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# Market Integration and Industrial Specialization on a Monopolistic Competitive Market

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## Abstract

*This paper examines the relationship between market integration and product diversification in a Chamberlinian model of monopolistic competition. In the first version of the model, production of the firm is organised in activities producing either one or two horizontally differentiated product-variants. The cost functions show both scale and scope economies. Market integration is illustrated by an increase in the market size. For increasing market size, each firm shifts from producing two variants to producing one variant only at a certain threshold value of market size. Passing this threshold value the firm size measured by total output changes discontinuously leaving the effect on firm size ambiguous. For specific specification of the perceived demand of the individual firm hysteresis of the industrial structure may appear in the sense that the threshold value of the market size for shifting from two to one variant production exceeds that of the threshold value of market size of shifting from one to two variants. In the last part of the paper, the model is generalised to a continuum of variants and it is shown that an increase of the market size reduces the number of variants produced by each firm, whereas the hysteresis phenomenon disappears.*

- **JEL Classifications:** D20, F02, L10
- **Key Words:** Market Integration, Monopolistic Competition, Specialization, Hysteresis of Industrial Structure

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## I. Introduction

Adam Smith’s famous theorem about diversion of labour states that specialization is limited by the size of the market. A specialized production at the firm level is characterised by the use of a large number of inputs and a small number of processes of production.

In the last two decades the “new” growth theory has offered a formal relationship between market size and specialization with focus on the input side of production of final goods. Labour productivity in producing final goods depends positively on both the total stock of capital and the number of variants of capital goods (Romer, 1990, Rivera-Batiz and Romer, 1991, and Barro and Sala-i-Martin, 1995). However, as each capital good is based on sunk costs related to an initial R&D-activity, a large market offers a large number of variants of capital goods and this allows for more efficient production activities, i.e. a higher labour productivity.

Less theoretical attention has been devoted to the relationship between market size and specialization on the output side at the firm level. In international trade theory it has been advanced by Caves (1989) that removal of trade barriers prompts the individual firm to concentrate on fewer activities. This intra-firm restructuring may take place both horizontally where the firm reduces the number of products or product variants delivered to the market or vertically where the number of processes in the value added chain produced internally by the firm is reduced. Specifically the incentive to outsource part of the production processes in the firm has been stressed by Krugman (1995), who points to the improved possibilities to utilize spatial factor price differences, when trade costs are reduced. Venables (1999) further shows that decreasing transport costs for intermediate goods leads to spatial fragmentation of production in firms and hence vertical or horizontal multinational firms will emerge depending on the labour intensity of downstream and upstream activities. Scale economies may also be a reason for outsourcing of processes in the value added chain. This point has first been made in Stigler (1951), who argues that an increase of the market size may lead to entry of one or more firms producing intermediates, which previously had been produced internally in the firm. When market size is small the emergence of specialized producers of intermediates is inhibited because of scale economies. Since the derived demand for specialized inputs increases with market size, this permits the possible entry of new firms specialized in producing intermediates.

This line of reasoning has much later on been presented in a formalised model by Dinlersoz (1998).

In business literature the development of specific competences and concentration on core activities horizontally and vertically has been emphasised in several contributions as important premises for success of the firm (see e.g. Skinner, 1974a, 1974b and Porter, 1980).

Several empirical analysis of firm diversification have been made since the 1970s (see e.g. Brush and Karnani (1996) and Montgomery (1994) for a survey). The general conclusion which appears from the empirical oriented literature is that the firms have become substantially less diversified in the last 25 years. However, only few of these studies investigate the link between trade costs and diversification. In a cross country study of plant size and specialization based on data from the mid 1997's Scherer et al. (1975) found some support of the hypothesis that removal of trade barriers has stimulated product specialization and utilisation of product specific scale economies. Similar conclusions was drawn by Baldwin et al. (1983) in an time series analysis of selected industries in Canada in the period 1970-79. Carlson (1989) also touches the issue. He argues that the increased competition from abroad is a main reason for firms disinvestment of activities of non-core business in US manufacturing in the late 1970s. Recently Baldwin et al. (2000) has specifically analysed the impact of trade liberalisation on the change in the diversification of the Canadian manufacturing firms in the period 1973 to 1997. Their analysis shows that the free trade agreement with the US and later the establishment of NAFTA was important triggers for the firm specialization in the Canadian manufacturing.

These conceptions about specialization also have important implications for the relationship between market size and firm size. On the one hand, an increase of the market size may increase the firm size, because keen competition on a larger market results in larger production runs in the individual firms, which survive on the market. On the other hand, the increase of market size may induce the firm to concentrate on core activities and this tends to reduce firm size. Theoretical analyses are therefore inconclusive with respect to the effects of market integration on firm size (see e.g. EAG 1997). Empirical assessments of the effects on firm size of the establishment of the Internal Market in Europe seem to confirm this ambiguity (European Commission 1996, EAG 1997).

The purpose of this paper is to analyse market size and specialization of output in a static Chamberlinian model with monopolistic competition. The Chamberlin model (1933) is extended by allowing the individual producer to produce more than one product variant. This gives a tractable analytical framework for an endogenously determination of both the total number of variants as well as the number of variants produced by each firm. Most of the analysis in the following is based on the assumption that the firm has to choose between producing one- or two-product variants sold on a market with numerous horizontally differentiated product variants. The costs function exhibit both scale and scope economies. Average variable unit cost is assumed to be constant but higher in the case where the firm produces two variants compared with producing one variant only. The total fixed cost of producing two variants is assumed to be less than twice total fixed cost of solely producing one variant. The specified cost structure makes it cost efficient to produce two variants for small product runs but only one variant for larger product runs. In the following theoretical analysis a conceptual distinction between firm and plant will not be made and throughout the analysis the term firm will be used for the organisational unit for production.

Based on the traditional Chamberlinian analysis of firm optimization and free entry and exit it is shown that the product runs depend positively on the market size, and hence two-variant firms dominate totally in equilibrium when market size is small, and one-variant firms when market size is large. Furthermore, it is shown in the model that hysteresis of the industrial structure may exist in the sense that the threshold value of market size, where a two-variant structure collapses and changes to a one-variant structure exceeds that of the threshold value of market size, where the opposite transition takes place. However, this latter result is sensitive to the specific assumptions about the perceived demand functions. The first conclusion about concentration on one variant on a big market seems to be more robust for several specifications of perceived demand functions. In the last part of the paper the model is generalised by introducing multi-variant firms i.e. firms where many variants may be produced. It is shown that also in this case an increase of the market size induces firms to produce fewer variants.

The paper is organised as follows: Section 2 introduces the basic assumptions of the model and illustrates the Chamberlinian market equilibrium in the alternative cases, where one or two product variants are produced. The relationship between market size and the quantity produced in the individual firm is also illustrated in section 2. Section 3 analyses the threshold values of market size for the shifts of the industrial structure and the possibility of hysteresis. The implications for the firm sizes are also discussed. Section 4 specifies a more general model with multi-variant firms. Section 5 summarizes the main conclusions of the paper and discusses the robustness of the results compared to other model specifications.

## II. A Chamberlinian Model with One or Two Product Variants

It is assumed that all firms produce and sell horizontally differentiated variants on a market where monopolistic competition prevails. The total number of variants on the market is assumed to be numerous and hence, the decisions made by the individual producer do not influence the demand conditions on the market. It is assumed that the demand for the individual variant is specified by the following linear demand function:

$$x_i = S(\alpha - \beta p)\left(\frac{1}{n} - \lambda(p_i - p)\right), \quad \alpha, \beta, \lambda > 0, \quad i = 1, 2\ldots\mathrm{n} \tag{1}$$

where $x_i$ is the quantity demanded of the specific variant $i$, $n$ the number of variants, $S$ the size of the market which depends on the number of consumers and their average income, $p_i$ the specific price of the variant, $p$ the average price level for all the variants on the market and $\alpha$, $\beta$, $\lambda$ parameters[1].

The first bracket of (1) $S(\alpha-\beta p)$ represents group demand of the good and the second the market share of the individual variant. If all producers charge the same prices ($p_i=p$) the market is equally shared i.e. the demand for each variant is $S(\alpha-\beta p)/n$. If all prices of the variants change equally the inverse slope of the demand curve of the individual variant equals $-S\beta/n$. However, the individual producer neglects his influence on the average price and hence, the inverse slope of the perceived demand curve for a specific variant appears to be $-S(\alpha-\beta p)\lambda$, i.e. if a producer considers reducing his price the perceived increase of his sale is proportionate to the group demand $S(\alpha-\beta p)$ which represents the depth of the market[2].

[1] The demand function (1) is a generalization of Krugman and Obstfeld (2000, chapter 6). In Krugman and Obstfeld group demand is assumed to be exogenously given, i.e. perfectly inelastic with respect to the average price. A utility foundation of the Krugman-Obstfeld specification of the demand function is given by Salop (1979). Note that the specification (1) neglects that the number of variants may influence group demand.

[2] The specification (1) may represent both a Lancaster type of demand (Lancaster 1979) where the individual consumer buys more or less of one variant only or a 'love of variety' type (Dixit and Stiglitz 1977) where the consumer spreads his budget on several variants. In the case where the individual consumer only demand one variant and the average demand of each consumer for this group of goods is ($\alpha$-$\beta p$) the term $S\lambda$ may be interpreted as the number of consumers, which the producer expect to capture from the competitors if he lowers his price by one unit.

All firms face the same set of input prices and have access to the same technologies. Each firm has the possibility to make one or alternatively two variants. For the specific choice, one or two variants, the costs functions are thus identical for all firms.

The cost function for a one-variant firm is specified by (2a):

$$C = F + cx_i, \quad i = 1, 2 \ldots n \tag{2a}$$

and for the two-variant firm by (2b):

$$C^* = F^* + c^*(x_i^* + x_j^*), \quad i, j = 1, 2 \ldots n, \quad i \neq j \tag{2b}$$

where $C$ and $C^*$ are total costs, $F$ respectively $F^*$ total fixed costs, while $c$ respectively $c^*$ indicate constant variable unit costs and the asterix indicates variables and parameters for the two-variant firm.

As production is most specialized in the one-variant firm we assume that:

$$c < c^*$$

In order to exclude that the one-variant firm is superior to two-variant firm for all sizes of output, it is furthermore assumed that:

$$F^* < 2F$$

The specification implies both *scale* and *scope economies.* In both alternatives scale economies follow from the inclusion of fixed costs and constant marginal costs implying decreasing average unit costs. As fixed costs per variant are less in a two-variant firm, scope economies exist for small product runs because cost savings may be obtained by producing in a two-variant firm compared with production in two one-variant firms[3].

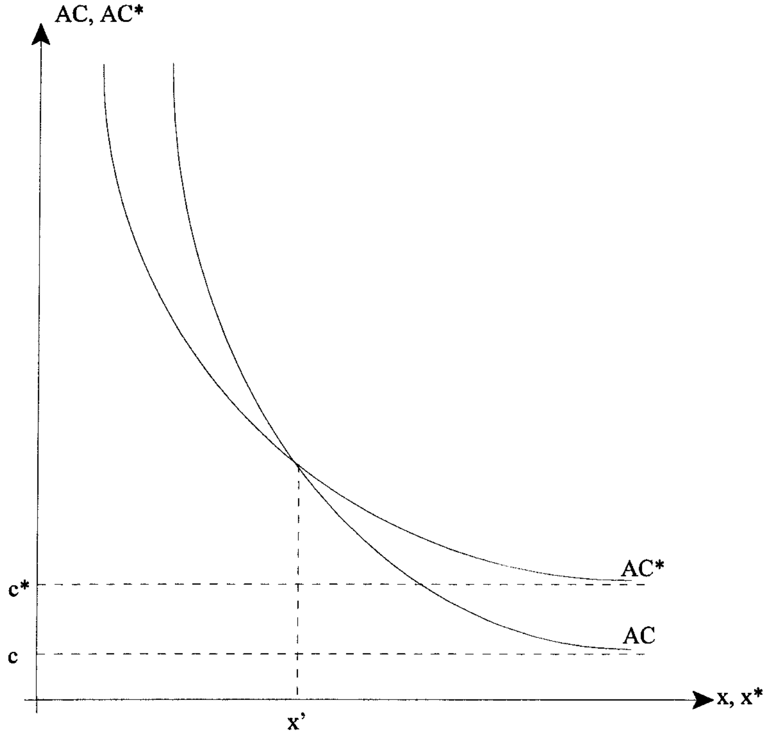
At least two arguments behind these assumptions may be forwarded. The first line of reasoning is related to the design of the fixed equipment of the plant. A one-variant firm represents specialized equipment and a two-variant firm flexible

[3]In general, economies of scope exist when it is less costly to produce two or more products in a single plant compared with production in separate plants where each plant produces one product only (See Panzar and Willig (1981) and Baumol *et al*. (1988) for a more thorough analysis). The specification above implies economies of scope for small product runs but diseconomies of scope for large product runs.

[4]This argument is similar to Stigler's (1939) cost analysis of flexibility. However, Stigler's analysis is related to flexibility of quantity produced of homogenous output, whereas the argument above is related to flexibility in the variant space.

equipment[4]. As the fixed costs of the two-variant firm are kept below twice the fixed costs of an one-variant firm the average variable unit costs are comparatively high. The second argument is related to managerial input, e.g. input of monitoring, information interpretation and decision making in manufacturing of goods[5]. Each firm is assumed to be run by one manager only, who devotes his resources to organize production of either one- or two-variants. If the manager concentrates his efforts on producing only one variant, production may be organized more efficiently with lower variable unit costs. Managerial input is thus assumed to be a fixed input in the firm[6]. If the fixed costs represent remuneration of management (the alternative income of a manager in other businesses), total fixed costs are identical for producing one or two-variants in the simple case, where the effort of

**Fig. 1.** Total unit costs in a one-variant and a two-variant firm.




[5]These characteristica of managerial input is analysed by others by Calvo and Wellisz (1978), Radner and Van Zandt (1992) and Javanovic (1993).

[6]A generalization of this assumption by allowing for the possibility of hiring more than one manager to the firm would not remove the scarcity problem of managerial capacity in the firm if the hiring of more than one manager involves some loss of control (Beckmann (1977) and Javanovic (1993)).

the manager is the same. However, if the manager intensifies his efforts, when producing two-variants, fixed costs in the two-variant case exceed that of fixed costs in the one-variant case.

From a resource point of view output is identical in a two-variant firm as the marginal costs are constant and identical for the two variants. Therefore, it makes sense to calculate total average cost also in the case of two-variant firms. The prices charged for each variant produced in a two-variant firm are identical because of identical demand functions and identical marginal costs, i.e. $x_i^*=x_j^*=x^*$. Total quantity produced in a two-variant firm thus makes up $2x^*$.

Total average costs in a one-variant firm AC are given by (3a) and in a two-variant firm by (3b):

$$AC = \frac{F}{x} + c \tag{3a}$$

$$AC^* = \frac{F^*}{2x^*} + c^* \tag{3b}$$

The average costs curves for the two types of firms are shown in figure 1.

If production of each variant is less than $x'$ a two-variant firm offers the lowest unit costs, because of the dominating role of fixed costs. If on the other hand production of each variant exceeds $x'$ unit costs will be lowest for a one-variant firm, due to lower variable unit costs.

## A. Market Equilibrium

Market equilibrium prevails when operating profit is maximised and when no incentive exists to enter or exit the market. Specifically, marginal revenue should equal marginal costs and the price should be equal to total average costs implying zero profit.

Solving the model for market equilibrium algebraically leads to quite awkward solutions. However, the model invites for a graphical analysis as market equilibrium may be illustrated, where the perceived demand curve of a firm is tangential to the average cost curve. As this is the only sale where the firm avoids negative profit, marginal revenue equals marginal costs. If the perceived demand curve crosses the average cost curve, positive profits will exist. Hence, new firms will enter the market and the demand curve will move to the left. If the perceived demand curve does not touch the average cost curve at all negative profits will prevail. In this case firms will exit the market and the demand curve will move to the right.

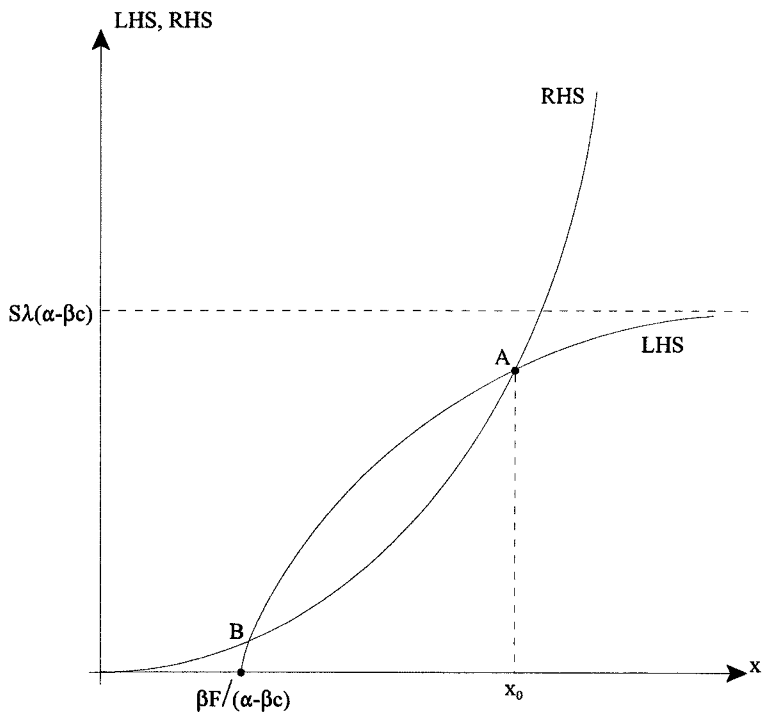
To find and describe the market equilibrium the following procedure is used. First, we determine production in equilibrium for each producer for a given market size. This result is derived by equalizing the slopes of the perceived demand curve and the average cost curve and by using that the price must equal average cost. Secondly, a positive relationship between production of each variant in equilibrium and market size is derived. Finally, market equilibrium in the two alternative cases with one- or two-variant firms, respectively is compared and analysed.

## B. One Variant Only in Each Firm

Deriving the slopes of the perceived demand curve and the average cost curve from (1) and (3a) and using the condition that the slopes are equal in equilibrium gives:

$$\frac{dp_i}{dx_i} = \frac{dAC}{dx_i} \Leftrightarrow \frac{dx_i}{dp_i} = \frac{1}{dAC/dx_i} \Rightarrow S\lambda(\alpha - \beta p) = \frac{x^2}{F} \tag{4}$$

**Fig. 2.** Determination of the market equilibrium in a one-variant firm.



Inserting the zero-profit condition $p=F/x+c$ in (4) leads to:

$$\underbrace{S\lambda(\alpha-\beta(F/x+c))}_{LHS} = \underbrace{x^2/F}_{RHS} \tag{5}$$

The left hand side (*LHS*) and the right hand side (*RHS*) both depend on $x$. It is easily shown that the *LHS* is growing in x but at a diminishing rate towards the asymptote $S\lambda(\alpha-\beta c)$ and that the *LHS* is negative for $x<\beta F/(\alpha-\beta c)$, see figure 2.

Market equilibrium exists where *LHS* and *RHS* intersect each other, i.e. in *A* and *B*. Only A represents a stable equilibrium. *A* small perturbation which pushes production above $x_0$ implies *RHS*>*LHS*. The perceived demand curve is thus steeper than the average cost curve and positive profit will be connected with a smaller production. The opposite forces apply if production is pushed below $x_0$. Applying the same way of reasoning it is easily shown that intersection *B* is an unstable solution. Hence, we neglect the solution given by intersection *B*[7].

Production in the stable market equilibrium depends on the market size, see (5). The *RHS* in (5) is independent of the market size *S*, i.e. the slope of the average cost curve does not vary with *S*. However, the *LHS* depends positively on *S*, i.e. the perceived demand curve gets flatter the higher *S*.

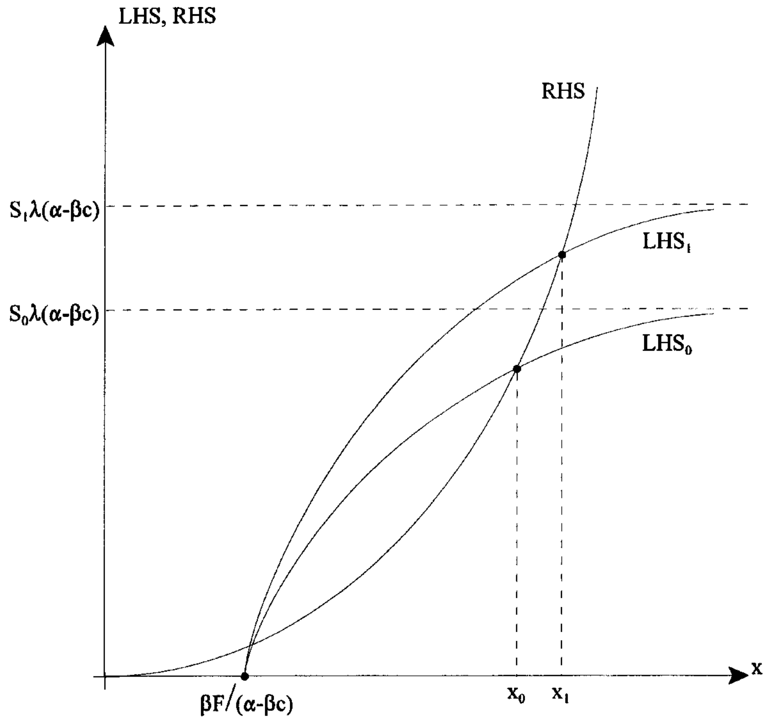
Figure 3 illustrates the equilibrium production for two alternative market sizes $S_0$ and $S_1$ ($S_0<S_1$). An increase of the market size from $S_0$ to $S_1$ moves the *LHS*-curve upwards and in the resulting market equilibrium production increases from $x_0$ to $x_1$. A positive relationship between market size and size of the product runs of each variant in market equilibrium thus exists.[8]

Referring to figure 1 equilibrium output in the one-variant case for a given market size, e.g. $x_0$ in figure 2 corresponds to the specific point on the *AC* curve, where the perceived demand curve is tangential. An increase in market size increases the production runs of each variant in equilibrium and the equilibrium thus shifts downwards on the AC curve as the perceived demand curve gets

[7]In the very special case where *RHS* and *LHS* have only one common point with the identical tangent, the equilibrium is stable for a right perturbation but unstable for a left perturbation. If the two curves do not intersect, no solution exists.

[8]In the alternative specification with isoelastic demand functions the product runs are independent of the market size. An increase in the market size will in this case increase the number of variants proportionally, leaving the market price and firm size unchanged. Such specification appears if the demand function is derived from a Dixit and Stiglitz “love of variety” specification of the utility function (Dixit and Stiglitz, 1977).

**Fig. 3.** Market size and product runs in one-variant firms.




flatter.

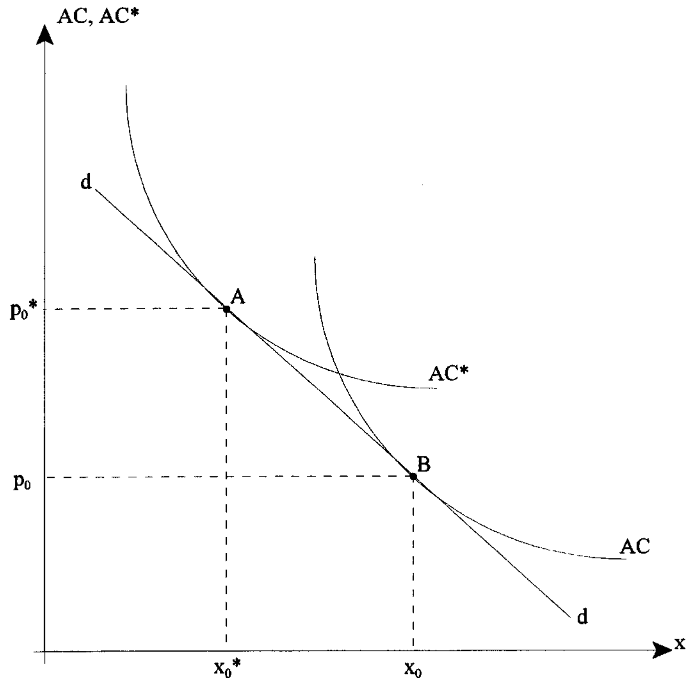
## C. Two Variants in Each Firm

Alternatively if *all* firms produce *two variants,* the cost conditions are specified by (2b). The market equilibrium is found as in the one-variant case. Using (1) and (3b) the equivalence to (5) appears to be:

$$\underbrace{S\lambda\left(\alpha-\beta\left(\frac{F^*/2}{x^*}+c^*\right)\right)}_{LHS^*} = \underbrace{\frac{(x^*)^2}{F^*/2}}_{RHS^*} \tag{6}$$

Determination of market equilibrium is analogous to the one-variant case and the results are equivalent. Referring to figure 1 an increase in $S$ implies a movement of equilibrium downward along the $AC^*$ curve. Hence the production per variant increases with $S$, whereas price falls.

**Fig. 4.** Perceived demand curve and zero-profit in both one- and two-variant firms.




## III. Market Size and Diversification

In the preceding section market equilibrium is illustrated on a market with either one-variant or two-variant firms. We now raise the question: is it possible for a one-variant producer to enter the market in an environment with only two-variant producers and conversely: is it possible for a two-variant producer to enter in an environment with only one-variant producers.

### A. A One-variant Producer in a Two-variant Environment

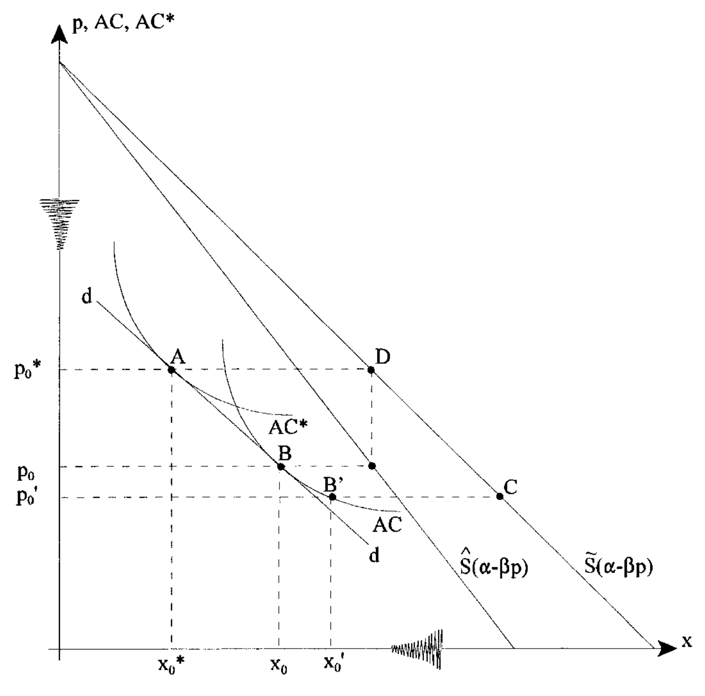
A one-variant producer requires non-negative profit if he should enter a market with only two-variant producers. This possibility is illustrated in figure 4. The dd-curve illustrates the perceived demand curve for producers in market equilibrium with only two-variant firms and the dd-curve is thus tangential to the $AC$*-curve. This specific equilibrium $A$ corresponds to a specific market size, say $\tilde{S}$. However, the dd-curve is also tangential to the $AC$-curve and a one-variant producer may therefore also produce with zero profit. If the firm chooses a two-variant activity market equilibrium will be $x_0$* and $p_0$*. If the firm alternatively chooses to be a one-variant producer marginal costs will be lower and the firm will charge a lower price $p_0$ and supply a larger quantity $x_0$ of the variant.

If the market size in a market with only two-variant firms is less than $\tilde{S}$, production runs in equilibrium have been shown to be smaller and it is obvious that in this case the steeper perceived demand curve precludes entry of a one-variant producer. $\tilde{S}$ thus makes up a threshold value of market size where a one-variant producer may enter.

## B. A Two-variant Producer in a One-variant Environment

Similarly, the question may be raised when a two-variant producer could enter a market with only one-variant producers. This may also be illustrated by figure 4 if the dd-curve now is interpreted as the perceived demand curve in a market equilibrium $B$ with only one-variant producers. This specific equilibrium $B$ corresponds to the specific market size $\hat{S}$. As the perceived demand curve also is tangential to $AC^*$ it will be possible for a two-variant producer to establish and produce at zero profit at the point A. It is obvious that if market size exceeds $\hat{S}$ the perceived demand function will not allow two-variant producers to establish with non-negative profit as the perceived demand curve then will be flatter. As will be

**Fig. 5.** Hysteresis of industrial structure.



shown below $\hat{S}$ and $\tilde{S}$ are not identical.

### C. Market Size and Shift in Firm Structure

Figure 5 expands figure 4 by introducing two different positions of the group demand curves i.e. demand curves representing the total demand for the group of all variants. The curve $\tilde{S}(\alpha\text{–}\beta p)$ illustrates group demand at the lowest level of market size $\tilde{S}$, where a one-variant producer could establish in a two-variant equilibrium. In this equilibrium the incumbent two-variants producers produce $x_0$* per variant at the price $p_0$* corresponding to the point A. The entrant one-variant producer produces $x_0$ at the price $p_0$ corresponding to the point B and the inverse slope of the perceived demand curve dd of this two-variant dominated equilibrium is given by $\tilde{S}(\alpha\text{–}\beta p_0{*})$.

The alternative curve $\hat{S}\lambda(\alpha\text{–}\beta p)$ illustrates group demand at the largest level of market size $\hat{S}$, where a two-variant producer could enter a one-variant equilibrium. Again the incumbent one-variant producers produce $x_0$ each at the price $p_0$ whereas the entrant two-variant producer plans to produce $x_0$* at the price $p_0$*. The inverse slope of the perceived curve is $\hat{S}\lambda(\alpha\text{–}\beta p_0)$.

The perceived demand curve in the two cases is identical and hence $\tilde{S}\lambda(\alpha\text{–}\beta p_0{*})=\hat{S}\lambda(\alpha\text{–}\beta p_0)$. Note that the total quantity demanded is equal in the two cases. At $p_0$ each consumer demands more so fewer consumers are required to generate the same total sale on the market, i.e. $\tilde{S}>\hat{S}$.

### D. Past Dependency

This difference between $\tilde{S}$ and $\hat{S}$ may give rise to past dependency or hysteresis of the industrial structure. Let us assume that market size is small initially ($S<\hat{S}$), and that the industrial structure is characterized by two-variant producers only. If, in this case the market size increases, the industrial structure will remain stable until the market size reaches $\tilde{S}$. At $\tilde{S}$ a one-variant producer might enter the market as he can operate with non-negative profit. This would decrease the average price of variants leading to exit of two-variant producers, and the structure might change to market equilibrium with only one-variant producers. This is illustrated in figure 5 by the one-variant market equilibrium *B*’, where the perceived demand curve is flatter ($\tilde{S}\lambda(\alpha-\beta p_0') > \tilde{S}\lambda(\alpha-\beta p_0^*)$). For $S>\tilde{S}$ only one-variant producers will be present at the market.

If we reverse the change of the market size the following scenario will be the outcome. Initially the market is large $S>\tilde{S}$ requiring a homogeneous industrial structure with only one-variant producers. This structure remains stable, until the market size decreases to $\ddot{S}$. At that point a two-variant producer might enter and if the process continues the production structure will be characterized by only two-variant producers for $S<\ddot{S}$.

The industrial structure thus depends on market size and for a certain interval of market size history also matters. For a small market size ($S<\ddot{S}$) equilibria with only two-variant producers exist, and for large market sizes $S>\tilde{S}$ we will end up with only one-variant equilibria. For medium market sizes $\ddot{S}<S<\tilde{S}$ hysteresis prevails in the sense that the industrial structure is given by the structure that prevailed in the past.

The intuition behind the hysteresis result is related to the impact of the industrial structure on the perceived demand functions. For a given market size the total quantity demanded for all variants in an equilibrium with only two-variant producers is comparatively small because of the high average price. Hence, the potential for increasing the sale for an individual producer by lowering his specific price is small as the effect is related to total sale of all producers on the market. This environment is unfavourable for a one-variant producer where the cost advantage of having low marginal cost is of little help in bearing the burden of high fixed costs. Conversely, in a large market where only one-variant producers are present, total quantity demanded for all variants will be comparatively high and hence the demand is more sensitive to the price in the perception of the individual producer. In this environment a two-variant producer may not have the possibility to enter the market because the two-variant producer has higher variable costs but lower fixed costs per variant.

## E. Firm Size

Market integration encourages a specialization as each firm restructures its activities from producing two- to producing one-variant only, i.e. the firm adopts a more focussed strategy. In this transformation process the firm size may change discontinuously. However, it is an open question whether firm size increases or decreases. The increase in market size increases the firm size by increasing the production of the variants in the firm. At market size $\tilde{S}$ the opposite effect arises. Firm size may decrease because of a shift to a more focussed strategy. This can be seen in Figure 5. At $\tilde{S}$ the firm structure changes from a two-variant equilibrium A to a one-variant equilibrium *B*'. In this structural transformation firm size changes from $2x_0$* to $x_0$' and depending on whether $2x_0$* is smaller or bigger than

$x_0'$ firm size increases or decreases[9]. Hence, the effect of integration on firm size is ambiguous. Regarding prices the effect of integration is unambiguous. As market size increases, prices will drop because of the higher sale per firm and because of the shift in firm structure. As firms change to one-variant producers prices drop discontinuously as shown in figure 5 by the movement from $A$ to $B$'.

## IV. A Continuum of Product Variants

We now assume that the firm has the possibility of producing a variable number of variants at the blueprint stage where the specific type of firm should be decided. To keep the model tractable the number of variants v designed to be produced by the firm is treated as a continuous variable. The cost function is given by (7):

$$C(v) = F(v) + vc(v)x \tag{7}$$

where $F$>0, $c$>0, $dF/dv$>0, $dc/dv$>0 and $F(\delta v)<\delta F(v)$ for $\delta$>1, $\delta \in N_+$.

For a given number of variants economies of scale prevail because of the fixed costs. Economies of scope also prevail as total fixed cost is assumed to increase less than proportionally with the number of variants. However, utilizing economies of scope is assumed to imply higher variable costs.

Using the cost function (7) the total average cost may be calculated as before:

$$AC(v) = \frac{F(v)}{vx} + c(v) \tag{8}$$

In order to examine more explicitly the relation between production structure and market size we assume that:

$$\frac{F(v)}{v} = v^{-\varepsilon}\,;\ (0 < \varepsilon < 1) \tag{9}$$

and

$$c(v) = v^{\theta}\,;\ \theta > 0 \tag{10}$$

Note, that the economies of scope is strong (weak) if $\varepsilon$ is close to 1 (0) and I close to 0 (high).

With a high value of $v$ it is evident, that the interval in market size where

[9]The relation between $2x_0^*$ and $x_0'$ depends on the cost structure in the two types of firms, i.e. the positions of the two unit costs curves $AC$ and $AC^*$.

hysteresis appears becomes very small, as the unit cost curves for a $v$-variant firm and a $(v+dv)$-variant firm will nearly coincide. Hence, for large values of $v$ the hysteresis effect vanishes. This establishes a one-to-one relationship between the market size and the industrial structure, i.e. the number of variants produced per firm.

The envelope curve for all the $AC(v)$ curves is used to solve for the industrial diversification. To find the envelope curve we minimise the total average cost with respect to the number of variants $v$. Inserting the specifications (9) and (10) in (8) the problem becomes:

$$\underset{v}{Min} < \left[\frac{1}{x}v^{-\varepsilon} + v^{\theta}\right] \tag{11}$$

The solution to (11) is:

$$v_{envelope} = \left(\frac{\varepsilon}{\theta}\right)^{\frac{1}{\theta+\varepsilon}} x^{-\frac{1}{\theta+\varepsilon}} \tag{12}$$

The perceived demand curve should be tangential to the envelope curve of all $AC(v)$-curves, and using the same procedure where the *RHS* and *LHS* are equalized the corresponding production per variant for a given market size is determined. This establishes a positive relationship between market size $S$ and production per variant $x$. Using this in (12), a negative relationship between the number of variants $v_{envelope}$ and market size thus appears.

The same kind of ambiguity exists for firm size as in the previous situation in section 2 and 3. The increase in market size increases the output per variant but the focussing strategy might decrease the firm size. The firm size is given by:

$$v_{envelope}x = \left(\frac{\varepsilon}{\theta}\right)^{\frac{1}{\theta-\varepsilon}} x^{-\frac{\theta+\varepsilon-1}{\theta+\varepsilon}} \tag{13}$$

Hence, the effect on firm size of an increase of market size is positive for $\varepsilon+\theta>1$ and negative for $\varepsilon+\theta<1$.

## V. Conclusion

Market integration may lead to a deep industrial restructuring in the individual firms. This article focuses on impacts of market integration on the horizontal specialization at the firm level. It is shown that an inverse relationship between market size and the number of variants produced by the firm exists. The nexus in the model is the conception that the product runs of a specific product variant in the individual firm increase with the market size and hence firms give up scope economies to concentrate on core activities. Because of this specialization the effect of market integration on firm size is ambiguous. On the one hand, an increase of the market size leads to larger product runs which increase the firm size. On the other hand, when the producer limits the number of variants produced the firm size decreases. The paper also points to the possibility of hysteresis of the industrial structure because the existing industrial structure influences the demand for all producers on the market.

Although the conclusions above are based on the simple assumptions of the Chamberlinian model, the main results may also appear for alternative model specifications. On oligopolistic competitive markets with a to given number of firms, market integration will diminish the market power of the individual firm and thus reduce mark-up. This may cause an exit of some of the firms leaving larger product runs to the remainder. In the case where an individual firm produces more than one good the larger product runs may induce the firm to restructure through output specialization.

Although welfare has not been analysed in the model above market integration improves efficiency through a decrease of unit costs. The decrease of unit costs is both a result of larger product runs for given technology i.e. for given product mix and a result of a shift in technology towards a more narrow product mix. An obvious avenue for future research would be to analyse explicitly the welfare implications of market integration when the firms enter into a specialization on the output side and it would be especially interesting to analyse cases where hysteresis of the industrial structure appears.

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