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Product Innovation with Parallel Imports *

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Abstract: In this paper, we develop a theoretical model of product innovation in the context of parallel imports with endogenous investment. It is shown that, in contrast to the existing arguments, parallel imports have ambiguous effect on product innovation and may facilitate product innovation. We find that parallel imports discourage product innovation in the following cases: symmetric transportation costs, unrelated products or symmetric market sizes when these two products are not substitutes. In other cases, parallel imports may facilitate product innovation.

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Product Innovation with Parallel Imports

1. Introduction

Controversy has arisen as to whether parallel imports reduce the manufacturer's incentives to innovate. Parallel imports are such activities that products produced under a protection or trademark, sold into another market without the manufacturer's permission. The popularity of parallel trade has received a wide attention for two main reasons: the first one is that it reduces the manufacturer's short-run profit by introducing intra-brand competition; the second reason which is the more important one is that parallel imports may decrease the long-run profit by creating the possibility of lowering the manufacturer's incentives to engage in innovation.

It is well known that there are two types of innovation: one is process innovation (cost-reducing innovation) and the other one is product innovation (develop a new product). Process innovation with parallel imports is the primary focus of another paper of mine. In that paper, it is found that cost-reducing innovation is helpful in lowering wholesale price. The main result is that parallel imports or the distortions associated with parallel imports discourage the manufacturer's incentives to make investment in process innovation. Those results are highly consistent with the existing intuitive analysis. Thus it is highly desirable to examine the product innovation in the presence of gray market activities. Accordingly of particular interest of this paper is trying to make a further step in bridging this gap.

The existing work on parallel trade argues that parallel imports discourage the manufacturer's incentive to make investment in innovation. [1] While such reasoning seems valid, after all parallel importers free ride on the manufacturer's investment and reduce the manufacturer's profit, it could be misleading not only because these arguments are typically based on intuitive analysis, but also because innovation could change the volume of parallel trade and result in the changes of sales together with the prices in related markets. Parallel imports reduce the profits no matter innovation is successful or not. It is the difference between these two levels of profitability that determines the manufacturer's incentive to innovate. Thus two important questions arise in this case: Do

[1] See Cavusgil and Sikora (1988); Cespedes, Corey and Rangan (1988); Duhan and Sheffet (1988); Michael and College (1998); Maskus (2000a, b) and Palia and Keow

parallel im

A manufacturer, M, has an existing product, X, and may make investment to innovate a new product, Y. M sells his products in two countries, A and B. M sells his products by himself in country A, and sells his products through an independent distributor, D, in country B. We assume that M cannot sell his product directly to country B. However the distributor can sell the products back to A through gray market. M cannot legally ban parallel trade activities. When D sells the products back to A, she competes with M in the fashion of Cournot competition in market A and incurs respective additional constant marginal costs , . In ma

Obviously x_A and y_A are increasing with β. That is, the sales of the two products in country A increase when the products are complements and decrease when they are

The above subsection is about the case in which the manufacturer does not succeed in product innovation. It follows that we need to examine the case where the manufacturer is successful in product innovation.

When M’s product innovation is successful, then M’s profit and D’s gross profit through sales in country A are

$$ {}_{AM} = x_{AM}[1-(x_{AM}+x_{AD}) + \quad (y_{AM}+y_{AD})] + y_{AM}[1-(y_{AM}+y_{AD}) + \beta(x_{AM}+x_{AD})] $$

In this section, we continue to solve the model in the previous section and determine the manufacturer's optimal wholesale prices and total profit. We then show that whether parallel imports discourage the manufacturer's incentives to make investment in product innovation.

4. 1. The optimal wholesale prices

In this subsection, it is necessary for us to solve the optimal wholesale prices of the existing product and the new invented product. When Muct product Y has ambiguous impacts on either the sales of these products or the volumes of parallel imports. Wh

To simplify our analysis, we make the following assumptions:

A1: $(3-14t_x)+\beta(3-14t_y)\geq 0$**;**

A2: $(3-14t_y)+\beta(3-14t_x)\geq 0$**.**

(1). If $0\leq t_x, t_y<\frac{3}{14}$, then $w_x=\frac{2}{13}(1+4t_x)$ and $w_y=\frac{2}{13}(1+4t_y)$. There are parallel imports for both product X and Y. It is important to see that the wholesale price of one

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w_y into x_{AM} and y_{AM}, then we have $\frac{1}{13}[\frac{5}{1-\beta}+\frac{7(\quad+\beta\quad)}{1-\beta^2}]$

Once the manufacturer notices the relation between these two products, he would like to adjust his decisions when he offers wholesale prices. [11]

Corollary 2: *If* $0 \le t_x < \frac{3}{14}$ *and* $\frac{3}{14} \le t_y < \frac{1}{2}$, *then volume of parallel trade of product* X *is,* $x_{AD} = \frac{1}{13}[\frac{3}{1-\beta} - \frac{14(t_x + \beta t_y)}{1-\beta^2}]$. [12] [13]

Although x_{AD} takes the same form as in corollary 1, it is different from that one because the transportation cost of good Y are different. See figure 2.

(3). If $0 \le t_x < \frac{3}{14}$ and $t_y \ge \frac{1}{2}$, then t_y is high enough to block parallel imports of product Y. However there are parallel imports for good X. Thus we should rewrite M's profit function and determine optimal wholesale prices by taking first order condition. [14] If $\beta > 0$, then X and Y are complementary goods. M will offer

$w_x = \frac{2}{13-4\beta^2}(1-\beta^2)(1+4t_x)$. $_x$ is exactly the same as case one when

Here the first effect is dominated by the second effect. Thus M is likely to offer positive w_y to increase his total profit. Second, we can see that w_x is lower in the case of X and Y are complements than that in the case of X and Y are substitutes. The logic is that if X and Y are complements, then M's direct sales of good X in country A is higher, [16] it forces D to sell fewer good X back to country A. This enables M to offer lower to reduce the distortion in market B.

Corollary 4: *If* $\frac{3}{14} \le t_x < \frac{1}{2}$ *and* $0 \le t_y < \frac{3}{14}$, *then volume of parallel trade of product* Y *is,* $y_{AD} = \frac{1}{13}[\frac{3}{1-\beta} - \frac{14(t_y + \beta t_x)}{1-\beta^2}]$. [21]

(5). If $\frac{3}{14} \le t_x, t_y < \frac{1}{2}$, then the first order conditions of the profit function with respect to w_x and w_y are positive. [22] Thus the manufacturer's incentives to prevent parallel trade are so high that he would like to offer wholesale prices are high enough to deter gray market activities for both products. That is, $w_x = \frac{1}{2}(1-2t_x)$ and $w_y = \frac{1}{2}(1-2t_y)$. It is not surprising to see that they are symmetric in terms of their own transportation cost. But w_x and w_y take the same forms as there is only one product. It is interesting that these wholesale prices only depend on their own transportation cost rather than on the other good's transportation cost. Obviously parallel imports for both goods are deterred in this case. The manufacturer's total profit is (B30) in appendix B(5).

(6). If $\frac{3}{14} \le t_x < \frac{1}{2}$ and $t_y \ge \frac{1}{2}$, then the high transportation cost of product Y blocks the parallel trade of the new good. The first order condition of M's profit function with respect to w_x is positive. [23] It is beneficial for M to offer high wholesale price for product X to deter parallel imports. Thus the optimal wholesale prices are $w_x = \frac{1}{2}(1-2t_x)$ and $w_y = 0$ when X and Y are complements ($\beta > 0$), and are $w_x = \frac{1}{2}(1-2t_x)$ and $w_y = -\beta\frac{1}{2}(1-2t_x)$ when X and Y are substitutes ($\beta < 0$). It is interesting that when X and Y are substitu

If $\beta > 0$, then $\pi_M^p = \frac{1}{16(1-\beta)}[8(1+a^2) - \frac{(1-2t_x)^2}{1+\beta}] - k^p$ (23)

If $\beta < 0$, then ${}_M^p \quad \underline{} \quad {}_x \quad {}^p$

$w_y = \frac{2}{13}(1+4t_y)$. Here parallel trade of product X does not occur, but parallel trade of good Y does occur. Again w_x is positive when

second case. Thus M is less likely to make investment in product innovation in the first case. It is somehow that the uncertainty of success in innovation makes the manufacturer distinguish the existing parallel trade from the anticipated parallel trade. Accordingly the manufacturer has different willingness to make investment in product innovation.

3.3. Do parallel imports lower the manufacturer's incentive to innovate?

How do we understand the role of parallel imports in a world in which the manufacturer may invest in product innovation? Some scholars assert that parallel trade inhibits the manufacturer's incentive to innovate. The basic logic behind these arguments is that the manufacturer's product innovation has the property of public goods so that parallel trad manufacturer's incentives in product innovation provided that $t_x = t_y = 0$ and $a = 1$. This result is highly consistent with previous arguments about parallel imports. We have confirmed their intuitive analysis by making use a simple numerical model.

Second, our proof in the second part indicates parallel imports may facilitate the manufacturer's incentive to innovater5862 6262.007i0001 Tc -0.000 Tc -0.0077 0 0 12.0077 90.0013036410

Motivated by the case of zero transportation costs for both products, we now turn to look at the case in which both the transportation costs approach to $\frac{3}{14}$ from the left side. Our results are represented in corollary 7.

Corollary 7: *The manufacturer is less likely to invest in product innovation with parallel trade than that without parallel trade if the transportations costs are both equal and close to* $\frac{3}{14}$, *i.e.* $t_x = t_y \rightarrow \frac{3}{14}$

proposition is sufficient but not necessary for M is less likely to innovate in the presence of gray market activities.

It is worth commentary for the case in which $a = 1$ and $\beta < 0$. If product X and Y are substitutes, we are not sure whether parallel imports discourage product innovation or not. Parallel trade could either facilitate [30] or inhibit [31] product innovation.

Proposition 3 concerns with the behavior of the manufacturer in a situation where the transportation costs are symmetric for the existing product and the new product. Proposition 4 focus the manufacturer's responses in a world where the two market sizes are the same when $\beta \geq 0$. Given what we have observed in this subsection, one may be encouraged to say whether there are some regular patterns concerning with M's decision for some values of β. The result is generated in the next proposition.

Proposition 5: *If* $0 \leq t_x, t_y < \frac{3}{14}$*, then parallel imports discourage product innovation when these two products are unrelated goods, i.e.* $\beta = 0$*.* [32]

Proposition 5 shows that when these two products are independent goods, parallel trade inhibits product innovation regardless the market sizes and the transportation costs.

4. Conclusions

Our contribution of the present paper is examining the debate concerning product innovation in the presence of parallel imports with endogenous investment choices. In contrast to the existing less formal argument on product innovation under gray market activities, we have developed a formal model to show whether parallel imports discourage the manufacturer's incentives to innovate and provided many valuable insights. In constructing the model, great em parallel trade in determining the manufacturer's investment in product innovation. It seems that the uncertainty of innovation matters here: the manufacturer is more willing to invest in product innovation when he has higher expected returns from this innovation.

The final result indicates that the manufacturer is less likely to make investment in product innovation in the presence of gray market activities in the following cases: symmetric transportation costs, unrelated products or symmetric market sizes when these two products are not substitutes. That is, parallel imports do discourage product innovation in these three cases: symmetric transportation costs, independent products or symmetric market sizes when these two products are not substitutes. We should mention here these conditions are sufficient but not necessary for parallel trade to discourage the manufacturer's investment in product innovation.

Although it is very important of the relation between the existing product and the new product in determining the manufacturer's investment in product innovation, we have not seen the regular pattern when they are related products. It could be possible that parallel trade makes the manufacturer more likely to invest in product innovation regardless these two products are substitutes or complements.

While we believe this paper is offering some valuable insights on how parallel imports affect the manufacturer's incentive to engage in product innovation, it is not enough in understanding the impacts of parallel trade on product innovation in more general cases. It would be interesting for the future research to extend the model is this paper to incorporate multiple markets and multiple distributors. Another interesting direction for further research is to include the possibility of incomplete information on the distributor's market. In addition, it would be desirable to find some data and test our conclusions of this paper.

Appendix:

A. M's profit in A and D's gross profit in B are

$$\pi_A = (1 - x_A + \beta y_A)x_A + (1 - y_A + \beta x_A)y_A \qquad \text{(A1)}$$

$$\pi_B = (a - x_B + \beta y_B - w_x)x_B + (a - y_B + \beta x_B - w_y)y_B \qquad \text{(A2)}$$

The first order conditions of (A1) and (A2) yield

$$x_A:\ 1 - 2x_A + 2\beta y_A = 0 \qquad \text{(A3)}$$

$$y_A:\ 1 - 2y_A + 2\beta x_A = 0 \qquad \text{(A4)}$$

$$x_B:\ a - 2x_B + 2\beta y_B - w_x = 0 \qquad \text{(A5)}$$

$$y_B:\ a - 2y_B + 2\beta x_B - w_y = 0 \qquad \text{(A6)}$$

We solve (A3), (A4), (A5) and (A6) to get the solutions.

$$x_A = y_A = \frac{1}{2(1-\beta)},\ x_B = \frac{(a - w_x) + \beta(a - w_y)}{2(1-\beta^2)} \text{ and } y_B = \frac{(a - w_y) + \beta(a - w_x)}{2(1-\beta^2)} \qquad \text{(A7)}$$

By using two-part tariff, M's total profit when he succeeds in product innovation is

It follows that we need to solve equations (B1) to (B6). The solutions are

$$x_{AM} = \frac{(1+t_x+w_x)+\beta(1+t_y+w_y)}{3(1-\beta^2)}, \quad x_{AD} = \frac{(1-2t_x-2w_x)+\beta(1-2t_y-2w_y)}{3(1-\beta^2)},$$

$$y_{AM} = \frac{(1+t_y+w_y)+\beta(1+t_x+w_x)}{3(1-\beta^2)}, \quad y_{AD} = \frac{(1-2t_y-2w_y)+\beta(1-2t_x-2w_x)}{3(1-\beta^2)},$$

$$x_B = \frac{(a-w_x)+\beta(a-w_y)}{2(1-\beta^2)} \quad \text{and} \quad y_B = \frac{(a-w_y)+\beta(a-w_x)}{2(1-\beta^2)}$$

With these results in hand, we are ready to get the manufacturer's profit. By plugging all the above solutions into M's profit function in (17), we have

$$\pi_M = \frac{1}{72}\Big(\frac{32}{1-\beta}+\frac{36a^2}{1-\beta}-\frac{16t_x}{1-\beta}+\frac{20t_x^2}{1-\beta}+\frac{20t_x^2}{1+\beta}-\frac{16t_y}{1-\beta}+\frac{40t_xt_y}{1-\beta}-\frac{40t_xt_y}{1+\beta}+\frac{20t_y^2}{1-\beta}+\frac{20t_y^2}{1+\beta}$$
$$+\frac{8w_x}{1-\beta}+\frac{16t_xw_x}{1-\beta}+\frac{16t_xw_x}{1+\beta}+\frac{16t_yw_x}{1-\beta}-\frac{16t_yw_x}{1+\beta}-\frac{13w_x^2}{1-\beta}-\frac{13w_x^2}{1+\beta}+\frac{8w_y}{1-\beta}+\frac{16t_xw_y}{1-\beta}-\frac{16t_xw_y}{1+\beta}$$
$$+\frac{16t_yw_y}{1-\beta}+\frac{16t_yw_y}{1+\beta}-\frac{26w_xw_y}{1-\beta}+\frac{26w_xw_y}{1+\beta}-\frac{13w_y^2}{1-\beta}-\frac{13w_y^2}{1+\beta}\Big)-k^p \qquad \text{(B7)}$$

The next step is to get the optimal wholesale prices given transportation costs. It requires that the wholesale prices together with the transfer payments maximize M's total profit.

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(2). If $0 \le t_x < \frac{3}{14}$ and $\frac{3}{14} \le t_y < \frac{1}{2}$, then we have

$$2+8t_y-13w_y = 2+21t_y-13(w_y+t_y) \ge 2+21\times\frac{3}{14}-13\times\frac{1}{2}=0.$$

Let $F=2+8t_x-13w_x$ and $G=2+8t_y-13w_y \ge 0$, then (B8) is simplified to be

$\frac{\partial \pi_M^p}{\partial w_x} = \frac{1}{18(1-\beta^2)}(F+\beta G)=0$. So we get $F=-\beta G$ and (B9) becomes

$\frac{\partial \pi_M^p}{\partial w_y} = \frac{1}{18(1-\beta^2)}(G+\beta F)=\frac{1}{18(1-\beta^2)}(G-\beta^2 G)=\frac{G}{18}\ge 0$. Thus M will offer w_y high enough to prevent the parallel imports of good Y. That is, w_x and w_y solve

$\frac{\partial \pi_M^p}{\partial w_x} = \frac{1}{18(1-\beta^2)}(F+\beta G)=0$ and $y_{AD}=\frac{(1-2t_y-2w_y)+\beta(1-2t_x-2w_x)}{3(1-\beta^2)}=0$. This

yields $w_x=\frac{1}{26(1-\beta^2)}[4(1+4t_x)-\beta(9+13\beta-42t_y-26\beta t_x)]$ and

$w_y=\frac{1}{26(1-\beta^2)}[(13-26t_y)+\beta(9-4\beta-16\beta t_y-42t_x)]$. By plugging

The first order conditions of (B16) are given by

$$x_{AM}:\ 1-(2x_{AM}+x_{AD})+2\beta y_{AM}=0 \tag{B17}$$

$$y_{AM}:\ 1-2y_{AM}+\beta(2x_{AM}+x_{AD})=0 \tag{B18}$$

$$x_{AD}:\ 1-(x_{AM}+2x_{AD})+\beta y_{AM}-w_x-t_x=0 \tag{B19}$$

$$x_B:\ a-2x_B+2\beta y_B-w_x=0 \tag{B20}$$

$$y_B:\ a-2y_B+2\beta x_B-w_y=0 \tag{B21}$$

We solve all the equations from (B17) to (B21) and get

$$x_{AM}=\frac{1}{2(1-\beta)}-\frac{1}{6}(1-2t_x-2w_x),\quad x_{AD}=\frac{(1-2t_x-2w_x)}{3},$$

$$y_{AM}=\frac{1}{2(1-\beta)},\ x_B=\frac{(a-w_x)+\beta(a-w_y)}{2(1-\beta^2)}\ \text{and}\ y_B=\frac{(a-w_y)+\beta(a-w_x)}{2(1-\beta^2)}$$

Plug all the solutions to (B16), we have

$$\pi_M^p=\frac{1}{36(1-\beta^2)}(17+18a^2+18\beta+18a^2\beta+\beta^2-8t_x+8\beta^2t_x+20t_x^2-20\beta^2t_x^2+4w_x$$

$$-4\beta^2w_x+16t_xw_x-16\beta^2t_xw_x-13w_x^2+4\beta^2w_x^2-18\beta w_xw_y-9w_y^2)-k^p \tag{B22}$$

The first order conditions are given by

$$\frac{\partial\pi_M^p}{\partial w_x}=\frac{1}{36(1-\beta^2)}(4-4\beta^2+16t_x-16\beta^2t_x-26w_x+8\beta^2w_x-18\beta w_y)=0 \tag{B23}$$

$$\frac{\partial\pi_M^p}{\partial w_y}=\frac{-1}{2(1-\beta^2)}(\beta w_x+w_y)\le 0 \tag{B24}$$

By solving (B23) and (B24), we have that if $\beta>0$ then

$w_x=\frac{2}{13-4\beta^2}(1-\beta^2)(1+4t_x)$ and $w_y=0$, and if $\beta<0$ then $w_x=\frac{2}{13}(1+4t_x)$ and

$w_y=-\frac{2}{13}\beta(1+4t_x)$

If $\beta < 0$, then $\pi_M^p = \frac{1}{52(1-\beta)}[25 + 26a^2 + \beta - 4(1-\beta)t_x(2-9t_x)] - k^p$ [33] (B27)

$$x_{AD} = \frac{3-14t_x}{13(1-\beta^2)} \quad (B28)$$

[34]

(4). If $\frac{3}{14} \le t_x < \frac{1}{2}$ and $0 \le t_y < \frac{3}{14}$, then

$a \quad t_x \quad t_x \quad t_y \quad t_x \quad t_x \quad t_x \quad 32t_y$

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contradiction with assumption $G+\beta F<0$. Accordingly it is impossible that both $F+\beta G$ and $G+\beta F$ are negative.

(3). Assume one of $F+\beta G$ and $G+\beta F$ is positive and the other is negative. Without loss of generality, we suppose that of $F+\beta G>0$ and $G+\beta F<0$. From $F+\beta G>0$, we get $F>-\beta G$, hence $G+\beta F>G-\beta^2 G=(1-\beta^2)G>0$. It contradicts assumption $G+\beta F<0$. Thus it is false that one of $F+\beta G$ and $G+\beta F$ is positive and th

$\beta F \geq 0$

$= \frac{1}{8}[\frac{3+4}{1-} \quad \frac{2(t_x+t_y)}{1-\beta} -$

$\frac{3}{14} \leq t \quad \frac{1}{2} \quad y$

$x \quad w$

$\frac{p}{M} = \frac{}{36(1 \quad ^2)}(4-4 \quad 16t_x - 16\beta^2 t$
x

$\frac{p}{M} = \frac{-}{2(1- \quad)}(\beta w_x +$
y

$\frac{\partial\pi}{\partial w} \quad 0$

$\frac{\partial\pi_M^p}{\partial w_y} =$

$-\beta w_x$

$\frac{p}{M} = \frac{}{18(1 \quad ^2)}(2-2 \quad 8t_x - 8\beta^2 t_x -$
x

Because $\pi_{M1} > \pi_{M2}$ and $\pi^p_{M1} = \pi^p_{M2}$ provided the condition 2. Hence we have

$$\Delta R^p_{M1} = \pi^p_{M1} - \pi_{M1} < \Delta R^p_{M2} = \pi^p_{M2} - \pi_{M2} \text{ and } k^p_1 = \frac{1}{2}(d - \frac{1}{\Delta R^p_{M1}}) < \frac{1}{2}(d - \frac{1}{\Delta R^p_{M2}}) = k^p_2 .$$

Therefore the manufacturer is more willing to make investment in product innovation in the second case than that in the first case. ♠

D. Proof of proposition 2: One problem we face is that the profit functions are too messy to compare without specifying some parameter values. However our focus is to get the basic idea about the impacts of parallel imports on M's incentive to innovate, we therefore look at some special cases here.

(1). In the first case of section 3.1 where M succeeds in product innovation, if we assume that $t_x = t_y = 0$ and $a = 1$, then we have $\Delta R^p_M = \pi^p_M - \pi^p_{MN} = \frac{25(1+\beta)}{52(1-\beta)}$. This is an extreme case with symmetric transportation costs and markets. If we consider the model in section 2.1 and assume that $a = 1$, then we get $\Delta R_M = \pi_M - \pi_{MN} = \frac{(1+\beta)}{2(1-\beta)}$. It is easy to see that $\Delta R^p_M < \Delta R_M$ and $k^p < k$. Accordingly, the manufacturer's incentive to make investment in product innovation is lower in the presence of parallel imports.

(2). But for the first case in section 3.1, if we assume that $t_x = \frac{3}{28}$, $t_y = 0$ and $\beta = -\frac{1}{2}$, then we get $\Delta R^p_M = \pi^p_M - \pi^p_{MN} = \frac{1}{30576}(2601 + 2548a^2)$. For the model in section 2.1, if we assume $\beta = -\frac{4}{5}$, then we get $\Delta R_M = \pi_M - \pi_{MN} = \frac{1}{12}(1 + a^2)$. It is easy to check that $\Delta R^p_M > \Delta R_M$ [38] and $k^p > k$. That is, parallel imports encourage M's investment in product innovation. [39] ♠

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[38] $\Delta R^p_M - \Delta R_M = \frac{53}{30576} > 0$

[39] Actually if we pick up $t_y = 0$ and $t_x = \frac{3(1+\beta)}{14}$, there are many $\beta \in (-1,0)$ such that $\Delta R^p_M > \Delta R_M$.

E. Proof of corollary 6: For the first case of section 3.1, if $t_x = t_y = 0$

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