatively correlated to c_G, thus an increase of c_G leads to a reduction of q_G.

This assumption represents the situation where the size of the gray marketer is sufficiently smaller than that of the manufacturer. However, in the linear demand model, we do not set this limitation of c_G. We show similar results in both constant-curvature demand and linear demand cases.

3.1 Constant-curvature demand case

The manufacturer M and the gray marketer G maximize the profits by choosing q_i and q_G, respectively. Hence, we can have the first-order conditions as follows.

$$\frac{\partial \pi_M}{\partial q_1} = FOC_{q_1} = p_1(Q_1) + q_1 p_1'(Q_1) - c_1 = 0, \tag{1}$$

$$\frac{\partial \pi_M}{\partial q_2} = FOC_{q_2} = p_2(Q_2) + q_2 p_2'(Q_2) = 0, \tag{2}$$

$$\frac{\partial \pi_G}{\partial q_G} = FOC_{q_G} = p_1(Q_1) - p_2(Q_2) + q_G[p_1'(Q_1) + p_2'(Q_2)] - c_G = 0. \tag{3}$$

Then we derive the second-order conditions for the manufacturer:[4]

$$\frac{\partial^2 \pi_M}{\partial^2 q_i} = SOC_{q_i} = 2p_i'(Q_i) + q_i p_i''(Q_i) < 0.$$

Because of $p_i'(Q_i) < 0$ and $p_i''(Q_i) \leq 0$, we can easily get the second-order conditions are negative. Moreover, from the above second-order conditions, we can also derive that $SOC_{q_i} < p_i'(Q_i)$.

Now, we discuss the effects of the transaction cost of the gray marketer c_G on the product quantities of the manufacturer q_i and the transaction volume by the gray marketer q_G. Substitute $Q_1 = Q_1(c_G) = q_1(c_G) + q_G(c_G)$ and $Q_2 = Q_2(c_G) = q_2(c_G) - q_G(c_G)$ into the first-order conditions FOC_{q_i} in (1) and (2) and FOC_{q_G} in (3). Since differentiating the first-order conditions with respect to c_G equals to zero, i.e., $\partial FOC_{q_i}(c_G)/\partial c_G = 0$ and $\partial FOC_{q_G}(c_G)/\partial c_G = 0$, we use them solving for $\partial q_i(c_G)/\partial c_G$ and $\partial q_G(c_G)/\partial c_G$. Recalling the second-order conditions

[4]It is easy to find that $\partial^2 \pi_M/\partial q_i \partial q_j = 0$ and the Hessian condition in which $\partial^2 \pi_M/\partial q_i^2 \cdot \partial^2 \pi_M/\partial q_j^2 - [\partial^2 \pi_M/\partial q_i \partial q_j]^2 = SOC_{q_i} SOC_{q_j} > 0$.

SOC_{q_i}, we then obtain the following results of the comparative statics. Note that here we consider the case where c_G is sufficiently large so that the transaction volume by the gray marketer is positive but sufficiently close to zero, i.e., $q_G \approx 0$ and then $Q_i \approx q_i$.

Lemma 1 *When c_G is sufficiently large, a reduction in the transaction cost of the gray marketer decreases the domestic output level, but increases the foreign output level and the transaction volume of the gray marketer. That is,*

$$\left.\frac{\partial q_1(c_G)}{\partial c_G}\right|_{q_G \approx 0} = \frac{SOC_{q_2}[p_1'(Q_1) - SOC_{q_1}]}{\xi} > 0,$$
$$\left.\frac{\partial q_2(c_G)}{\partial c_G}\right|_{q_G \approx 0} = \frac{SOC_{q_1}[SOC_{q_2} - p_2'(Q_2)]}{\xi} < 0,$$
$$\left.\frac{\partial q_G(c_G)}{\partial c_G}\right|_{q_G \approx 0} = \frac{SOC_{q_1} SOC_{q_2}}{\xi} < 0,$$

where $\xi = SOC_{q_1} SOC_{q_2} p_1'(Q_1) + SOC_{q_2} p_1'(Q_1)^2 + SOC_{q_1} p_2'(Q_2)[SOC_{q_2} + p_2'(Q_2)] < 0$.

An intuition behind Lemma 1 is simple. An increase in c_G raises the marginal cost of the gray marketer. Hence, q_G decreases with c_G, $\partial q_G(c_G)/\partial c_G < 0$. In the domestic market, because of the strategic substitutability, the decrease of q_G leads to an increase of the output of the manufacturer q_1, i.e., $\partial q_1(c_G)/\partial c_G > 0$. In the foreign market, the decrease of q_G causes a shrink of the demand, thus the output of the manufacturer q_2 decreases, i.e., $\partial q_2(c_G)/\partial c_G < 0$.

Then we analyze the effect of c_G on the profit of the manufacturer M. The manufacturer's profit is shown as $\pi_M(c_G) \equiv [p_1(Q_1(c_G)) - c_1]q_1(c_G) + p_2(Q_2(c_G))q_2(c_G)$, where $Q_1(c_G) = q_1(c_G) + q_G(c_G)$ and $Q_2(c_G) = q_2(c_G) - q_G(c_G)$. Substituting the results in Lemma 1 into the manufacturer's profit, and then differentiating $\pi_M(c_G)$ with respect to c_G, we have

$$\left.\frac{\partial \pi_M(c_G)}{\partial c_G}\right|_{q_G \approx 0} = \frac{c_1 SOC_{q_2}[p_1'(Q_1) - SOC_{q_1}] + \psi}{-\xi} \tag{4}$$

where $\psi = SOC_{q_2} p_1(Q_1)[SOC_{q_1} - p_1'(Q_1)] + SOC_{q_1} p_2(Q_2)[p_2'(Q_2) - SOC_{q_2}] - q_1 SOC_{q_2} p_1'(Q_1)^2 + q_2 SOC_{q_1} p_2'(Q_2)^2$. Note that $\partial \pi_M(c_G)/\partial c_G$ in (4) is a linear function of c_1 and the coefficient

of c_1 is negative. Therefore, solving $\partial \pi_M(c_G)/\partial c_G = 0$ for c_1, we obtain the threshold value c_1^* and then the following result.[5]

Proposition 1 *When c_G is sufficiently large, a reduction in the transaction cost of the gray marketer increases the profit of the manufacturer, which indicates that an increase of the transaction volume by the gray marketer benefits the manufacturer, if*

$$c_1 > \frac{\psi}{SOC_{q_2}[SOC_{q_1} - p_1'(Q_1)]} \equiv c_1^*.$$

We have a clean intuition behind this proposition. When the gray marketer is active, the manufacturer has two channels to supply its product to a domestic market. The first is the direct channel, where the manufacturer supplies its product directly to the domestic market; the second is the indirect channel, where the manufacturer supplies its product to the foreign market and the gray marketer resells it to the domestic market. When the marginal cost of the production for the domestic market c_1 is large, the direct channel becomes inefficient. In this case, the manufacturer can make more profit by using the indirect channel. Thus, a decrease in the transaction cost (an increase of the transaction volume) of the gray marketer brings more profit to the manufacturer, i.e., $\pi_M(c_G)/\partial c_G < 0$.

3.2 Linear demand case

Here, we present the condition where the gray marketer benefits the manufacturer under a linear demand model. Similar to the mechanism in the general demand model in the previous subsection, the linear inverse demand functions in the domestic market and the foreign market are $p_1(Q_1) = 1 - q_1 - q_G$ and $p_2(Q_2) = F - q_2 + q_G$, respectively. We assume that the market size of the foreign market is smaller, hence $F < 1$.[6] In addition, we assume $1 - F > c_G > 0$, which is a sufficient condition to enable the gray marketer to engage in the transaction between the foreign market and the domestic market. Moreover, we assume $1/4 < F < 1$ to guarantee all the outcomes in the equilibrium are positive.

[5]Since the coefficient of c_1 is negative in (4), $\partial \pi_M(c_G)/\partial c_G < 0$ if $c_1 > c_1^*$. Moreover, c_G is inversely related to q_G.

[6]The set-up of the linear inverse demand functions is similar to Mukherjee and Zhao (2012).

Substituting the linear inverse demand functions into the profit functions of the manufacturer and the gray marketer, from the the first-order conditions $\partial\pi_M/\partial q_i = 0$ and $\partial\pi_G/\partial q_G = 0$, we have the following outcomes.

$$\begin{aligned}
q_1^L =& \frac{1-2c_G+5F+c_1}{12}, \quad q_2^L = \frac{5+2c_G+F-7c_1}{12}, \quad q_G^L = \frac{1-2c_G-F+c_1}{6}, \\
\pi_M^L =& \frac{[13+4c_G^2+13F^2+2F(5-c_1)-34c_1+25c_1^2+8c_G(1-F-2c_1)]}{72}, \\
\pi_G^L =& \frac{(1-2c_G-F+c_1)^2}{18},
\end{aligned}$$

where the superscript L represents the case under linear inverse demand functions.

Now, we examine the effect of c_G on the profit of the manufacturer M. Differentiating the profit of the manufacturer with respect to c_G yields

$$\frac{\partial\pi_M}{\partial c_G} = \frac{1+c_G-F-2c_1}{9}.$$

Note that when there is no marginal production cost for the manufacturer in the domestic market, i.e., $c_1 = 0$, we have $\partial\pi_M/\partial c_G = (1-F+c_G)/9 > 0$, which means that an increase of the gray marketer's transaction cost always benefits the manufacturer. In another word, without cost asymmetry, gray market always hurts the manufacturer, which is a conventional result. Here, with the marginal cost c_1 for the manufacturer, solving $\partial\pi_M/\partial c_G < 0$ for c_1, we obtain the following result.

Proposition 2 *With linear demand functions, a reduction in the transaction cost of the gray marketer increases the profit of the manufacturer if* $c_1 > (1+c_G-F)/2$.

An intuition behind this proposition is similar to that behind Proposition 1. The manufacturer has two channels to supply its product to the domestic market: the direct channel and the indirect channel. If the marginal cost of production in the domestic market, c_1, is large or the marginal cost of the gray marketer, c_G, is small, the direct channel is less inefficient than the indirect channel. In this case, an increasing share of the gray marketer by reducing c_G makes more profit for the manufacturer.

4 Conclusions

When manufacturers sell their branded goods at different prices in different markets or channels, gray marketers buy goods in the low-priced market and resell them in the high-priced market to compete with the manufacturers' authorized sellers. Conventional wisdom and evidence show that gray market always hurt the manufacturers by creating competition. However, by introducing the marginal production cost in the high-priced market, which is higher than the low-priced market, we show that gray market may benefit the manufacturer. This result occurs when the marginal production cost in the high-priced market (cost asymmetry) is sufficiently large (or the transaction cost for the gray marketer is sufficiently small in the linear demand case).

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