Pergamon

Technovation 23 (2003) 461–513

technovation

www.elsevier.com/locate/technovation

Product diversification in the vehicles industry: a techno-economic analysis

G. Barbiroli *, A. Focacci [1]

Business and Management Department, Faculty of Economics, University of Bologna, Technology and Resources Volarisation Area, Piazza Scaravilli, 2-40126, Bologna, Italy

Abstract

The current tendency towards product differentiation in many areas of manufacturing is generally considered to be a positive phenomenon. What we have attempted to do here is to analyse the real degree of diversification that exists within the vehicles industry (in the case of all those models of cars, scooters and motorcycles for which we managed to find figures) by measuring global performance together with the use of statistical correlation. We have elaborated our figures using the technical specifications and prices available in the (Italian) market.

This method enables us to evaluate the actual degree of diversification within the vehicles industry, and to calculate the price/global performance ratio, a real measure of the relationship between the global quality of a product and its price, in order to get a critical understanding of the technical and economic results.

Keywords: Product diversification; Vehicle industry; Global performance; Quality; Price

1. Introduction

The current trend in a great deal of consumer durable manufacturing is towards an ever-increasing diversification of products, designed to ensure greater market shares. This behaviour, partly dictated by the specific nature of demand in the industrialised world could, be justified from the commercial point of view in terms of the need companies have to gain a secure position in already saturated markets. The majority of consumers in fact give great importance to the choice of a wide range of different products and brands (Pindyck and Rubinfeld, 1996) and, as a consequence, the production of differentiated goods (to a lesser or greater degree) would guarantee a company a predominance over potential rivals, especially with regard to its specific product (Beath and Katsoulacos, 1991). The first important theoretical contributions to the analysis of product differentiation in markets characterised by imperfect competition can be found in the models created by Hotelling (1929) and Chamberlin (1933), which however lead to diametrically opposed conclusions: in the case of Hotelling, the result is the minimum degree of differentiation, while in that of Chamberlin the opposite is true, with maximum differentiation being achieved. Subsequent studies have broadened the conceptual aspects of the question, and led to the formulation of more complete models (Eaton and Lipsey, 1975; Dixit and Stiglitz, 1977; Salop, 1979).

As a result, companies are no longer solely interested in the tried-and-tested marketing strategy of creating an 'apparent variety' of goods, but also in looking for new production mixes which tend to constitute a 'real variety' of products once again considered to be of central importance within the modified competitive framework (Starr, 1982; Clark and Wheelwright, 1993). The production of a greater variety of goods, characterised by increased managerial and operational complexity, thus leads to the development of new productive strategies (Perera et al., 1999).

It remains to be seen, nevertheless, if and to what degree an increase in the overall level of diversification leads to a reduction in costs for the company (Kikuchi, 1996). The achievement of near technological perfection and the wider use of production procedures and methods,

* Corresponding author. Tel.: +39-051-2098053; fax: +39-051-222949.

E-mail addresses: gbarbiroli@economaunibo.it (G. Barbiroli); focacci@economia.unibo.it (A. Focacci).

[1] Tel.: +39-051-2098054

0166-4972/02/$ - see front matter © 2002 Elsevier Science Ltd. All rights reserved.
doi:10.1016/S0166-4972(02)00100-1

however, have led scholars to believe that the end result of such developments is the generalised standardisation of output which had previously been differentiated to a much greater degree. The consequent higher levels of overall productivity, constituting a considerable saving in terms of resources, and thus enabling further investment programmes to be got underway, would therefore seem to lead to both the creation of new products and the development of other technologies (Abernathy and Utterback, 1975, 1978; Sahal, 1981; Metcalfe and Gibbons, 1989).

2. Use of the global performance index (GPI) as a basis for objective analysis

In the present work we have tried to see whether there is any correspondence between the commercial value (price) and the objective quality of a wide number of vehicles. In order to do so, we initially gathered figures for the main properties/performances that together contribute towards the definition of the quality of the products (a brief discussion of the methods involved for the vehicles taken into consideration is given later, although it should be said that universal standards of reference have yet to be accepted throughout the world), and then condensed them into a numerical index capable of providing quantitative terms (GPI).

Briefly, this GPI can be calculated by considering all the vehicles' technical properties and expressing them in terms of a single figure by means of a standardisation procedure—utilised in several previous works—involving the transformation of the absolute figures for each property/performance into a percentage value, taking into account the maximum possible real range given by the following algorithm (Barbiroli, 1989, 1992; Barbiroli and Fiorini, 1992; Barbiroli et al., 1992; Barbiroli and Focacci, 1999):

$$x_j^{(k)} = [x_{j,\min}^{(k)} - \Sigma_{i \in S(j,k)} \lambda_i^{(k-1)} R_{i,k-1} x_{i,\min}^{(k-1)}] + \Sigma_{i \in S(j,k)} \lambda_i^{(k-1)} R_{i,k-1}^{(j,k)} x_i^{(k-1)},$$

where, $x_j^{(k)}$ is the value of index j at level k; $x_{j,\min}^{(k)}$ is the minimum forecast value of index j at level k; $\lambda_i^{(k-1)}$ is the weight to be given to variable i of level k–1 in defining the variable of the subsequent level; $S(j,k)$ is the set of indices of the 'successors' of variable j of level k, and

$$R_{i,k-1}^{(j,k)} = (x_{j,\max}^{(k)} - x_{j,\min}^{(k)}) / (x_{j,\max}^{(k-1)} - x_{j,\min}^{(k-1)})$$

is the scale ratio between variables j of level k, and i of level k–1.

It should be noted that the weights $\lambda_i^{(k-1)}$ must satisfy the relation of normalisation: $\Sigma_{i \in S(j,k)} \lambda_i^{(k-1)} = 1$.

We should point out, at this juncture, that we have deliberately left out all those features (of importance when it comes to the consumer's final decision) linked to subjective evaluations (such as appearance or perceived quality) which, however, cannot be easily and uniformly appreciated and compared by the vast range of potential consumers. Such a situation has already been examined in a previous paper (Barbiroli and Focacci, 2000).

Having calculated the GPI for the various goods (and for all existing varieties of model), it is then compared with the prices of the said goods (given directly by the publicly available price lists contained in publications within the sectors in question) to give an idea of the relationship between the objective quality of the goods and their commercial price (Quattroruote, 1998a; In Sella, 2000).

One further point of methodological interest is that one analytically important figure was not available, and that is their durability. Here we need to make a theoretical distinction between the product's economic life (calculated on the basis of opportunity cost), and its technical life (taken as the maximum time period for which the product can physically fulfil its function, until repair and reconditioning costs reach prohibitive levels) (Cooper, 1994; Kostecki, 1998). The proposed definitions—together with that submitted by Smith (1973), which attempts to permeate both economic and technical connotations and is linked to the calculation of the time between purchase and scrapping—imply the possession of information that is simply not available. For purely illustrative purposes (Table 1), a number of average figures taken from Kostecki's study (1998) have been given.

The idea of calculating the time a model remains on a manufacturer's catalogue, which at first glance may seem a possible solution, also presents a number of problems given that manufacturers often introduce modifications (some small, others more substantial) which may eventually lead to the renaming of the product in question, thus rendering this kind of analysis impossible.

One feature lending support to the proposed study is provided by the statistical correlation of data. This analysis is based on a linear regression model, the best choice for correlating any direct correspondence between the quality of the goods (summarised in terms of performance) and their respective prices. The statistical

Table 1
Estimated average life of selected consumer durables (years)

Bicycles	4–8
Cars	8–9
Microwave ovens	8–10
Personal computers	3–5
Refrigerators	8–12
Telephones	4–6
TV sets	8–10
Washing machines	7–10

Source: Kostecki, 1998.