CONSUMER TARGETING UNDER QUALITY COMPETITION IN A LIBERALIZED VERTICALLY DIFFERENTIATED MARKET

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This paper examines consumer targeting by cost-asymmetric home incumbent and foreign entrant under quality and price competition among them in a liberalized home-country market. With the home incumbent offering a price-quality menu before the foreign entrant offers his menu, the extent to which the home incumbent enjoys a home-market advantage over a technologically efficient foreign entrant determines the nature of market segmentation. When the home-market advantage is not too large, the home incumbent targets accommodates entry by targeting only the low-type home consumers. Gains from liberalization, however, depends to a large extent on the distribution of home consumers over different types.

Keywords: Consumer Targeting, Quality Competition, Liberalization, Accommodating Entry

JEL classification: D43, F12, L15.

1. INTRODUCTION

This paper addresses consumer targeting by a foreign entrant competing with a single local incumbent in terms of both price and quality of their product in a liberalized market with different types of consumers and local incumbent's response to such competition by varying quality of its own product(s). These issues are of interest because policy makers in a typical developing country often conceive open trade regime as a policy instrument for improving the local technology and product quality.

Often foreign firms entering an erstwhile protected domestic market are observed to offer a higher range of products targeting the high-type consumers. Indian automobile

market is one such example where despite incumbent Maruti-Suzuki's popular low range product Maruti Standard in the Light Motor Vehicle category, new entrants like Hyundai, Fiat and Daewoo concentrate at the high-end of the market for the same category passenger car by offering their respective high-price brands Santro, Palio and Matiz, respectively.

An explanation often floated by the businessmen is that targeting consumers at the high-end of the market who have a higher marginal willingness-to-pay makes profit prospects better than serving all segments of the market. Of course, this possibility arises because of imperfect information regarding consumer types: At the separating equilibrium the low-type consumers are charged their reservation prices whereas the high-types are charged below their reservation prices. This leaves a scope for the firms to extract greater surpluses from the high-type consumers as they learn about their true types. A critical element of this type of reasoning, however, is some threshold number of high-type consumers in relation to the low-types and the differences in their respective marginal willingness-to-pay (MWP).

Another plausible explanation of such market segmentation may be that the MNCs have a comparative cost advantage in producing higher quality goods but not in lower quality goods. Such cost advantage in higher quality varieties relaxes competition from local firms and thus enables the foreign multinationals to extract more surpluses and allow them to cover initial high fixed costs of distribution and marketing. Thus, the target set of consumers for the MNCs and consequent segmentation of a liberalized market between local firms and foreign entrants may be either demand-driven or cost-driven.

Theoretically, the role of demand pattern or distribution of consumers across different types in the context of simultaneous entry decision by firms has been emphasized by Shaked and Sutton (1982, 1983) in their pioneer works and in the subsequent development of literature on quality competition. Of late, Acharyya and Roy Chowdhury (2004) have also demonstrated that if consumers with low MWP is sufficiently large in number, only one firm will enter and monopolize the market at a subgame perfect Nash equilibrium, however small the entry cost is. The significance of distribution of consumers across different types in a monopolistic market, on the other hand, has earlier been emphasized by Acharyya (1998) in the context of the extent of market coverage or consumer targeting; and later by Bandyopadhyay and Acharyya (2004) in the context of choice of innovation types. In light of these results, the demand-argument for consumer targeting by the new foreign entrants might seem obvious.

However, these results are established either in case of simultaneous entry with no cost asymmetry among firms or when there is no threat of entry for a monopoly firm. But simultaneous-entry assumption does not fit well in the context of competition among local firms and foreign MNCs as a consequence of trade liberalization in the developing countries. It is thus worthwhile to examine whether such results hold even in the context of sequential entry, or more relevant, in an incumbent-entrant structure with cost asymmetry, before subscribing to the demand-explanation.

The analyses that come closest to ours are that of Donnenfeld and Weber (1992) and Aoki and Prusa (1996) who examine quality choices by firms when they enter a market sequentially. Our analysis, however, differs in two respects. First, we allow for both cost asymmetry between firms and non-uniform distribution of consumers to examine what roles these might play in the quality competition, for reasons spelled out above. Second, the decision structure is slightly different. Instead of the incumbent and the entrant sequentially choosing their quality levels and then simultaneously choosing prices, we assume that they sequentially choose the whole menu (i.e., the price-quality package). This assumption, of course, simplifies the structure of the post-liberalization game, but also seems to be more reasonable decision structure in the present context.

However, the scope of the present analysis is neither kept confined to this particular question nor to the specific observation of the Indian automobile industry that we started with. Rather, we intend to address the following set of issues in a more general context of liberalizing an erstwhile protected market in a developing country. First of all, what quality does a foreign entrant choose when it faces competition from an already established local firm? Does it offer only a high quality and caters only to the high-type local consumers? The second issue relates to how does the incumbent react to such threat of entry. Does it downgrade or enhance its quality compared to what it was offering before liberalization (and in absence of any threat of entry)?[1] Thirdly, we examine what implication does such trade liberalization and quality competition have on the welfare of the domestic economy.

These issues per se are relevant in the more general context of gains from liberal trade policies pursued of late by many developing countries. A favourable effect of trade liberalization that has been often perceived is that the consequent foreign competition per se will induce local incumbents to invest in R&D and enhance quality of their products.[2] This coupled with price competition will benefit domestic consumers and raise total surplus. The counter argument is that trade liberalization will lower the incentive for innovation for the local firms since foreign competition lowers their output and profit [Clemenz (1990), Rodrik (1992)]. In the present setting, pro-competitive effect of trade liberalization does enhance the quality of local products offered to the low-type consumers. But total gains may still be lower than what could be achieved in the protected market because of partial loss of markets for local firms. Gains for consumers from such quality enhancement at the low-end of the domestic market overcompensates the loss of market for the local firm at the high-end of the market only when the size of the low-end of the market is sufficiently large, which, in turn, depends on the distribution of consumers across different types. Thus, trade liberalization per se does not improve welfare of the domestic economy despite enhancement of local quality.

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[1] Similar issue has been addressed by Kabiraj and Roy (2003) assuming a fixed quality of the foreign entrant.

[2] See, for example, Lall (1984).

The rest of the paper is organized as follows. In Section 2 we set out the basic model. Section 3 discusses consumer targeting by an incumbent and an entrant under quality and price competition when the domestic market is liberalized. In Section 3 we examine the gains and losses from liberalization that the domestic economy experiences given the choices of the firms. Some concluding remarks are provided in Section 5.

2.   THE MODEL UNDER AUTARKY

2.1.   Preference Pattern and Technology

Consider an initially protected home-country market with a single domestic firm and two types of consumers, $\alpha_2 > \alpha_1$, with n_j number of type α_j consumers. The domestic firm offers a price-quality package (p_j, q_j) to the α_j -consumers, selecting quality q_j from the technologically feasible set $[0, \overline{q}]$. The qualities of the good are observable to all. Each consumer buys, if at all, only one unit of the good. The net utility that type- α_j consumer derives from the menu (p, q) is,

$$U_j = u(\alpha_j, q) = \alpha_j q - p, \quad j = 1,2 . \tag{1}$$

This linear preference structure satisfies the following properties as is usually assumed in the literature [Cooper (1984), Mussa and Rosen (1978)]:

$$u(\alpha_2, q) > u(\alpha_1, q) \text{ and } u_q(\alpha_2, q) > u_q(\alpha_1, q), \tag{2}$$

where $u_q(.)$ denotes the marginal utility of quality.

Consumers participate in the market if payoff from a menu is individually rational:

$$\alpha_j q \geq p . \tag{3}$$

On the other hand, menu (p_2, q_2) is selected if the corresponding (net) payoff is incentive compatible:

$$\alpha_j q_2 - p_2 \geq \alpha_j q_1 - p_1 \quad \text{for } q_2 > q_1 . \tag{4}$$

Since the firm does not have full information regarding the consumer type, he cannot discriminate among the consumers in terms of the price-quality package to the extent to which a first-degree discriminating monopolist would have done to extract all surpluses from all types of consumers. The discriminatory power of our monopolist domestic firm

is thus limited and he should set packages according to (4) to avoid mimicking by the high-type of the behaviour of the low-type. Consequently, the high-type consumers, at a separating (or discriminatory) equilibrium, derive strictly positive net utility.[3]

The home firm's technology of producing the good is assumed to be the following type:

$$C(x,q) = (\frac{1}{2}cq^2 + c_0)x, \ c_0 \geq 0 , \tag{5}$$

where x denotes the output level. Cost of production has two components: one which depends only on the output level, $c_0 x$, capturing the cost incurred at the basic stage of production for example, and the other which depends on both the quality level and the number of units of the good produced, $\frac{1}{2}cq^2 x$. Thus, though, for any given quality of the good, the marginal cost of production (MC), $\frac{1}{2}cq^2 + c_0$, is invariant with respect to the output level produced (x), total as well as marginal cost of production is larger for better quality goods. Whereas, the total cost of producing x units increases at the rate cqx, the marginal (as well as unit) cost of production increases at the rate cq for each marginal enhancement in quality.

2.2. Pre-Liberalization Quality Choices

It is straightforward to check that, pre-liberalization and with no threat of entry by other domestic firms, the domestic monopolist offers the following separating menus, if at all:

$$q_{1a} = \frac{n_1\alpha_1 - n_2(\alpha_2 - \alpha_1)}{2n_1 c}, \quad p_{1a} = \alpha_1 q_{1a} , \tag{6a}$$

$$q_{2a} = \frac{\alpha_2}{2c}, \quad p_{2a} = \alpha_2(q_{2a} - q_{1a}) + \alpha_1 q_{1a} . \tag{6b}$$

Of course, such a separating menu is profitable only if the composition of the market is such that,

$$\frac{n_1}{n_2} > \frac{(\alpha_2 - \alpha_1)}{\alpha_1} . \tag{7}$$

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[3] See Cooper (1984).

Otherwise, the monopolist would cater to only the high-type and extract all surpluses from them by charging their reservation price:[4] $\tilde{p}_2 = \alpha_2 \tilde{q}_2$. Figure 1 illustrates such a separating (or discriminatory) equilibrium for representative consumers of each type.

These menus are, however, socially sub-optimum. The socially optimum qualities are $\tilde{q}_1$ and $\tilde{q}_2$ such that social welfare $W = [n_1 u(\alpha_1, q_1) - C(n_1, q_1)] + [n_2 u(\alpha_2, q_2) - C(n_2, q_2)]$ is maximum. That is,

$$C_q(x, \tilde{q}_j) = u_q(\alpha_j, \tilde{q}_j), \quad j = 1, 2, \tag{8}$$

with corresponding marginal cost pricing:

$$\tilde{p}_j = C_x(x, \tilde{q}_j). \tag{9}$$
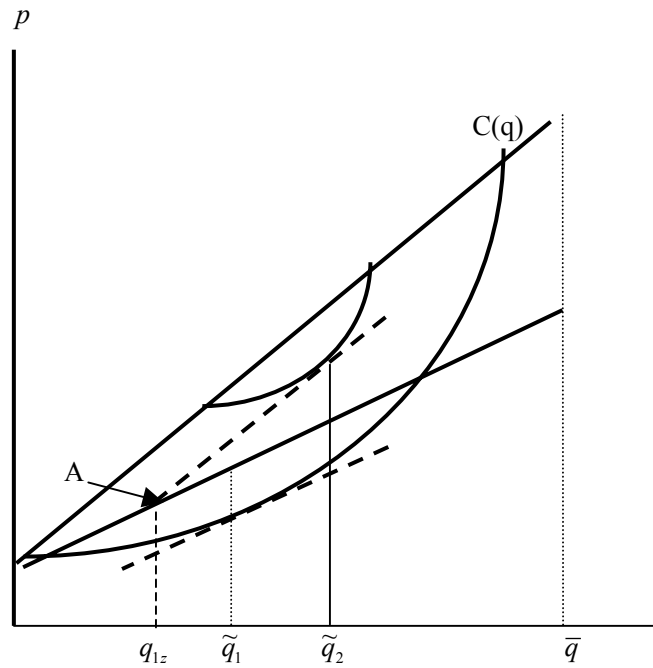
Figure 1.   Pre-liberalization Quality Choices

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[4] See Acharyya (1998).

Under the linear preference function (1), these socially optimum packages equal,

$$\widetilde{q}_j = \frac{\alpha_j}{2c}, \widetilde{p} = \frac{1}{2}c\widetilde{q}_j^2 . \tag{10}$$

Comparing these quality levels with those offered by the domestic firm, it is immediate that quality distortion occurs at the bottom which is the standard result shown by Mussa and Rosen (1978). Thus, unregulated profit maximization results in sub-optimal welfare level before liberalization.

3.   LIBERALIZATION AND CONSUMER TARGETING

Suppose, the local government allows entry of a foreign firm which has a superior production technology than the local incumbent defined below. In face of such entry possibility, the local incumbent revises his menu since earlier choices are no longer optimal. We assume that the local firm first announces his price-quality menu *before* the foreign firm enters and then the entrant selects his menu observing the choice made by the incumbent. This decision structure is different from Donnenfeld & Weber (1992) and Aoki & Prusa (1996) who assume that the incumbent and the entrant sequentially choose their quality levels and then simultaneously choose prices.

3.1.   Nature of Cost Asymmetry

The entrant has a superior production technology which allows it to produce all qualities at a lower marginal cost:

$$C_q^*(x,q) < C_q(x,q) \;\; \forall q \in [0,\overline{q}] . \tag{11}$$

But the foreign firm has a higher total as well as marginal cost at the basic stage of production:

$$C^*(x,0) > C(x,0) . \tag{12}$$

This difference may reflect higher price of some essential or basic inputs use of which though do not matter for the quality level produced. Alternatively, this cost difference may be due to higher initial cost incurred by the foreign firm towards distribution and marketing of the good in the home-country market and thus can be

interpreted as home-market advantage of the domestic firm.[5] Thus, what we assume in (11) and (12) is that, though the foreign firm is not as efficient as the home firm at the basic stage of production (or at the distribution and marketing stage), he is more efficient in developing newer varieties or developing better qualities.

These assumptions imply that we can define a quality level $\hat{q}$ such that,

$$C^*(x, \hat{q}) = C(x, \hat{q}) .$$

Thus for all quality levels beyond $\hat{q}$, the foreign entrant has absolute as well relative cost advantage.

Given such a nature of cost asymmetry, the following specific form of the cost function of the foreign firm will be used to determine choice of menus:

$$C^* = (c_o^* + \frac{1}{2}\beta c q^2)x, \beta < 1, c_o^* > c_o . \tag{13}$$

The critical level of quality $\hat{q}$ thus varies with the difference in both the marginal cost of quality (β) and the fixed costs, $\delta \equiv c_o^* - c_o$:

$$\hat{q} = \left[\frac{2(c_o^* - c_o)}{(1 - \beta)c} \right]^{\frac{1}{2}} . \tag{14}$$

Figure 2 illustrates the different scenarios. For any given difference in the marginal cost of quality (i.e., for any particular value of β), a higher difference in fixed costs $(c_o^* - c_o)$ pushes up the foreign cost curve further away from the home cost curve, and therefore, increases the range of qualities $[0, \hat{q}]$ over which the home firm has *absolute* cost advantage in producing those qualities. As we will see later, this degree of cost advantage

Is a critical element in determining post-entry competition and consumer targeting and consequent market segmentation. Of course, the degree of relative cost advantage (as captured by the value of β) is equally important. However, we shall confine ourselves with how consumer targeting varies with different values of $(c_o^* - c_o)$, keeping the value of β constant, simply because that will allow us to keep the optimal quality choices for any target group unchanged as the curvature property of the cost functions (and therefore

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[5] In Indian automobiles market, Maruti-Suzuki and even the late entrant in the light motor vehicle category, Tata, enjoy such a home market advantage over foreign companies like Daweoo and Fiat, through their wide distribution and service networks. Hyundai however is fast catching up these companies with its improved distribution network.

that of the iso-profit functions) will not be disturbed by that thought experiment.

At this point it is relevant to define the competitive qualities with foreign technology, denoted by $\widetilde{q}_i^*$, as

$$C_q^*(x, \widetilde{q}_i^*) = u_q(\alpha_i, \widetilde{q}_i^*).\tag{15}$$

Given linear preference function defined in (1) and the foreign technology in (13) such qualities boil down to:

$$\widetilde{q}_i^* = \frac{\alpha_i}{2\beta c}.\tag{15a}$$

3.2.   Quality Competition and Consumer Targeting

We assume that firms have complete information regarding their strategies, timing of the game, demand structure and nature of cost asymmetry. Thus, the post-liberalization competition between the cost asymmetric local incumbent and a foreign entrant is a two-stage game of complete and perfect information. The choice of menus or price-quality packages can therefore be obtained by backward induction.
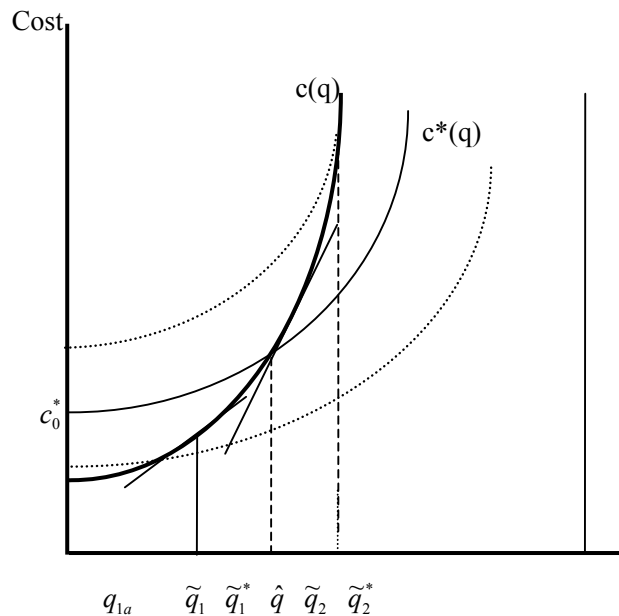
Figure 2.   Differences in Fixed Costs and Absolute Cost Advantage of Home Firm

Finding the quality choices under the assumed sequential decision structure involves constructing the best-response function of the entrant and then finding profit-maximizing qualities of incumbent given such responses. For any price-quality menu (p_1, q_1) chosen by the home firm for the low-type consumers and corresponding incentive compatible menu $(p_2, \tilde{q}_2)$ chosen for the high-type, the entrant can attract both types by offering the same quality q_1 to the low-type consumers but at a slightly lower price than charged by the home incumbent, $(p_1 - \varepsilon)$, and corresponding incentive compatible menu $(p_2^*, \tilde{q}_2^*)$ to the high-type consumers to, provided of course $p_1 > c^*(q_1)$. But, if $p_1 = c^*(q_1)$, the foreign entrant offers $(p_1^*, \tilde{q}_1^*)$ to the low-type consumers. This follows from the self-selection constraint of the low-type. They strictly prefer (p_1^*, q_1^*) offered by the foreign firm to any price-quality menu (p_1, q_1) offered to them by the home firm if,

$$\alpha_1 q_1^* - p_1^* \geq \alpha_1 q_1 - c^*(q_1).$$

Thus, for a higher quality q_1^* than q_1, the entrant can charge $p_1^* = c^*(q_1) + \alpha_1(q_1^* - q_1)$. Otherwise, she must charge $p_1^* - \varepsilon$ to attract them. Thus foreign entrant's profit (from such an offer) equals $\pi_1^* = n_1[c^*(q_1) + \alpha_1(q_1^* - q_1) - c*(q_1^*)]$ in the former case and $\pi_1^* - \varepsilon$ in the latter. In any case, however, profit maximization yields, q_1^* as the optimal quality offered by the foreign firm (which is the same as the competitive quality defined in (15a)). Given such an offer to the low-type consumers, the menu offered to the high-type must once again be incentive-compatible. In particular, for any pair of incentive-compatible menus $\{(p_1, q_1), (p_2, q_2)\}$ chosen by the home incumbent, the best-response function of the foreign entrant is:

$$B*\{(p_1^*, q_1^*), (p_2^*, q_2^*)\} = \begin{cases} (p_1 - \varepsilon, q_1), (p_2^*, \tilde{q}_2^*) \; \forall p_1 > c^*(q_1) \\ (p_1^*, \tilde{q}_1^*), (p_2^* - \varepsilon, \tilde{q}_2^*) \; \forall p_1 = c^*(q_1) \end{cases}. \tag{16}$$

What emerges from this best-response function of the foreign entrant is that by charging a price p_1 above $c^*(q_1)$ for the quality q_1 offered to the low-type consumers, the home firm cannot have a positive demand. But since $c^*(q_1) > c(q_1) \forall q_1 < \hat{q}$, there is scope for the home firm to attract the low-type consumers and yet make non-negative profits by charging a price even below $c^*(q_1)$. However, since the best offer that the entrant can make is the menu $(p_1^* = c^*(\tilde{q}_1^*), \tilde{q}_1^*)$, the home firm, being the first-mover, cannot charge a price more than

$$\overline{p}_1 = c^*(\widetilde{q}_1^*) - \alpha_1(\widetilde{q}_1^* - q_1) . \tag{17}$$

when he offers a quality $q_1 > \widetilde{q}_1^*$ and $\overline{p}_1 - \varepsilon$ when he offers a $q_1 \leq \widetilde{q}_1^*$. Of course, the home firm will offer such a menu if the price covers its cost of production, $c(q_1)$. This means the nature of cost asymmetry becomes important. Similarly, from the best-response function it is evident that the home incumbent can make positive profit by offering an incentive-compatible menu $(p_2, \widetilde{q}_2)$ to the high-type only if the price p_2 is greater than $c^*(\widetilde{q}_2^*)$. More precisely, the home incumbent cannot charge more than

$$\overline{p}_2 = c^*(\widetilde{q}_2^*) - \alpha_2(\widetilde{q}_2^* - \widetilde{q}_2) . \tag{18}$$

Once again such a price must cover its cost, $c(\widetilde{q}_2)$. What is to be noted that even if $\overline{p}_1 - \varepsilon > c(q_1)$, $\overline{p}_2$ may be less than $c(\widetilde{q}_2)$ given our earlier assumption regarding the nature of cost asymmetry. Therefore, specific assumptions regarding the level of critical quality $\hat{q}$, or regarding the extent of difference in fixed costs, $c_o^* - c_o$, are required to determine the post-entry choice of menus and consumer targeting. In particular, lemma-1 below specifies when the home firm cannot cater to the high-type consumers under the threat of foreign competition. Let us define a critical cost difference δ^{**} such that,

$$\delta^{**} \equiv \frac{3(1-\beta)\alpha_2^2}{8\beta c} . \tag{19}$$

Lemma 1: *For $c_o^* - c_o \leq \delta^{**}$, there is no profitable menu (p_2, q_2) which the home incumbent can offer to the high-types to induce them not to buy the imported variety $\widetilde{q}_2^*$ at price $c^*(\widetilde{q}_2^*)$.*

Proof: Suppose the home firm offers a menu (p_2, q_2) to the high types. Since the second mover foreign firm can always undercut the price as long as p_2 is greater than the his cost of producing q_2, and the best offer he can make is $\{c^*(\widetilde{q}_2^*), \widetilde{q}_2^*\}$, the home firm can attract high-types only when he charges $p_2 \leq \overline{p}_2$. The tie-breaking rule in the decision of selecting menu by the consumers, however, allows the home firm to charge $\overline{p}_2$ only when $q_2 > \widetilde{q}_2^*$, in which case he earns $n_2[c^*(\widetilde{q}_2^*) - n[c^*(\widetilde{q}_2^*) - \alpha_2(\widetilde{q}_2^* - \widetilde{q}_2) - c(q_2)]$. Otherwise he can charge at most $\overline{p}_2 - \varepsilon$ and earn $n_2[c^*(\widetilde{q}_2^*) - \alpha_2(\widetilde{q}_2^* - \widetilde{q}_2) - c(q_2)] - n_2\varepsilon$. In any case, for any given menu (p_1, q_1) offered to the low-type, home firm's profit from catering to the

high-type is maximum at $q_2 = \tilde{q}_2 = \dfrac{\alpha_2}{2c}$. Since, $\tilde{q}_2 < \tilde{q}_2^* = \dfrac{\alpha_2}{2\beta c}$, so he charges $\overline{p}_2 - \varepsilon$ for that quality, if at all. But he offers such a menu only if $\overline{p}_2 - \varepsilon > c(\tilde{q}_2)$. For ε infinitesimally small, setting $\overline{p}_2 = c(\tilde{q}_2)$ yields $c_o^* - c_o = \delta^{**}$. Since the home firm's profit varies positively with $c_o^* - c_o$, this means the menu $(\overline{p}_2 - \varepsilon, \tilde{q}_2)$ is unprofitable for the home firm for all $c_o^* - c_o \le \delta^{**}$.

Hence the claim. $\square$

Therefore, for absolute cost advantages not too large in the sense defined above, the home firm cannot offer any menu to high-type consumers when the imported variety is available. Thus, monopolist can only cater to the low types and can make strictly positive profit, $\pi = n_1[p_1 - c(q_1)]$ as long as $c(q_1) < p_1 < \overline{p}_1 = c^*(\tilde{q}_1^*) - \alpha_1(\tilde{q}_1^* - q_1)$. Since for any q_1, profit is maximized for $\overline{p}_1 - \varepsilon$, the monopolist essentially must choose q_1 to maximize,

$$\pi = c^*(\tilde{q}_1^*) - \alpha_1(\tilde{q}_1^* - q_1) - c(q_1) - \varepsilon , \tag{20}$$

which yields the competitive quality, $\tilde{q}_1$, as defined in (10), as the optimal offer of the home incumbent to the low-type consumers.

Once again the home firm will offer such a menu only if it is profitable, and, as lemma-2 states, this is the case when the absolute cost advantage of the home firm is not too small. In particular, define cost difference δ^* such that,

$$\delta^* = \frac{3(1-\beta)\alpha_1^2}{8\beta c} . \tag{21}$$

Then,

Lemma 2: *For all $c_o^* - c_o \le \delta^*$, the home firm cannot profitably offer the menu* $\left(\overline{p}_1 - \varepsilon, \tilde{q}_1\right)$.

Proof: The menu $\left(\overline{p}_1 - \varepsilon, \tilde{q}_1\right)$ is unprofitable if $\overline{p}_1 = c(\tilde{q}_1)$. By (17) and specific functional forms of cost functions this reduces to $\dfrac{1}{2}\beta c(\tilde{q}_1^*)^2 - \alpha_1(\tilde{q}_1^* - \tilde{q}_1) = \dfrac{1}{2}c(\tilde{q}_1)^2$. Substitution of values from (10) and (15a) yields $c_o^* - c_o = \delta^*$.

Hence the claim. $\square$

Since $\alpha_1 < \alpha_2$, what appears from lemma 1 and 2 is that unless the absolute cost advantage of the home incumbent is sufficiently high in the sense that $c_o^* - c_o > \delta^*$, the foreign entrant, having a relative cost advantage $(\beta < 1)$, will offer menus to attract all consumers leaving the incumbent with zero demand. Anticipating a loss by the amount of the cost incurred in producing the quality offered in such a case, the home firm does not offer any menu at all, and given such an irreversible decision, the foreign entrant offers the usual discriminatory monopoly menu(s) to the domestic consumers.

Therefore,

Proposition 1: For all $c_o^* - c_o \le \delta^*$,

> a) the home incumbent does not offer any menu and the liberalized domestic market is monopolized by the foreign firm;
> b) the foreign firm caters to all consumers by offering a separating menu only if the demand pattern satisfies (7).

Proof:

a) Follows directly from lemma 1 and 2.
b) The foreign entrant chooses q_i^* to maximize his profit from catering to all consumers:

$$\pi^* = n_1[\alpha_1 q_1^* - c^*(q_1^*)] + n_2[\alpha_2(q_2^* - q_1^*) + \alpha_1 q_1^* - c^*(q_2^*)].$$

Profit maximization yields following menus:

$$q_1^* = \frac{n_1\alpha_1 - n_2(\alpha_2 - \alpha_1)}{2n_1\beta c}, \quad p_1^* = \alpha_1 q_1^*, \tag{22a}$$

$$q_2^* = \widetilde{q}_2^* = \frac{\alpha_2}{2\beta c}, \quad \widetilde{p}_2^* = \alpha_2(\widetilde{q}_2^* - q_1^*) + \alpha_1 q_1^*. \tag{22b}$$

But $q_1^* > 0$ if (7) holds.
Hence proved. $\square$

Therefore, for the home incumbent to survive in competition from an entrant who has a lower marginal cost of producing qualities, the home firm's absolute cost advantage captured in $c_o^* - c_o$ must be large enough. For $c_o^* - c_o > \delta^*$, he can profitably cater to the low-type consumers.

However, for even larger advantage, $c_o^* - c_o > \delta^{**}$, though he can cater to the high-type consumers as well, he may not do so. What lemma 1 states is that for such

differences in costs, the home firm can profitably offer the menu $(\overline{p}_2 - \varepsilon, \widetilde{q}_2)$ to the high-type consumers which they will prefer to the best-possible menu $\{c^*(\widetilde{q}_2^*), \widetilde{q}_2^*\}$ offered by the foreign entrant. But such a menu must also prohibit the low-type consumers to mimic the high-type by buying this menu instead of the menu $(\overline{p}_1, \widetilde{q}_1)$ offered to them by the home firm.

Of course, this depends on the parametric value and in case they do mimic, the home firm has to decide whether to cater to the high-type at all, depending on the profit levels. This because, if the price $\overline{p}_2$ is too low to induce the low-type to mimic the high-type consumers, then profit is lower than what the home firm could achieve through the separating menu. Following lemma defines the parametric value in this regard:

Lemma 3: If $\beta < \dfrac{3}{4}$, the low-type consumers will mimic the high-type consumers by purchasing $\widetilde{q}_2$ at price $\overline{p}_2$.

Proof: If the low-type mimics the high-type then by their self-selection constraint the following must be true:

$$\alpha_1 \widetilde{q}_2 - \overline{p}_2 - \varepsilon \geq \alpha_1 \widetilde{q}_1 - \overline{p}_1 .$$

Substituting values of the quality and price levels, this boils down to $(\alpha_2 - \alpha_1)\left[(3 - 4\beta)\alpha_2 + \alpha_1 \right] \geq 0$ which is satisfied whenever $\beta < \dfrac{3}{4}$.

Hence, proved. □

Of course, low-types can mimic the high-type consumers even for $\beta > \dfrac{3}{4}$, but to keep the analysis simple and avoid multiplicity of cases we shall confine ourselves with $\beta < \dfrac{3}{4}$ in rest of the analysis.

Thus, given this assumption, the low-type consumers mimic the high-type consumers when the home firm offers the menu $(\overline{p}_2 - \varepsilon, \widetilde{q}_2)$ to the high-type consumers. The home firm then has to decide whether to cater to only the low-type by offering the menu $(\overline{p}_1, \widetilde{q}_1)$, leaving the high-end of the market to the foreign firm, depending on the profit levels.

Clearly, the relative size of the low-type consumers would be a critical element underlying such a decision. When the home firm caters only to the low-type and

accommodates entry of the foreign firm in the higher segment, he secures for himself a profit equal to,

$$\pi(\alpha_1) = n_1 \left[c^*(\widetilde{q}_1^*) - \alpha_1(\widetilde{q}_1^* - \widetilde{q}_1) - c(\widetilde{q}_1) \right] - n_1 \varepsilon . \tag{23}$$

On the other hand, if he offers $(\overline{p}_2 - \varepsilon, \widetilde{q}_2)$ targeted at the high-type consumers, by lemma 3, low-type consumers also buy this menu resulting in a profit for the home firm equal to,

$$\pi = (n_1 + n_2) \left[c^*(\widetilde{q}_2^*) - \alpha_2 (\widetilde{q}_2^* - \widetilde{q}_2) - c(\widetilde{q}_2) \right] - (n_1 + n_2) \varepsilon . \tag{24}$$

For ε infinitesimally small, we can write

$$\pi(\alpha_1) - \pi = n_1 \left[\delta^{**} - \delta^* \right] - n_2 \left[(c_o^* - c_o) - \delta^{**} \right]. \tag{25}$$

Therefore,

Proposition 2: Even when offering the menu $(\overline{p}_2 - \varepsilon, \widetilde{q}_2)$ to the high-type consumers is feasible and profitable, the home firm targets only the low-type consumers if they are sufficiently large in the sense defined in (26) below.

Proof:

By lemma 1, the home firm can make positive profit by offering the menu $(\overline{p}_2 - \varepsilon, \widetilde{q}_2)$ to the high-type consumers when $(c_o^* - c_o) > \delta^{**}$. But by lemma 3, such a menu will attract the low-type consumers also as it gives them strictly higher net utility than the menu $(\overline{p}_1, \widetilde{q}_1)$ targeted at them. Consequently, the home firm realizes π. But by not offering the menu to the high-type consumers and targeting only the low-type consumers he gets $\pi(\alpha_1)$. From (25) it is immediate that targeting only the low-type consumers is more profitable if the distribution pattern is such that,

$$\frac{n_1}{n_2} > \frac{(c_o^* - c_o) - \delta^{**}}{\delta^{**} - \delta^*} . \tag{26}$$

Hence proved. □

The condition (26) can alternatively be written as,

$$\left(c_o^* - c_o\right) < \delta^{**} + \frac{n_1}{n_2}\left(\delta^{**} - \delta^*\right) \equiv \delta^{***}. \tag{27}$$

Thus, for home market advantage of the home firm in the range $\left[\delta^{**}, \delta^{***}\right]$, even though he can forestall entry of the foreign firm in the high-segment of the market, he accommodates such entry by targeting only the low-type consumers. Of course, greater is the relative size of low-type consumers, $\frac{n_1}{n_2}$, larger is the home market advantage for which the home firm will accommodate entry of the foreign firm in the high-segment of the market. Therefore,

Proposition 3:

> a) Post liberalization, both firms will operate in the market for home market advantages in the range $\left[\delta^*, \delta^{***}\right]$. The home incumbent will target the low-type consumers and the foreign firm will cater to the high-type consumers.
> b) For $\left(c_o^* - c_o\right) > \delta^{***}$, the foreign firm will not enter the market even for a very small entry cost.

Proof:

a) By lemma 1 and 2, for all $\left(c_o^* - c_o\right) \in \left[\delta^*, \delta^{**}\right]$, the home firm can profitably offer the menu $\left(\overline{p}_1, \widetilde{q}_1\right)$ to the low-type for which the foreign firm cannot have a positive demand for its low-quality variety. On the other hand, by Proposition 2 and (27) it follows that for all $\left(c_o^* - c_o\right) \in \left[\delta^{**}, \delta^{***}\right]$, the home firm *targets* only the low-type consumers.

What remains to be shown that for all such home market (dis-)advantages, the foreign firm can have positive demand for its high-quality variety from the high-type consumers, and earn strictly positive profit. Note that, the foreign firm can have positive demand only if the menu $\left(p_2^*, q_2^*\right)$ offered to them is incentive-compatible in the sense that they derive at least the same net utility as they would derive by accepting the menu $\left(\overline{p}_1, \widetilde{q}_1\right)$ offered to the low-type by the home firm. This means, for any $q_2^* > \widetilde{q}_1$, the foreign firm can charge at most,

$$p_2^* = \alpha_2(q_2^* - \widetilde{q}_1) - \alpha_1(\widetilde{q}_1^* - \widetilde{q}_1) + c^*(\widetilde{q}_1^*), \tag{28}$$

and earn $\pi^* = n_2\left[p_2^* - c^*(q_2^*)\right]$. Profit maximization yields the quality level as $\widetilde{q}_2^*$ which is as defined in (15a). The maximum profit then equals
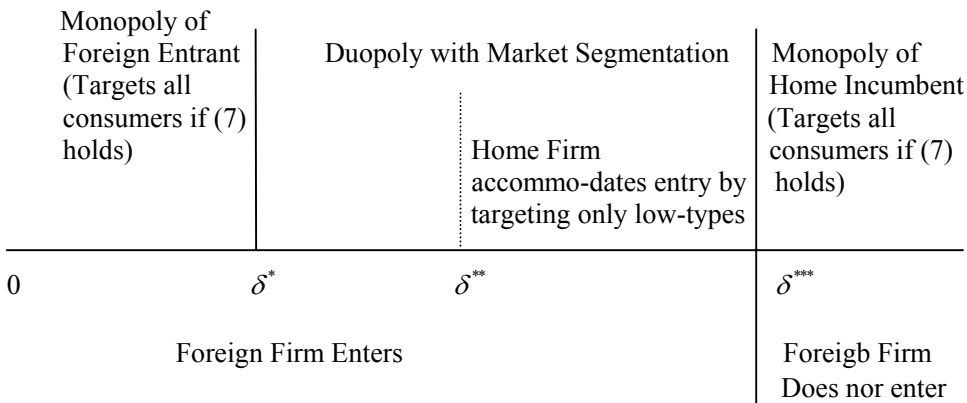
$$\pi^* = n_2 \left[\frac{(3-4\beta)(\alpha_2^2 - \alpha_1^2)}{8\beta c} \right].$$

which is positive by our earlier assumption that $\beta \le \frac{3}{4}$. This completes the proof.

b) By Proposition 2, for $(c_o^* - c_o) > \delta^{***}$, the home firm will offer the menu $(\overline{p}_2 - \varepsilon, \tilde{q}_2)$ to attract all consumers. The foreign firm then cannot have any positive demand. Its gross profit is thus zero if it enters the market. For a very small but positive entry cost, he opts not to enter the market.
Hence proved. □

With foreign firm not entering the market for very large home market advantage of the home firm, and such decision being irreversible, the home firm targets to cater all consumers by offering the same separating menu as he did before liberalization only if (7) holds. The following diagram presents the complete characterization of post-liberalization equilibria for different degree of home market advantage.

Monopoly of Foreign Entrant (Targets all consumers if (7) holds)	Duopoly with Market Segmentation		Monopoly of Home Incumbent (Targets all consumers if (7) holds)
		Home Firm accommo-dates entry by targeting only low-types	

0	δ^*	δ^{**}	δ^{***}
	Foreign Firm Enters		Foreigb Firm Does nor enter

Figure 3. Configuration of Post-Liberalization Equilibrium

4. GAINS FROM LIBERALIZATION

What appears from the above characterization of quality competition is that the gain for the domestic economy from trade liberalization should depend on the home market advantage of the home incumbent. Of course, the consumers will now get higher qualities of the varieties than they were offered pre-liberalization regardless of the nature

of post-liberalization equilibrium. The incumbent offers the higher competitive quality to the low-type consumers, if at all, under the threat of competition from the foreign entrant. This is the pro-competitive effect of liberalization. On the other hand, the entrant offers higher qualities (even when it offers discriminatory monopoly qualities) because of its superior technology as reflected in the lower marginal cost of quality enhancement $(\beta < 1)$. Competition also lowers the prices in all cases below the pre-liberalization levels. Domestic consumers are, therefore, unambiguously better off. At the same time, post-liberalization competition lowers the profit of the domestic firm. Gains from liberalization for the domestic economy, measured by change in total surplus or welfare is thus ambiguous.

For home market advantage low enough, $\delta \in \left[0, \delta^*\right]$, the home incumbent does not offer any menu and the market is monopolized by the foreign entrant. If distribution of domestic consumers over the two types does not satisfy (7), the entrant offers only one menu targeting only the high-type consumers and extracting their entire surplus. Since pre-liberalization, home firm earned strictly positive monopoly profit and the high-type consumers enjoyed strictly positive net utility, liberalization of the economy makes the home country unambiguously worse off in this situation.

For distribution pattern satisfying (7), the entrant caters to both types by offering a separating or discriminating menu. But once again it extracts the entire surplus from the low-type consumers by pushing them to their reservation net utility, just as what the home incumbent did before liberalization, even though they are now offered a higher quality. The high-type consumers, on the other hand, gets a strictly positive net utility, whereas the home firm loses its entire sales. Thus, welfare of the domestic economy equals just the net utility that the high-type consumers enjoy from consuming the imported variety $\tilde{q}_2^*$ at a price $\tilde{p}_2^*$ as defined in (22b). Formally,

$$W_F(\delta \le \delta^*) = n_2[\alpha_2 - \alpha_1]q_1^*. \tag{29}$$

Pre-liberalization domestic welfare, on the other hand, equals the sum of home firm's monopoly profit and the positive net utility that the high-type consumers get from the menu (q_{2a}, p_{2a}) as defined in (6b):

$$W_A = \sum_{i=1}^{2} n_i(\alpha_i q_{ia} - c_o - \frac{1}{2}c q_{ia}^2). \tag{30}$$

which upon substitution of values from (6a) and (6b) boils down to:

$$W_A = \frac{[3n_1\alpha_1 + n_2(\alpha_2 - \alpha_1)][n_1\alpha_1 - n_2(\alpha_2 - \alpha_1)]}{8n_1c} + n_2\left[\frac{3\alpha_2^2}{8c} - c_o\right] - n_1c_0. \tag{30a}$$

Subtraction of (29) from (30a), using (22a), yields the change in welfare as:
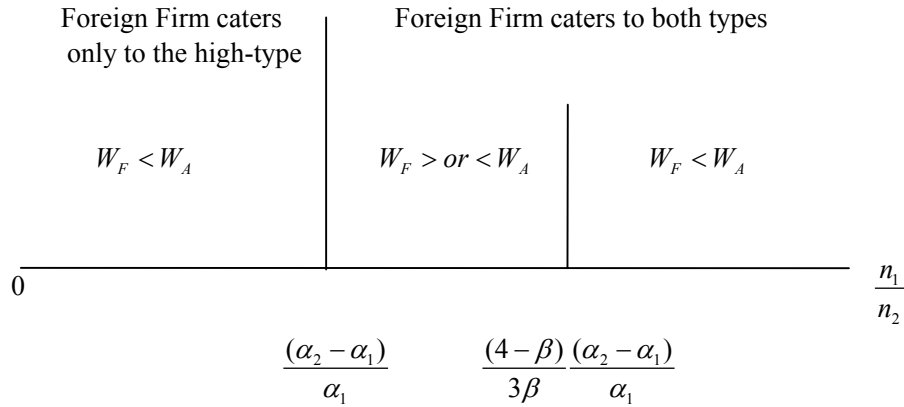
$$W_F - W_A = n_1 c_0 - \frac{[3n_1\beta\alpha_1 - (4-\beta)n_2(\alpha_2 - \alpha_1)][n_1\alpha_1 - n_2(\alpha_2 - \alpha_1)]}{8n_1\beta c} - n_2\left[\frac{3\alpha_2^2}{8c} - c_o\right].$$

(31)

Thus, for sufficiently small value of c_0, the domestic economy loses from liberalization when the distribution of consumers is that,

$$\frac{n_1}{n_2} > \frac{(4-\beta)}{3\beta}\frac{(\alpha_2 - \alpha_1)}{\alpha_1} .$$

(32)

Since $\beta < 1$, so $\frac{(4-\beta)}{3\beta}\frac{(\alpha_2 - \alpha_1)}{\alpha_1} > \frac{(\alpha_2 - \alpha_1)}{\alpha_1}$. This means, when relative number of low-type consumers is very high as defined in (32), which is even higher than the critical size defined by (7), the welfare falls as the domestic economy is liberalized. This is easy to understand. In such a case, the loss of profit of the domestic firm in the low-end of the market alone is too high to be compensated by the gain that the high-type consumers have from liberalization. For the relative size of the low-end of the market smaller than what is defined by the strict equality in (32), such a loss is smaller than what the high-type consumers gain. But, still there is the loss of profit for the domestic firm from losing the high-end of the market. Thus, even then liberalization may lower of the domestic economy.

Figure 4 below illustrates these welfare implications of liberalization for different distribution patterns, for home market advantage in the range $[0, \delta^*]$.

Foreign Firm caters   Foreign Firm caters to both types
only to the high-type

$W_F < W_A$ $W_F > or < W_A$ $W_F < W_A$

0 $\frac{n_1}{n_2}$

$\frac{(\alpha_2 - \alpha_1)}{\alpha_1}$ $\frac{(4-\beta)}{3\beta}\frac{(\alpha_2 - \alpha_1)}{\alpha_1}$

Figure 4. Distribution Pattern and Gains from Liberalization for $\delta \in [0, \delta^*]$

For intermediate range of home market advantage, $\delta \in \left[\delta^*, \delta^{***}\right]$, on the other hand, the domestic market is segmented between the firms with the home incumbent catering the menu $(\overline{p}_1, \widetilde{q}_1)$ to the low-type consumers and the foreign entrant offering the menu $(p_2^*, \widetilde{q}_2^*)$ to the high-type consumers, where $p_2^* = \alpha_2 (\widetilde{q}_2^* - \widetilde{q}_1) + \overline{p}_1$. The level of domestic welfare, denoted by W_F^d (where d denotes the duopoly equilibrium) thus equals,

$$W_F^d = n_1 [\alpha_1 \widetilde{q}_1 - c_o - \frac{1}{2} c \widetilde{q}_1^2] + n_2 (\alpha_2 - \alpha_1) \widetilde{q}_1 + n_2 [\alpha_1 \widetilde{q}_1^* - c_o^* - \frac{1}{2} \beta c \widetilde{q}_1^*] . \tag{33}$$

The first term in (33) is the sum of surplus that the low-type consumers have and the profit that the home incumbent reaps by offering the menu $(\overline{p}_1, \widetilde{q}_1)$ to them. The second and third term together measures the surplus that the high-type consumers enjoy by consuming the foreign high-quality variety. The pre-liberalization welfare defined in (30) can similarly be decomposed as:

$$W_A = n_1 [\alpha_1 q_{1a} - c_o - \frac{1}{2} c q_{1a}^2] + n_2 (\alpha_2 - \alpha_1) q_{1a} + n_2 [(\alpha_2 \widetilde{q}_2 - c_o - \frac{1}{2} c \widetilde{q}_2^2) - (\alpha_2 - \alpha_1) q_{1a}] . \tag{30b}$$

Now the second term measures the surplus that the high-type consumers had before liberalization whereas the third term measures the profit that the home firm could reap by offering the menu $(\widetilde{p}_2, \widetilde{q}_2)$ to them.

By the property of the optimum quality, $\widetilde{q}_1$ generates more surplus than q_{1a} in the low-segment of the domestic market. Thus, the first term in (33) is greater than the first term in (30b). That is, the gain from liberalization for low-type consumers overcompensates the loss that the home incumbent incurs by raising the quality and lowering the price offered to them. Since $\widetilde{q}_1 > q_{1a}$, the second term in (33) is also greater than that in (30b) capturing the pro-competitive effect on the quality of the good offered by the home incumbent. Thus the only adverse effect of liberalization is the loss of profit for the home incumbent from the high-segment of the market. But, unless the number of high-type consumers is very large, such a profit loss cannot outweigh the gains that the domestic economy can enjoy from liberalization. Therefore, once again the size of sub-markets in this economy becomes relevant, though now in a more complicated way than in the earlier case.

For even higher home market advantage, $\delta > \delta^{***}$, the domestic economy unambiguously gain from liberalization. Note that since the home firm offers the same quality $\widetilde{q}_2$ to the high-type consumers in both pre and post liberalization equilibrium, the total surplus generated in this high-end of the market - the home firm's profit and the

surplus enjoyed by high-type consumers - remains the same. But, in the low-end of the market total surplus increases since the home incumbent raises its quality to $\widetilde{q}_1$.

A few inferences can be drawn from the above discussion. First, in general, the greater is the home market advantage, more likely that the domestic economy gains from liberalization. Second, demand patterns or relative size of sub-markets are important only for small and moderate home market advantage.

5.   CONCLUSION

What we have demonstrated in this paper is that consumer targeting and market segmentation among firms in a sequential decision structure depends more on the nature of cost asymmetry than on the pattern of demand. Demand pattern becomes relevant only in two cases. First is when the home firm's home-market advantage is too small. The foreign entrant then monopolises the home-country market and decides to cater to both types of consumers only when there is sufficient number of low-type consumers. Second is the case when the home market advantage of the local firm is moderately large $(\delta > \delta^{**})$ to enable it to profitably offer a menu to the high-type consumers but threat of foreign competition does not allow it to effectively discriminate among different types of consumers. In such a case, once again if low-type domestic consumers are sufficiently large in number as defined in (26) above, the local incumbent targets only these consumers and accommodates entry of the foreign firm in the high-end of the market.

On the other hand, though trade liberalization induces the local incumbent to enhance quality of its product (when it survives), the gain from liberalization critically depends on the demand pattern or the distribution of consumers across different types.

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