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THE SPECIFICATION AND QUALITY OF BRITISH PRODUCTS

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Editor's Foreword

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Abstract

We define "specification" (spec) for any product as being higher the more characteristics it possesses, the more willing its producer is to customise it for different consumers and the faster the rate at which its characteristics change through time. Spec is one important dimension of quality. The others relate to how well the product is delivered to spec. It is an important concept for the study of education and training policy. Our hypothesis is that lower spec products are high spec products.

Many commentators believe that UK business produces more at the low spec end than do our major competitors. This introduces the possibility that the UK's modest (by international standards) education and training record might, in part, be the consequence of low employer demand for skill as opposed to failings in the education and training system.

The evidence on product spec is fragmentary. This paper attempts a systematic review of what is available. Different authors often use different definitions of quality, whilst few specifically address the issue of spec. Some of the evidence is direct, coming from case studies or from hedonic regression analysis. Some of it is derived, usually indirectly. From surveys of enterprises. There are also long traditions of using evidence on comparative prices and on elasticity of export demand to make inferences about quality.

As far as the broader issue of UK quality is concerned, we conclude that it is hard to make conclusive international comparisons or intertemporal assessments on the basis of available studies. The same is true of the narrower concept of product spec. The paper concludes with suggestions for making more progress then hitherto.

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1. Introduction

The concepts of product quality and product specification have played a central part in SKOPE's work to date. An organisation's choice of its product's specification (spec) will, in part, determine the production processes used which in turn will determine the organisation's demand for skill. It has been argued that, in contrast to the Government's vision of a high skills/high value added economy, many British producers pursue a low spec, low skills strategy. However, as both sides of the debate acknowledge, the evidence is fragmentary. This paper gives a critical review of the evidence available, in an attempt to provide a platform for further research.

2. The distinction between quality and product specification

The quality of a good or service has two dimensions: product specification and delivery to specification. Product specification relates to the number of characteristics of a good or service and the rate at which these characteristics change through time or across customers (customisation of the product). Delivery to specification reflects other aspects of quality, related (for example) to the reliability and consistency of the product or service being purchased, the ease of access to it and the ability of the suppliers to deal with complaints or to offer after-sales services.

Two products have different specifications if they offer a different number of characteristics or if the level of technology embodied in (at least) one of these characteristics is different. Similarly, when we think about the rate at which the characteristics of the product change through time or about its degree of customisation, we think about how the number and/or the level of technology embodied in the characteristics of the product respond to variations in preferences across time and across individuals.

Let us consider for the moment only the number of characteristics of a product. We can express n, the number of characteristics, as a function of time t and heterogeneity across individuals i:

$$n = n(t, i). \qquad (1)$$

The rate at which the number of characteristics change through time will be given by:

$$r = \frac{\partial n(t,i)}{\partial t}, \tag{2}$$

while p is the degree of customisation of the product:

$$p = \frac{\partial n(t,i)}{\partial i}. \tag{3}$$

In this simple case, we can express product specification, s, as a function of n, r and p:

$$s = f(n,r,p), \tag{4}$$

and define the quality of the product, q, as:

$$q = g[f(n,r,p)], \tag{5}$$

where delivery to specification is a mapping of product specification onto the consumer's quality space. In other words, $g(\cdot)$ represents the way in which measurable and identifiable attributes of the product are perceived by the customer.

We can imagine, however, that each characteristic is defined by a specific level of technology and that the latter can also vary with time and across individuals. Let's therefore indicate with k_j the level of technology associated to each characteristic of the product:

$$k_j = k_j(t,i), \qquad \text{for each j=1,2, …,n,} \tag{6}$$

with s the rate at which the level of technology advances with time:

$$s = \frac{\partial k_j(t,i)}{\partial t}, \qquad \text{for each j=1,2, …,n,} \tag{7}$$

and with f the rate at which the level of technology is adjusted to the customer's needs:[1]

$$f = \frac{\partial k_j(t,i)}{\partial i}, \qquad \text{for each j=1,2, …,n.} \qquad (8)$$

It is now possible to define with h the 'degree of sophistication of the product':

$$h = y\left(n(t,i), k_1(t,i), k_2(t,i), ..., k_n(t,i), t, i\right), \qquad (9)$$

where $y(\cdot)$ represents the way in which the total number of characteristics and the level of technology associated to each of them are combined together in order to identify a particular product or service.

The degree of sophistication of the product could be seen, for instance, as the weighted sum of the level of technology embodied in each of its characteristics. But this is only one possibility among many and we would like to keep the concept as general as possible. We represent $y(\cdot)$ as a function of time and heterogeneity across individuals, in order to indicate that t and i influence the degree of sophistication of the product not only through n or k_j, but also by changing the way in which the total number of characteristics of the product and the level of technology associated to each of them interact with each other.

The degree of sophistication of the product changes through time according to:

$$l = \frac{\partial y}{\partial t} = \frac{\partial y}{\partial n} r + s \sum_{j=1}^{n} \frac{\partial y}{\partial k_j} + \frac{\partial y}{\partial t}, \qquad (10)$$

and changes with respect to customers' needs and tastes according to:

$$q = \frac{\partial y}{\partial i} = \frac{\partial y}{\partial n} p + f \sum_{j=1}^{n} \frac{\partial y}{\partial k_j} + \frac{\partial y}{\partial i}. \qquad (11)$$

[1] We are assuming that s and f are the same for each characteristic of the product in order to keep ur argument and the notation simple.

It follows that product specification can be defined as a function of the number of characteristics of the product, its degree of sophistication and the rate at which these features change through time and across individuals:

$$s = v(n, h, r, p, l, q), \tag{12}$$

while quality will be seen as a mapping of product specification onto the consumer's utility space:

$$q = w[v(n, h, r, p, l, q)]. \tag{13}$$

Although very stylised, this discussion aims to provide a language which will be useful in defining aspects of product quality and in introducing the concept of product specification. It is essential to distinguish 'high-spec' products - characterised by a high number of valuable characteristics, which change frequently through time and can be easily adjusted to respond to customers' needs - from mass-produced highly standardised products - competitive only in delivering their 'low-spec' features.

In the next section we discuss the concept of product quality with reference to the most common definitions proposed by the marketing and economics literature. Our main concern is to compare different definitions of quality highlighting their underlying assumptions. As we might expect, there is no unique mode of definition. The same word is given a slightly different meaning depending on the purpose of the analysis and the way quality relates to the observability, measurability and level of information about the characteristics of a product.

Section 4 will present a survey of the available empirical evidence on the quality of British products, in particular of its exports. However, we should keep in mind that the available evidence refers to the quality and not to the specification of the products or services considered. As we will see, it is difficult to draw any general conclusion about the *average* quality of British products, but it is virtually impossible to draw a picture of the average specification of the British manufacturing and non-manufacturing sector. Section 5 concludes and argues that by focusing on the broader concept of product quality the marketing and economics literature are in danger of

giving too much weight to aspects of delivery to specification and draw a misleading picture of British competitiveness in world markets.

3. Definitions of quality

As with any definition, it is important that the one we ultimately choose is useful and empirically relevant. A definition that is too broad and generic would be of no use to the researcher and any discussion based on it would seem self-indulgent. At the same time, we must not make the mistake of identifying the concept of quality only by the attributes of the product we can easily measure. As we will see, much of the economics literature tends to proxy quality by using information on the level of technology embodied in the product, or to identify quality by some observable characteristics of the product. Striking a balance between these two extremes is a motivation behind this paper.

In most of the economics literature reviewed here, there are surprisingly few attempts to discuss explicitly the concept of product quality. What is meant by quality is often assumed to be obvious or described by one or two examples, but attempts to clarify the underlying assumptions of a specific approach are rare. In fact, it would appear that there are wide differences in the concepts of quality being analysed. While in some cases quality coincides with the non-price attributes of a product, in other circumstances the price of a product is assumed to reflect quality. From a certain point of view, however, these differences are more apparent than real. The various economic approaches to the study of quality have in common the idea that quality is objective and can be measured, be it directly or indirectly.

Objective and subjective differences in product quality are usually analysed by economists in terms of vertical and horizontal product differentiation. Vertical product differentiation of a commodity with several characteristics is said to be present when the absolute amount of all (or most) characteristics is increased or lowered so that there is unambiguousness in ranking goods according to a certain order. This is what is called a 'quality change' by most economists. Differentiation between two commodities is said to be horizontal when the level of some

characteristics is lowered while it is increased for some others.[2] An example might be a product which offers a series of options and the consumer is asked to choose her preferred combination. In this case no unambiguous ranking of the goods is possible; different consumers simply believe that different products are best.

By focusing on measurability, economists run into the danger of confusing "product innovation" with "quality improvement".[3] For example, a compact disc is a product which is unique and physically different from records and cassette tapes and which also represents, without doubt, a quality improvement as well as a product innovation. However, a new song which is unanimously considered a quality improvement with respect to previous songs by the same artist will not be considered product innovation. The difference in this case is that innovation refers to easily defined and measurable physical characteristics, while quality improvement refers to differences in perceptions, whether these are measurable or not.

Assuming that objective differences in quality could all be measured, either directly or indirectly, there remains the problem of how to consider horizontal differences in quality. As the latter merely reflect differences in tastes or fashion[4], the approach followed by most economists, using more or less sophisticated methods, is to control for horizontal quality in order to isolate vertical quality differences. For example, one can try to separate the contribution of horizontally differentiated trades from that of vertically differentiated trades by defining horizontally differentiated trades as ones for which the difference between the export unit value and the import unit value is within a arbitrary predetermined range, for instance between 40 per cent or 50 per cent.[5]

In the marketing literature, however, "quality does not exist in isolation", but varies according to the subject analysed (buyer or seller), the time at which the assessment is carried out (time of purchase or time of consumption) and the informational structure of the market in which it is sold (grades and branding)[6]. There is generally more emphasis on the subjective aspects of quality, as it is recognised that consumers do not necessarily get their satisfaction from the objectively measurable characteristics of a product and that they might not base their purchases on them. The

[2] Martin (1993).
[3] Payson (1994).
[4] Broadberry (1997).
[5] Temple (1998).
[6] Bowbrick (1992).

distinction between horizontal and vertical differences in quality becomes blurred since the concept of quality is moulded around the belief that the characteristics of a product are identifiable only as far as they respond to customers' needs and concerns. Since these needs vary from individual to individual, it is impossible to maintain that any of the features that define a product are entirely objective.[7]

In this tradition much effort is devoted to analysing consumer perceptions about the quality of a product. The motivation is twofold: a change in the objective characteristics of a product cannot be expected to change sales unless the customer's perceptions change and - perhaps more importantly - these perceptions can be changed using the appropriate marketing tools. This second aspect is based on the assumption that there is imperfect information about the characteristics of a product and that by appropriately labelling, grading and pricing a commodity, the consumer's perceptions of its quality will be affected. In the absence of perfect information the price itself becomes a relevant characteristic of the product and the Law of the Single Price may not apply any more; products with similar observable characteristics may sell at a different price because price will be taken as proxy of the unobservable characteristics.

The idea that quality might be a function of price is not ignored in the economics literature. In particular it has been applied to the analysis of the labour and credit markets.[8] In the literature on product quality reviewed below, it is very often assumed that information about the characteristics of the product is perfect and that a good sold at a higher price must be higher quality. This is clearly the idea behind the unit value approach, for example, where the quality of an aggregate bundle of commodities is measured by the price or 'willingness to pay' per unit of product sold.[9] Similarly, hedonic regressions are based on the hypothesis that it is possible to identify a relationship between the price of a good and its observable characteristics. The residual amount of variation in prices is then attributed - among other things - to imperfect information.[10] Once a specific parametric specification for the price-quality

[7] Bacharach (1991).
[8] See Stiglitz (1987) for an extensive review.
[9] This problem is only mildly reduced when we consider *relative* unit values. By taking the ratio of the average price of exports with respect to the average price of imports, for example, it is simply assumed that the degree of imperfect information in the market for export and imports of the aggregate good considered is the same.
[10] Cowling and Rayner (1970).

relationship is chosen, however, a restrictive assumption about the distribution of imperfect information in the market considered is inevitably made.

In the next section we offer a review of the most important empirical studies on the quality of British products, highlighting international comparisons when these are available. In the vast majority of these studies scant attention is paid to a serious definition of product quality and the analysis is generally restricted to the manufacturing sector. There are very few attempts to capture quality differences in services. As we shall see, evidence about the performance of British products with respect to some of its major trading partners is still rather mixed and incomplete. The aim of the survey is to point out gaps and contradictory findings hoping to stimulate further debate in this area.

4. The quality or non-price competitiveness of British goods

Quality features (including performance, design, reliability, variety and innovation) are now widely recognised to be at least as important as price in determining the competitiveness of a country in international markets.[11] Empirical studies use a variety of different approaches, which either look directly at the observable characteristics of products and services or indirectly approximate general quality features of an entire sector or industry in order to draw an overall picture of British non-price competitiveness.

The main advantage of direct investigation is its flexibility. The definition of quality used does not need to be generally applicable, but it can be adjusted to the specific features of the product or service considered. On the other side, however, detailed analysis of specific products is extremely costly and, although it provides valuable information, it cannot be generalised and used to draw broad conclusions. Indirect measurement of quality is much less resource-intensive and is sometimes preferred because it gives the opportunity to carry out comparisons among countries and across time for a variety of goods or services. This approach makes use of imperfect proxies of the non-price attributes of a product and looks at the inputs of the production process - analysing for example the number of patents or the amount of

[11] See Fagerberg (1988), Greenhalgh (1990), Greenhalgh *et al.* (1994), Swann (1998) and Carlin *et al.* (2001).

R&D expenditure in a sector of the economy - or simply at the average value placed on a product by those who purchase it.

4.1. Direct evidence

4.1.1. Case studies

In a series of direct comparisons of the productivity of British and other European establishments, the *National Institute of Economic Research* collected what is perhaps the most interesting survey evidence on the quality of goods and services produced in Britain. The research programme started in the mid 1980s and was initially aimed at investigating matched manufacturing plants in Britain and Germany in order to analyse the roles of machinery and skills in explaining comparative productivity performance. It later developed to include the service sector and a wider sample of European countries.

The idea behind the project was to investigate productivity differences that did not translate into differences in the quality of products. The sampling procedure consisted in matching plants according to the quality of the goods produced, but it became immediately evident that what had seemed a relatively straightforward procedure could become a very interesting area of research in its own right. It simply was not possible to match with a satisfactory degree of accuracy the quality of German products since these were characterised by a broader and more specialist range of varieties then their British counterparts[12].

The problems encountered in matching even simple products according to their non-price features encouraged the National Institute researchers to investigate the quality range of British and other European products in order to provide substantive information on the sampling criteria applied in each of their case studies. It is interesting to note that, although the evidence on quality is only a by-product of this research and the sample of goods and services chosen can be considered random with respect to the analysis of quality differences, the majority of these studies show

[12] "Even in the plants that we selected as producing relatively simple and ostensibly similar products in the two countries, a considerable variety of product specifications and processes was encountered" (Daly *et al.*, 1985, p. 48).

Britain at substantial disadvantage in producing goods and services of quality comparable to that observed in other European countries.

The first study of the series was conducted between 1983 and 1984 and was based on interviews with managers and others at approximately 45 firms operating in metalworking manufacture in Britain and Germany[13]. The products chosen (coil springs, cutting drills, hydraulic valves and motor parts) were particularly simple in order to reduce the problem of quality variations and allow measurement of productivity in physical terms rather than use the value of production in national currencies converted at some rate of exchange. It was observed that German products were technically more advanced and of higher quality than British products. For example, in matching screws, the researchers had to choose a rather special type produced in both countries since the more standard types still made in Britain were no longer produced in Germany, while it was impossible to find a British metal pressing machine similar to the ones produced in Germany, because the latter were much more complex.

The next sector analysed was woodworking (fitted kitchens), where it was hoped that "the long-standing German advantage in engineering would no longer be such a significant factor".[14] But even in this relatively less technically complex sector it was necessary to distinguish between top of the range products - characterised by a wide choice of colours and accessories, high quality materials and possibility of adaptation to customers' needs – and middle to bottom of the range products – characterised by lower quality materials, restricted ranges of finish and colours and standard sizes. In a series of interviews conducted between 1986 and 1987 very few British manufacturers were found to compete at the top of the market range, while German firms producing at the middle to bottom of the market were the exception. Interestingly, these differences did not simply reflect differences in consumers' tastes: about 23 per cent of British sales originated from imports (of which 63 per cent were from Germany) while British exports accounted for only 4 per cent of domestic production.

Similar patterns emerged analysing a sample of women outwear manufacturing firms, matched on the basis of the goods produced (coats, blouses, skirts, dresses,

[13] Daly *et al.* (1985).
[14] Steedman and Wagner (1987).

suits and jackets) and the number of total employees.[15] It was again possible to distinguish high quality and low quality garments and it was noticed that while British firms mainly produced very long runs of standard items, German manufacturing plants owed their success to the production of small batches of high quality goods in great variety.[16] It was also noticed that the average value of German exports in this sector was more than twice the average value of its imports, while the corresponding figure for Britain was only one third. Moreover, even though German exports were of higher average value than British exports, this did not result in Germany exporting less: 40 per cent of the German domestic production was exported compared to 20 per cent for Britain.

One of the most recent large case studies was conducted by Mason *et al.*(1994) on the food processing industry between October 1989 and December 1991. About 29 biscuit manufacturing plants were selected from four countries: Britain, Germany, France and the Netherlands. In each of these plants the research team carried out semi-structured interviews with production and/or personnel managers classifying products according to broad quality grades (basic, medium, high) in the light of information on their physical characteristics. The results showed that, even though the quality range was substantially similar across countries, the more basic variety of biscuits accounted for a larger proportion of total output in the British sample (35 per cent in Britain, 25 per cent in the Netherlands, 15 per cent in Germany and 20 per cent in France) while a much higher proportion of German output could be classified in the high quality grade (35 per cent in Germany, 15 per cent in the Netherlands, 10 per cent in France and only 5 per cent in Britain). It is possible, however, that some of these differences are simply due to differences in tastes. Although there is free trade between these countries, the volume of exports and imports is so small that it is perhaps correct to think that British customers have a preference for simpler biscuits and are therefore not willing to pay a high premium for German biscuits.[17]

Jarvis and Prais (1995) report substantial evidence that quality differences cannot be simply accounted for by horizontally differentiated products. In a detailed examination of a range of British and German products chosen randomly from the top and bottom deciles of the 1991 Eurostat relative price consumer product-groups

[15] Steedman and Wagner (1989).
[16] As in the previous study by the same authors, all the interviews were conducted in 1986 in Germany and in 1987 for UK based firms.

ranking, it emerged that the quality of German products, evaluated according to the weighted average of prices in different quality grades, was about 65 per cent higher than in Britain. It was also noted that, according to their calculations, German products incorporated higher average quality irrespective of whether the products were initially classified as more expensive in Germany than Britain or vice versa. Moreover, even if German consumers bought a greater proportion of high-quality grades than British consumers, the gap between the two countries in the average quality of consumption was distinctively less than the gap in the average quality of production.[18] This reflects a greater German proportionate import of basic grades and a greater German specialisation in the production of higher grades.

the first attempt to analyse productivity differences in the service sector was a study of matched samples of hotels in Britain and Germany n 1988-89.[19] Hotels were matched on the basis of size and quality. Given that the elements which must be taken into account in assessing the quality of an hotel – for example, friendliness and efficiency of personnel, comfort and location – may involve a large element of subjective judgement, the researchers decided to classify British and German hotels using the quality grading of the Michelin guide. These grades are based on inspectors' reports on a hotel's services judged as a whole and the same principles are used in each country. Unfortunately, since the quality assessment of hotels was effectively delegated to an external source, the study offers no further analysis of the average quality of British hotels as compared to German ones.

In a second study, Mason *et al.* (1999) analysed productivity differences in bank lending practices across Britain, the United States and Germany in the period between 1995 and 1996. In this case two different definitions were proposed; quality was assessed from the bank's perspective in terms of loan failure rates, and from the borrower's perspective in terms of the speed of response and effort to gain a detailed understanding of the client's credit needs.[20] Different indicators were used to measure the latter definition of quality and, as a consequence, the picture that emerges is rather mixed. However, there are indications that German banks were able to build

[17] See Broadberry (1997).
[18] The British-German gap was of the order of 27 per cent in the average value of consumption against 50 per cent in the average value of production of secateurs, 36 per cent and 60 per cent for the consumption and production of blouses.
[19] Prais *et al.* (1989).
[20] As the marketing literature suggests, definitions of quality may be different according to the subject analysed.

very close relationships with their customers and rapidly access the information necessary for credit evaluation, while British banks were still oriented towards achieving large volumes of security-based lending.

Even without referring to a general definition of product quality, it is relatively easy to capture quality differences in manufactured goods by taking into account their physical characteristics. Problems arise when analysing services because many of their relevant features are not measurable using a standard approach and very specific solutions must be found. At least in principle, however, it is possible to think about definitions of product quality that could be applied to both services and manufactured goods. If we consider our definition of product specification - which relates to the number of characteristics of the product, the rate at which these characteristics change through time and its degree of customisation - it is not clear, for example, why we cannot measure product differences in bank lending by simply looking at the number and degree of standardisation of loans offered instead of using scores on the "effort to gain a detailed understanding of clients' needs".[21]

Although we might argue in favour of our definition of product specification, we nevertheless recognise the need for further research in this area. A team working at Strathclyde University is specifically investigating how to address quality differences in some representative services. The research will build on experience acquired running advanced professional courses for the hotel and restaurant trade. It is expected that the results of this research will provide useful guidelines for analysing quality differences in services and thus help to overcome the limitations shown in the studies conducted by the National Institute of Economic Research.

4.1.2. Hedonic regressions and non-parametric methods

The analysis and measurement of quality-price relationships has a long history in economics, but there has been relatively little systematic investigation of international differences in product competitiveness[22]. The traditional approach is the so-called hedonic technique, based on the regression of price on a set of measurable

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[21] See Mason *et al.* (1999).
[22] See, for example, Court (1938), Griliches (1971, 1990), Lancaster (1971, 1990) and Triplett (1990).

characteristics of the product. The quality-adjusted price is usually derived according to a simple linear relationship:

$$P = a + \boldsymbol{b}'\boldsymbol{Z} + u, \qquad (14)$$

where P is the actual price, $\boldsymbol{Z}$ is a vector of observable ad measurable attributes of the product, and u is an error term which is assumed to be normally distributed with mean zero and variance σ_u^2.

The competitiveness of the product is computed by comparing the actual price, P, with the expected (predicted) price P^*. If the actual price is below the expected price, the product is said to be relatively competitive, while if the actual price is above the expected price, the product is relatively uncompetitive. It is also possible to say how much of the product competitiveness is attributable to quality and how much to price. This is done simply by computing $\boldsymbol{b}'\boldsymbol{Z}$ for the product in question: if $\boldsymbol{b}'\boldsymbol{Z}$ is large in relation to a, then the product is quality competitive.

The parametric formulation imposes a particular functional form on the price-quality relationship and the error distribution. Despite the possibility of adopting flexible functional structures, any parametric specification ultimately chosen remains essentially arbitrary. In fact, the parametric price function has no rigorous theoretical underpinning; it is not a typical contour of a cost or production function, nor is it a typical consumer's indifference curve. At best it is an envelope of diverse cost functions and indifference curves, reflecting more the diversity of agents than the functional forms of the individual curves. It defines competitiveness of a product with respect to the 'average' rather than the 'best' combination of prices and quantities.

For these reasons, a boundary approach has been often preferred. This implies the adoption of non-parametric methods, which allow the shape of the frontier price function to be very responsive to small product innovation, define the competitiveness of a particular product with respect to the immediately neighbouring products rather than the whole market, and avoid another shortcoming of the hedonic residual method, namely the fact that parametric regressions always find about half the products competitive and half uncompetitive. The boundary approach, however, is particularly sensitive with respect to the number of characteristics of the product

included in the analysis and if a sufficient number of characteristics is included we could have a model in which all the products sold in the market are competitive.

Cubbin and Murfin (1987) strongly and convincingly argued in favour of non-parametric techniques. They calculated quality-adjusted prices based on traditional hedonic regressions and compared it with efficiency scores obtained through non-parametric methods where price is treated as the 'input' and the set of characteristics as 'outputs'. The first variable corresponds to traditional measures of price competitiveness, while the second is to be interpreted as an indicator of quality competitiveness. The correlation between the two series was positive and statistically significant. Analysing a cross section sample of cars available on the UK market in 1982 they reported evidence that UK cars were more price and quality competitive than cars produced in West Europe or Japan.[23] Although the technique adopted is certainly interesting, the results should be interpreted very carefully. The authors include among UK cars all cars produced by UK-based companies, considering cars produced in the UK by foreign-owned companies (like GM and Ford) and including imports in the sales of the multinational firms. So, for example, a car produced by Ford and imported from the US is considered to be a UK car because Ford produces some of its cars in the UK.

Swann and Taghavi (1992) conducted a very extensive study on 18 manufactured products whose characteristics and prices were collected at several different points in time during the 1980s. The technique adopted was non-parametric and consisted of computing the highest price at which a product would sell given the prices and quality of existing products. If this 'ideal' price is undefined, the product is considered competitive by virtue of an outstanding mix of quality features; if the 'ideal' price is higher than the actual price, the product is competitive by virtue of its price; all the remaining products are uncompetitive.

The evidence reported indicates that British products are competitive mainly by virtue of their price, but no single pattern emerges and in some markets there is a higher incidence of competitiveness due to quality among British goods than among imported goods. The authors show the (normalised) differences between the 'ideal' price and the actual price for each brand or country of origin of the product and investigate how these residuals change when different numbers of characteristics are

[23]The exception were East European cars, which emerged from their analysis as highly competitive outliers.

considered. It would have been interesting to develop this idea further and calculate, for example, the elasticity of the degree of competitiveness with respect to the characteristics analysed. Quality could have been defined by the contribution of valuable characteristics to the level of competitiveness of the product.

It is clear that direct evidence on the quality of British products is at best able to support only neutral results. The case studies conducted by *the National Institute of Economic Research* suggest that the German-British productivity gap cannot be attributed to a superior quality of British goods and that, on the contrary, Britain is specialising in the production of lower quality grades. However, it is quite possible to argue that this evidence is based on an unrepresentative sample of products, which accounts for a very small part of manufacturing. When detailed information on a variety of consumer goods is analysed, it is very difficult to distinguish a clear pattern of specialisation. Moreover, we should not underestimate the fact that too little is known about British quality performance in the service sector. Indirect approaches can provide a solution to these problems and help us to draw a more complete picture of the non-price competitiveness of the British economy, but we must bear in mind that an across-the-board analysis is not without costs.

4.2. Indirect evidence

4.2.1. Surveys of enterprises

Some evidence about the relative importance of price and non-price factors comes from surveys that ask firms where their competitive advantage lies. Again the picture emerging from international comparisons is rather mixed. Hooley *et al.* (1988) report the results of interviews conducted on a large and representative sample of firms operating in Britain. As many British companies as their foreign counterparts considered that their distinctive competitive advantage derived from non-price factors like product performance, quality or design, distribution and after-sales service. Price was mentioned as a significant source of competitive advantage only by 7 per cent of the companies interviewed.

A much less comforting report is to be found in Doyle *et al.* (1992), who conducted a detailed three-year study of a sample of ninety major American, Japanese

and British companies that competed directly against each other in the UK market at the end of the 1980s. The basic data for the study were obtained from interviews with senior management. The sectors chosen were significant at the national level in terms of size and growth. Their products were among the top thirty UK imports from Japan and the US.

A fifth of British companies admitted they had cheap "down market" products, while none of the Japanese and few American companies would accept this definition of their offers. As found by Hooley *et al* (1988), after-sales service, product differentiation and innovation appeared to be the most significant drivers of performance for all companies, but the local British companies rated themselves poorly on all these factors. The most frequently mentioned competitive advantages the British seemed to possess were: low prices, a "traditional brand name" and "being British". The survey indicated that British firms were clustered in the low value-added segments, the Americans in the high-technology premium niches, whilst the Japanese straddled the mass market with increasing penetration of the higher value-added areas. In terms of positioning, the Japanese had a clear focus on quality, service and innovation, the US firms emphasised product range and technology while the British stressed traditional brand names.

This study is unusual because it compares the overseas practices of American and Japanese companies rather than the characteristics of their home operations and holds constant differences in objectives or strategies due to the idiosyncrasies of particular markets or industries by limiting the analysis to one overseas market, the UK market. We should therefore consider these results suggestive of differences between Japanese and American firms and, although the evidence on product and market strategies followed by British domestic firms is new in many respects and interesting in itself, it is not indicative of the performance of Britain vis a vis the US or Japan.

4.2.2. Unit values

In evaluations of trade flows, quality analysis has been mainly undertaken using unit values indexes, which measure the average price of a bundle of items from a given product grouping. This approach poses two immediate problems. First, it assumes that a higher unit value reflects higher quality rather than simply 'bad value

for money'. Second, since unit values are a measure of quality derived from the aggregation of different goods and/or services, the composition of the 'bundle' must be carefully considered when analysing differences across trade flows, countries or periods of time.

These problems are widely acknowledged. Since price can be a poor indicator of quality, many studies have adopted relative prices indexes instead. By comparing the unit value of exports with the unit vale of imports, or the unit value of exports between two countries, it is possible to construct relative unit value indexes which give a better representation of quality differences. Alternatively, one can try to distinguish vertically differentiated trades from horizontally differentiated trades, hoping to isolate 'bundles' of goods for which discrepancies in average prices are sufficient to suggest they are produced by different techniques of production.[24]

By contrast, the literature shows that it is far more difficult to control for compositional effects. The possibility of testing the robustness of the results according to the level of disaggregation is often restricted by data limitations and by the ultimate object of the study. In establishing the competitive position of a country with respect to its most important trading partners, unit values indexes are necessarily derived from highly aggregated commodity groups. These issues often represent a very serious obstacle and, as we will see shortly, depending on the level of disaggregation employed different studies often reach different conclusions about the competitive position of Britain and its change over time.

British international trading performance and in particular the non-price competitiveness of its manufacturing sector have been very long debated in the literature. In a report for the *National Economic Development Office*, Stout (1977) found that in 1974 about three quarters of British manufacturing industries exhibited export unit values lower than import unit values. This compared unfavourably with Germany or France, where the proportion of industries in which relative unit values – given by the ratio of export unit values to import unit values – was below unity was one quarter and one half respectively. Moreover, the relative unit value of British mechanical engineering products had shown a trend decline over the previous decade while at the same time the UK share of world manufacturing had continued to

[24] See Greenway *et al.* (1995).

shrink.[25] These findings reinforced the impression that the relative 'cheapening' of UK exports in most sectors was not due to an increase in price competitiveness, but could instead be the result of lack of competitiveness in non-price features.

The issue merited further investigation. According to Brech and Stout (1981), it was possible that the UK comparative advantage lied in a broad class of products with relatively low unit values. Given that there was an "up-market bias in the structure of incremental demand", the unit value of UK exports rose less fast than the unit value of its imports and this created pressure on the nominal exchange rate[26]. A nominal devaluation compensated for the trend decline in relative unit values, which initially had occurred without there being a quality gap within narrower categories of products, but had detrimental effects in the long run. Intervention on the exchange rate is inappropriate in these circumstances and the ease with which older and more price-elastic products can be sold encourages producers to behave passively and deters them from developing new and more advanced technologies. The result is that UK manufacturing was pushed further towards 'downmarket' products and a change in the composition of exports - reflecting also a change in the average quality of exports - occurred.

In order to verify this hypothesis, the authors constructed a product mix index which was meant to reflect the changing composition of exports between high and low unit value products and tested whether this index varied systematically over time with movements in the exchange rate. The index was computed for one specific sector, Machine Tools, further subdivided into 40 narrower categories, and was given by the difference between the usual unit value measure and a weighted average of this measure based on changes of average prices in each specific category of products within the broad aggregate. By using this index, Brech and Stout (1981) attempted to measure the movements among 40 types of UK machine tool exports, abstracting from changes in the composition of exports between wider categories of manufactures to capture more closely changes in non-price competitiveness.

[25] Thirwall and Gibson (1992) note that the decline in the UK share of world exports (which has been accompanied by a decline in the UK share of world imports) should not generate any surprise. The decline is simply explained by the fact that the UK's share of the world's manufacturing output has declined as resources have shifted from agricultural to industrial activities throughout the world. What is worrying is that the UK has performed more poorly with respect to other European countries, which have managed to retain their share of world's exports.

[26] See Brech and Stout (1992).

The results of this analysis, carried out over the period between 1972 and 1980, show a negative and statistically significant effect of the (lagged) nominal exchange rate on the product mix index. This confirms the hypothesis that a devaluation is associated with a reduction in non-price competitiveness and that there is - at least within the Machine Tools sector - a vicious cycle between product inferiority, nominal devaluation and increased loss of non-price competitiveness.

Using information on exports and imports at the level of the four-digit industry classification, Temple (1998) conducted an analysis of unit values patterns of UK trade flows within the 12 major OECD economies in 1992. Unit value 'norms' were estimated for each commodity group on the basis of the geometric mean of the observed unit values across all countries. The value of the trade flows were then subdivided according to one of three categories - high-quality, medium-quality or low-quality. The line of separation was based on whether the logarithm of the recorded unit value exceeded the logarithm of the norm unit value by 0.2 or more (high-quality) or fell short of the norm by 0.2 or more (low-quality) in an attempt to separate 'vertical' differences from 'horizontal' differences in quality.

Temple observed that the highest percentage of UK imports was concentrated in the low-quality range and that export-import ratios were higher in the high-quality range. But, even if this indicates that in the UK the relative (with respect to imports) composition of exports is specialised in high quality goods, this could be for two opposed reasons. On the one hand, it is possible that exporting industries might be particularly innovative in areas where demand growth is strong, so that specialisation in high quality products is combined with strong trade performance. On the other hand, the observed relative specialisation might be the result of a lack of competitiveness in lower-quality products, so that exports of these products simply disappear.

Regressing the (log of) export-import ratio in high-quality trade normalised by the aggregate export-import ratio on the (log of) export-import ratio and industrial dummies, Temple found that quality specialisation was inversely related to the relative volume of exports. However, these results were based on a cross section of data on exports and were derived from a very simple econometric exercise. This is to be considered only 'preliminary' evidence that the relatively high-quality composition of exports is due to a lack of competitiveness in lower quality products. A much

more thorough test of this hypothesis would require an analysis of import data and the availability of observations at different points in time.

The non-price competitiveness of a country can be adequately analysed only in the long-run because what really matters is not just the average quality level of exports at any given point but its time trend. Oulton (1990) performed an extensive investigation of unit values of UK exports over its imports between 1978 and 1987, essentially conducting a follow-up of the study in Stout (1977). He found that although there were wide variations across different sectors, there was no systematic tendency for the unit value of the UK imports to exceed those of UK exports. The percentage of industries in which relative unit values were below one was about 50 per cent in 1987 against 75 per cent found by Stout (1977) in 1974. According to this study, UK international competitiveness in quality features was generally improving, but no positive trend could be detected with respect to important trading partners like Germany, France or the US.

In order to investigate the issue further, in a later article Oulton (1996) calculated the ratio of the unit value of UK exports to the unit value of German exports, considering the average values for the period 1978-1987. Examining a weighted average of trade flow data disaggregated at the level of a five-digit industry classification, he found that UK exports in manufacturing were about the same quality as German ones. The only difference was that German exports were (depending on the market) two to four times greater in volume than UK exports. This suggests that the UK and Germany have comparative advantage in the same sort of products, but that Germany's comparative advantage is stronger.

The hypothesis put forward by Oulton is that both Germany and the UK are countries producing high-quality goods, but that Germany is less capacity constrained than the UK because it has more highly skilled workers and can export higher volumes of goods. This is consistent with the evidence that although the UK's performance in world markets for manufactures seems to have improved in the 1980s, this improvement did not apply to a comparison with Germany.

The main problem with the Oulton and Temple studies is that, although the authors recognise that there is an enormous variation by industry in unit value figures, too little effort is made to control for this source of heterogeneity. In Oulton (1996) we observe weighted averages of relative unit values across five-digit industries; in Temple (1998) we find a highly debatable distinction between high-quality ranges and

low-quality ranges. With the exception of Brech and Stout (1981), there is no effective attempt to construct unit value indexes which could come closer to 'true' quality indicators.

The overall picture is confused because of the use of very aggregated measures for unit values, because of the different ways in which unit value ratios are constructed (sometimes using exports and imports of the same country, sometimes relating exports from one country with exports from another) and because of the different periods considered. If anything, this survey shows the limitations rather than the advantages of the unit value approach. Until more rigorous methods of controlling for aggregation problems are developed, unit values will hide more than they reveal.

4.2.3. Elasticity of exports

Some studies have sought to make inferences about non-price competitiveness from the results of standard econometric trade models, which usually predict that factors affecting the quantity of goods exported by a country will be the same as those affecting a country's demand for imports. Among these factors there is the ability and willingness of domestic producers to supply, which depends partly on capacity and partly on the pressure of domestic demand. Secondly, the prices of exports compared to the prices charged by foreign competitors is expected to exert some influence. In addition, the level of income in foreign markets is thought to affect the quantity of exports.

Like the import function, the export function is assumed to be multiplicative, implying a constant elasticity of exports with respect to each of the explanatory variables. It follows that one can model exports as a function of domestic production capacity, relative prices and income:

$$X_t = a C_t^{g} \left(\frac{P_d}{P_f} \right)_t^{-h} Z_t^{\,b}, \qquad (14)$$

where X_t is the quantity of exports at time t, C_t is a measure of capacity utilisation in the home country, $\left(P_d / P_f\right)_t$ is a measure of the prices of domestically produced

goods traded in foreign markets relative to competitors' prices, Z_t is the level of world income, g is the elasticity of exports with respect to capacity utilisation, h is the price elasticity of exports and b is the world income elasticity of the demand for exports.

Assume for the moment that equation (14) is to be strictly interpreted as a demand equation and that prices are fully flexible, so that the capacity of a country to supply exports should not be included among the independent variables.[27] Assume also, following Thirlwall (1979), that relative prices are roughly constant in the long run, so that the second term in (14) can be neglected. In this scenario, the quantity of exported goods will depend entirely on world income and differences in the income elasticities of exports will give a fairly good idea of differences in international performance across countries.

In all export demand functions, especially those which take the form of (14) above, the variable representing world income or world trade is always significant and in most instances the only variable that appears to matter. As a consequence, numerous studies on international competitiveness carried out especially during the 1970s and 1980s attempted to explain differences in world markets shares comparing estimates of the long-run world income elasticity of exports across countries. Almost without exception the reported estimate for the UK was the lowest of all countries and this seemed to explain the trend decline in market shares of British producers in world markets during most of the post-war period.[28]

However, in a widely cited study, Landesmann and Snell (1989) reported that the UK income elasticity of exports increased considerably during the 1980s and suggested that the shift in the parameter was largely due to the reforms of the Thatcher administration from 1979 onwards. In order to disentangle the different factors which affect UK manufacturing export performance, Landesmann and Snell (1989) estimated a standard export demand equation - where current domestic exports are regressed on current world exports and current and lagged values of relative export prices - and focused upon possible shifts in the parameters, which might have occurred during the period between 1972 and 1986 and, in particular, after the deep recession of 1979-1981.

[27] This assumption will be relaxed shortly, here it is introduced only for expositional reasons.
[28] See for an extensive review of this empirical evidence Goldstein and Khan (1985).

They pointed out that there might be two reasons why one would observe shifts in the parameter b and that it was necessary to distinguish 'apparent' from 'real' shifts. 'Apparent' movements in b might occur because of missing variables in the demand equation. This is because the demand curve for UK exports is the horizontal summation of the demand curves of a number of UK producers, each producing a slightly different product. Thus, if the equation (in log form) we would like to estimate is:

$$\log X_t = n_t \log a + b \log Z_t , \qquad (15)$$

where n_t is the number of producers, by omitting n_t[29] the estimated $\hat{b}$ would be subject to a bias given by:

$$Bias\left(\hat{b}\right) = \left(\sum_{i=1}^{T} Z_i n_i \Big/ \sum_{i=1}^{T} Z_i^2 \right) \log a \qquad (16)$$

then, in periods dominated by bankruptcies the coefficient will be downward biased, while when the manufacturing sector is growing it will be upward biased.[30]

'Real' movements in the parameter might be due to: (i) changes in the composition of the manufacturing sector and (ii) changes in the internal structure of the existing firms within manufacturing. The first element of real change in b might occur because any shrinkage in capacity arising from a recession will result in a 'shake out' of particular producers, especially of those who supply low quality goods with a low income elasticity of demand. The second factor reflects the hypothesis that, after a recession, product strategy changes might take place in the remaining establishments, with a resulting increase in b .

Given the limitations imposed by the lack of a good proxy for capacity, n_t, the model is estimated using a fairly flexible specification for b , which is allowed to follow a kinked linear spline function for the period after 1979. The hypothesis tested for the time path of b is that British manufacturing was subject to a 'collapse' phase

[29] It is clear that n_t here represents capacity and that Landesmann and Snell are using an exports equation that differs from a simple demand equation and therefore takes into account supply side variables.

[30] See Landesmann and Snell (1989) for a more rigorous description of the model.

during 1979-1981, when capacity contractions were dominating, followed by a period of 'recovery', in which the industries stabilised returning to more normal patterns of exits and entrants and in which the compositional changes came through (shake-up phase) and finally underwent a 'consolidation' phase in which the path of b reflected the modernisation process of exporters in those industries.

This hypothesis is tested using aggregate data for manufacturing and comparing the results obtained from two different specifications of the model. In the first case, the effect of varying capacity on b is controlled for by allowing this parameter to follow a flexible time path; in the second specification several alternative proxies for capacity are introduced.[31] The results of a simulation exercise reveal that a flexible time path specification represents, with a reasonable degree of accuracy, the shifts in b due to capacity variations. The model is then estimated on disaggregated data for five industries within the manufacturing sector: electrical engineering, chemicals, transport equipment, mechanical engineering and textiles, clothing and leather.

Although there are obvious problems in comparing the aggregate results and the results by industry, a similar picture emerges from both sets of estimates. In both cases $\hat{b}$ is markedly higher in 1986 than in 1979 and both time paths show an upward trend for the second part of the Thatcher era. This supports the view that the increase in the income elasticity of exports (which still did not reach values much above one) represented a 'real' quality improvement of exports and that, after the events of 1979-1, the "shrunken remains" of the UK manufacturing sector exhibited a stronger growth dynamic relative to its predecessor[32].

4.2.4. Non-price competitiveness: innovations, patents, R&D expenditure and standards

By the end of the 1980s, studies which focused exclusively on comparisons of the income elasticity of exports were abandoned in favour of a new approach. If estimates of b could be interpreted in terms of the "innovative ability" of the

[31] One of the capacity variables is given by the number of firms going into liquidation in a particular year in relation to the manufacturing sector's total capital stock. The second proxy represents the profitability of exports and is given by the ratio between export prices and unit costs, the latter being a weighted average of unit labour costs and the prices of materials and fuels.
[32] Landesmann and Snell (1989), p. 23.

producers in different countries, it made sense to include these factors in the equations for exports (and imports) instead of relying on estimated proxies[33].

Therefore, according to Fagerberg (1988), a country's exports will depend not only on the country's ability to compete in prices, or on its ability to meet foreign demand for its goods (capacity), but also on the ability to compete in technology.[34] Equation (14) should now include an additional term reflecting the innovative features of the goods produced or, in other words, their technological competitiveness. Thus, the demand for exports should be specified as:

$$X_t = a C_t^{\,g} \left(\frac{P_d}{P_f} \right)_t^{-h} \left(\frac{T_d}{T_f} \right)_t^{e} Z_t^{\,b} \qquad (17)$$

where the term $\left(T_d / T_f\right)_t$ represents the level of technological competitiveness of a country relative to the world's highest technological achievements.

The model estimated by Fagerberg consists in a system of simultaneous equations including: (a) an export and (b) an import equation, (c) a balance of payment equilibrium growth rate, (d) an equation describing growth in relative unit labour costs, (e) an equation which represents growth in relative prices (which depend on unit labour costs), (f) a growth rate equation for the domestic economy, which feeds back to the import share and to (g) an equation for physical investment. The system is estimated through 2SLS on pooled cross-country and time series data for a group of 15 industrial economies over the period 1960-1983.

The relative level of technological competitiveness is proxied using a weighted average of R&D expenditure (as a percentage of GDP) and number of patent applications per capita, where each variable is divided by the highest value found in the sample in each period in order to construct an index varying between 0 and 1.[35] Capacity is proxied by gross investment as a percentage of GDP because measures of physical capital were not available for the entire time period. The results indicate that

[33] Kaldor (1981), p.603.
[34] More precisely Fagerberg's (1988) discussion emphasises all the non-price features of international competitiveness, including capacity, which he sees as the combination of three factors: (a) the growth in technological capability and know-how, which creates scope for innovation, (b) the growth in physical capital and (c) the rate of growth of demand. Since capacity has already been discussed in the previous section, here we mainly discuss competition in technology, broadly interpreted as quality.
[35] Fagerberg (1988) considers also the rate of growth of technological competitiveness.

non-price competitiveness, represented by capacity and technology, is by far the main factor influencing differences in international competitiveness and economic growth across countries.

Following the same line of enquiry, Greenhalgh (1990) attempts to quantify the contribution of price and non-price factors in determining UK net trade performance over the period between 1954 and 1981. Using time series data on 31 industries of traded goods and services, she explores the hypothesis that industries with a high level of technological competitiveness will export more, face a higher income elasticity and a lower price elasticity with respect to industries which lag behind. The variable chosen to represent technological ability is measured by data on innovations 'produced' and 'used' collected at the industry level by the Cambridge Growth Project databank. The model also includes strike incidence as a proxy for the reliability of the UK supply (capacity).

One of the most interesting features of the model is that it is estimated separately for each industry, exploring the time series properties of the data. Pooling different time series together enables the researcher to explore the panel structure of the model, but imposes restrictions on the parameters which may give biased estimates of the values of interest. The analysis in Greenhalgh (1990) reveals that there is considerable difference across industries both in the long-run cointegrating regressions and in the short-run dynamic equations. Moreover, it appears that panel data estimation does not result in any more substantial insights than does separate analysis for each industry.

The results reveal that in manufactured goods innovations have positive effects on trade volumes for approximately half of the industries and for the majority of the non-manufacturing sector. Surprisingly, in some of the industries classified as leaders in technological advance, innovations did not have a positive effect on trade performance. As was expected, the number of strikes had a negative effect especially on manufacturing export volumes, reflecting the adverse impact of a poor system of industrial relations on a country's volume of trade. It was found that non-price competitiveness does indeed increase the income elasticity and decreases the price elasticity of exports, but the coefficients on the relevant interaction terms were not robust to different specifications of the model. Overall, this analysis supports the idea that industry differences may be very important.

In a second paper, Greenhalgh *et al.* (1994) specify a more articulated model where innovations are allowed to have an effect on the trade balance by affecting export prices as well as having a direct impact on the demand for exports. From a theoretical point of view, export prices might respond to innovations in different ways. A 'process' innovation reduces costs of production and either leads to increased profit per unit of output or permits prices to be reduced. A 'product' innovation, by contrast, might induce an increase in prices in the short-run and – once the product is established and the desire to increase market shares prevails – a price reduction in the longer term. But even if it is possible to distinguish 'process' from 'product' innovations, the aggregation of firms across sectors makes the estimated effect of innovation on export prices ambiguous.

The model is estimated over a larger data set than previously available (36 industries over the period between 1945 and 1983) and, as before, the industry time-series are not pooled. Technological competitiveness is proxied using data on innovations or, alterntively, data on patents, which can be compared across countries providing evidence of 'relative' innovation activity. In all cases an 'output' measure of the innovative process is preferred to 'input' indicators, such as R&D expenditure. The results confirm the well-known higher propensity of the UK to import rather than export as world and domestic income rise and the negative effect of strikes on trade performance. A positive role of innovations or patenting activity on trade volumes and the balance of trade is found, while the impact of these variables on export prices shows that both positive and negative effects are possible.

In order to evaluate the importance of factors such as product variety, product quality and innovation in the determination of trade flows, Anderton (1966) experiments with several different proxies, such as patents, R&D expenditure, domestic inward investment and foreign direct investment. He also introduces strike activity and relative capacity utilisation as supply-side features. The method adopted for capturing the impact of the above variables on trade flows is to estimate a basic equation of imports using a general to specific procedure and then to augment the parsimonious specification introducing one of the relative non-price terms. The period of observation extends from 1972 to 1992, but the time series obtained are too short to allow robust estimation of separate industry equations, so the model is estimated by pooling together six broad manufacturing sectors.

The results indicate that an increase in UK patenting activity relative to its major competitors decreases import volumes almost everywhere. Improvements in the UK's relative expenditure on either R&D or investment also positively affect import performance. On the other hand, fewer categories of exports seem responsive to changes in the non-price variables. An increase in the UK's relative patenting activity or relative investment increases export volumes in three sectors, while R&D expenditure is only significant for metal products. Contrary to the findings in Greenhalgh (1990) and Greenhalgh *et al.* (1994), imports and exports seem unaffected by strike activity while physical capacity constraints show a significant influence only in some sectors.

The inability of the model to detect significant effects of capacity might be the main reason why the model can explain the trade share movements from 1979-1984 but fails to provide an interpretation of the strong recovery of the mid-1980s onwards. As Anderton (1996) suggests, elements related to the supply-side composition of UK producers might play a role because after the 1979-1981 shake-out in manufacturing; the surviving firms were probably those with a higher level of non-price competitiveness.[36]

Swann *et al.* (1996) attempt to study the impact of standards on UK trade performance. Theoretically, standards can have a positive or negative impact on the volume of imports and exports. The literature on non-price competitiveness and trade performance predicts that standards promote domestic product quality, encouraging exports and reducing imports. By contrast, the literature on non-tariff barriers to trade sees idiosyncratic standards as barrier to imports and (possibly) exports, while the literature on economic integration posits that internationally accepted standards will promote intra-industry trade.

In order to estimate which effect prevails, a net trade equation, an export equation and an import equation are fitted to data for 83 three-digit manufacturing industries over the period between 1985 and 1991. The specification of the three equations includes among the independent variables proxies for total demand, relative prices and the stocks of international and idiosyncratic British and German standards. It is found that UK standards appear to increase exports as well as imports and have a generally positive effect on the trade balance and that British and German standards

[36] See the discussion of Landesmann and Snell (1989).

are not mutually offsetting. These findings are generally consistent with the intra-industry trade perspective and do not support a non-price competitiveness explanation.[37]

The contribution of this paper is mainly in its use of standards as a proxy for quality variables. Unfortunately, as pointed out by Swann *et al.* (1996), it is possible that standard counts are simply acting as other measures of non-price competitiveness. Introducing R&D expenditure, for example, noticeably reduces the size and the significance of the estimated effect of standards and is evidence of a close correlation between the two. In the light of this, it is perhaps safer to conclude that standards are a good proxy for quality but that their effect might not be identified separately from the effect of other aspects of non-price competitiveness.

In an attempt to understand why improvements in UK international performance over the 1980s have not been accompanied by a strong growth of the entire manufacturing sector, Temple and Urga (1997) analyse the behaviour of UK imports of manufactured goods evaluating in particular the impact of capacity constraints, international specialisation and industrial standards. This study provides new and interesting insights. Exporting is a highly concentrated activity whereby large foreign-owned companies account for up to two fifths of total manufactured exports while another large percentage is accounted for by multinationals. Thus, it possible that the improvement in competitiveness which has been observed elsewhere for manufacturing exports[38] has not been felt in the entire manufacturing sector, leaving a "long tail" of poorly performing firms producing for the domestic market vulnerable to competition from abroad[39].

This hypothesis is tested by estimating import equations on aggregate data for UK manufacturing over the period 1970-1993 and on disaggregated data at the three-digit industry level for the period 1985-1990. The aggregate import demand equation includes overall demand for manufactured goods, relative prices, and a specialisation index measured by the ratio of OECD manufacturing exports to OECD total production. This index represents the benchmark rate of import penetration; a coefficient above/below one would reflect a higher/lower level of non-price

[37] However, it is also found that idiosyncratic UK standards have a stronger positive effect on exports and imports than internationally equivalent standards. This is incompatible with the intra-industry trade explanation unless we are prepared to maintain that the transformation of idiosyncratic standards into international standards has a variety reducing effect which negatively influences trade volumes.

[38] See Oulton (1990, 1996) and Landesmann and Snell (1989).

competitiveness of domestic goods. Other aspects of non-price competitiveness are captured by the ability of producers to respond to increases in demand (physical and skilled labour constraints). In the disaggregated model the specialisation index is replaced by industrial standards, which are supposed to act as proxies for technology and other quality features.

The results indicate that the most important influence on import penetration in all the periods considered is increasing international specialisation; the response elasticity to this variable is stable and considerably above one, suggesting a considerable and continuing loss of competitiveness in UK domestic manufacturing attributable to non-price factors. In contrast with the results of Swann *et al.* (1996), the evidence supports a non-price competitiveness effect of standards since it is now found that the latter reduce imports, perhaps by increasing the quality of domestic production and by creating non-tariff barriers to trade. The results also suggest that, among the cyclical factors affecting the volatility of imports, skilled labour shortages are more important than physical capacity shortages.

The most recent and complete study of international competitiveness is to be found in Carlin *et al.* (2001), who investigate the relationship between export market shares and relative unit labour costs using a long panel of 12 manufacturing industries across 14 OECD countries. The study analyses the sensitivity of export markets shares to changes in relative costs under the hypothesis that this elasticity might vary with the level of technology observed at the industry level or that it might depend on the trend towards globalisation, since it is possible that costs become more important as barrier to trade disappear and competition increases. The relative importance of these effects is found by estimating separate elasticities for different industries, countries and time periods.

The data run from 1970 to 1992 and information is confined to the 12 main divisions of manufacturing. Preliminary descriptive analysis shows that the cross-country correlation between the average annual rate of change of relative unit labour costs for manufacturing as a whole and the relative export shares is positive (an example of the 'Kaldor paradox'). A pooled regression of relative export shares on contemporary and lagged relative unit labour costs by industry shows, however, a negative and significant effect of the latter on the former. But the significance of

[39] See temple and Urga (1997).

country dummies - which stand for trends since the regressions are estimated in first differences - reveals the existence of important trends in market shares that cannot be explained purely in terms of relative unit labour costs and suggests a problem of model misspecification.

Since, as we have documented above, modern international trade theory stresses the importance of quality differentials arising from different technological capabilities across countries, it is possible that relative unit labour costs are less important than technology factors. In order to investigate this hypothesis, three measures of technology observed at industry level are used: research and development expenditure, patenting activity and investment in fixed capital (as a proxy for embodied technological change).

The results indicate that R&D variables are wrongly signed and not significant, patents have the right sign but are not significant, while investment is the only significant and positive proxy for the effect of technological competitiveness. The balance of the evidence supports the view that technological improvements embodied in new capital goods promote export performance in ways that are not picked up by the productivity trends. On the contrary, R&D intensity and patenting activity have no impact on trade over and above that reflected through productivity in relative unit labour costs. However, even after introducing non-price factors, the country dummies remain jointly significant. This leaves open the hypothesis that other factors, and in particular institutional elements, not captured by 'input' or 'output' measures of innovative activity might explain the trends in a country's exports performance.

It has been suggested that the system of human capital formation, patterns of diffusion of incremental innovation within and between industries and the role of committed owners in fostering long-term objectives might account for success in high quality manufacturing.[40] To examine whether these institutional factors have any explanatory power across OECD countries Carlin *et al.* (2001) regress the coefficients of the country dummies from the pooled regression (those including investment) against a series of country specific indicators. The three most significant factors are human capital formation, disembodied technological progress across the business sector (including organisational change), and the structure of corporate ownership.

[40] See Porter (1990) and Carlin and Soskice (1997).

More than half the variation in the underlying country trends is accounted for by these three variables.

By allowing the coefficients to differ across industries it is possible to observe that export performance in R&D intensive industries exhibits a lower elasticity with respect to relative unit labour costs. By allowing the coefficients to vary across countries, it is found that German exports and exports from other countries in the ERM area are less cost sensitive than the exports of Japan, the US and the UK. More generally, it is noted that the sensitivity of export market shares to costs seems to be closely related to two of the institutional variables considered: the level of ownership concentration and business sector total factor productivity. These results suggest that the factors responsible for successful export performance might be deeply embedded in a country's institutions.

5. Conclusions

In the previous section we offered a review of different approaches to the study of non-price competitiveness, with particular emphasis on the performance of the British economy relative to its most important trading partners. The picture that emerges indicates that it is extremely unlikely that we can reach clinching conclusions about relative the relative quality of British goods and services. It is similarly impossible to be certain about Britain's performance in terms of product specification.

Since our definition of product specification is still relatively new in the literature and we propose a distinction between this concept and the concept of quality, we were prepared to accept that evidence on non-price competitiveness, (or quality) might provide only clues about specification. Interestingly, however, we discovered that any international or intertemporal assessment of the broader concept of the relative quality of British production is extremely difficult to justify in the light of the results reviewed above.

Direct evidence tends to show that Britain has lower productivity levels compared with many countries (especially Germany) which is not attributable to differences in quality. In the case studies conducted by the *National Institute of Economic Research* it also emerges that the quality of British goods is inferior to the quality of goods

produced in other European economies.[41] The non-parametric hedonic technique applied by Swann and Taghavi on a sample of goods produced for the UK market reveals that, although British-produced goods tend to be competitive by virtue of their price more than by virtue of an exceptional combination of characteristics, there is substantial heterogeneity across different goods and countries and no overall picture emerges.

By contrast, evidence provided by indirect approaches seems to suggest that there was an improvement in the non-price competitiveness of British goods in the 1980s compared with the 1970s. This can be seen clearly in the study of Landesmann and Snell(1989) and in comparing the main conclusions in Stout (1977) and Oulton (1990). Oulton argues that, on the basis of figures on the unit value of UK exports relative to German exports, British goods were of the same quality of German goods by the end of the 1980s. However, a note of caution emerges from the recent study by Carlin *et al.* (2001), which finds that German exports and exports from other European countries are generally less cost-sensitive than the exports of the UK, although this difference is attributed mainly to institutional factors.

We have discussed extensively the relative merits and demerits of different approaches and we should have all the elements we need to trace the direction of future research. First of all, it is crucial to recognise the nature of the difference between the concept of product specification and the concept of quality. As we argued in section 2, specification is broadly defined by the number of characteristics of a product, the frequency with which these characteristics change through time and their responsiveness to customers' needs. Quality incorporates specification but refers also to the way in which the characteristics of a product are delivered to the customer. This distinction implies that although quality can be somehow considered a 'residual' concept - in the sense that it can be measured as what remains after accounting for price differences – and can therefore be analysed using indirect approaches, specification is defined by very definite elements which need to be measured directly.

While we see the future of studies on non-price competitiveness mainly in the developments of the literature on R&D expenditure, innovations and patents rather than in the analysis of unit values, the methodology we need to implement for an

[41] The evidence is less clear-cut for services. Investigation of quality in the service sector is still in its infancy.

adequate investigation of product specification is essentially confined to the collection of direct evidence. On the one hand it would be useful to proceed in the direction traced by the *National Institute of Economic Research* and carry out detailed sectoral studies, possibly gathering information on the specification of products produced by multinational firms in different countries. This approach would offer the advantage of collecting for the first time very detailed evidence on product specification.

On the other hand, it would be interesting to try to overcome the limitations of case studies and conduct a representative survey in order to obtain an overall picture of the specification of British production, by collecting evidence on the characteristics of products and the frequency with which these characteristics are changed or customised. This second approach is certainly very appealing but also much more challenging, since we would need to develop a methodology for eliciting truthful revelation of product features and market strategies though interviews or questionnaires. Whether this is possible or not is still an open question, but it is worth considering as a potentially fruitful avenue of future research. If evidence at the national level were to become available, and this evidence could be matched with information collected by our trading partners, we would have the basis for a robust investigation of the relative performance of the British economy in this important dimension.

References

Anderton, B. (1996): "UK Trade Performance and the Role of Product Quality, Innovation and Hysteresis: Some Preliminary Results", *National Institute for Economic and Social Research*, Discussion Paper no. 102

Bacharach, M. (1991): "Commodities, Language and Desire", *Journal of Philosophy*, Vol. 87(7), pp. 23-40

Bowbrock, P. (1992): *The Economics of Quality, Grades and Brands*, Routledge

Brech, M.J. and Stout, D.K.: "The rate of exchange and non-price competitiveness: a provisional study within UK manufactured exports", *Oxford Economic Papers*, Vol. 33, pp. 268-281

Broadberry, S. (1997): *The Productivity Race: British manufacturing in International Perspective, 1850-1990*, Cambridge University Press

Carlin, W., Glyn, A. and Van Reenen, J. (2001): "Export Market Performance of OECD Countries: An Empirical Examination of the Role of Cost Competitiveness", *The Economic Journal*, Vol. 111 (468), pp. 128-162

Carlin, W. and Soskice, D. (199): "Shocks to the system: the German political economy under stress", *National Institute Economic Review*, Vol. 159, pp. 57-76

Casey, B., Keep, E. and Mayhew, K. (1999): "Flexibility, quality and competitiveness", *National Institute Economic Review*, Vol. 168(2), pp. 70-81

Court, A. (1938): "Hedonic Price Indexes with Automotive Examples", *The Dynamics of Automobile Demand*, New York, General Motors Corporation

Cowling, K. and Rayner, A. (1970): "Price, Quality and Market Share", *Journal of Political Economy*, Vol. 78, pp. 1292-1309

Cubbin, J. and Murfin, A. (1987): "Regression Analsysis versus Linear programming in the Analysis of Price-Quality Relationships: an Application to the Determination of Market Shares", *Oxford Bulletin of Economics and Statistics*, Vol. 49 (4), pp. 385-399

Daly, A., Hitchens, D. and Wagner, K. (1985): "Productivity, Machinery and Skills in a sample of British and German Manufacturing Plants", *National Institute Economic Review*, Vol. 111

Department for Education and Employment (2000): *Skills for all: research report from the National Skills task Force*

Doyle, P., Saunders, J. and Wong, V. (1992): "Competition in Global Markets: a Case Study of American and Japanese Competition in the British Market", *Journal of International Business Studies*, p. 419

Fagerberg, J. (1988): "International Competitiveness", *The Economic Journal*, Vol. 98(391), pp. 355-374

Feenstra R. (1995): "Exact Hedonic Price Indexes", *The Review of Economics and Statistics*, Vol. 77 (4), pp. 634-653

Finegold, D. and Soskice, D. (1988): "The failure of training in Britain: analysis and prescription", *Oxford Review of Economic Policy*, Vol. 4(3). Pp.21-53

Finegold, D., Wagner, K. and Mason, G. (2000): "National Skill-creation Systems and Career Paths for Service Workers: Hotels in the US, Germany and the UK", *International Journal of Human Resource Management*, June, pp. 497-516

Goldstein, M. and Khan, M. (1985): "Income and Price Effects in Foreign Trade", in Jones, R. and Kenen, P. (eds.), *Handbook of International Economics*, Vol. 2, Amsterdam: North-Holland

Greenhalgh, C. (1990): "Innovation and Trade Performance in the United Kingdom", *The Economic Journal*, Vol. 100(400), pp. 105-118

Greenhalgh, C., Taylor, P. and Wilson, R. (1994): "Innovation and Export Volumes and Prices: a Disaggregated Study", *Oxford Economic papers*, Vol. 46

Greenhalgh, C. and Gregory, M. (2000): "Labour Productivity and Product Quality: their Growth and Inter-Industry Transmission in the UK, 1979-1990", in Barrel *et al.* (eds.), *Productivity, Innovation and Economic Performance*, Cambridge University Press

Greenway, D., Hine R. and Milner, C. (1995): "Vertical and Horizontal Intra-industry trade: a cross industry analysis for the UK", *Economic Journal*, 105, pp.1505-1518

Gregory, M., Zissimos, B. and Greenhalgh, C. (2001): "Jobs for the Skilled: How Technology, Trade and Domestic Demand Changed the Structure of UK Employment, 1979-1990", *Oxford Economic Papers*, Vol. 1, pp. 1-27

Griffith, R. (1999): "Using the ARD Establishment Level Data to Look at Foreign Ownership and Productivity in the United Kingdom", *The Economic Journal* , Vol. 109 (June), pp. F416-F442

Griffith, R. and Simpson, H. (2001): "Characteristics of Foreign-Owned Firms in British Manufacturing", *Institute for Fiscal Studies*, mimeo

Griliches, Z. (1971): *Price Indexes and Quality Change*, Cambridge Mass: Harward University Press

Griliches, Z. (1990): "Hedonic price indexes and the measurement of capital and productivity", in Berndt, E. and J. Triplett (eds.), *Fifty Years of Economic Measurement*, University of Chicago Press

Hooley, G., Lynch, J. , Brooksbank, R. and J. Shepherd (1988): "Strategic market environments", *Journal of Marketing Management*, Vol. 4(2), PP. 131-147

Horn, E., Klodt, H. and Saunders, C. (1985): "Advanced machine tools: production, diffusion and trade" in Sharp, M. (ed.) *Europe and the New Technologies*, London: Francis Pinter

Kaldor, N. (1981): "The role of increasing returns, technical progress and cumulative causation in the theory of international trade and economic growth", *Economic Applique (ISMEA)*, Vol. 34, No. 4, pp. 593-617

Keep, E. and Mayhew, K. (1999): "The assessment: knowledge, skills and competitiveness", *Oxford Review of Economic Policy*, Vol. 15(1), pp. 1-15

Jarvis, V. and Prais, S. (1995): "Quality of Manufactured Products in Britain and Germany", *National Institute for Economic and Social Research*, Discussion Paper no. 88

Lancaster, K. (1971): *Consumer Demand: A New Approach*, New York: columbia University Press

Lancaster, K. (1990): "The Economics of Product Variety: A Survey", *Marketing Science*, Vol. 9(3), pp. 189-206

Landesmann, M. and Snell, A. (1989): "The Consequences of Mrs Thatcher for UK Manufacturing Exports", *The Economic Journal*, Vol. 99, pp. 1-27

Martin, S. (1993): *Advanced Industrial Economics*, Blackwell Publishers

Mason, G., van Ark, B. and Wagner, K. (1994): "Productivity, Product Quality and Workforce Skills: Food Processing in Four European Countries", *National Institute Economic Review*, Vol. 147

Mason, G., Keltner, B. and Wagner, K. (1999): "Productivity, Technology and Skills in Banking: Commercial Lending in Britain, the United States and Germany" *National Institute for Economic and Social Research*, Discussion Paper no. 159

Nickell, S. and Nicolitsas, D. (2000): "Human Capital, Investment and Innovation: What are the Connections?" in R. Barrel, G. Mason and M. O'Mahony (eds.), *Productivity, Innovation and Economic Performance*, Cambridge University Press

Oulton, N. (1990): "Quality and Performance in UK Trade, 1978-87", *National Institute for Economic and Social Research*, Discussion Paper no. 197 (old series)

Oulton, N. (1996): "Workforce Skills and Export Competitiveness", in Booth, A. and Snower, D. (eds.), *Acquiring Skills*

Panic, M. and Rajan, A. (1979): *Product Change in Industrial Countries' Trade*, 2nd edn., London, NEDO

Payson, S. (1994): *Quality Measurement in Economics: New Perspectives on the Evolution of Goods and Services*

Phlips, L. (1983): *The Economics of Price Discrimination*, Cambridge: Cambridge University Press

Porter, M. (1990): *The Competitive Advantage of Nations*, London: Macmillan

Prais, S., Jarvis, V. and Wagner, K. (1989): "Productivity and Vocational Skills in Services in Britain and Germany", *National Institute Economic Review*, Vol. 130

Steedman, H. and Wagner, K. (1987): "A Second Look at Productivity, Machinery and Skills in Britain and Germany", *National Institute Economic Review*, Vol. 122

Steedman, H. and Wagner, K. (1989): "Productivity, Machinery and Skills: Clothing Manufacture in Britain and Germany", *National Institute Economic Review*, Vol. 128

Stout, D. (1977*)*: *International Price Competitiveness, Non price factors and export performance*, NEDO, London

Stiglitz, J. (1987): "The Causes and Consequences of the Dependence of quality on Price", *Journal of Economic Literature*, Vol. 25(1), pp. 1-48

Streeck, (1985): "Industrial relations and technical change in the British, Italian and German automobile industry", *IIM discussion paper,* 85-5, Berlin

Swann, P. (1987): "International differences in product design and their economic significance", *Applied Economics*, Vol. 19, pp. 201-213

Swann, P. (1998): "Quality and competitiveness", in Buxton *et al.* (eds.), *Britain's Economic Performance*, pp. 117-140

Swann, P., Temple, P. and Shurmer, M. (1996): "Standards and Trade Performance: the UK Experience", *The Economic Journal*, Vol. 106, pp. 1297-1311

Swann, P. and Taghavi, M. (1992): *Measuring Price and Quality Competitiveness*

Temple, P. (1998): "Quality Specialisation in UK Trade", in Buxton *et al.* (eds.), *Britain's Economic Performance*, pp. 69-98

Temple, P. and Urga, G. (1997): "The Competitiveness of UK Manufacturing: Evidence from UK Imports", *The Economic Journal*, Vol. 49, pp. 207-227

Thirlwall, A. (1979): "The balance of payments constraint as an explanation of international growth rate differences", *Banca Nazionale del Lavoro Quarterly Review*, Vol. 32, No. 128, pp. 45-53

Triplett, J.E. (1990): "Hedonic methods in statistical agency environments: An intellectual biopsy", in Berndt, E. and J. Triplett (eds.), *Fifty Years of Economic Measurement*, University of Chicago Press