MEASURING THE PRODUCTIVITY OF PROFESSIONAL SERVICES: A CASE STUDY OF SWEDISH MANAGEMENT CONSULTING FIRMS

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Lilach Nachum
ESRC Centre for Business Research
Department of Geography
University of Cambridge
Downing Place
Cambridge
CB2 3EN

Phone: 01223 339097
Fax: 01223 355674
Email: ln207@cus.cam.ac.uk

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Abstract

Existing measures of productivity were designed to measure productivity in industries in which both inputs and outputs are tangible standardised quantities. They are inadequate for productivity measurement of professional services, where intangible and specialised factors of production are in use. This paper seeks to address the difficulties associated with the measurement of the productivity of professional service firms and to propose a more adequate measure of productivity in these industries. This measure is tested on a sample of Swedish management consulting firms, and is assessed in relation to several performance indicators of these firms.

The findings illustrate the inadequacy of the manufacturing-based measurement procedures and demonstrate that a measure which acknowledges the unique characteristics of professional services correlates better with firms' performance. As this field of research is in its infancy, these findings are only suggested as indications for directions in which future research is needed.

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1. Background

The commonly accepted wisdom among economists is that productivity[1] of services lags behind productivity of manufacturing (e.g., Stanback and Noyelle, 1990; Drucker, 1991; Sherwood, 1994). Statistical figures make it appear to be so (see for example various publications of the US Bureau of Labour Statistics), as they reveal that while productivity of manufacturing has improved steadily during the last century, service productivity barely grew at all. However, it might be that at least part of the disparity in productivity between services and manufacturing is a statistical illusion, resulting from inadequacy of existing data and techniques of measurement. Productivity measures are dominated by manufacturing paradigms and are based on quantities of standardised and clearly identified units of measurement. The large variance in the content and quality of the input and output of service firms seems to make such measures inappropriate.

The need to measure productivity of services in ways which are different from those used to measure productivity in manufacturing has attracted considerable research attention. Some studies have sought to illustrate the conceptual limitations of existing procedures for measurement of productivity of service firms (e.g., Hjern, 1990; Stanback and Noyelle, 1990; Mellander, 1992; Gummesson 1991, 1992, 1994; Gordon, 1996). Other studies have addressed the technical problems of productivity measurement for particular service industries and have demonstrated the limitations of measures based on manufacturing paradigms for these industries (e.g., Berg, 1991; Berg, Forsund and Jansen, 1989, 1992 for Norwegian banks; Bjurek et al, 1992 for Swedish day care centres; Hjalmarsson and Veiderpass, 1992 for Swedish electricity distribution; Fare et al, 1989 for Swedish hospitals).

Unique characteristics of professional services may limit the validity of the research which addresses service productivity in general to productivity measurement of these industries. In terms of the input and output and the nature of the production process, notably the most relevant attributes for a discussion of productivity measurement, professional services can be defined by two main characteristics. First, professional knowledge is their core resource, and it is both the input and output in their production processes. This type of knowledge is derived from professional training and it is associated with recognised professional associations. The production processes of these services are based on manipulation and application of this knowledge by highly educated employees to provide a one-time solution to specific clients' problems. This characteristic implies the need to measure the productivity of knowledge, a measurement issue which distinguishes professional services from most other service industries.

Second, the clients of professional service firms are other firms, organisations or government departments, and their output is used as an intermediate input in the production processes of these firms or organisations. Professional service firms differ considerably in this respect from other service industries whose output is used for the final consumption of private consumers. For the purpose of productivity measurement, this difference implies a different role for the client in the production process and a need for different ways to assess the output (see ahead for further elaboration of these issues).

The industries characterised by these two characteristics represent a wide range of professions and include management consulting, engineering consulting, advertising, market research, public relations, accounting, data processing and computing services[2].

In spite of the recognition of the unique nature of professional service industries and the wide differences between them and other service industries (see for example Lowendhal, 1997), issues related specifically to productivity measurement of professional service firms

have gone unexplored by previous research. For two main reasons, such research is of special importance. First, the rapid growth of professional services requires adequate measurement of the productivity of the resources employed by these industries. The share of employment in professional service industries in the total labour force of the OECD countries doubled between 1970 and 1990, and together with finance and insurance reached about 13% of the labour force in the early 1990s (ILO, 1994). With such a large share of labour concentrated in professional service industries, their productivity becomes an issue which cannot be ignored. Yet, without adequate measurement, it cannot be addressed.

Second, these industries are most suitable for the study of the more general issue of productivity of intangible factors of production, notably knowledge. Intangible factors have been recognised as key factors of production in a growing number of industries (e.g., Itami, 1987) and their productivity has become a central challenge for managers and policy makers: 'The single great challenge... in developed countries of the world is to raise the productivity of knowledge.... This challenge will ultimately determine the competitive performance of companies and the very fabric of society and the quality of life in every industrialised nation' (Drucker, 1991, p. 94). The production of professional services is based entirely on intangible factors, whose productivity determines the productivity of firms. Therefore these industries provide an excellent opportunity to study the productivity of intangible factors of production, isolated from the impact of the tangible ones.

This study seeks to take a first step in addressing theoretical and technical issues related to measurement of productivity of professional services. It seeks to address the specific difficulties associated with the productivity measurement of these industries and to propose a measure of productivity which acknowledges the unique characteristics of the inputs and outputs of these industries. This measure is illustrated by an

application to a sample of Swedish management consulting firms and it is compared with a manufacturing-based measure.

2. The Manufacturing-Based Measure and its Inadequacy for Professional Services

Productivity measurement is regarded in terms of its relevance for the internal control of firms. Productivity measures provide bench-marks for evaluating methods and for improving the use of resources (McLaughlin and Coffey, 1990). Without them, activities undertaken to achieve competitive improvements are left largely unguided (Brignall 1993). Better measurement procedures provide tools for the more efficient use of resources and ways to evaluate the contribution of particular resources to the overall performance of the firm.

The productivity of a firm producing tangible products is measured by physical units of input and output, which are assumed to be of identical quality. The basic approach in such measures is that they are not meant to reflect variance in the quality of both the input and the output. Input data typically consist of hours of labour and capital. Labour inputs are treated as homogenous and additive with no distinction made between hours of different groups of workers. Output is measured by physical quantities of the product(s), or, if replaced by prices, the price is in consistent ratio to units of output, so the assumption of identical quality is maintained.

Attempts have been made to apply a similar approach to some service industries and to construct quantifiable measures of both input and output (see McLaughlin and Coffey, 1990 for review of this literature). In these studies inputs are typically calculated by accumulation of identical labour hours used in the production. Measures of output are based on standardised units, such as the number of kilowatt hours as the units of output of the electric industry; number of transactions as the units of output of commercial banks (Dean and Kuntze, 1992); number of contracted children as the units of output of day care centres

(Bjurek et al., 1992). The assumption underlying these measures is that output and input are standardised and quantifiable, similarly to those of manufacturing industries.

For two reasons, these measurement procedures are inadequate for professional services. First, both input and output in the production of these services are highly specified and specialised and cannot be quantified in a manner similar to the manufacturing-based measures, nor to some other service industries which are more standardised (Levitt, 1976). The input consists of creative and innovative work, which differs among professionals. The output is tailored to meet the requirements of the purchasing client and it varies substantially from client to client (Lowendhal, 1997). This heterogeneity prevents the establishment of standardised quantifiable units of measurement, which is the basis for the manufacturing-based measure of productivity.

Second, and largely related to the first reason, is the variation in the quality[3] of both input and output in the production of professional services. Quality and productivity are closely related in all service industries (Gummesson, 1992), but the nature of the link may be specific to professional services. The professional inputs vary in quality as a result of differences in intelligence, education, experience and so on of the service producers. The highly tailor-made nature of the work and the involvement of the clients in the production introduce large variations in the quality of the output. Due to the intangible nature of the output of professional services and the underlying heterogeneity of the transactions, it is difficult to assess quality differences and to incorporate them into the measurement of productivity. Yet, in many cases the output of the service can only be measured in terms of quality change and therefore measurement of productivity without taking account of quality change can often be meaningless. The manufacturing-based measures, which are based on the assumption of identical quality, cannot capture this variation.

Empirical evidence from the advertising industry highlights the limitations of manufacturing-oriented measures of productivity when applied to a professional service industry (Nachum, 1996). Productivity (measured by turnover per employee) was found to be insignificant in explaining the differences between winners and losers in the advertising industry. Likewise, casual observation of the list of the top management consulting firms (Consultant News, 1997) suggests no relationship between firms' size and their productivity (measured by turnover per consultant). These findings illustrate the limitations of the manufacturing-based measures when applied to professional services.

There is a certain variation among the various professional service industries in terms of their standardisation and the value of creativity and innovation in the production. At the more standardized end are industries in which both the input and the output are relatively standardized (e.g., accounting) while at the innovative end, of which advertising is an example, the input and output vary more among various projects and assignments. Even in the latter, however, the use of prototypes and structured knowledge which is customized to take account of specific clients' needs is common. An example from the management consulting industry is the 're-engineering myopia' (Management Consultants International, 1995b), where the same idea is applied to different firms with specific adjustments. Likewise, thousands of unique adaptations spring off a few selected advertising ideas. A module of knowledge, in which a number of standardized components are used in different combinations for each client, describes this work better than a complete innovation. As a result of these differences, the measurement difficulties discussed above apply to different professional service industries to varying degrees, and yet exist in all of them.

3. A Search for an Improved Measure of Productivity of Professional Service Firms

Proposing a measure of productivity of professional service firms is more than a technical measurement issue, since the factors determining productivity in these industries are only partially known. Consequently, the ability to identify the relevant forces which should be measured is limited. Thus, in the first place, the conceptual problem of what should be measured ought to be addressed. The failure to construct adequate measures partially reflects a neglect of the theoretical side of the problem.

In addition to the conceptual problems, there are also technical difficulties of measurement. The factors at work are intangible, abstract constructs which cannot be measured directly. Transforming these constructs into precise, explicitly defined operational measures often results in a discrepancy between the constructs and the operational counterparts used and the accuracy of the former as measures of the latter might be doubtful. Nonetheless, as expressed by McLaughlin and Coffey: 'While intangibles may be an inherent problem, they are not an excuse for avoiding productivity analysis....Intangibility makes measurement difficult, but it is seldom a reason to avoid measurement even if proxies must be used' (1990, p. 47).

In what follows we present the theoretical reasoning for the choice of specific factors as input and output in professional services, discuss the operationality of these theoretical concepts and suggest possible measures for them.

We have chosen to use the single firm, rather than an assignment, as the unit of analysis. These units of analyses would yield different findings in terms of managerial control, and each has its advantages and disadvantages. Using an assignment as the unit of analysis is likely to prove useful in identifying specific sources of inefficiency and can help much when making operational decisions related to the improvement of

the firm's effectiveness. Aggregate measures provide useful information for evaluating overall economic policy, making decisions on what services to produce, including analysis of comparative advantage and deciding on relative input to various assignments (McLaughlin and Coffey, 1990). However, the practical measurement problems are likely to increase when a single assignment is used as the unit of analysis, as it is often hard, if not impossible, to distinguish and measure meaningfully the resources (input) used for a single assignment within a firm, and for this reason we have chosen to use the firm as the unit of analysis.

As discussed above in some length, the production and delivery processes of professional service firms involve the resources of both the producer and the client[4]. An adequate measure of productivity should therefore acknowledge both.

4. Input

4.1. Input of the producer

4.1.1. Labour

Since labour makes the crucial contribution in the production of professional services (Svieby and Lloyd, 1987; Maister, 1993; Aharoni, 1997; Lowendhal, 1997; Nachum, 1999), it is likely to have a powerful impact on the productivity of professional service firms. However, measurement procedures of the performance of labour have remained largely undeveloped (certainly relative to models used to trace the performance of financial and capital resources).

The major difficulty with the measurement of labour input in the production of professional services is the variation in its quality. The measure has to somehow capture the variance in the quality because it determines the impact of labour on the production. This variation rules

out the possibility of using any standardised measure (e.g. number of hours of work)[5].

Since the quality of labour cannot be measured directly, there is a tendency to measure instead the factors which determine it (such as knowledge, experience, intelligence of the professional). However, we cannot specify all these factors, and those which can be specified can only partially and indirectly be measured. In addition, the quality tends to vary for individual professionals between assignments, in line with such factors as their state of health, relevance of experience, 'chemistry' with the key players in the client's organisation, and so on, further complicating the measurement.

In order to overcome some of these difficulties, we use wages as an operational measure for labour input. The higher the combined wages paid by a firm, the more input labour it uses in the production. Wages vary among professionals in a manner which reflects both levels of education and years of experience, the two most important determinants of labour quality. Indeed, it is a widely used operational measure for labour quality (see for example Montgomery, 1991; MacDonald and Reynolds, 1994)[6].

Wages will be adjusted to average pay levels in the industry to control for changes in pay levels which do not reflect changes in labour input at the level of the firm (for example, a result of accelerated growth, or excess supply of labour). There are two sources for possible bias in wages as an operation for labour input. First, firms have different attitudes towards pay levels, and those may not be related to the input of the labour. For example, successful firms may be able to pay lower wages than the industry average and attract professionals by the reputation and work opportunities they offer. Second, in several professional service industries (notably management consulting, accounting, law) partnerships (an ownership structure in which the firm is owned by its top executives) represent a common ownership structure. Typical of this structure is that the wages of the partners are

deducted from the profits and are not reported as part of labour costs. This procedure distorts the picture of the labour input used in the production. In order to get some indication of the potential bias which might be introduced by this problem we will compare firms with different ownership structures.

4.1.2. Knowledge and learning

The production of professional services consists of suggesting solutions to specific clients' problems, using existing knowledge and 'prototypes' (Hedberg, 1990) as input. The manipulation of knowledge by the professional employees is thus a critical input in the production process. The acquisition of knowledge is what is usually termed 'learning'. Effective knowledge in the production of professional services needs to be renewed constantly, via learning new methods and processes, a process which in turn allows the more efficient use of resources. Learning is thus the underlying force driving shifts in the production (Arrow, 1962) and is a major component in explaining productivity gains. The acquisition of new knowledge and learning are thus critical inputs in the production, and productivity measurements should explicitly account for their contribution.

In manufacturing, the acquisition of new knowledge is typically measured by R&D expenses (see for example Griliches, 1993, 1994; Graves and Langowitz, 1993; Henderson and Cockburn, 1996). The equivalent for R&D in professional service firms, i. e., the activity of acquiring new knowledge, is in developing new services which enhance the ability of the firm to provide rigorous analytical thinking and to develop its intellectual capital. Additional activity associated with obtaining knowledge is training, which spreads the knowledge of the firm among its employees. Therefore, resources allocated to the development of new services and to training will be used as operational measures for knowledge acquisition.

These measures have two deficiencies as operations for the acquisition of new knowledge. First, there tends to be a long time lag for productivity measures to reflect the resources allocated to the acquisition of new knowledge. In the short run, increased input devoted to the acquisition of new knowledge will tend to decrease productivity because the productivity measure reflects increased input without corresponding increase in output (Griliches, 1979)[7]. Introducing a time lag between these measures and the productivity measurement may provide only a partial remedy to this problem, because the time lag between the effect of current knowledge on measured productivity varies across industries and types of knowledge and is often known only in retrospect. The narrower the scope of the study in terms of industries, countries and time span, the more feasible it is to have some indication about the appropriate length of the time lag, but such a remedy is only partial, and the relevant time lag is also likely to vary considerably among firms operating within the same environment.

Second, the amount of direct resources allocated for the development of new knowledge only partially reflects the acquisition of new knowledge by a professional service firm. The processes of acquiring new knowledge, as well as spreading it within the firm by training, are to a large extent informal (see for example Consultants News, 1994 for management consulting) and are not captured by statistical data. Much of the knowledge development occurs in assignments, and the professionals generalise knowledge obtained in one assignment and use it in their future work. This activity is not visible, and the assessment of the direct resources allocated to it is at best partial.

4.1.3. Knowledge stock

The knowledge of a firm at any time consists of both its current and past knowledge. Therefore there is also a need to measure the accumulated stock of knowledge. The role of accumulated knowledge in increasing productivity has long been observed, first by engineers who recognised that the number of labour-hours used in the production

of airframes is a decreasing function of the total number of airframes of the same type previously produced. This came to be known as the 'learning curve', implying that the very activity of production gives rise to problems for which favourable responses are selected over time in a process of learning (Arrow, 1962). Learning is a product of experience and the advantages associated with it thus increase over time, leading to productivity improvements. This link has been confirmed empirically (see for example, Luh and Stefanou, 1993).

The creative nature of professional services may reduce the value of accumulated knowledge relative to industries in which the production is more standardised. Nonetheless, the duration of business activity has been maintained to be particularly important for these types of firms (see Itami, 1987), because the accumulation of essential resources in their production is a long and time consuming process. Indeed, accumulated experience (proxied by firms' age) was found to have a strong impact on the performance of advertising agencies (Terpstra and Yu, 1988). This finding was attributed to the fact that while to a certain extent 'the wheel has to be reinvented' each time a new service is produced, there is a certain amount of standardisation which allows the learning by repetition of similar tasks.

The discussion above suggests the use of variables which represent cumulative experience associated with learning[8]. We select cumulative investment in the acquisition of knowledge and in training, measured over a period of five years, as an operational measure for the stock of knowledge.

The problem with such measures of the stock of knowledge is that knowledge changes its value as a factor of production over time, and these changes are not fully reflected in its costs. The earning capacity of firm-specific knowledge erodes over time, both because it begins to lose its specificity (it leaks to other firms in the industry) and because improved methods and techniques become available, making this knowledge obsolete. Consequently, the growth in the stock of

knowledge is not equal to the gross level of current resources invested in expanding it. There is a depreciation of the value of this input over time which might be impossible to measure because the rate of the depreciation is unknown (Griliches, 1979). The actual effect of this bias is difficult to assess since the value of the stock of knowledge varies, and sometimes considerably so, over time and among firms (that is, certain types of knowledge are more sustained over time; some firms are better able than others to exploit knowledge developed or obtained in the past).

4.1.4. Spillover

The knowledge of any firm is not only derived from its own investment but is also affected by the knowledge borrowed or stolen from other firms. This arises from the intangible nature of knowledge. Unlike tangible inputs, which belong exclusively to the firm employing them, knowledge does not belong to the firm in the same sense and is not fully under its control. Consequently, some kinds of knowledge can be employed in the production processes of firms other than those which initially produced them, a phenomenon known as spillover[9]. One consequence of this characteristic is that the costs of knowledge vary substantially between the firms producing it and those who imitate it. This necessitates allowing for a measure of spillover to be included as input. Several empirical studies have demonstrated this need (e.g., Griliches and Mairesse, 1984; Henderson and Cuckbock, 1996).

Spillover can be common in professional service industries because there are no patents to protect knowledge. Yet, the creative nature of the work makes knowledge obtained in one project less applicable to others, and limits the scope for imitation.

Spillover occurs via interactions with other firms and individuals which possess relevant knowledge. Probably the main mode of spillover is movement of employees among firms. When employees move between firms, they carry with them the tacit knowledge which is specific to a

particular firm and which cannot be bought or sold, or even written down. They take with them the knowledge they acquired while working in a particular firm and bring it to another firm (Maister, 1985). This is one of the main reasons for the interest of firms in hiring employees who were previously employed by their competitors. Other mechanisms through which spillovers occur are via professional associations, professional conferences, etc.

Possible operational measures for spillover are the movement of employees in and out the firm, membership of industry associations and participation in professional conferences, and firms' assessment of their level of interaction with their competitors.

A major problem associated with the measurement of spillovers and their impact on productivity is defining the relevant 'boundaries' for spillover. We do not deal with one closed industry within a closed economy but rather with a whole array of firms and industries in different countries which 'borrow' different amounts of knowledge from different sources according to their economic and technological distance from them. Presumably, the usefulness of somebody else's knowledge to a firm is highest, the shortest this distance, but the 'relevant distance' is very hard to define conceptually and empirically (see Griliches, 1979 for a thorough discussion of this issue). Our operational measure for spillover assumes a single industry with no national borders (i.e., both the domestic and international industry) to be the 'relevant' boundaries, but these boundaries might be too narrow as firms also borrow ideas from firms active in other industries.

4.1.5. Capital

While intangible factors of production are undoubtedly the most critical in the production processes of professional services (Lowendhal, 1997; Nachum, 1999), and their utilisation is the major determinant of productivity, capital is becoming an increasingly important factor of production. Capital is needed mainly to purchase office space and

communication facilities (both within the firm and with clients) and to finance transportation. As firms increase their international coverage and information technology is becoming more capital-intensive, these expenses account for an increasing part of the total costs associated with the production of professional services.

The tangible nature of capital makes measurement straightforward. Capital is measured by total amounts used annually and depreciation of past investment.

The inputs discussed above are closely linked, to an extent which may entail 'double counting' into the measurement. Knowledge exists within the employees, current knowledge affects the stock of knowledge, etc.. Moreover, most of the variables of interest tend to move together over time, making it hard to untangle their separate effects.

4.2. Input of the client

The manufacturing idea of boundaries between producers and consumers does not hold for professional services (nor indeed for most other service industries). Unlike in manufacturing, in professional services clients are not simply a source of demand, nor are they only passive recipients of the producer's output. Rather, they are also a source of production input (Hill, 1977; Larsson and Bowen, 1989; Hirsch, 1990). The client provides part of the input into the production by introducing his problems and needs to the producer and by sharing with him his industry-specific knowledge (which is often larger than the knowledge of the service producer)[10]. In addition, the output involves some change in the condition of the client (Hill, 1977), which cannot be achieved without the client's active participation. This characteristic creates interdependency between the supplier and the client, in which the productivity of the producer depends not only on his own performance but also on the client of the service, a factor over which the provider has limited control. Improving the productivity of

the firm thus becomes a matter of improving the productivity of the client (Lovelock and Young, 1979). Therefore the performance of the latter has to be incorporated explicitly in the productivity measure of the former.

The client's input can be captured in terms of the labour resources that the client invested in the relationship. These are measured by wages to account for the heterogeneity of the labour involved (see the discussion above about the selection of wages as an operational measure for labour input of the producer). The problem with this measure is that the tendency is to measure only labour which is assigned directly to a particular project, but much of the labour input might be indirect and thus usually not measured. For example, frequently the highest cost to the client is the time of the top management spent on a specific project but this is rarely measured in the context of specific projects. We will return to the issue of the measurement of the client's input in the following sections.

5. Output

The scope and definition of the output of professional service firms is a major conceptual difficulty. What is the output of accounting or consulting advisory services, software design, advertising? Is it the number of reports produced? level of profits? satisfied customers? The problem of definition arises because in many cases it is not clear what is being transacted and what services correspond to the payments made to their providers.

Gummesson (1978) suggested three different ways to approach the issue of the output of professional service firms, corresponding to various stages in the production processes:

1. proposing solutions to problems. These suggestions are presented in the form of, for example, advertising campaigns of advertising agencies, a consultancy report written by management consultants,

or a market report prepared by market research institutes. Such an approach to the output yields a quantifiable measure, with clearly defined units of production. It also makes a clear separation between production and consumption and assigns a main role to the service producer, while the role of the client is limited to the provision of some input.

2. involvement in the implementation of a solution. The involvement varies among professionals and firms within the professions. Advertising agencies usually implement their campaigns, management consultants may or may not take part in implementation, market research institutes are rarely involved with their customers at this stage. In this conceptualisation of the output the production occurs partly with the consumption and the input of the client is critical. The output is produced over a period of time, which is not always clearly defined.

3. the impact of the professionals' work on the economic situation of their clients. The distinction between output and input becomes more vague (compared to the second view) because the output is produced together with the clients, and the consumption is part of the production. The client is a critical determinant of the output and its role must be incorporated in the measurement. As the work includes future benefits, the output should be measured over a period of time.

We will adopt the third conceptualisation of the output. The value added of the work of professionals lies in the consequences of their work, i.e., the change in the client, and the measurement of the output has to acknowledge this change. The mere performance of some activity by the producer is not enough if the client is not affected in some way (Johnston, 1963; Hill, 1977). Therefore, a measure of the output of professional service firms should consist of both the volume of their own business and the enhancement of the competitive position of their clients.[11]

5.1. Output of the producer

Financial indicators (e.g., turnover) are used as operational measures for output when the nature of the latter rules out the possibility of using physical units, which is the situation in many service industries. For example, the US Bureau of Labour Statistics uses turnover to measure the output of trade-related services (Dean and Kuntze, 1992). Turnover is also used as an operational measure for outputs in this study. The price paid for a piece of work reflects its value for the client.

Turnover as an operational measure for output of professional service firms can be biased on several grounds. First, because of the heterogeneity and the intangibility of the output, prices are often not related to what was actually received by the client (see Sibson, 1971 for a discussion of this issue), and consequently the turnover may not reflect an 'objective' value of the output. Second, prices of some professional services (e.g., architects and engineers, advertising agencies) are based on standardised fees or commission which are not directly related to the actual output produced. For example, the industry norm in the advertising industry is that agencies are paid 15% of the total amount they spend on behalf of their clients (Recently, there has been a move to competitive pricing in some countries but standard fees are still dominant in most countries). Under such circumstances, prices are determined arbitrarily in a manner which does not reflect variations in the value of the output to the clients. Turnover thus can be used as a reasonable operational measure for output only when firms can compete with each other on price. Third, turnover can be affected by various market forces and thus may not reflect the mere usage of resources. For example, a change in turnover can be caused by a shift in demand or the exit/entry of a competitor to the market, without any change in the output. In a study of a single industry in a single country, like the present one, it is possible to partially control for this potential bias, as firms face similar forces in their market. Yet, market forces are likely to affect some firms more than others. Fourth, the price that a professional service firm is able to charge is strongly affected by its

reputation, in a manner which not necessarily and not directly reflects the level of its output.

5.2. Output of the client

For the reasons discussed above, a measure of output should capture the improvement of the situation of the client as a result of the professional's work. The ideal measure is based on a comparison between the situation at the end of the job and that which obtained at an earlier reference period before it started. For example, changes in the client's competitive position which can be attributed to the work of the professional service firm. This improvement can be measured by objective measures (e.g., market share) or subjective ones, for instance, based on the perception of the client.

Severe measurement problems are associated with this operation. Not all the activities of professional service firms can be adequately measured in quantitative terms (Johnston, 1963). Of those which can be measured, there is a major difficulty in determining the consequences of the work of the professionals and isolating its impact from other influences. There is a need to separate the change in the client brought about by the supplier from other changes that might occur when the service is provided (Sherwood, 1994). What part of growth in sales can be attributed to an advertising campaign? to a new strategy proposed by a management consultant? There are so many intervening factors between the output of the professionals and the actual creation of economic value to the client that in many cases no feasible amount of research would disentangle that net effect from all the other forces at work (Johnston, 1963).

Furthermore, the purpose of different management consultancy assignments may vary considerably, and the measurement of their output can often only be assessed in relation to the purpose of each assignment, a task which might be very difficult from a methodological point of view. For example, if market share is used to assess the

improved situation of the client as a result of the professional's work, some assignments, such as downsizing and outsourcing, do not aim at increasing the client's market share but perhaps rather the contrary.

The problems of what is measured are compounded by problems of the time horizon implicit in most measurement systems. Since the output is defined as a process rather than as a static event, a proper measure should reflect the impact on the client over a period of time (Quinn, 1992, Pfeffer, 1997). But what is the 'right' time span? Typically reaching changes require long-term investments, and the costs of these efforts can be seen quickly, but the return is only realised some time in the future. There are no definite answers to these problems and subjective judgements of the clients and the service producers have to be used.

Table 1 summarises the variables identified as inputs and outputs in the production of professional services and possible ways to operationalise them in statistical analyses.

6. Methodology

6.1. The choice of an industry

We analysed a single professional service industry in order to control for industry effects. The management consulting industry was chosen to be the focus of this research because certain characteristics of professional services seem to be more apparent in this industry, making the issue of productivity measurement particularly challenging[12]. First, the output is produced in close relation with the client, making the latter an active participant in the production process and a significant determinant of the output (Aharoni, 1997), more so than in many other professional service industries (e.g., accounting, engineering consulting). Second, unlike several professional service industries in which prices are determined as standardised fees, in management

consulting prices are set competitively, and consequently turnover can be used as a reasonable operational measure for output.

6.2. The Sample

The 60 largest management consulting firms active in Sweden, which together account for about 70-80% of the total turnover of the Swedish industry (according to an estimation of the Swedish management consulting association, Konsultvarlden) were approached for the purpose of collecting data for this research. Some 35 of these provided the data sought (response rate 60%). The final sample is very heterogeneous and includes large and small firms, Swedish as well as foreign-owned, young along with very old firms. Some characteristics of the sample are presented in Appendix A.

In order to examine possible bias in response patterns, we compared some characteristics of the firms which refused to participate with those of the firms which provided the data. This comparison is limited to the information available on the nonrespondents from secondary sources (the publications of Konsultvarlden). The Kruskal-Wallis test yielded no significant differences between the respondents and nonrespondents at the level of 0.05 (see Appendix B).

Data were collected in personal interviews conducted during the autumn of 1996. Respondents were the chief executives, managing directors or senior consultants in the firms. Since the questions covered a wide range of activities, there was usually a need to interview a few people in each firm (we interviewed two to three people in each firm). The firms which provided the data wish to remain anonymous and their names cannot be disclosed.

6.3. The statistical technique

Data Envelopment Analysis (DEA), a non parametric statistical method for assessment of productivity, was used to calculate productivity

scores for the firms which provided data for this research. This method is based upon Farrell's (1957) original article, and later extensions of his work (see Bjurek et al. 1992 for review). DEA evaluates the relative efficiency of a group of firms in their use of input to produce output. It identifies the relatively more efficient ('best practice') firms and the less efficient, and compares the magnitude of the inefficiency of the latter with the 'best practice' firms. Efficiency is defined as minimum input for any particular combination of outputs, and the optimal level is the maximal attainable output for a given combination of inputs. The productivity of the firm is thus measured according to the efficiency with which the firm is using its resources. A firm is productive when it obtains the maximum possible reduction in input quantities while keeping the level of output unchanged. DEA is a relative efficiency measure. The 'best practice' firm is not necessarily efficient in any absolute sense, only relative to the other firms included in the analysis.

DEA is an adequate technique for the measurement of service productivity because, unlike the classical econometric approach that requires a pre-specification of a parametric functional form and implicit or explicit assumptions about the production correspondences, DEA does not require the specification of a functional form to the relationship between output and inputs (i.e., production function). This is a valuable feature for productivity measurement in services, where the production function is typically unknown. Furthermore, DEA is suitable for production processes which involve multi-input and multi-output, a common situation in service industries, which requires techniques which can consider explicitly this mix of inputs and outputs. Indeed, DEA has been used widely as a measurement technique of service productivity (examples include Berne and Mugica, 1994 for Spanish grocery outlets; Sjogren, 1994 for Swedish transport services; Banker et al., 1986 for hospitals in North Carolina; Bjurek and Hjalmarsson, 1990 for Swedish social insurance companies; Schefczyk, 1993 for airlines; and Kestemont, 1996 for Belgium banks).

Some of the variables presented in Table 1 above were excluded from the DEA analysis. The measures of the input and output of the clients were excluded because the firms interviewed could not provide this information. Typically they do not know what resources their clients allocate for the project (the input of the clients), apart from their own payment. Most firms reported following up with their clients regarding the impact of their work on their performance (the output of the clients) but were unable to quantify this impact in any meaningful way. We will return to the limitations introduced due to the inability to acknowledge the input and output of the clients in the discussion which follows.

Resources allocated for new service development were dropped from the analysis due to too many missing observations. Both measures of knowledge accumulation were excluded from the analysis because most firms reported maintaining similar shares of resources in total revenues over the last 5 years and this information is provided by the measure for the acquisition of new knowledge. Of the several operational measures for spillover, more complete data were obtained for attendance of professional conferences and assessment of interaction with competitors and the other measures were dropped.

7. Statistical Analysis and Discussion of the Findings

Table 2 presents the productivity scores of the firms studied according to DEA and to a measure of productivity drawn from manufacturing, namely the ratio between costs and turnover.

DEA scores range from 0 to 1. 1 implies that the firm under consideration is productive, i.e., the output obtained from a given amount of input is maximal. 0 implies that the firm is not productive, which means that more output can be produced with the same amount of input.

DEA is conducted under the assumptions of a constant and variable return to scale. With a variable return to scale, large firms tend to

appear as fully efficient, if only for the lack of truly efficient firms of comparable size (Berg, 1991). The assumption of a constant return allows one to compare large firms with smaller ones and avoid having them appear artificially efficient. Indeed, the scores in the DEA under the assumption of a constant return to scale are considerably lower than in the DEA under the assumption of a variable return to scale (table 2). 25% and 57% of the firms have reached the maximum efficiency levels (DEA=1) under the constant and variable return assumptions respectively.

The cost/turnover ratio can assume any value between 0 and infinity. When the ratio is between 0 and 1, turnovers exceed the costs. The lower the value of the ratio (i.e., closer to 0), the larger is the former compared with the latter. When the ratio is higher than 1, costs exceed turnovers, and the higher the ratio is, the larger is the difference.

The different measures of productivity assess the productivity of firms considerably differently (table 2). For example, firms no. 4 and 21 are very productive according to the cost/turnover ratio (i.e., their turnover exceeds by far their costs) but have low scores in the two DEA analyses. By contrast, firm no. 7 has DEA=1 in both DEA analyses (which implies that it is on the frontier in terms of efficient use of resources) but has a high ratio of costs to turnover. Indeed, the pearson correlation coefficients between the DEA analyses and the cost/turnover ratios are -0.312 and -0.036 in the analyses under the constant and variable return assumptions respectively (significant at the 0.05 level). These correlation coefficients illustrate how differently the productivity of firms is assessed by the various measures. These findings also provide some indications regarding the value of individual variables in this measurement exercise. Thus a few measures (notably labour cost, capital cost, turnover) appear in both the DEA and the cost/turnover ratio. Yet, these latter measures rank the firms considerably differently. This implies that those few variables which are included in the DEA but not in the cost/turnover ratio, i.e., the

measures for knowledge and learning and spillover, do indeed introduce considerable variation among the firms studied.

Table 3 presents the correlation coefficients between the various measures of productivity and several measures of firms' performance. This exercise is conducted in order to assess the new measure and to compare it with the manufacturing-based measure. Productivity is considered by economists as the single most important determinant of performance. Much empirical evidence confirms this link (see for example Kremp and Mairesse, 1993; Magi, 1994 for services). A firm's long term competitive position improves when its productivity increases faster than that of its competitors. Therefore we expect that an adequate measure of productivity should correlate strongly with performance.

The literature suggests many possible measures for performance. When selecting among them we chose to capture many facets of the performance of firms, thus increasing the validity of the exercise. This intention often has the cost of including measures which may suffer certain deficits. For example, profit figures may not always be reliable since firms tend to 'play around' with profits to avoid taxes. It might be argued that size does not necessarily distinguish among firms by their level of performance, as some small firms might be very successful (e.g., in terms of profitability). At the same time, however, size arguably provides some indication of the possession of unique assets, not available to competitors, and of the efficient use of these assets, which allows the firm to outperform its competitors and to grow and reach a large size.

Since turnover is part of all the measures of productivity, it is not used as a proxy for size of economic activity. We use instead number of employees. Performance is measured both in static (size, profits) and dynamic (size change) terms, as well as in absolute (profits) and relative (profits per consultant) terms in order to account for different aspects of a firm's performance.

The accounting procedure used by firms which are owned by their top managers (partnerships) may introduce bias into the analyses. Such firms typically report zero profits since the profits are divided among the partners. Consequently, they do not report the salaries of the partners as part of labour costs. Several of the firms in our sample pursue such an accounting procedure. This can bias both the productivity measure (via the impact on labour costs) and the profit-based measures of performance. In order to avoid such bias, we conduct two separate sets of correlation analyses - one for all the firms included in the sample and a second only for those which include the salaries of the partners as part of labour costs (5 firms fall into this category) (table 3).

The DEA scores under the constant return assumption correlate positively with all the measures of performance. The direction of causality with the DEA under the variable return assumption is mixed, with some coefficients positive and others negative. The correlation coefficients of the cost/turnover ratio with all measures of performance are negative. The strength of the correlation is highest among the DEA under the constant return assumption with all the performance measures except for size change. For this measure there are differences between the complete sample and the partial sample. The DEA under the variable return assumption correlates more strongly when the complete sample is considered while the correlation is higher for the DEA under constant return for the partial sample (the latter includes only firms in which partners' salaries are reported as part of labour costs). The differences between the two DEA analyses are due to the importance of size in the DEA under the variable return assumption (discussed above). When the role of size is relaxed in the DEA under the constant return assumption, DEA predicts the performance of firms considerably better.

These findings indicate that the new measure proposed in this study (notably when analysed under the constant return assuption) is more closely related to various aspects of performance of the firms studied

than is the cost/turnover ratio. To the extent that the link with performance can be taken as an indication of the adequacy of productivity measures, these findings support our basic argument regarding the inadequacy of the traditional measures of productivity for professional services and suggests the need for a measure which acknowledges the unique characteristics of these industries.

Overall, the strength of the correlation between the DEA scores and the performance measures is quite low. The highest coefficient - between DEA under the constant return assumption and size change for the partial sample - is 0.686. Other coefficients are considerably lower. This suggests the need for further improvement of both the variables used as input and output in the DEA analyses and their operational measures. In particular, the exclusion of clients' input and output data from the DEA is a serious drawback. The development of operational measures to gather such data remains a task for future research. Another possible explanation for the weakness of the correlation might lie in the fact that, due to difficulties of collecting historical data, no time lag was introduced between productivity and performance measures. As discussed above, it might be that a period of time is required for productivity gains to translate into higher performance.

8. Summary and Research Contribution

Our ability to understand the productivity of professional service firms is linked to the development of adequate measures of productivity. Such measures are of paramount importance for both firms and policy makers.

Due to the lack of adequate measurement procedures, professional service firms do not measure their productivity as manufacturing firms do, and consequently lack the ability to assess properly their operations and to improve them. Furthermore, to the extent that they measure their productivity, they use measures drawn from manufacturing (notably turnover per consultant, or the ratio between turnover and costs). The

main objective of productivity measurement is productivity improvement, and appropriate measures provide a prognostic tool as to how to achieve this goal. Productivity measurement is a management control device, which enables identification of the characteristics of the services which are particularly critical for productivity gain. The value of productivity measurements is in their impact on the capability to manage and monitor, in order to reach a more efficient use of resources (Ballantine et al., 1998; Fitzerald and Moon, 1996; Modell, 1997).

The present study suggests an improved tool for professional service firms to measure their productivity. The analysis in table 3 highlights the possible danger in relying on a manufacturing oriented measure as a guide for managerial control, as it correlates negatively with all measures of performance. At the same time, however, this study signifies a preliminary attempt to reach a better measure of productivity (see ahead) and its value in providing reference points for performance evaluation may be limited, particularly as a basis for distributing rewards (see Mondell 1997). The main factors limiting the value of the new measure as an operation tool for management control are its aggregated nature and the limitations of various operational measures in reflecting the theoretical concepts they are designed to measure. The improvement of the new measure along these lines is a task left for future research.

Practitioners seem to be aware of their need to gain deeper knowledge of the productivity of the intangible, highly valuable, yet not directly measurable, assets used in their production. Several firms (notably Skandia (Stewart, 1994; Skandia, 1994, 1995, 1998) and Interbrand (The Economist, 1996)) have recently made attempts to incorporate the measurement of intangible assets into their balance sheets, alongside other assets (see Modell, 1996 for a recent example of academic efforts to apply accounting systems to acknowledge the unique characteristics of service industries). The great interest of the firms interviewed for this study in the results of our research demonstrates firms' recognition of their need for adequate measures of their productivity.

Also from the point of view of policy response, there is a need to be able to get a far more exact picture of the productivity changes in professional service industries in order to allow adequate policy actions. Unless we improve the measurement of productivity of these industries, both in terms of the conceptual frameworks and the actual data needed for measurement, we will not be able to guide both firms and policy makers in this respect.

This research represents an attempt to fill in the large gap in this direction. Its major contribution lies in two main areas. First, in a thorough discussion of the factors which affect the productivity of professional service firms and in suggesting possible ways to measure them. Second, in contrasting the new measure proposed with the more traditional one and in comparing them. The use of performance to assess these two measures further adds to the paper's value. It was shown that the new measure predicts firms' performance better than does the traditional measure, a finding which suggests the need to acknowledge the unique characteristics of professional service industries in order to measure their productivity properly.

As the discussion in this paper has repeatedly acknowledged, the measurement problems are very severe, both from the conceptual and technical aspects, because the factors at work are notoriously hard to measure. Furthermore, in many cases, it is not possible to assess the nature and extent of the bias introduced by the measures selected to operationalise the theoretical concepts. These measurement difficulties seriously question the value of the findings. However, we believe that the importance of improving the measures of the 'unmeasureable' factors justifies the attempt despite its serious limitations, and we hope that we have made an important step forward by highlighting the problems and proposing ways to remedy them.

The questions raised in the course of the preceding discussion and analysis provide a basis for pointing to the directions in which improvement of the measurement procedures should be made. In the

search for new, more adequate measures, there might be a need to depart from conventional ways of measurement and to explore new territories, perhaps grounded in other disciplines, which will allow us to capture the intangible, not directly measurable, factors used in the production of a growing number of industries.

One specific area in which future research is particularly needed, and in which the present study has serious limitations, is the measurement of the outputs and inputs of the clients. The experience of this study suggests the need to collect data simultaneously from the service provider and from their clients. Our intention to gather information on the client from the service providers has proven inadequate, as the latter often lack such information. Due to the limitations of objective measures for the improvement of the client's position attributed to the work of the professional (discussed above), it might be more adequate to use subjective measures, based on an assessment by the client of the extent of this improvement. Such an assessment should be made in relation to the project's goals.

The applicability of the findings of this research, with its focus on a single professional service industry, to other service and manufacturing industries, is a question which requires more research. The measurement of the productivity of intangible factors of production - which is the central issue addressed by this research - is a challenge in all the industries in which these factors make a critical contribution to productivity and performance. This is the case in a growing number of manufacturing and service industries alike. The findings of the present study are likely to apply, to certain degrees at least, to many of these industries. At the same time, however, some of the critical factors which affect productivity often vary considerably across industries, even among the more narrow group of professional services, and in such cases there is a need to develop different measures which are relevant to particular industries. The actual validity of the findings ought to be tested by future research, using larger samples of both firms and industries.

Notes

1. Productivity is defined as the level of output produced per unit of input. Changes in productivity reflect changes in the ratio between input and output, e.g., increase/decrease in output produced from a given input, or same output produced with more/less input.

2. There is no universally accepted definition of professional services and various scholars define these industries differently, typically in line with the ultimate goal of the definition (see for example, Silvestro et al. 1992 for a definition originated from the more general service literature, based on the amount and nature of the interaction with the client, customization and reliance on human resources; Haywood-Farmer, 1988, for a classification based on labour intensity, degree of contact and interaction with the client proposed for quality control purposes; Haywood-Farmer and Stuart, 1990 for a definition originated from the sociological literature, based on the nature of the profession; and Lowendhal, 1997 for a definition based on a resource based view of the firm for the purpose of strategic management). These classifications seem to be less adequate for productivity measurement, since they do not emphasis the nature of the production of these services.

3. There are a large number of possible definitions of quality, and we adopt the two definitions referred to by Gummesson (1991). The first is a primarily technology-driven and production oriented definition, which states that in order to achieve quality, a firm must establish requirement specifications, and once these are established, the quality goal of the various functions of the firm is to comply strictly with these specifications. Explicit in this definition is the evaluation of quality relative to an established target. The second definition is fitness for use. This definition is primarily market driven and customer oriented, as it

puts the customer utility and satisfaction in focus. It emphasises the perceived quality in the eyes of the customer.

4. It has been argued that in addition to the input of the producer and the client alone, there is also a joint input for both of them, which results from the interaction between the producer and the client in the course of the production and consumption of the service (Hirsch 1990). We do not include this factor as a separate input variable because we believe that it will entail 'double counting' with the input of the producer and client alone.

5. Differences in the quality of labour introduce variation not only into the input but also into the output. In this regard, there is a difficulty in drawing the line between input and output.

6. An illustration of the link between pay levels and the quality of professionals is suggested by the competition among US management consulting firms for the top business school graduates, where increasingly higher wages are used as the tools to attract the best talents (Management Consultants International, 1995a).

7. Probably the most widely discussed example of such a situation is what became known as the 'productivity paradox', which describes the situation in which the large investment in communication technology has not yet led to productivity gains (see e.g., The Economist 1997).

8. Not all cumulative variables necessarily reflect learning. For example, cumulative output measures increase in output which is not necessarily associated with learning. By contrast, variables which reflect changes in the environment in which production takes place, so that learning is taking place with continually new stimuli, make plausible the possibility of continuous learning.

9. Only certain kinds of knowledge spill over. At one extreme is public knowledge which, in principle at least, is equally available to all firms and can be purchased in the market (e.g., from academic institutions). There are no spillovers of this kind of knowledge. At the other extreme are some kinds of firm-specific knowledge, such as accumulated experience, codified and particularly uncodified norms and routines which accrue from collective learning processes and past investment. This knowledge is the firm's main source of differentiation. The proprietary nature of this knowledge reduces its value for other firms and makes it hard, if at all possible, to spill over. In between these two extremes are various kinds of firm-specific knowledge which are of value to other firms and spill over via interactions among them. Particularly important in this context is the distinction between knowledge which 'belongs' to individuals and knowledge which 'belongs' to the firm. The former is more vulnerable to spillover, primarily through the movement of professionals among firms.

10. In this context, a distinction might be made between various types of participation of the client, depending on the extent to which he is able to identify the nature of his problem. For example, when a client wants to build a house he knows what the problem is, but does not know how to solve it. By contrast, when a client goes to a doctor he often knows neither what is the problem nor how to solve it. He can only report on the symptoms of his problem. In the context of professional services, in some cases the clients are only able to report on the symptoms of their problems (e.g., declining market share, loss of a client) but they don't know what is the problem, i.e., what has led to these outcomes. In other cases, they might be more aware of the nature of their problems (for example, if they report on a need for organisational change in their organisation to better fit specific circumstances).

11. Professionals increasingly value their work in this way, i.e., according to its impact on their clients rather than according to the solution they suggest. This change is apparent in the management consulting industry. While in the past, the main requirements of the job were the production of bright ideas in cogent reports, today there is an increased emphasis on results. This change is also reflected in the increased use of fees which are linked to results, rather than flat fees (The Economist 1997a).

12. This judgement is based on the author's familiarity with various professional service industries. As there are no studies which compare these industries in terms of the characteristics relevant in this context, this judgement cannot be supported by empirical evidence. The few studies which address issues such as the involvement of the client in the production of services (Larsson and Bowen, 1989; Silvestro et al, 1992) make no distinction between various types of professional services but rather contrast them with other service industries.

TABLES

Table 1. Input and output variables in the production of professional services

Variables	Possible operational measures	Unit of measurement
Input variables		
Input of the service producer		
Labour	labour costs (*)	annual costs
Acquisition of new knowledge	1. resources allocated for new service development 2. resources allocated for training (*)	annual shares in total revenues measured with time lag (1 year)
Stock of knowledge	1. accumulated resources allocated for new service development 2. accumulated resources allocated for training	accumulated shares in total accumulated revenues over the last 5 years
Spillover	1. membership in professional associations 2. participation in professional conferences (domestic and international) (*) 3. interaction with competitors (*) 4. movement of employees	1. number of membership 2. number of conferences attended annually 3. firms' own assessment on a scale from 1 to 5 4. no. of employees joining/leaving the firm
Capital	annual expenditure + depreciation (*)	annual amounts + depreciation
Input of the client		
Labour	labour costs associated with a project	annual costs (5 largest clients)
Output variables		
Output of the service producer		
Turnover	total turnover (*)	annual
Output of the client		
Improved competitive position	changes in market share	changes in the 2 years after the completion of a project (5 largest clients)

(*) Variables included in the DEA analysis (see ahead).

Table 2. Productivity of management consulting firms, various measures, 1995

Firms	DEA scores (constant return to scale)	DEA scores (variable return to scale)	Cost/turnover
1	1	1	0.247
2	1	1	0.833
3	1	1	0.285
4	0.625	0.783	0.344
5	0.880	0.886	0.889
6	0.834	1	0.807
7	1	1	1.018
8	0.314	0.333	1.092
9	1	1	0.264
10	0.500	0.500	1.108
11	0.567	0.677	1.221
12	0.251	0.261	0.989
13	0.915	0.915	0.817
14	0.722	0.722	0.945
15	0.313	0.340	0.860
16	0.541	1	1.106
17	0.282	0.283	1.036
18	0.337	0.662	0.794
19	1	1	0.751
20	0.391	1	0.714
21	0.361	0.368	0.631
22	1	1	0.982
23	0.942	1	0.970
24	0.251	1	1.700
25	0.193	0.198	0.840
26	0.415	1	0.973
27	0.332	1	0.882
28	0.219	1	1.525
29	0.240	1	0.909
30	0.223	0.236	1.545
31	1	1	0.958
32	1	1	0.905
33	0.285	0.369	0.750
34	0.207	1	1.111
35	0.425	1	0.833

Table 3. Correlation between productivity and performance
(Pearson coefficients)(*)
(in parentheses coefficients of firms in which partners` salaries are reported as part of labour costs)

	Performance measures			
Productivity measures	Size (**) 1995	Size change (1993-5)	Profits 1995 (mil. SKR (***))	Profits per consultant 1995 (SKR)
DEA (variable return)	0.117 (-0.050)	0.349 (0.399)	-0.011 (-0.006)	-0.043 (-0.024)
DEA (constant return)	0.465 (0.368)	0.273 (0.686)	0.288 (0.268)	0.125 (0.138)
Costs/Turnover	-0.497 (-0.309)	-0.356 (-0.202)	-0.364 (-0.312)	-0.317 (-0.318)

(*) significant at 0.05 or less.
(**) measured by no. of employees
(***) SKR = Swedish Krona

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APPENDICES

Appendix A: Characteristics of the sample (N=35)

(1995 data, financial data in Swedish Krona)

	Revenues ('000)	Revenues/ consultant	no. of employ.	Pre-tax Profits (mil.)	Marginal profit. (profit/ revenues)	Age (years from estab.)
Average	36.1	1,530.9	27.7	4.2	8.9	16.1
Standard deviation	32.7	569.3	22.6	5.8	6.7	12.1

Ownership:
6 firms - affiliates of foreign firms based in Sweden (50% or more foreign ownership);
29 firms - Swedish owned

Appendix B. Test of nonresponse bias

(Nonparametric test Kruskal-Wallis)

	Respondents	Non-respondents
Revenues ('000)	36.1	36.4
Revenues/consultant	1,530.9	1,667.7
no. of employees	27.7	22.1
N	35	25

We select a non-parametric rather than a parametric test because we suspect that the two requirements of the latter (1. each of the groups is an independent random sample from a normal population, and 2. in the population the variances within the groups are the same) may not hold. The Kruskal-Wallis one-way analysis of variance tests the null hypothesis that the two samples compared come from the same population or from identical populations with the same medians. The null hypothesis was accepted at the level of 0.05 significance.