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J Evol Econ (2009) 19:471–486

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DOI 10.1007/s00191-009-0145-9

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Published online: 5 May 2009

Abstract The present paper aims at examining the role of variety in the ski manufacturing industry and its relevance in firms' price setting strategies. In particular, it intends to investigate and to empirically test three hypotheses concerning the relations between: product quality and prices; variety in technical characteristics and prices; variety in service characteristics and prices. Our empirical investigation finds that prices are positively affected by product quality and positively affected by variety in service characteristics. This means that a high degree of product variety allows firms to charge a premium price on consumers, who are able to find the product that best meets their needs and are therefore willing to pay a higher price. By contrast, variety in technical characteristics negatively impacts prices. In a context where a dominant design has emerged and new varieties are not radically different from each other, the gains in economies of scale and scope outweigh the costs of the increased flexibility in the equipment required to produce variety.

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Keywords Variety · Product and service characteristics · Ski manufacturing sector

JEL Classification L15 · L23 · O31

1 Introduction

What drives firms' pricing strategies in relation to new products? Improved quality and different costs of production are necessarily good predictors, although not exhaustive. Specifically, new products increase variety within an industry and this might heavily impacts upon consumers' willingness to pay and thus upon prices. This paper investigates the relationship between price and variety in the ski-manufacturing industry. This industry has some peculiarities, which make it particularly interesting from an economic perspective. First, even in presence of a dominant design, we observe a high degree of product variety, which is mainly driven by consumers' heterogeneity. Since different market segments (e.g. beginners and professionals) have very different preferences, manufacturers have to produce many different models of skis in order to meet the needs of consumers. Second, the industry is characterized by a very short product life cycle. In such a dynamic environment, product innovation plays a crucial role and results in an incessant realignment of both organization of production and willingness to pay.

Starting from these considerations, the aim of the paper is to investigate the role of variety in an industry where a dominant design has emerged and to understand, in particular, how product variety affects pricing strategies. Variety generation in the ski manufacturing industry will be discussed on the basis of the theoretical framework of products as bundle of characteristics, in the spirit of Lancaster (1990), Saviotti (1991, 1994) and Frenken et al. (1999). This approach allows us to distinguish two kinds of variety that have opposite effects on prices: market-related variety acts as a mechanism to meet consumers' preferences and gain market power, while production-related variety impinges upon economies of scale and scope.

The paper relies upon an original dataset including all the skis produced by 42 manufacturers and sold in the European market between 1992 and 2007. For 4193 models, we have collected data on key product characteristics and price, and we investigate price determinants, putting particular emphasis on the role of product quality and product variety (in terms of technical and service characteristics) over time. The paper is organized as follows. Section 2 provides a brief overview of the literature on the concept of variety and on its impact on competition, and puts forward the theoretical hypotheses to be tested. Section 3 presents the dataset and some descriptive evidence on price dynamics, demand heterogeneity and firms' strategies of product differentiation. Section 4 describes the empirical analysis, first presenting the model and putting forward the hypotheses on the expected effects of the explanatory variables on prices, and then discussing the results in light of the existing literature. Finally, Section 5 concludes.

2 Variety and industry evolution in the literature

The notion of variety is quite fuzzy and the literature has widely discussed the issue by taking into account mainly two different perspectives. First, it is possible to think of variety as representing *diversification strategies* at the firm level: this has to do with the breadth of a firm's product portfolio (Schmalensee 1978; Piore and Sabel 1984; Randall and Ulrich 2001; Guerzoni 2004). Second, one can conceive of variety as identifying the degree of *product diversity*, i.e. the extent to which a product differs from other products in the market. For the scope of this paper, we are particularly interested in this second type of variety, because our level of analysis concerns the single innovation and its relationship with the overall industry.

As pointed out by Lancaster (1966, 1971), the theoretical approaches on variety and market power can be divided in two blocks: models of monopolistic competition, rooted in Chamberlain's work, and address models branching from Hotelling's seminal work (Hotelling 1929; Eaton and Lipsey 1979; Gabszewicz and Thisse 1986). The former models discuss the case of an industry in which firms produce slightly heterogeneous goods and, due to the quasi-concavity of the utility function, each single consumer buys a positive quantity of each good produced in the industry. In these models, demand is homogenous and described by a representative agent. By contrast, in address models, demand is heterogeneous and consumers purchase only one unit of a specific variant of the goods. The latter approach and its extensions better fit the ski industry, as consumers buy only one unit of the goods.

The analysis of variety generation within the Hotelling's framework originally addresses the relationship between price and product differentiation. Although his principle of minimum differentiation (i.e. firms supply identical products at the marginal price) turned out to be incorrect, Hotelling had the merit of clearly identifying the trade off between price and differentiation: "Firms seek differentiation to avoid unbridled price competition" (Irmen and Thisse 1998, p. 77). Hotelling's contribution has been very fruitful. Two extensions of his basic work are particularly relevant for the topic of this paper: the relationship among price and location extended to an n-dimensional space, and the relationship between vertical and horizontal product differentiation. As will emerge from the discussion, none of these classes of models found clear results and their validity is still an open question.

For the sake of this paper, the most important addition to Hotelling's framework is Lancaster's intuition that the model can be extended to an n-dimensional space. In Lancaster's view, consumers perceive a good as a bundle of characteristics and they form their preferences over these attributes. The most advanced theory has been modelled by Irmen and Thisse (1998) and Neven and Thisse (1990), whose theoretical result is that, in equilibrium, competitors seek the maximum differentiation in one characteristic and the minimum differentiation along the rest of the attributes spectrum. This result is crucial to highlight once again the Hotelling trade-off between the two alternative strategies of reduction in prices or increase in product differentiation. For this reason, in equilibrium we observe a balance between high differentiation to obtain some degree of market power and low differentiation to increase market size.

Despite their relevance, these results hold only in duopolistic industries and do not seem to be very robust to alternative specifications.[1] Moreover, the authors do not provide any empirical evidence for this—undeniably counterintuitive—outcome. However, their approach is particularly interesting from a methodological point of view: for a vast range of products, it is possible to collect data about their characteristics and to analyze the impact of each of them on the price level. This methodology, known as *hedonic price analysis*, has been widely employed to create quality adjusted inflation baskets (Griliches 1971; Rosen 1974), but also to gain a better understating of price formation in specific sectors such as the PC industry (Pakes 2002) and the automotive industry (Feenstra and Levinsohn 1989). Notably, Feenstra and Levinsohn (1989) develop a model in which the product characteristics are used to design an *n*-dimensional space, where the competition among firms is the tougher, the more they locate close to each other. The present paper will heavily draw from this tradition and analyze price dynamics as a function of product characteristics.

A second extension to the Hotelling's setting, which is particularly relevant to our analysis, concerns the introduction of the distinction between vertical and horizontal product differentiation, and the investigation of their relationship (Shaked and Sutton 1982; Gabszewicz and Thisse 1986):

> Horizontal product differentiation is rooted in taste differences. More precisely, the potential customers have heterogeneous preferences about the proportion in which the attributes of the product should be combined....By contrast, vertical product differentiation refers to a class of products which cohabit simultaneously on a given market, even though customers agree on a unanimous ranking between them. The survival of a low-quality product then rests on the seller's ability to sell it at a reduced price. (Gabszewicz and Thisse 1986, p.160).

In order words, without understanding the structure of consumers' preferences, no prediction can be made a priori as to the outcome of either quality or price competition. Not only does a consumer face the choice of buying a specific variety, but he has also to choose the level of quality. For this reason, any empirical model willing to deal with the concept of variety first has to take into account the improvements in quality. Thus, the first hypothesis we put forward (H1) concerns the impact of quality on prices.

[1] For instance, the authors check the results only with quadratic transportation costs.

H1: product quality has a positive impact on prices.

The second question we address concerns the link between product variety and prices: the literature suggests the existence of a positive link, but so far there is not much convincing empirical evidence supporting this argument. We argue that the lack of empirical evidence originates in a theoretical flow in the concept of variety. In particular, as Gabszewicz and Thisse (1986) suggested, the Hotelling strategic effect—i.e. differentiated product exhibit higher prices—holds only if consumers give value to variety.

Here, we fully exploit the potential of the approach based upon product characteristics. As pointed out by Metcalfe and Saviotti (1984), we can distinguish among two sets of characteristics: technical characteristics represent the internal structure of the product, while service characteristics capture service features as perceived by the users (Metcalfe and Saviotti 1984). For a correct estimation of the Hotelling strategic effect, we can only refer to product differentiation in the product characteristics space. By contrast, the degree of variety available in technical characteristics for each single product will serve as a control for possible economic of scale and scope in the organization of production. As Clark (1985) emphasizes, once a dominant design has emerged (such as in the ski industry), incremental innovations and production of new variety can affect only peripheral components of the design. For this reason, gains in economies of scale and scope can outweigh the cost of the increased flexibility in the equipment required to produce variety. Therefore, we argue that this second type of variety negatively impacts prices, following a decrease in the cost of production. On this basis we test two hypotheses:

H2a: product variety in technical characteristics has a negative impact on prices

H2b: product variety in services characteristics has a positive impact on prices

3 The ski manufacturing sector: an overview

Although the history of modern ski equipment begins in the nineteenth century, the first ski equipment dates back to 2,500 BC and was found in Sweden. Prehistoric skis were used as a means of travelling for Scandinavian hunters and fishermen. Later, skis became useful during wartime for Scandinavian troops. Scandinavia is also the place where skiing started to be a recreational activity.[2] However, modern downhill skiing appeared only in the nineteenth century in the Alps, when Sondre Norheim from Telemark (Norway) invented the *Telemark ski*, with tip and tail broader than the waist, which remained the dominant design in the sector until the mid-1940s, when the modern ski became the dominant design and Telemark became a niche product.

[2] Around 1,000 AD, Icelandic poetry described skiing as a competitive sport.

In terms of materials, skis used to be crafted with a single piece of wood until 1932, when the laminated ski with multiple wood layers was introduced. By 1951, more than 90% of all skis produced were laminated.[3] Despite the predominance of wood in ski manufacturing, firms started experimenting with other types of materials (metals). During the 1950s, Howard Head produced very successful skis using spring-steel edges, aluminium, wood and plastic, and in 1955 he introduced new materials such as fiberglass, polyethylene and rubber, which helped reduce vibrations at high speed. In 1962 Kneissl, a leading US manufacturer, developed the *White Star*, a very successful wooden laminated ski with a fiberglass case. Soon other companies developed their own fiberglass designs[4] and by the end of the 1960s fiberglass-made skis began to out-perform and out-sell skis made of metals. The most important recent breakthrough in the ski design came in the early 1990s, when Elan and Kneissl, inspired by snowboarding, developed the first prototypes of carving skis, and were soon imitated by their competitors during the mid 1990s. These skis were originally designed for beginners, but soon intermediate and expert skiers realized that the new design had significant advantages and the carving shape was recognized as the new standard. In 2002, carving skis represented almost 100% of total industry-wide ski sales.[5]

In terms of market trends, in 2006 there were about 50 million skiers worldwide and the market for skis was estimated to be about €400 million at the wholesale level.[6] Europe is the main market (64% of total sales), followed by North America (23%) and Japan (10%). In the last two decades, the ski market has declined, from 6.5 million of pairs sold per year in the late 1980s, to an estimated 4.1 million in 2006. This decline can be explained by the increasing success of snowboarding during the 1990s, by the emergence of ski renting as a popular habit for European consumers and, partially, by the economic downturn in Japan.[7]

With reference to consumers' skills, we can identify four levels: beginner, intermediate, expert, professional. Different types of skiers require different features, so that products for different categories have different characteristics. For example, skis for beginners tend to have very short side cut radius, which allows easy turns, while skis for expert skiers have narrower side cuts, which

[3] www.aspenhistory.org

[4] Soon after Kneissl, K-2 introduced its first full fiberglass model, the Holiday, and in 1968 Rossignol developed the Strato and Dynamic produced the VR-17, which differed from the earlier moulded fiberglass skis because it was constructed of fiberglass wrapped around an interior core.

[5] Head Form 20-F, 2002. www.head.com

[6] Head Form 20-F, 2006.

[7] Recently, companies have tried to address the needs of some specific market niches: for example, "freeride" skis and "park and pipe" skis have significantly increased their sales. Freeride skis are good allround skis, as comfortable on the slope as off. They are fat enough to give novice off-slope skiers enough float to cope with powder conditions, but thin enough for edge to edge speed on the slope. Park and pipe skis are specifically designed for acrobatic movements in the snow parks. Another important trend is the increase in the development of ski models for women, which have a lighter weight and a higher manoeuvrability as compared to models designed for men.

allow more gradual curves at a higher speed. Furthermore, beginners need highly flexible skis that can easily bend and turn, while experts prefer stiffer skis, which are more difficult to manoeuvre, but ensure a higher stability at high speeds. In terms of product characteristics, it is possible to identify different segments—e.g. race, carving, allround, freeride, freestyle. It is important to highlight that this second type of market segmentation is strictly related to the concept of demand heterogeneity: consumers buy skis not only taking into consideration their skills, but also according to their skiing preferences. Moreover, quite often consumers give more importance to their preferences than to their ability, and overestimate their skills when buying a pair of skis.

4 Empirical analysis

Our empirical exercise aims at investigating the impact of variety on prices in the ski manufacturing sector, through a hedonic price approach. The idea behind this model is that most consumer goods are sold in many varieties, which differ according to their properties, dimensions or other attributes (Griliches 1971). This means that, at any time, we can observe a set of different prices for different varieties in the market. Basically, if we assume that goods are bundles of attributes, the price is a function of a set of attributes and some additional random factors. A hedonic function, therefore, explains the price of goods as a function of these attributes. The basic hedonic price model can be written as:

$$\overline{p} = f(X) \tag{1}$$

where $\overline{p}$ is the vector of prices and X is the matrix of the product characteristics. We intend to estimate the following equation with robust OLS regressions, including time-dummy and firm-dummy variables:

$$\log p_{it} = f(\text{C}, \text{STRUCTURE}, \text{MATERIALS}, \text{INDEXCOST}, \text{AVERAGE LENGTH}, \text{NUMBER OF LENGTHS}, \text{MAXIMIN}, \text{PRODSIMIL}) \tag{2}$$

where i is the index for the product variant and t refers to the year of observation. We use the semi logarithmic form, which relates the logarithm of the price to the absolute values of the attributes (see Griliches 1971).

The empirical analysis relies upon an original dataset of innovations including 5,109[8] new skis sold in the European market between 1992 and 2007. The main source is *Sciare*, an Italian specialty ski magazine, whose buyers' guides provide information on key product characteristics.[9] Each year, companies sell new models, while old skis are usually kept for rentals. This means that, for

[8]Due to some missing data, we perform the analysis on a set of 4,193 skis.

[9]In some cases, companies' websites have been used to complement the available information.

each year, our dataset includes an entirely new set of skis. We have collected detailed information concerning the following variables:

- Price
- Type of consumers (beginner, intermediate, expert, professional)
- Style of consumer (e.g. special slalom, giant slalom, allround, freestyle)
- Lengths
- Carving measures (cut side radius, tip-waist-toe width)
- Ski construction (sandwich, cap, monoblock, torsion box).
- Ski core materials (e.g. wood, fiberglass).
- Anti-vibration system
- Edge materials (e.g. steel)
- Base materials (e.g. graphite, extruded polyethylene).

The total number of new models in the market has substantially increased, from 296 models in 1992 to 552 models in 2007. It is interesting to notice that this variable was quite stable until 1999, had a peak in 2002 (with 510 new models) and then decreased substantially until 2006. Since our dataset includes new skis each year, each product appears just once in the dataset, so that we cannot exploit a panel structure.

4.1 Explanatory variables and their predicted signs

The independent variables of the econometric model are presented in Table 1.

As underlined in Section 2, our model aims at testing the following three hypotheses:

H1: Product quality positively affects prices
H2a: Product variety in technical characteristics negatively affects prices
H2b: Product variety in services characteristics positively affects prices

In order to test the first hypothesis, we build two measures of product quality (STRUCTURE and MATERIALS), and we also consider a measure of ski size (AVERAGE LENGTH). We compute these three variables in the following way.

Table 1 The explanatory variables

Variable	Description
STRUCTURE	Sum of the dummy variables for structure, edges and base
MATERIALS	Number of materials used in the ski core
INDEXCOST	Average standardised cost of materials
AVERAGE LENGTH	Average length of the ski
NUMBER OF LENGTHS	Number of available lengths
MAXMIN	Difference between the maximum and the minimum length
PRODSIMIL	Degree of originality in the overall market

As far as STRUCTURE is concerned, we consider the following three categorical variables (groups of characteristics):

- *Structure complexity*. We identify four main categories defining the ski structure: Sandwich, CAP, Torsion Box and Monoblock. In general, Sandwich is the most complex structure and it is usually employed in top level skis, while Monoblock is the least complex structure. However, some models may have more than one feature characterizing the structure, so that it is quite difficult to understand whether a Monoblock ski is more or less complex than a Sandwich ski. We therefore build a dummy variable for each type of structure, which takes value 1 if the ski has that specific structure and 0 otherwise. Then, we build the variable *structure complexity*, summing up all the dummies.
- *Edges*. Edges can be different across different models of skis, both in terms of materials (e.g. iron, steel, diamond) and in terms of structure (e.g. trapezoidal vs. segmented). Different edges may have different combinations of materials and different combinations of structures. We build a dummy for each characteristic, which takes value 1 when that characteristic exists and 0 otherwise. Then, we build the variable *edges*, summing up all the dummies.
- *Base*. At a very general level, we can distinguish polyethylene bases from graphite bases. The presence of graphite ensures a lower level of friction, therefore increasing speed. Furthermore, a lower level of friction is associated with a higher molecular weight, which ensures a high resistance to abrasion and makes the skis self-lubricating. Also in this case, it is important to underline that some models may have different features in their bases. Once again, we build a dummy variable for each characteristic that takes value 1 if that specific characteristic exists and 0 otherwise. Then, we build the variable *base*, summing up all the dummies.

For each ski, STRUCTURE is the sum of structure complexity, edges and bases.[10] The higher this variable, the more complex the ski and the higher the cost of production. We therefore expect STRUCTURE to have a positive impact on prices, as it signals both a higher quality of the product and higher production costs.

As far as the variable MATERIALS is concerned, we identify 56 different materials that can be currently used to produce the ski core, ranging from wood to fiberglass, kevlar, carbon.[11] The ski core can include few or many different materials, ranging from poor ones (e.g. polyurethane foam) to precious ones (e.g. fiberglass). In order to control for the number of the materials, we build 56 dummy variables—one for each material—and then generate the variable

[10]We sum up the three values instead of entering the dummies as separate variables in order to avoid multicollinearity.

[11]These materials refer *only* to the ski core: we do not consider here materials that are included in the base and/or in the edges.

MATERIALS, by simply counting the number of materials used for each ski. In general, we expect complexity to have a positive impact on prices. However, the sheer number of materials is not a very precise indicator to capture the overall ski quality, since the materials are extremely variable in terms of quality. Two skis with the same number of materials may in fact differ substantially in terms of quality, and this can have an impact on prices. In order to control for this variety, we collect information on material unit prices, standardize them to account for differences in units of measurement, and then build the variable INDEXCOST, which is a proxy for the average cost of materials for each ski. We expect INDEXCOST to have a positive impact on prices. Finally, we consider a general indicator of the ski size—the average length of the ski (AVERAGE LENGTH)—and we argue that that, given a specific set of materials, this factor (partially) reflects the overall cost and should display a positive relationship with prices.

The above described set of independent variables allows us to capture product quality and the related production costs. Under the condition that these variables have a positive effect on prices, we can now turn to address the main question of the paper, i.e. we ask what the impact of different types of variety on prices is.

Following the literature and given our previous considerations on the nature of the ski sector, we distinguish between production-related variety and market-related variety. Production-related variety considers how many variants of the same model of ski are available. Market-related variety captures to what extent a specific ski differs from others available in the market. We proxy production-related variety with variety in the technical characteristics, which identify the internal structure of the product.[12] Market-related variety is measured by variety in the service characteristics, which describes the specific use of skis by consumers.

In terms of variables related to the technical characteristics, we consider two measures of variety: NUMBER OF LENGTHS, which is the number of available lengths for a product, and MAXMIN, which is the difference between the maximum and the minimum length. In principle, we could assume variety to have a positive impact on market power and therefore we could expect this variable to have a positive effect on prices. However, product variety related to technical characteristics is easy to achieve and does not require any specific investment. For this reason, it does not lead to diseconomies of scope, even though it might generate economies of scale. Furthermore, and even more relevant for our analysis, variety in technical characteristics is often not perceived as an important variable by consumers, so that firms cannot easily charge a high price for that. Therefore, following *H2a*, we expect the availability of many lengths and the existence of a wide range of lengths to have a negative impact on prices.

[12] Since the level of our analysis is the product, we consider here production-related variety within-product and not within-firm. Nevertheless, we introduce firm dummy variables to control for other possible sources of heteroskedasticity at the firm level.

Table 2 Service characteristics

Style	Gender/Age	Top	Carve	Type of race	Value
Freeride	Lady	Yes	Yes	Giant slalom	1
Alpine	Junior			Special slalom	2
Race					3
Allround					4
Easy					5
Other	Other	No	No	Other	0

With reference to the variables related to the demand side, we exploit the information on ski service characteristics and build one indicator that measures the variety at the level of the specific market segment for each ski. We proceed in the following way. We first identify five different service characteristics for each ski, which refer to all the existing market segments: gender/age, carve, top, type of race, style. Each characteristic can take different "values", as shown by Table 2. In particular, top and carve are either present (1) or not (0); gender/age can be "lady" (1), "junior" (2) or "other" (0); style identifies different styles of skiing (e.g. freeride, easy); type of race identifies different types of race (e.g. giant slalom, special slalom) and can take three different values.

According to this classification, we define a vector of service characteristics for each ski, i.e. a vector T_i of dimension $n = 5$, where the nth entry takes a specific value according to the features of the ski. Each vector can be conceived as a specific market segment made of five different service characteristics.

Starting from this, we calculate the variable PRODSIMIL. From the theory we know that higher variety is associated with higher costs and thus higher prices. Furthermore, higher variety firms have the possibility of reaching different types of consumers, offering a product which is closer to their preferences and for which consumers should have more willingness to pay, thus leading firms to charge higher prices. PRODSIMIL identifies the degree of originality of each ski in relation to the overall market. In order to build this indicator, we first calculate the number of skis that are identical to the ski under consideration along all the five characteristics (SIMIL5), along four characteristics (SIMIL4), along three characteristics (SIMIL3), along two characteristics (SIMIL2), along one characteristic (SIMIL1), and along no characteristic (SIMIL0). Then we build the

Table 3 Predicted signs of the explanatory variables

VARIABLES	Predicted sign
Product-specific variables	
Structure	+
Materials	+
Indexcost	+
Average length	+
Number of lengths	−
Maxmin	−
Prodsimil	−

Table 4 Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
Structure	2.641649	1.17118	1	7
Materials	2.96992	1.411708	1	8
Indexcost	.0109449	.0114066	1.00e-09	.0678529
Average length	172.3255	16.18569	63	217.25
Number of lengths	4.954961	1.931172	1	19
Maxmin	26.22825	11.12288	0	105
Prodsimil	658.8927	301.5258	82	1300

variable $\text{PRODSIMIL}_i = \sum_{j=10}^{5} j * \text{SIMIL}_j$. This variable indicates the degree of similarity of each ski with other skis in the market: the higher PRODSIMIL, the higher the similarity with other skis and the lower the degree of product originality. In line with our hypothesis *H2b*, we therefore expect a negative relationship between PRODSIMIL and price, which would confirm the fact that variety in service characteristics positively affects price.

Table 3 shows the predicted signs of the explanatory variables. Tables 4 and 5, respectively, illustrate the descriptive statistics and the correlation matrix of the explanatory variables. The correlation matrix does not reveal high correlations among the covariates. Quite interestingly, if we consider the evolution of our measures of variety over time, we notice that variety in technical characteristics has a decreasing trend, which is in line with the emergence of a dominant design in the ski industry, while variety in service characteristics has a non linear trend, showing a decrease between 1992 and 1999, an increase between 1999 and 2005, and then again a decrease in the last 2 years.

4.2 Results

Our results are illustrated in Table 6. The coefficients indicate the estimate of the percentage increase in price due to a one-unit change in the specific characteristic, other variables being constant. We estimate three models. Model 1

Table 5 Correlation matrix

	Average length	Number of lengths	Structure	Materials	Maxmin	Index cost	Prodsimil
Average length	1.0000						
Number of lengths	0.0173	1.0000					
Structure	−0.0149	0.0877*	1.0000				
Materials	0.2298*	−0.0330*	−0.0221	1.0000			
Maxmin	0.1815*	−0.0120	−0.0426*	0.1083*	1.0000		
Index cost	0.0331*	−0.0192	−0.0341*	−0.0896*	0.4037*	1.0000	
Prodsimil	−0.2158*	0.0055	0.0025	−0.1732*	−0.2974*	−0.1280*	1.0000

*Significance level at 5%

Table 6 Determinants of prices

Independent variable	Model 1	Model 2	Model 3
STRUCTURE	0.0372[a]	0.0361[a]	0.0310[a]
	(0.0050)	(0.0049)	(0.0047)
MATERIALS	0.0177[a]	0.0206[a]	0.0165[a]
	(0.0052)	(0.0050)	(0.0048)
INDEXCOST	2.002[b]	1.683[c]	1.312
	(0.99)	(0.97)	(0.92)
MATERIALS*INDEXCOST	−0.582[b]	−0.530[b]	−0.369
	(0.28)	(0.27)	(0.25)
AVERAGE LENGTH	0.0178[a]	0.0174[a]	0.0174[a]
	(0.00050)	(0.00047)	(0.00046)
NUMBER OF LENGTHS		−0.0399[a]	−0.0316[a]
		(0.0039)	(0.0038)
MAXMIN		−0.00229[a]	−0.00204[a]
		(0.00055)	(0.00053)
PRODSIMIL			−0.000602[a]
			(0.000030)
Time dummy variables	Yes	Yes	Yes
Firm dummy variables	Yes	Yes	Yes
Constant	2.847[a]	3.022[a]	3.458[a]
	(0.12)	(0.12)	(0.12)
Number of obs.	4193	4193	4193
R^2	0.61	0.62	0.66

Dependent variable: *logprice*
[a]Significant at 99%
[b]significant at 95%
[c]significant at 90%

considers just the impact of the quality/complexity variables on prices, Model 2 also accounts for the role of variety in technical characteristics and prices, while Model 3 includes the variable indicating variety in service characteristics.

First, if we examine the relationship between the quality/complexity of skis and prices, we find, as expected, a positive relationship between the price and the quality of the product in terms of structure complexity and number of materials. In relation to this, we also find that AVERAGE LENGTH is positively associated with prices. Interestingly, INDEXCOST has a positive impact on prices (although the result is not very robust). However, the incidence of INDEXCOST on prices decreases with the number of materials (i.e. when we interact INDEXCOST with MATERIALS, the variable has a negative coefficient). The intuition behind this result is that what matters in terms of complexity (and therefore what impacts on prices) is the process of assembling different materials in the same ski, more than the specific type of materials that are used. All in all, our empirical findings suggest that quality has a positive impact on prices and, therefore, confirm our hypothesis $H1$.

If we turn to Model 2 and Model 3 and examine the relationship between variety and prices, we find very interesting results both on technical characteristics and on service characteristics. As far as variety in technical characteristics is concerned, we observe that the price is negatively affected by the NUMBER OF LENGHTS and by the range of available lengths (MAXMIN). This result corroborates our hypothesis $H2a$, according to which there is a negative relationship between variety in technical characteristics and prices. In an industry where a dominant design has emerged, the variety in technical characteristics can be associated with economies of scale and scope and therefore allows firms to have a relatively high price-cost margin without charging high prices. Moreover technical characteristics do not impact on consumer preferences and, therefore, an increase in prices in a competitive market is hardly justifiable.

A further possible explanation for our findings relies in the specific features of the demand structure in the ski industry. Amateur skiers are likely to be much more heterogeneous in terms of individual characteristics than professional skiers, the vast majority of whom are adults. Having to meet the needs of very different consumers, the skis for amateurs show more heterogeneity in terms of technical characteristics than top-level skis, which have a lower number and a narrower range of lengths. Since top-level skis tend to be also relatively more expensive, it is quite intuitive that a higher number and a wider range of available lengths have a negative impact on prices.

As far as variety related to service characteristics is concerned, the results are in line with our predictions. In particular, the variable defining product similarity confirms our hypothesis that product differentiation leads to higher prices. In particular, if a ski is different from other products in the overall market, then its price tends to be relatively high. This result suggests that a high degree of product variety allows firms to charge a premium price on consumers, who are able to find the product that best meets their needs and are therefore willing to pay a higher price. This result supports our hypothesis $H2b$.

Finally, we offer a brief note on time dummy variables. As expected, the coefficients of these variables are all significant and negative up to 2003, revealing a trend of decreasing prices over time. There seems to be a different trend starting in 2005, which would require further investigation.

5 Conclusions

The present paper aimed at examining the role of variety in the ski manufacturing industry and its relevance in firms' price setting strategies. In particular, it intended to investigate and to empirically test the presence of two different types of variety upon prices, controlling for quality: variety in technical characteristics, which has to do with the production process, and variety in service characteristics, which has to do with consumers' heterogeneity. Our empirical analysis relied upon an original dataset of 4,193 new skis offered in the market between 1992 and 2007. Our empirical investigation confirmed that the price is positively affected by the quality/complexity of the product, is negatively affected by the variety at the level of technical characteristics, and is positively affected by the variety at the level of service characteristics. First, in industries where a dominant design has emerged, the variety on the production side is not substantial and the gains from economies of scale and scope outweigh the cost of more flexible equipment, so that the variety in technical characteristics is associated with relatively low prices. Second, the results concerning variety in service characteristics show that a high degree of product variety allows firms to charge a premium price on consumers, who are able to find the product that best meet their needs and are therefore willing to pay a higher price. These preliminary results therefore have important implications for firms' strategies in terms of product positioning and types of consumers to be targeted.

The literature has highlighted a trade-off in firms' differentiation strategies, due to the co-existence of benefits stemming from close-to-customers product positioning and costs related to the ability to compete successfully in different markets, which often requires not only deep market knowledge, but also continuous changes in the production process. However, our results have shed light on a possible balance for this trade-off. In particular, they suggest that new production technologies might nowadays allow the exploitation of economies of scale and scope even with a certain degree of product differentiation, thus enabling firms to couple the gains in market power stemming from product differentiation with the reduced costs of production. This means that, even if the impact of variety on prices is uncertain (i.e. prices can either increase or decrease because of product differentiation), the outcome in terms of firms' market power might benefit companies searching for variety. Future research in this respect calls for a more careful analysis at the firm level, in order to investigate the degree and sources of product differentiation among different competitors, distinguishing in particular between market leaders and niche players.

Acknowledgements The authors would like to thank the participants in the DIME conference "Demand, Product Characteristics and Innovation" held in Jena in 2007, and in particular Uwe Cantner, Roberto Fontana, Alessandro Nuvolari and Rene Soellner for their helpful comments and suggestions. A special thank to Matteo Malacarne and Alexander Schacht, who provided invaluable research assistance during the process of data collection. Marco Guerzoni acknowledges the financial support of DFG (grant RTG 1411) and Nicoletta Corrocher acknowledges the financial support of the Research Council of Norway (Project n°172603/V10: "The Knowledge-based society").

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