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Product variety and price strategy in the ski manufacturing industry

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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 empirically test two hypotheses concerning the relation between variety and prices. The first concerns the relationship between product quality/complexity and prices. The second refers to the existence of two kinds of varieties having opposite effects on price formation: market-related variety and production-related variety. We are able to empirically disentangle these two effects, by using variety in service characteristics as a proxy for market-related variety and variety in technical characteristics for production-related variety. Our empirical investigation confirms that prices are positively affected by product complexity and quality and positively affected by variety at the level of 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 meet their needs and are therefore willing to pay a higher price. On the contrary, variety at the level of technical characteristics negatively impact on prices, because in a context where a dominant design emerges and new varieties are not radically different, gains in economies of scale and scope outweigh the cost of the increased flexibility in the equipment required to produce variety. The resulting decrease in marginal costs negatively impinges upon prices.

Keywords: variety, product and service characteristics, ski manufacturing sector

JEL: L15, L23, O31

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1. Introduction

This paper investigates the relationship between price and variety in the ski-manufacturing industry. This industry has some peculiarities, which make it particularly interesting to investigate 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 characterised by a very short product life cycle. In such a dynamic environment, innovation plays a crucial role in determining firms' competitive strategies and market leadership. Sometimes new models represent just incremental innovations, but often changes can be much more radical and can concern the materials used or the production technique.

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 firms' 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 and 1994) and Frenken et al. (1999). This approach allows us to distinguish two kinds of variety having 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 (5109) produced by 42 manufacturers and sold in the Italian market between 1992 and 2007. For each model, we have data on key product characteristics and price, and we will investigate price determinants, putting particular emphasis on the role of product quality and product variety over time. In the paper, Section 2 provides a brief overview of the literature on the concept of variety and of its impact on competition, and puts forward the theoretical hypotheses to be tested. Section 3 illustrates the historical origins and current trends of the ski manufacturing sector, while Section 4 presents the dataset and some descriptive evidence on price dynamics, demand heterogeneity and firms' strategies of product differentiation. Section 5 describes the empirical analysis, first presenting the model and putting forward hypotheses on the explanatory variables, and then discussing the results in light of the existing literature. Finally, section 6 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, we can 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; Ulrich, 2001; Guerzoni, 2007). Second, we can conceive variety as identifying the degree of *product diversity*, i.e. how a product differs from others in the market. For the scope of this paper, we are particularly interested in this second type of variety, because by generating market power impinges upon prices.

As pointed out by Lancaster (1966 and 1971), the literature 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 et al., 1979). The former models discuss the case of an industry where 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. On the contrary, in address models demand is heterogeneous and consumers purchase only one unit of a specific variant of the goods. Because of these assumptions, the latter approach and its extensions better fit the ski industry.

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 differentiation. As it 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 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 differentiation to obtain some degree of market power and minimum differentiation to increase market size.

Despite their relevance, these results hold just 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 analyse 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 (Pakes, 2002)

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

and the automotive ones (Feenstra and Levinsthon, 1989). Notably, Feenstra and Levinsthon develop a model where product characteristics are used to design an n-dimensional space, where competition among firms is the tougher, the more they locate close to each other. The present paper will heavily draw from this tradition and analyse 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 vertical and horizontal product differentiation, and the investigation of their relationship (Shaked and Sutton, 1982; Gabzewitz 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". (Gabzewitz and Thisse, 1986).

In order words, without understanding the structure of consumers´ preferences, no prediction can be made a priori on the outcome of either quality or price competition. Not only a consumer faces the choice of buying a specific variety, but also he has to choose the level of quality. Furthermore, the supply of variety and the supply of quality might be interrelated.

Summing up, from the above-reviewed literature we take the Lancaster methodological approach and two research questions that should be addressed in order to understand how product variety affects prices. The first question concerns the link between product quality and prices: here the literature suggests that vertical product differentiation has a positive impact on prices and we expect this result to be confirmed by our empirical analysis. The second question 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 suggest that the lack of empirical evidence originates in a theoretical flow in the concept of variety. On the one hand, address models are dealing with variety defined as the distance of a product form its consumer in a Lancastrian space: in other words, these models are interested in the value that consumers give to variety. Following this line of thought, we expect variety to have a positive impact on prices. On the other hand, the production of distinct variety of a product can lead to economies of scale and scope when, as it is the case for the ski manufacturing sector, product varieties do not differ too much. As Clark (1985) emphasizes, once a dominant design has emerged, incremental innovations and production of new variety can affect only peripheral components of the design. For this reason, gains in economies of scale and scopes outweigh the cost of the increased flexibility in the equipment required to produce variety. For this reason, variety should negatively impact upon prices, following a decrease in the cost of production.

In order to spot these two opposing effects, we make use of the distinction among two set 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, 1994). While the former can capture the negative (or not significant) impact of variety on prices, the latter should be used to test the validity of the pure Hotelling´s strategic effect.

For this reason, we first consider a set of characteristics that capture at the same time vertical product differentiation and absolute production costs. Then we turn to examine horizontal product differentiation and we investigate the impact of variety in technical characteristics on price. In this way, we are able to control for any effect of economies of scale or scope over costs of production. Finally, we investigate the relationship between price and variety in services characteristics, which undeniably capture a pure strategic effect.

To conclude, we will test the following three hypotheses:

H1: product quality has a positive impact on prices.

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

3.1 The history of the ski

Although the history of modern ski equipment begins in the nineteenth century, the first ski equipment dates back to 2500 BC and was found in Sweden. Prehistoric skis were used as a means of travelling for Scandinavian hunters and fishermen. Later on in centuries, skis became useful during wartime for Scandinavian troops. Scandinavia is also the place where skiing started to be a recreational activity. Around 1000 AD, an Icelandic poetry described skiing as a competitive sport; however the modern downhill skiing appeared just in the 19th century in the Alps. The first ski school was founded in 1892 in Austria by Mathias Zdarsky, but it was another Austrian named Hannes Schnieder who developed the revolutionary "Arlberg method", which was the first systematic ski teaching method which made skiers change technique, from simple snowplough to the parallel turn.

The popularity of skiing substantially increased in the mid-19th Century, when Sondre Norheim from Telemark (Norway) invented the *Telemark ski*, with tip and tail broader than the waist. Along with the increasing popularity of skiing, the demand for more and more reliable skiing equipment grew. Furthermore, the emergence of Telemark determined an important change in the organisation of production: individual craftsmen, who were traditionally responsible for ski production could not keep the pace of a growing demand and, as a consequence, the first ski factories started to operate. Telemark skis remained the dominant design in the ski manufacturing sector until the mid-1940s, when the modern ski became the dominant design and Telemark a niche product.

Although the quest for greater speed stimulated new breakthroughs in binding technology during the first decade of the last century, the basic design of the ski remained relatively stable until the invention of ski tows and chair lifts during the

1920s and 1930s. This innovation inspired a series of new developments in ski design, among which the most innovative was the steel edge, invented in 1928 by an Austrian metal worker, who was looking for a way to increase the durability of the sides and bottoms of skis. In terms of materials, skis used to be crafted with a single piece of wood until 1932, when a laminated ski with multiple wood layers was introduced. Layers differed in terms of resilience, durability and torsion strength. The technologically most complex laminated skis were introduced in 1939, following the development of a particular glue, which was able to hold the various laminations together permanently. By 1951 more than 90% of all skis produced were laminated[2]. Despite the predominance of wood in ski manufacturing, firms started making some experiments in order to manufacture metal skis. During the 1950s Howard Head produced very successful skis using spring-steel edges, aluminium, wood and plastic. In 1955 he improved his technique by introducing new materials such as fibreglass, polyethylene and rubber, which helped reduce vibrations at high speed. Fibreglass in particular was considered the most advanced material because of its resilience, which allowed excellent shock absorption and grip. In 1962 Kneissl, a leading American manufacturer, developed the *White Star*, a very successful wooden laminated ski with a fibreglass case. Soon other companies developed their own fibreglass designs: 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 molded fiberglass skis because it was constructed of fiberglass wrapped around an interior core. By the end of the 1960s, fiberglass construction began to out-perform and out-sell metal skis.

In the late 1980s, Salomon and Elan introduced a new ski design with a one-piece cap on the top and sides. At that time, most skis were made of synthetic polyethylene with steel edges embedded into the sides, were usually quite long (from 175 to 210 centimetres) and had a straight shape. The important breakthrough in ski design came in early 1990s, when Elan and Kneissl, inspired by snowboarding, developed the first prototypes of carving skis, and were soon imitated by competitors during the mid 1990s. Because of their very wide tips and tails and narrow waists, as well as

[2] Source: www.aspenhistory.org

of their shorter length (typically 160-180 centimetres), these skis were originally designed for beginners, because they made it much easier to turn when placed on edge. Soon, however, also intermediate and expert skiers realised that the new design had significant advantages on the existing one and the carving shape was recognized as the new standard. In 2002, carving skis represented almost 100% of total industry-wide ski sales[3].

3.2 Current 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[4]. The ski market is strictly linked to the market of ski bindings and boots: due to bundling opportunities, these industries are more and more interrelated, as witnessed by many strategic alliances, mergers and acquisitions, and brand extensions that have characterized the winter sports market in recent years. 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 across Europe and, partially, by the economic downturn in Japan. Quite 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. Another important trend is the increase of models for women, which have a lighter weight and a higher manoeuvrability as compared to models designed for men.

With reference to consumers' skills, we can identify four levels: beginners, intermediate, experts, professionals. Clearly, different types of skiers require different products' attributes, and thus products for different categories have different characteristics. For example, skis for beginners tend to have very short side cut radius, which allows easy turns; narrower side cuts allow more gradual curves at

[3] Head Form 20-F, 2002.
[4] Head Form 20-F, 2006.

a higher speed and are therefore more suitable to expert skiers. Furthermore, beginners need highly flexible skis that can easily blend and turn, thus guaranteeing earlier improvements in technique and confidence, 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 such as race, carving, allround, freeride, freestyle. It is important to highlight that this second 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, anecdotic evidence suggests that quite often consumers give more importance to their preferences than to their ability, and overestimate their skills when buying a pair of ski.

4. Data and descriptive evidence

The empirical analysis relies upon an original dataset including 5109 models of skis sold in the European market between 1992 and 2007. The main source is *Sciare*, a specialized ski magazine, whose buyers' guides provide information on key product characteristics[5]. In particular, for each model the available information concern 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, fibreglass).
- Anti-vibration system
- Edges' materials (e.g. steel)
- Base materials (e.g. graphite, extruded polyethylene).

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

The total number of 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 models) and then decreased substantially until 2006.

Demand heterogeneity is one of the main sources of variety. If we segment the market according to consumers' skiing preferences, we can investigate more in depth firms' patterns of specialisation. Models are divided into 11 categories, which are highly heterogeneous in terms of structure, materials and targeted consumers. It is important to notice that each specific model can belong to different categories. Even within similar segments, we can observe substantial differences in the ski characteristics – e.g. racing skis for giant slalom are quite different from racing skis for special slalom, although they both target the high-end segment of the market.

Even when observing variety at the level of different styles of consumers, some interesting differences across firms emerge, especially if we consider relative numbers (see table 1).

{Insert Table 1 about here}

First, we notice that the market leaders produce in all the categories (the only exception being Salomon and Head with no products in the "*alpine*" segment) and often they are in the top 5 producers in terms of numbers of models produced within a specific segment over total number of models in that segment. In this respect the "*alpine*" and the "*freeride*" segments constitute important exceptions, as the top producers are respectively Ski Trab and Scott USA. Second, we observe that the overall market leaders are also leaders in most segments, producing more than half of total models, but this percentage is lower for the "*alpine*" segment (around 35.2%) and for the "*freeride*" segment (47.1%), where niche players often lead the market.

5. Empirical analysis

The empirical analysis 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, 1961). This means that, at any time, we can observe a set of different prices for different varieties in the market. Basically, if we take that goods are bundles of attributes, the price is 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:

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

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

(2) $\log p_{it} = f$ (*C, STRUCTURE, MATERIALS, INDEXCOST, AVERAGE LENGTH, NUMBER OF LENGTHS, RANGE OF LENGHTS, PRODSIMIL, PRODCOMP*)

Here *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, 1961).

5.1 Explanatory variables and their predicted signs

The independent variables of the econometric model are presented in Table 2.

{Insert Table 2 about here}

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. 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. Sandwich is the most complex structure and it is usually employed in top level skis and Monoblock is the least complex structure. However, some models may have more than one feature characterising the structure, so that notwithstanding the above-mentioned distinction, 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, lower friction is also associated by a high molecular weight, which also ensures a high resistance to abrasion and makes the skis self-lubricating. Also in this case, it is important to underline that some models have more than one feature 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. The higher this variable, the more complex the ski and more expensive to be produced: we therefore expect STRUCTURE to have a positive impact on prices, as it signals both a higher quality of the product and higher costs of productions.

As far as MATERIALS is concerned, we identify 56 different materials that can be currently used to produce the ski core, ranging from wood to fibreglass, kevlar, carbon[6]. The ski core can include very few or many different materials, ranging from poor ones (e.g. polyurethane foam) to precious ones (e.g. fibreglass). In order to control for materials' number and quality, we build 56 dummy variables - one for each material - and then generate the variable 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 does not represent a precise indicator to capture the overall ski quality, as materials are extremely variable in terms of quality. This means that 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 materials' unit prices, standardise 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. Finally, we consider a general indicator of ski size - the average length of the ski (AVERAGE LENGTH) – and we argue that that this factor (partially) reflects overall costs (given a specific set of materials) and should display positive relationship with prices.

The above described set of independent variables allows us to capture product quality and the related production cost. 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 whether variety has a positive impact on prices.

[6] 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.

Following the literature and given our previous considerations on the nature of the ski industry, with reference to the indicators of variety, we distinguish between production-related 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 technical characteristics, which identify the internal structure of the product[7]. On the other hand, market-related variety is captured by service characteristics, which describe the use of the ski made by consumers.

In terms of variables related to technical characteristics, we consider two measure of variety: NUMBER OF LENGTHS, which is the number of available lengths, 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. . This kind of product variety such number of length, is simple to achieve and do not require any specific investment. For this reason, it does not involve any diseconomies of scope, while it might lead to economies of scale. Following H2a, we expect the availability of many lengths and the extended range of lengths to have, if significant, a negative impact on prices.

With reference to variables related to the demand side, we exploit information on skis' service characteristics and build two indicators that take into account variety at the level of the specific target market segment for each ski. We proceed in the following way. We first identify five different service characteristics for each ski, which refer to the target market: *gender/age, carve, top, type of race, style*. Each characteristic can take different "values", as shown by Table 3 below. 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

[7] As the level of our analysis is the product, we consider here production-related variety within-product and not within-firm. Nevertheless, firm dummy variables control for other possible source of heterosckedasticity at the firm level.

race identifies different types of race (e.g. giant slalom, special slalom) and can take 3 different values.

{Insert Table 3 about here}

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 n^{th} entry takes a specific value according to the features of the ski. Each vector can be conceived as a specific market segment composed by five different service characteristics.

Starting from this, we calculate two variables: PRODCOMP and PRODSIMIL. From the theory we know that higher variety is associated with higher costs and thus higher prices. Furthermore, with higher variety firms have the possibility of reaching different types of consumers, providing 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. PRODCOMP represents the degree of competition in each market segment and is computed by taking the average number of competitors across the "submarkets" composing each ski's market segment. For example, if we have a ski designed for junior giant slalom races, we compute the number of products in the 3 submarkets *junior*, *giant slalom* and *race*, and take the average. Following the literature, we expect a relatively higher price for skis that have a lower number of competitors in their market segment (*H2b*). This is because PRODCOMP signals the extent to which a ski has to face price competition along its specific service characteristics and, therefore, it represents product variety with respect to competitors. 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 5 characteristics (SIMIL5), along 4 characteristics (SIMIL4), along 3 characteristics (SIMIL3), along 2 characteristics (SIMIL2), along 1 characteristic (SIMIL1), and along no characteristic (SIMIL0). Then we build the variable $PRODSIMIL_i = \sum_{j=0}^{5} j * SIMILj$. 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 confirms the fact that variety in service characteristics positively affects price.

Table 4 shows the predicted signs of the explanatory variables.

{Insert Table 4 about here}

5.2. Results

Our empirical results are illustrated in Table 5. 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.

{Insert Table 5 about here}

If we examine the relationship between quality/complexity of skis, and prices, we find, as expected, a positive relationship between price and 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 does not have a statistically significant impact on prices. 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 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 examine the relationship between variety and prices, we find very interesting results both on technical characteristics and on service characteristics. As far as technical characteristics are concerned, we observe that the price of ski is negatively affected by the number of lengths, while the range of available lengths is not significant. This result corroborates our hypothesis *H2a*, according to which there is a negative relationship between variety in technical characteristics and price. Beside the presence of economies of scale, a possible explanation for our finding relies in the specificity of the ski industry: skis designed for expert skiers tend to have a lower range of available lengths than skis for beginners. Since the length needed depends on consumers' characteristics, it is more likely to have more heterogeneity among beginners, where we find both adults and children. On the contrary, top-level skis are used mainly by expert skiers, who are in the vast majority adults. Therefore, since top-level skis are generally more expensive than beginners' skis, a higher number of available lengths per model will imply a negative impact on prices.

As far as variety related to service characteristics is concerned, we observe results in line with our predictions. In particular, the two variables defining competition in the specific market segment and product originality confirm our hypothesis that product differentiation leads to higher prices. In particular, if a ski has a low number of competitors in the specific market segment and if it is different from other products in the overall market, then it is more likely that it has a relatively high price. These results suggest 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 results support our hypothesis *H2b*.

Finally, we can make 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.

6. 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 empirically test the presence of two opposite effects of variety upon prices, after controlling for vertical differentiation. Our empirical investigation confirms that prices are positively affected by product complexity and quality and positively affected by variety at the level of 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 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. We also find that variety at the level of technical characteristics negatively impact on prices. In industry where a dominant design has emerged variety on the production side is not substantial and gains from economies of scale and scopes outweigh the cost of more flexible equipment.

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 successfully compete in different markets, which often requires not only deep market knowledge, but also change in the production process. However, our results 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 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 particularly market leaders and niche players.

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Tables and Figures

Table 3 – Skis by company and style of consumers

Company	*Style of consumers*										
	Race	**Giant Slalom**	**Junior**	**Lady**	**Allround**	**Special Slalom**	**Carve**	**Top**	**Alpine**	**Easy**	**Freeride**
AK	2	4	0	0	0	2	2	0	0	0	0
Atomic	101	43	43	48	187	43	87	3	3	31	33
Authier	0	6	8	8	21	7	3	1	2	0	0
Blade	6	8	0	0	2	4	4	0	0	0	4
Blizzard	117	65	38	35	125	49	83	1	3	21	48
Bottero Ski	2	4	0	4	6	2	2	2	0	0	0
DKB	4	4	0	0	0	0	4	0	0	0	0
Duel	4	2	0	2	2	4	2	0	0	0	2
Dyad	6	0	0	2	2	0	0	0	0	0	6
Dynamic	99	25	35	25	106	28	75	2	3	45	23
Dynastar	117	39	32	53	133	32	72	7	8	38	43
Elan	113	40	23	33	111	28	94	4	1	40	37
Fischer	128	59	29	39	190	43	138	1	5	53	11
Hagan	0	2	0	2	3	1	0	0	0	0	0
Hart	6	0	0	0	0	0	4	0	0	0	4
Head	101	34	31	52	162	38	90	1	0	30	32
K2	85	40	15	50	99	37	72	3	3	13	29
Kästle	39	25	40	21	66	24	31	1	7	7	9
Kneissl	50	26	10	33	81	18	41	2	5	8	23
Lacroix	3	4	0	7	17	4	2	0	0	0	1
Longoni	7	1	0	0	4	3	11	0	0	5	0
Maxel	10	10	0	8	22	6	7	0	0	0	3
Morotto	0	2	2	2	4	0	0	1	3	0	0
Nava Ski	2	2	0	2	2	2	0	0	0	0	2
Nordica	66	18	0	23	62	17	54	0	0	22	24
Olin	2	2	0	0	5	1	1	0	0	0	0
Pre	0	3	0	6	8	2	2	1	0	0	0
Prime	12	6	4	0	2	0	14	0	0	7	3
Quechua	13	3	0	6	9	3	10	0	0	5	3
Rossignol	126	37	37	44	146	35	96	2	2	50	41
Salomon	119	37	8	56	171	29	93	4	0	37	38
Scott USA	81	4	1	7	30	12	38	0	0	4	62
Ski Trab	18	25	24	14	35	15	4	4	10	0	0
Spalding	10	16	20	10	37	12	4	2	3	2	0
Sport Specialist	6	6	0	2	2	10	6	0	0	0	0
Sporten	2	4	0	6	12	4	2	0	0	0	0
Stöckli	78	20	6	15	47	17	61	0	0	12	47
Tecno Pro	16	0	0	12	29	3	15	0	0	10	3
Tua Ski	37	8	10	13	62	8	29	2	9	17	13
Tyrolia	9	11	15	13	48	11	3	0	0	3	0
Volant	13	3	2	28	45	4	15	1	0	0	10
Völkl	115	48	21	37	116	41	87	1	4	38	36
TOTAL	**1725**	**696**	**454**	**718**	**2211**	**599**	**1358**	**46**	**71**	**498**	**590**

Table 2 – 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 LENGHT	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
PRODCOMP	Degree of competition in the specific market segment

Table 3 – 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

Table 4 – Predicted signs of the explanatory variables

VARIABLES	**Predicted sign**
Product-specific variables	
STRUCTURE	+
MATERIALS	+
INDEXCOST	+
AVERAGE LENGHT	+
NUMBER OF LENGTHS	+
MAXMIN	+
PRODORIG	-
PRODCOMP	-

Table 5 –Determinants of prices

Dependent variable: *logprice*

Independent variable	***Model 1***	***Model 2***
Structure	0.0100*	0.0415***
	(0.0055)	(0.0051)
Materials	0.0165***	0.0113***
	(0.0043)	(0.0038)
Indexcost	-0.456	-0.0240
	(0.52)	(0.47)
Average length	0.00770***	0.00915***
	(0.00093)	(0.0012)
Number of lenghts	-0.100***	-0.0398***
	(0.0041)	(0.0042)
Maxmin	-0.00116	-0.000791
	(0.00081)	(0.00064)
Prodsimil	-0.0000604***	-0.000587***
	(0.000022)	(0.000032)
Prodcomp	-0.000742***	-0.000296*
	(0.00015)	(0.00016)
Time dummy variables	No	Yes
Firm dummy variables	Yes	Yes
Constant	5.132***	5.100***
	(0.16)	(0.19)
Number of obs = 4520		
F(63, 4456) = 197.83		
Prob > F = 0.0000		
R-squared = 0.5418		

***Significant at 99%; ** significant at 95%; *significant at 90%.