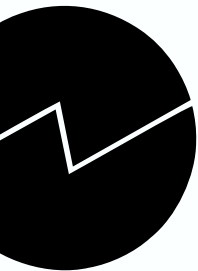


Statistics Norway
Department of Economic Statistics

Richard Ragnarsøn

**The Role of Subcontracting in
the Production System**



Preface

First of all, this document is partly a result of the work with the harmonisation and the implementation of the new European structural business statistics¹ and production statistics². The Commission has pinpointed the need for statistics on subcontracting³, which is considered to play a vital role in the new globalised economy. Subcontractors are often small and medium sized enterprises (SMEs) which participate in regional or international production systems, and hence availability of subcontracting data could benefit the Community policies concerning the SMEs, employment and competitiveness, internationalisation, regionalisation etc. The need for statistics has resulted in the inclusion of subcontracting in the Regulation on structural business statistics (see footnote 1) and several pilot studies in different EU-countries.

Secondly, the document does not offer an extensive theoretical discussion or empirical analysis of subcontracting, but rather serves as an introduction to the concept of subcontracting and provides some background material for understanding the role of subcontracting in the production process. The complexity of the concept is widely recognised and Eurostat has experienced that the understanding of subcontracting varies not only between countries and languages but between sectors⁴ as well.

Finally, I was inspired by the course "Innovation, Entrepreneurship and SMEs"⁵ which made me collect some of my writings and previous work on subcontracting into this paper. The course also served as a guideline into some of the literature on this and related topics.

¹ See Council Regulation No 58/97 of December 1996 for a description concerning structural business statistics.

² See Council Regulation No 3924/91 of December 1991 for a description of the Community survey of industrial production.

³ DOC Eurostat/D1/ISS-SPC/NOV97/8- Subcontracting

⁴ See Draft report of the Commission to the European Parliament and the Council concerning the implementation of Council Regulation No 58/97 of 20 December 1996 concerning structural business statistics.

⁵ Course in Comparative Social Science Studies held at the University of Oslo August 1999.

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1 Introduction

The focus in the paper is on the role of subcontracting in the new production system, from mass production to flexible specialisation. Consequences of the new organisation of production have been a split up of the value chain, increased importance of network and cooperation, interactive learning and interactive innovation, and in this context subcontractors are assumed to play a vital role. Reduced firm size and increased importance of SMEs (small and medium sized enterprises) have been observed, and among other explanation factors for this development, extended use of subcontractors is one. It will be argued that subcontracting, outsourcing and externalisation of work have influenced not only firm size but also the proportions between industries, where the manufacturing industry has experienced decline while the service industries have experienced growth.

The EU-Commission has emphasised⁶ that the development of subcontracting can help to explain:

- the decreasing average size of enterprises (repositioning of activity in the most competitive segment)
- the development of the service sector (emergence of new enterprises specialising in the design and dissemination of products and delegating production to subcontractors)
- the intensity of transactions between enterprises, on a national and international scale (multiplication of transactions involving intermediate goods)

The new role of subcontractors is underlined in articles by Asheim (Asheim 1998) and Asheim and Cooke (Asheim and Cooke 1999) where this quotation by Tödting⁷ appears "subcontracting relationships [...] have changed substantially: they are no longer confined to the goal of cost savings only, but increasingly include aspects of product quality and technology development and improvement. This implies more selective and fewer but stronger relationships between firms since they cover not just production but also quality control, joint research and development as well as information exchange on and coordination of future planning".

Subcontracting also plays a vital role in transnational value chains and networks, and small open economies might increasingly become dominated by firms supplying the large foreign global operating enterprises through subcontracting arrangements (Statistics Denmark 1996). The importance of subcontractors has increased due to their contribution in development of parts and products and sub-systems and many of them have entered international supply chains which play an important role in the global economy (Andersen and Christensen 1997).

First of all, in this paper, the transition from mass production to flexible specialisation and the role of subcontractors are studied. Furthermore, in order to understand the concept of subcontracting a definition is established and a classification of different types of subcontractors are presented as well as a concrete example of the role of subcontractors in a value chain. Finally, we investigate the role of subcontracting in Norway, with an emphasis on contract work in the manufacturing industry, and we also study the effects of subcontracting on firm size and industries.

2 From mass production to flexible specialisation

The importance and the interest of the role of subcontracting in the economy originate from essential structural changes in the organisation of production. The traditional industrial society based on Fordist

⁶ DOC Eurostat/D1/ISS-SPC/NOV97/8- Subcontracting

⁷ F. Tödting (1995): Firm Strategies and Restructuring in a Globalised Economy.

mass production is being replaced by the information society where the production model is characterised by flexibility. The transformation has been so profound that it could be characterised as a techno-economic (Reinert 1996) shift of paradigm, and it has and will continue to influence the value-chains in many different sectors, which in turn creates new products and changed production processes. "Fordism", as the previous techno-economic period was called, emerged around 1920-30 and was named after Henry Ford's famous car factory and its well-known assembly line production. Important industries in the epoch were car production and products based on synthetic materials. Oil was the "new and cheap" resource that contributed to make this production paradigm possible, and the first major setback came as a result of the oil crisis in 1973 and through the success of Japanese car producers on the world market in the seventies. As opposed to the previous periods, the infrastructure in the mass production era was characterised by development of the network of roads and the fact that air transport became an ordinary means of transport.

By the introduction of the information society in the -70s and -80s, the centre of gravity changes from traditional manufacturing industry to various forms of service activities. The globalisation of the economy lowered the importance of the national state for, amongst others, the benefit of the regions. Important industries were and are computer activities and biotechnological related ones, and the "new and cheap" resource was microelectronics. The development of digital telecommunication has been a central infrastructural prerequisite for this epoch. For the producers, this development has led to specialisation within the core activities and a further split-up of the value chain, and also further development of the relation between producers and subcontractors.

2.1 The system of mass production

Under the system of mass production the giant corporation, which integrated in one physical structure a whole range of activities, was considered the most effective production unit. Furthermore, the large-scale production lines implied standardised products and routinised production processes, which were decomposed into simple operations performed by product-specific machines and supplemented by semi-skilled workers. Investments in human capital were considered to be unnecessary, and labour was regarded as a commodity to be hired and fired as demand fell and rose. In addition the relationship between the principal enterprise and subcontractors were as much the same as the one between employer and employee, and reducing suppliers' and subcontractors' profits and workers' wages were equivalent ways to increase the profit of the enterprise. It was not expected that neither workers nor suppliers should show any initiative to improve products or processes. The role of SMEs and subcontractors was of a lesser significance in the period of mass production, since the giant corporation included more links in production chain in such a way that potential subcontractors and suppliers were part of the corporation and not independent smaller companies. Finally, a precondition for the system of mass production was that huge investments in production plants and product-specific machines could be amortised over huge production runs.

In the early 1970s, many advanced economies faced the first serious economic backlashes since World War II, and the response under the regime of mass-production was increased production. Firms tried to cut costs by exploiting economies of scale in even larger production series. Products were additionally standardised and introduced on the world market and both Ford's and GM's introduction of "world cars"⁸ were examples of such a strategy that should meet the decline in profits. Production was reorganised to allow decentralisation of labour-intensive processes to low-wage areas. However, the strategies were not successful, the markets were fragmented and there were no longer room for huge production series and especially the Japanese gained market shares.

⁸ GM's "J-car" and Ford's "Escort-Lynx" (Tolliday and Zeitlin 1986).

Particularly the American and parts of the European car industry were badly hit by the economic setback and the new competition. Their organisation and their strategy based on cosmetically differentiated mass production were no longer competitive. Huge and standardised production lines in combination with a rigid system of production led to large stocks of goods and increased costs. Quantity was prior to quality, and the contrast to consumers' demand for differentiated products and freedom of choice versus the standardising and the homogeneity of the mass production system was striking.

On the contrary, the Japanese car producers had introduced the model of flexible specialisation and formerly, both Japanese and European producers had to focus more on product differentiation. Home markets in these countries were relatively small and segmented, as well as it is obvious that e.g. Scandinavians have other demands concerning cars than Italians. The standardised products of the mass production system did not satisfy the demands of the consumers, who as a result of increased income, were willing to pay a "premium" for variation and different variants. Producing more expensive products adapted to the needs of the consumers was a better strategy than producing "cheap" products designed for the average consumer.

2.2 Flexible production

In order to meet the demand from challenging customers and the increased competition the companies had to increase the rate of development and innovation. Moreover, the companies were forced to accelerate the rate of adaptation and change in production to facilitate increased demand when a specific product or variant of a product became a "winner". In other words, the companies had to become flexible.

The model of flexible specialisation implies that all decisions except strategic ones should be made on a decentralised level, i.e. at the operating units. Bureaucracies and hierarchies are cut down, and the workers and subcontractors are no longer treated as programmable automata but as junior partners with influence on the development of products and potential improvements in the production process. As a result of this reorganisation the headquarters shrank, and other functions as R&D, accounting and financial services either ceased to grow or were dismantled or outsourced. The parent company was often transformed to a holding company, while the subsidiaries were treated as quasi-independent companies.

Changing demand in the markets required a continuous reorganisation of the production and development of new products. Design engineering and production engineering became an integrated part of the production process, which in turn accelerated the product development.

This system of production demanded flexible production factors, and flexible capital goods replaced product-specific machines. Workers were encouraged to increase their competence and to learn many different tasks concerning the production process, to be able to move from job to job as reorganisations and new production methods required. In Japan workers could not be laid off, and the human-resource base had therefore to be made into a strategic asset which required further development through education and training. Continuously incremental innovations were important tasks for every employee in the flexible model, and viewing the work force as a strategic asset with a major role in the innovation system led to a system with focus on development on human capital through responsibility and life-long learning.

3 The role of subcontractors under the new production regime

According to Sabel (Sabel 1989), the transformation of the operating units extends to their relations with *subcontractors*. Subcontractors play a more independent role being partly responsible for design, development, purchases and production of parts and components, while the customer or main-producer (i.e. the large corporations) concentrates their expertise in coordinating design and assembly of the *final* product. On the one hand subcontractors become more integrated with the large-firm customers through more extensive use of long-term contracts, sharing the burden of designing parts and components and guaranteeing defect-free products "just-in-time". On the other hand the subcontractors become less integrated as they act as more independent firms seeking outside customers. However, information between customers and subcontractors is shared more freely due to the increased importance and independent role of subcontractors in this system.

Langlois and Robertson (Langlois and Robertson, 1995) illustrate the relationship to subcontractors by comparing production of a car seat in the USA and Japan. In the USA the seat could be put together by parts and components produced by several subcontractors, while following the Japanese network model the responsibility for design, quality, adjustments and production of the whole seat would be handed over to a "first-hand" subcontractor. The result is a network based on mutual confidence and trust, which subsequently lowers transaction costs.

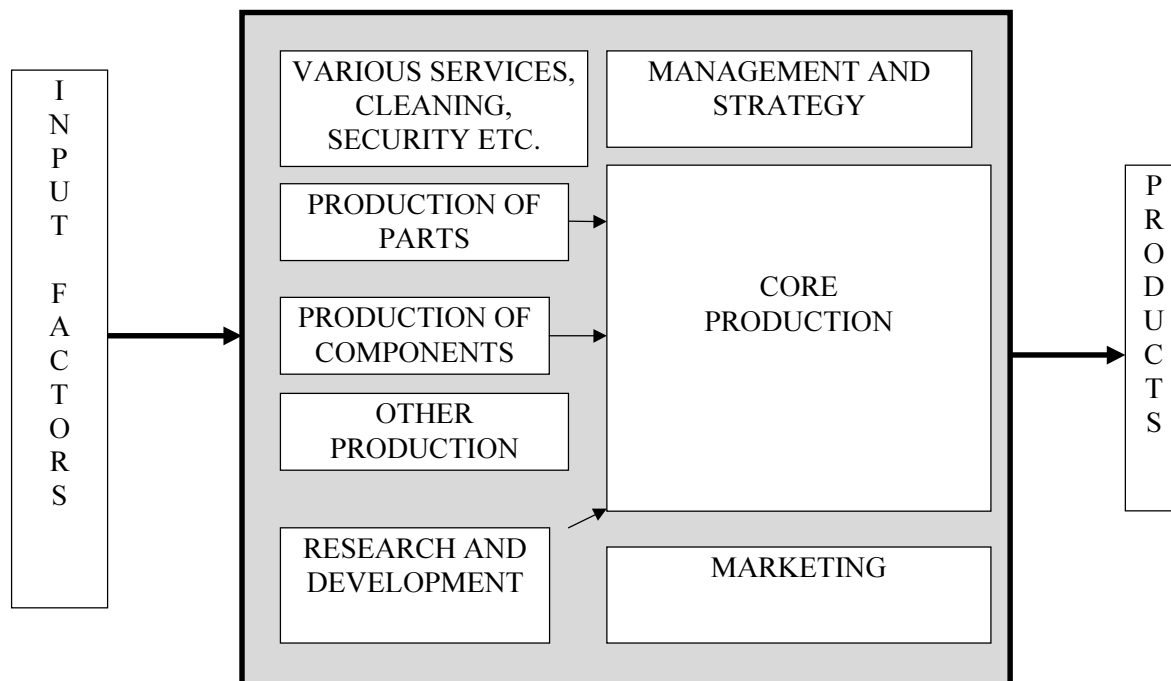
According to de Vet (de Vet, 1993) the system of flexible specialisation or "Toyotism" has its origin in Japan, and it is characterised by a considerable number of SMEs acting as highly specialised subcontractors surrounding the large corporations. A concrete example of a network of flexible producers is Benetton, where Benetton itself is responsible for design, but small subcontractors conduct more than 80 per cent of the production. Almost all of these subcontractors acted as independent firms before they became a part of Benetton's network. Generally, many SMEs have changed from being independent producers to become subcontractors for large corporations, which are parts of global networks of production.

The production networks which are created in the milieu of flexible specialisation and extensive use of subcontractors can be viewed as a learning system (Sabel, 1989). R&D costs are spread down in the production chain through the division of responsibility and production. Even the large enterprises do not have complete knowledge and information about all stages of the production process or about possible technologies, and they are not able to track all changes in the market. As a consequence the large enterprises have to learn from their subordinates, i.e. the subcontractors or workers. This learning system disperses the costs on several links of the production chain and diversifies the risks of the participants, and it creates a system that minimises transaction costs by fostering high-trust relations, such as costs concerning contracts or bureaucratic rules.

4 The effects of a new production model on organisation of firms and the value chain

A further separation of the value chain was an effect of the transition from the system of mass production to the flexible specialisation model. Previously, the production in a firm comprised a whole range of activities in addition to the core activity. These activities, such as production of parts, components and sub-system and services such as accounting, marketing, computer-support, security and R&D, were all a part of the firm-internal production. According to this model a substantial share of the value-added as a result of the production process was concentrated within the firm.

The production process



The separation of the value chain into more links lead to further specialisation and division of labour compared with the system of mass production. Several of the activities illustrated in the above figure are separated from the enterprise, which focuses on the core activity. Some activities could be separated in independent units within the organisation of the multi-enterprise (such as R&D-activities), other services are outsourced (such as cleaning, accounting and security), while deliveries of components and parts are being made by subcontractors. Effects of this transition are that more links are added to the value chain as well as the number of firm-external transactions increases which result in a growth in trade. The "original" enterprise which concentrates on "core-products" in a value chain experiences a substantially growth of inputs of goods and services, while the value-added will decrease relative to turnover or production value as a result of lesser "in-house" production (see appendix A for a formal presentation).

5 What is subcontracting?

It is difficult to provide a clear and distinct definition of subcontracting or activities concerning subcontracting, and the subcontracting scene has changed enormously in recent years through new methods of organising production. In many countries it has been common to divide industrial services into two main categories; contract processing and repair and maintenance. Repair and maintenance are not considered to be a part of a subcontracting agreement, and the concept covers repair work on capital goods. The concept of contract processing concerns transformation of raw materials furnished by the customers and this concept has been used for measuring subcontracting in a narrow sense. However, one needs to have the scope extended to take account of the cases of subcontracting in which the subcontractor himself buys in the materials required to manufacture the product for which he received specifications, i.e. to include the "new" independent subcontractors (which fit in the "Other" box in the figure below).

Subcontracting

Components of subcontracting		
Components of industrial services		
Repairs/ maintenance	Contract processing	Other components, where the customer do not provide raw materials

Source: Eurostat

Certainly, there must be some kind of relationship concerning production activities between the main producer or customer and the subcontractor. Since the subcontracting relationship involves at least two participants it must be described, in economic terms, by two variables, one for the income and another for the costs. According to the definition of Eurostat *Income from subcontracting* comprises payments received by the unit from third parties in return for industrial goods and services supplied as part of a subcontracting relationship defined as follows:

Two enterprises are linked by a *subcontracting relationship* whenever conditions A and B are met together:

- A) The customer enterprise, also said *main-contractor*, participates in the conception of the product providing, even partially, technical specifications to the *supplier enterprise*, also said *subcontractor*, and/or provides it with the materials to be processed
- B) The customer enterprise sells the subcontracted product, either as such or as part of a more complex product, and takes on the after-sales liability for the product.

The *Costs of subcontracting* is defined in accordance with the income definition. Every form of contract work is included in the definition of subcontracting, but it is pointed out that the mere stipulation of a colour, size or catalogue number does not constitute a technical specification in itself.

6 Subcontracting relationships

A useful method to help us understand the concept of subcontracting is to identify and classify different types of subcontracting relationships. The following is based on a study conducted by Statistics Denmark (Statistics Denmark, 1996) on subcontracting.

Subcontracting relationships are categorised into three different stereotypes:

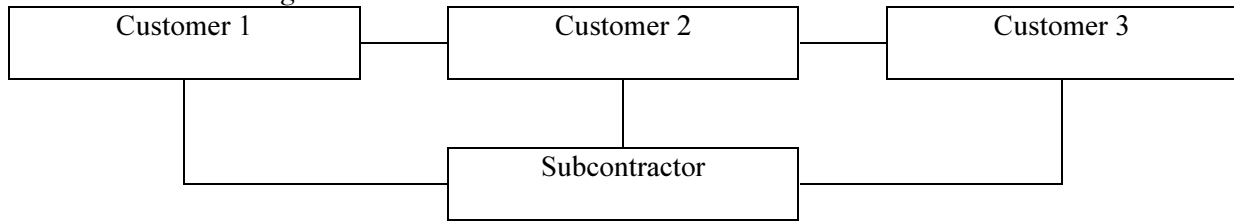
- Capacity subcontractors
- Competence subcontractors
- Outsourcing subcontractors

These three types of subcontractors are not mutually strictly exclusive, and subcontracting relationships comprise several different functions.

6.1 Capacity subcontractors

To meet fluctuations in demand, which create excess capacity, unfilled orders and long delivery times, a network of subcontractors can act as a buffer and smoothen out the cycles. Especially in the metal working industry and the manufacture of clothing are types of vertical relationships common to flatten the fluctuations in demand.

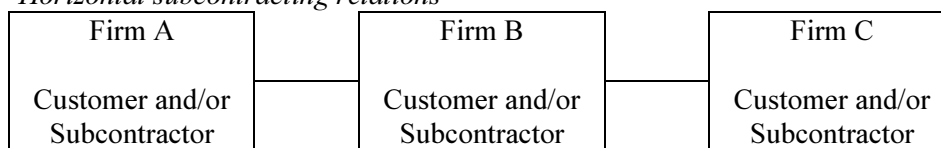
Vertical subcontracting relations



Source: Statistics Denmark

However, horizontally capacity subcontractors occur as well as vertical ones. In industries where orders fluctuate and exceed the capacity of the receiving firm, some of the production can be transferred to local rivals, which then act as horizontal subcontractors. These kind of relations were found in the furniture industry, but the most successful part-time subcontractors tend to specialise and develop a permanent *vertical* subcontracting relationship with their former rivals.

Horizontal subcontracting relations



Source: Statistics Denmark

A third type of capacity subcontractors is found between the two types described above. These are firms that now and then do jobs on a subcontracting basis for their customers, in addition to the non-subcontracting production. This situation is observed especially in the shipbuilding and the construction industries, where the competitiveness of even large firms are dependent on potential subcontractors to be able to fulfil big orders.

6.2 Competence subcontractors

Sometimes a firm needs access to processes, machinery, skills, know-how etc., which are not easily available within the firm or available on the open market. In such cases the firm may engage in a competence subcontracting relationship with some specialist in order to produce the needed output. The relationship is characterised by trust between the customer and subcontractor, as it often involves details about production processes, and the results of the close ties are lower transaction costs and elements of interactive learning.

6.3 Outsourcing subcontractors

The technological development within telecommunication, information technology and transport together with the increased competition following liberalisation of trade, standardisation and global banking systems, have resulted in specialisation and concentration in core activities, in which the firms believe they have a future comparative advantage. Each value chain will gradually consist of more and more participating firms producing to smaller and smaller segments of expanding markets.

When a firm chooses to focus on the core activity, it outsources the other activities that previously were conducted in-house. In order to minimise the risks the firm may try to build long-term trust relations with the future supplier or customer either financially, legally or proprietary. However, it is difficult to distinguish between an outsourced activity that leads to a new subcontracting relationship or just a regular supplier relationship.

7 An example of subcontracting

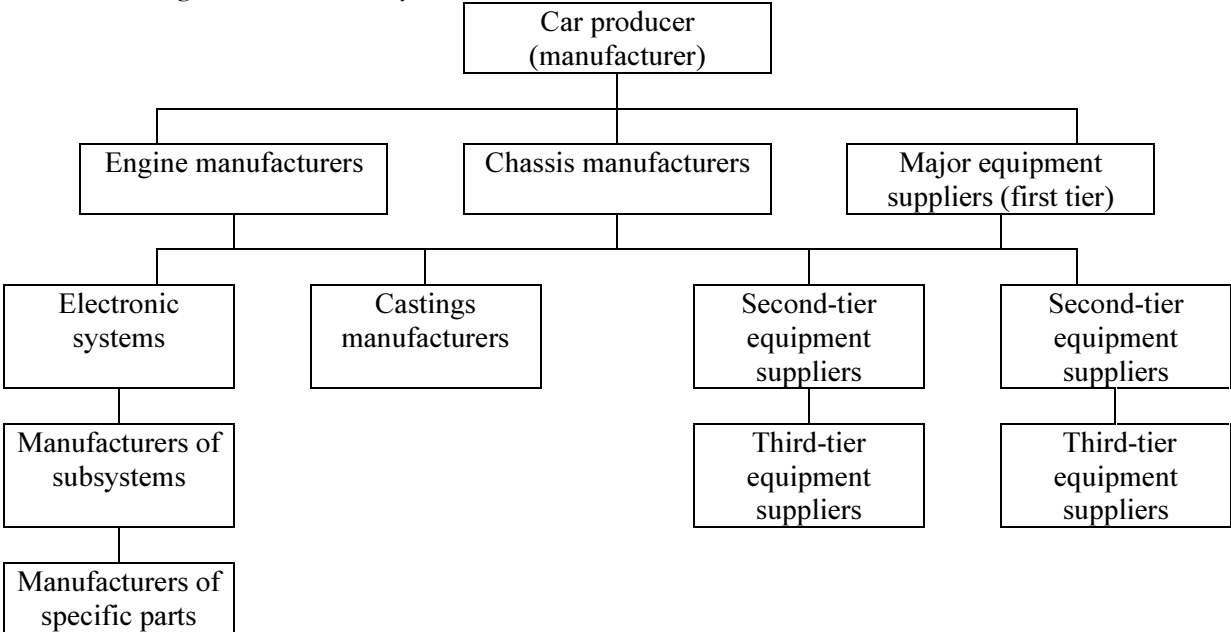
Surveys concerning subcontracting were implemented in the early nineties in several European countries (Eurostat 1997), and the surveys concentrated on sectors where one assumed that subcontracting was widespread, such as automobile, electronics, textiles, clothing and aeronautics. I will focus on the car industry because the methods of production in large car corporations have given name to and are identified with the epochs and systems of production described earlier.

7.1 Subcontracting in the car industry

Cars are complex and composite products which consist of a whole range of part and components. The main producer often designs, constructs and assembles the vehicle, in addition to producing those parts it can not or will not let suppliers or subcontractors produce. The manufacturing of specific equipment, accessories and parts almost solely for use in vehicles are done by equipment suppliers or subcontractors, whose activities range from manufacturing of simple components to designing and producing complex systems as gearboxes and ABS systems. The jungle of suppliers included other industries such as those producing tyres, windscreens, seats and electronic components.

As a result of the growing competition from Japan and other car producers in recent years, the European producers tried to increase productivity by restructurations and rationalisations of the production process. The consequence was a split up of the once so vertically integrated production chain in the car industry. The car producers are dealing directly with a series of "first-tier" suppliers, which in turn deal with "second-tier" suppliers and so on. This pyramidal nature of subcontracting in the automobile industry is illustrated in the figure below.

Subcontracting in the car industry



Source: Eurostat

The vehicle manufacturers included familiar names such as Renault, Volkswagen, Ford, Honda and Mercedes-Benz and also well-known equipment suppliers such as Bayer, Continental, Thyssen, Bosch etc.

70 -80 per cent of the purchases of the car producers were from subcontractors, inclusive intra-group purchases. On average the pyramidal structure of subcontractors connected to each European car producers consisted of about 1000, while in Japan the average number was around 200 subcontractors.

7.2 Relationship between subcontractor and customer

The relationships between car producers and subcontractor were highly formalised, more than 80 per cent of the main contractors had formal contract with their subcontractors, and this was a high share compared with the textile industry where only 10-20 percent had formal contracts with their customers. Another indication of trust and true partnership between the customer and subcontractor was that more than 80 per cent of the "first tier" suppliers were involved in designing products. The share of subcontractors involved in the design was smaller further down the pyramid. Cooperation in R&D were relatively widespread, and 50 per cent of the vehicle producers had R&D agreements with their subcontractors.

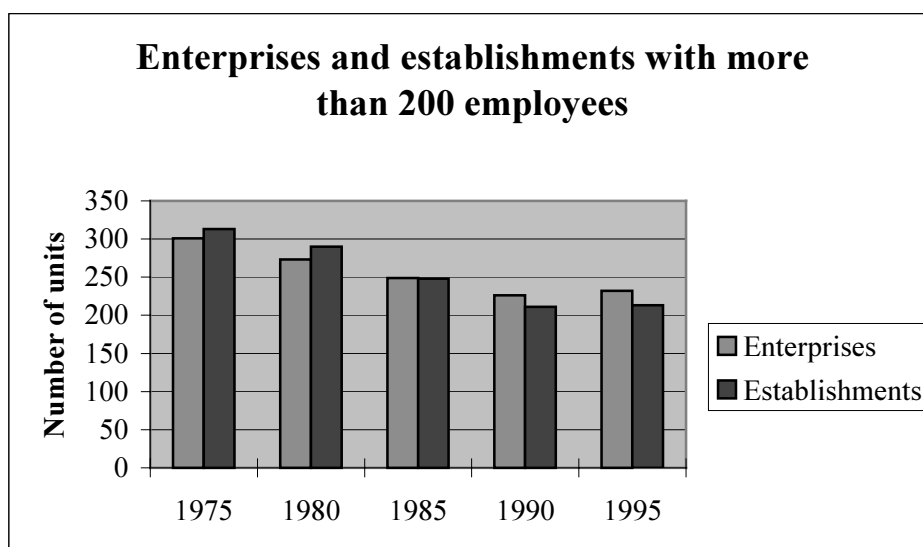
7.3 Why subcontracting?

The strong competition between vehicle producers and between suppliers was the main reason for subcontracting, and the strategy was to concentrate on their main activity by specialising and subcontracting. Reducing production costs by choosing the most competitive subcontractor was another incentive for subcontracting, as well as the need for optimum stock management and minimising the firm's investments in different technologies.

The picture of the production system in the car industry drawn from the results of surveys on subcontracting confirms many of the theoretical assumptions and models presented in the previous chapters, and in fact one observes an extensive use of subcontracting and also close cooperation between customer and subcontractor. The pyramidal structure in the industry was very appropriate for division of labour and specialisation that resulted in better allocation of investments and hence cooperation in design and R&D. Several links of subcontracting relationships were established downwards the pyramid.

8 Subcontracting in Norway

It has not been conducted an extensive survey on subcontracting in Norway, but through statistics on Norwegian manufacturing (both structural and production) and the concepts of contract work, we will study parts of the subcontracting activity, and try to find out if some of the trends observed in other European countries were present in Norway. It is the opinion of the EU-Commission that subcontracting is one of the factors explaining the decrease in the average size of manufacturing enterprises, and subcontracting is also regarded to be an important factor explaining the relative decline of this sector.



8.1 Decreasing firm size

In Norway, the number of large enterprises⁹ and the number large establishments¹⁰ have been reduced since the -70s. The relative importance of large establishments for manufacturing employment has also been reduced, and the share of employees in establishments with more than 100 employees fell from 50 per cent in 1980 to 45 per cent of the total manufacturing employment in 1992. The immediate reason for this decrease was both shutdowns and reductions in employment in existing establishments (Manufacturing Statistics 1992).

Employment per establishment in manufacturing shrank between 1980 and 1989 (Kvinge 1994), and this was the case for both large establishments (with at least 50 employees) as well as smaller ones (with 5-49 employees). Several factors influence the average size of establishments, such as shutdowns, mergers, reorganisations, demand etc. An important factor, according to Kvinge, for explaining the reduced average employment per establishment, was the split up of the value chain in such a way that the production involves more and smaller establishments than previously. The motivation for splitting up, was to increase flexibility to better meet changes in demand and exploit the advantages of this way of organising production as described earlier in this paper.

The decreasing average size of manufacturing establishments is also documented by Hammervoll and Heum (Hammervoll and Heum 1992), and calculations based on the manufacturing statistics show that the average size per establishment was reduced from 27.7 employees in 1975 to 24.3 employees in 1989. One assumes that this development is the result of, among other factors, greater focus on the core activity within the establishments. Changes in the production technology made it more profitably to tailor-make products according to the customers' preferences, and this led to the introduction of a more flexible production model. The share of value added of the total production value decreased in most of the branches from 1975 to 1989, and for total manufacturing the share fell from 31.8 per cent of the production value to 28.0 per cent in the same period. According to Hammervoll and Heum this confirms that manufacturing firms cultivate their core competence. Lower value added, as a share of the production value can be a result of establishments purchasing goods and services they formerly

⁹ An enterprise is defined as an organisational unit comprising all economic activities engaged in by one and the same owner. Hence an enterprise is a legal entity covering one or more productive units, i.e. establishments.

¹⁰ An establishment is defined as a functional unit which at a single physical location is engaged mainly in activities within a specific activity group, i.e. a local kind-of-activity unit.

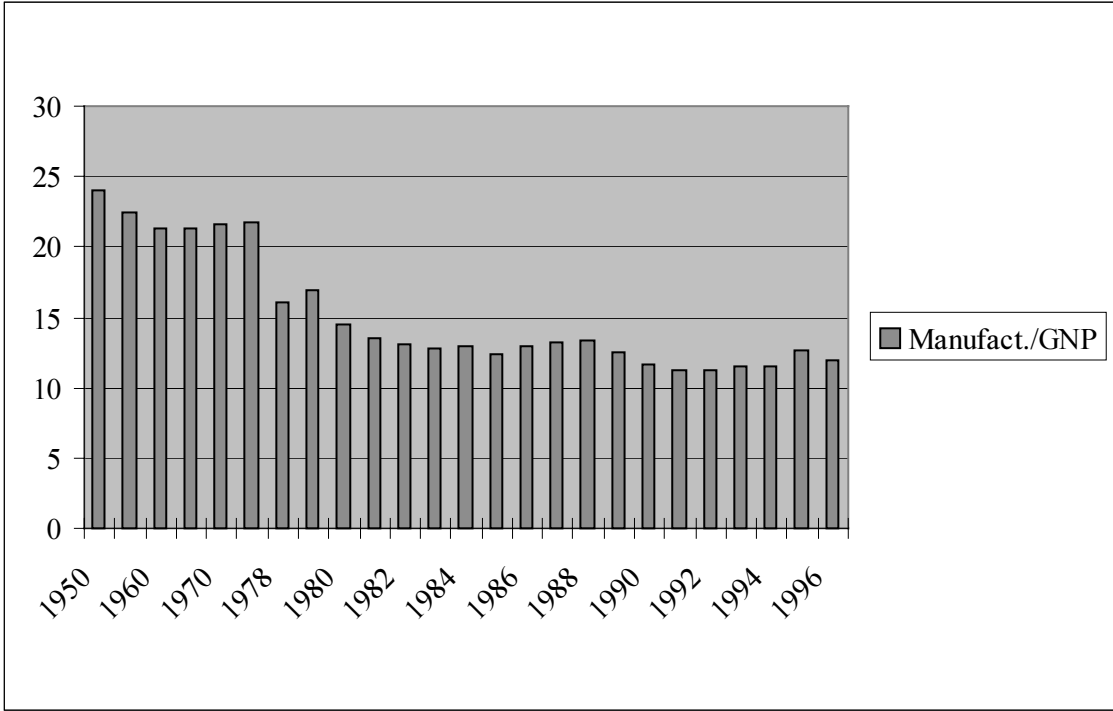
produced in-house. The value chain has been divided and the production value and value of input factors in the different links (i.e. production units) have swelled out relative to value added as a result of increased specialisation.

A comparison of the development of employment in the 30 largest manufacturing groups, showed that the employment had been reduced slightly from 1975-1990 (Hammervoll and Heum 1993). However, the ten largest of these manufacturing groups increased the employment in the same period, and their share of total manufacturing employment was 24 per cent in 1990 compared with 17 per cent of the manufacturing employment in 1975. A conclusion is that more and more of the value added in Norwegian manufacturing takes place in production units that, although they are smaller, are divisions or parts of larger groups of enterprises.

8.2 The decline of the manufacturing sector

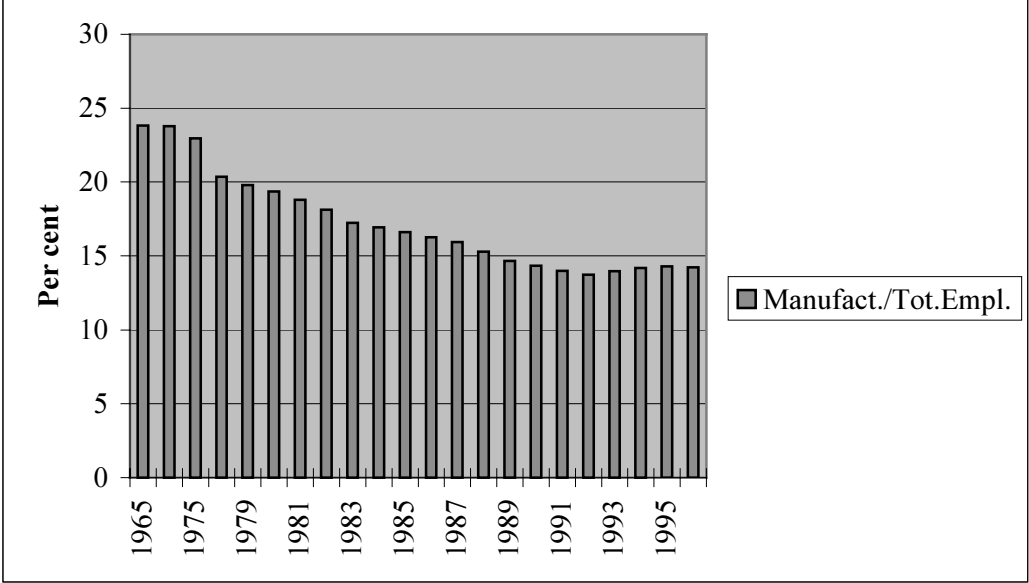
The importance of the manufacturing industry in the total economy has been reduced measured by a lower share of total employment and a lower share of the gross national product (GNP). The manufacturing's share of the GNP decreased from over 20 per cent in the mid-seventies to around 11-12 percent in the nineties.

Value added in manufacturing as a percentage of the GNP



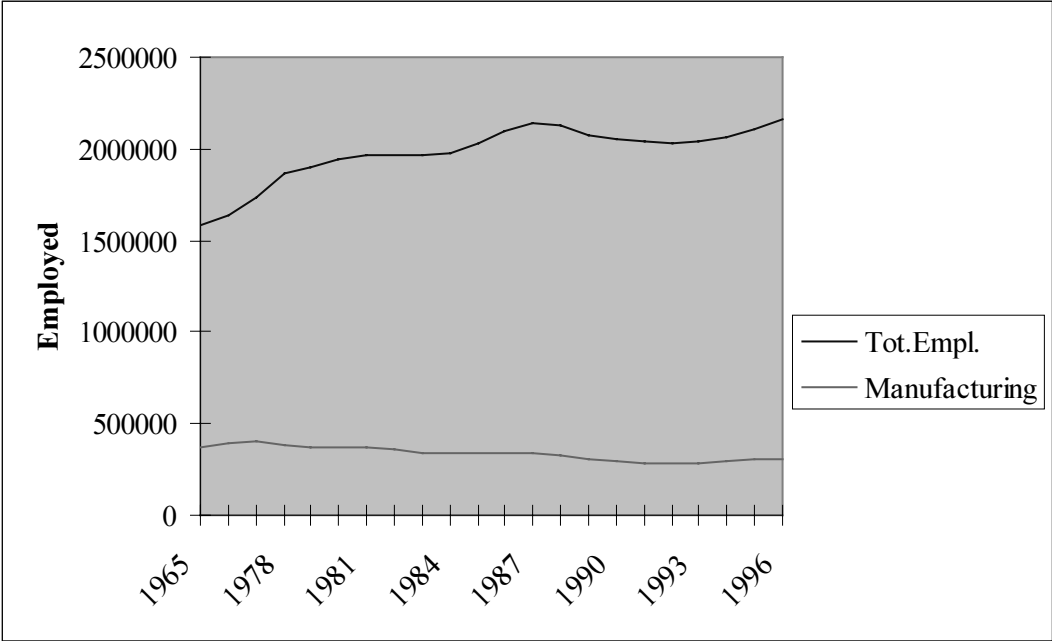
The manufacturing industry's share of total employment in Norway has followed the same downward trend as the development of the share of the GNP, and the share has fallen from more than 20 per cent in the mid -70s to around 14 per cent in the -90s.

Manufacturing employment as a share of total employment.



Furthermore, it was not only the real decrease in manufacturing employment that caused the decline, but also the employment growth in other sectors led to the relative weakening of the manufacturing industry. The total employment in Norway has increased with more than 35 per cent since 1965, and amounted to 2 159 700 employees in 1996. In the corresponding period manufacturing employment was reduced with 18 per cent and amounted to 306 900 persons¹¹.

Development of total employment and manufacturing employment 1965-1996.



¹¹ According to the National Account-figures.

Numerous tasks and activities that previously were conducted in-house such as R&D, accounting, marketing, security and components and parts, are now outsourced and purchased. Many of these products and services are either produced in firms which are not classified in the manufacturing sector or they are imported from other countries, and this is one factor explaining the relative decline of the manufacturing industry in recent years¹².

In the period of 1992-95 there was a tendency of outsourcing among Norwegian manufacturing establishments, according to a survey covering externalisation of work (Nesheim 1997). Half of the manufacturing establishments used subcontractors or used outsourced services, and the extension of these kinds of relationships and services has increased in recent years, and are expected to continue to increase. Furthermore, differences between large establishments (with more than 50 employees) and smaller ones were observed, and e.g. 46 per cent of the small establishments used external accounting services compared with only 11 per cent among the large establishments, while concerning cleaning 62 per cent of the large establishments used external services and 39 per cent of the small establishments.

Share of manufacturing establishments using subcontractors or related services

Activity	Share that purchases external services
Suppliers of components	61
Computer support	73
Strategy and management	36*
Repair and maintenance	85*
Marketing	49*
Accounting	11*
Cleaning	62*
Security	47*
Transport	89*

*Only establishments with more than 50 employees. Source Nesheim(1997).

Not all of the activities above are activities defined within the narrow definition of subcontracting, but on the other hand they contribute to the explanation of the decline of the manufacturing sector, the growth of the service sector and the division and externalisation of labour.

9 Contract work in Norwegian manufacturing

The new EU-harmonised production statistics, which Norway adapted in 1995(Ragnarson 2000), comprise industrial services in addition to production of physical goods, and a whole range of these services are typical contract works, such as treatment and coating of metals, processing of textiles, printing etc. By identifying specific contract work products, one is able to say something about the extent and importance of subcontracting within the different industries. Some of the physical products are components and parts, which obviously are input factors in the production of other products, and these input goods are often produced under a subcontracting relationship.

¹² Two other important factors are the change of preferences among consumers as income rise, i.e. increased demand for services, and that several industries within the manufacturing sector, especially low-tech and labour-intensive production have moved from high-cost to low-cost countries.

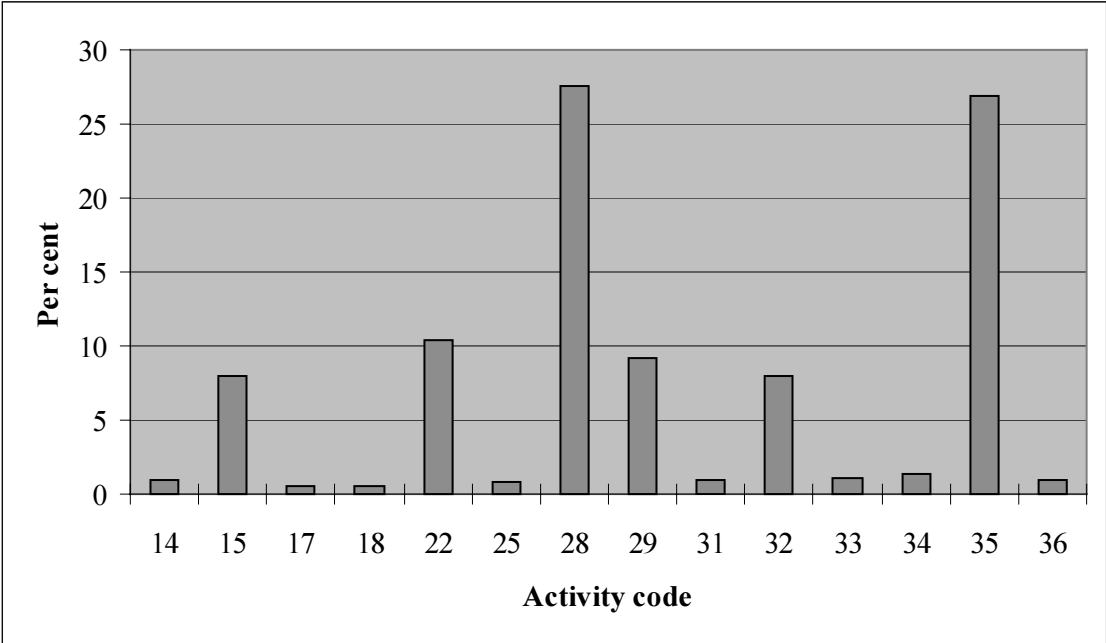
9.1 Total contract work conducted for others

According to production statistics, contract work conducted for others amounted to 4.5 billion Norwegian kroner in 1996 in manufacturing and mining industries. The figure is based on information from all enterprises with more than 20 employees classified in the above mentioned industries. Contract work conducted by establishments that belong to the same multi-establishment enterprise was not included. About 15 per cent of the enterprises in the survey did contract work for other enterprises, and only 3 per cent of these had contract work as the only industrial income.

9.2 Activity and products

Contract work conducted in the manufacturing industries was not distributed evenly across the different activity groups, and production of metal goods and building and repairing of ships dominated contract work and more than 50 per cent of all contract work measured by value was conducted within these two industries. Other important industries regarding contract work were publishing and printing, manufacture of food products, manufacture of machinery and equipment and production of communication equipment and apparatus, and each of these industries had from 8-10 per cent of all contract work. Together these six industries conducted 90 per cent of the total contract work in the manufacturing industry.

Contract work for others(See appendix B for explanation of the activity codes).



In order to understand better what contract work is and why certain industry groups are more involved in contract work, we had to break down the data from industry level to product level. Contract work was not only concentrated on specific industries, but also on specific products, especially industrial services. The 40 largest identified contract work products comprised 55 per cent of all contract work measured by value. Contract work is often either industrial services executed by the contractor for the customer or special constructions and production of parts accomplished in accordance with the specifications of the customer.

Various types of coating of metals were the most important forms of contract value, and the largest coating enterprises received fees from the principals or customers which amounted to 28 per cent of all

contract work. The coating and treatment of metals were concentrated in the two largest contract work industries, and consisted of coating of ships and oil-platforms and coating of metals in general.

Production of metal goods comprised other typical contract work activities, such as forging, pressing, stamping and roll forming of metal and general mechanical engineering. Building of ship hulls and modules to ships and oil-platforms were other major contract work activities.

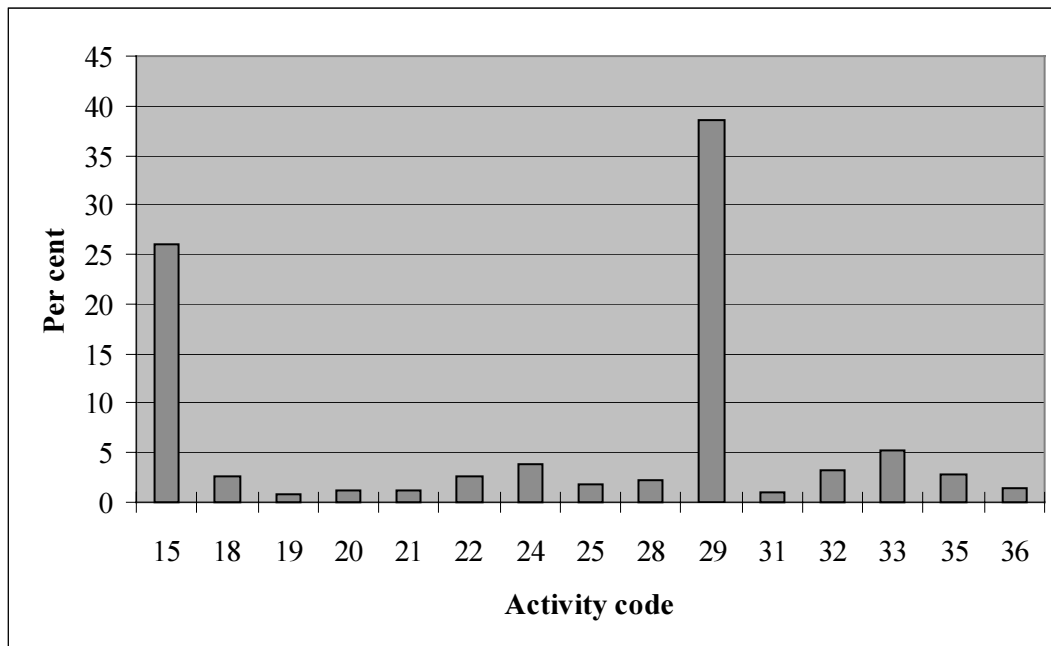
Regarding the food industry the importance of contract work was more significant in the fish industry than in the meat industry, and subcontractors carried out much of the production process concerning fish. Drying, freezing, slaughtering and preparing of fish were the most important services within the food industry that were produced on contract basis. Furthermore, in the industry of publishing and printing it was particularly the printing that was done by other enterprises (the subcontractors) than those enterprises (the customers) which published or sold the end products. Other significant contract works products in Norway were cranes and winches and some telecommunication equipment.

9.3 Contract work by others

Here we measured the value of products sold which were produced on a contract basis by another enterprise. The quality of the data concerning contract work *by* others was not as good as the data on contract work *for* others, and these data were not broken down on product level. However, contract work by others amounted to more than four billion Norwegian kroner in 1996, and the concentration on specific industries was even larger than for contract work for others.

Manufacture of machinery and equipment had 38 per cent of the sales of goods produced by others on a subcontracting basis. Within the machinery industry products such as lifting and handling equipment, engines for ships and machinery to the paper industry dominated among the external produced products. The food industry sold 26 per cent of the products produced by contractors, and important products were frozen fish and dried fish. Among the other industries only production of optical instruments had a share of over five per cent of total sales of products produced by subcontractors.

Contract work by others(See appendix B for explanation of the activity codes).



9.4 Comparison of contract *for* others and *by* others

A comparison of contract work *for* others and contract work *by* others revealed that it is problematic to follow the flows of goods and services between customers and contractors, and this was and is not the purpose of the production statistics either. However, some relations were observable. A large amount of the fish products were processed by other enterprises than those which sold the products, and the fish industry was one of the dominant industries concerning both contract work for others and contract work by others. Sales of lifting and handling equipment produced by others partly corresponded to lifting and handling equipment and parts to cranes produced for others on contract basis.

10 Summary

The new way of organising production led to an increased importance of subcontractors and SMEs as the value chain was divided into more production units. Focus on the core activity resulted in reduced firm size, but this was not the case for all large corporations (i.e. groups of firms), where some of the largest have extended their activity. Increased turnover and hence trade was another outcome of the shift of production model (as shown in appendix A). Manufacturing industry has lost some of its position as the central industry in advanced economies, not necessarily as a result of plain de-industrialisation, but also as a consequence of externalisation of work, outsourcing and subcontracting, where activities previously conducted within the large manufacturing enterprises now were carried out by smaller independent service firms.

By using structural and production manufacturing statistics we were able to recognise some of the trends observed in other advanced economies also in Norway. Firm size in the manufacturing industry was reduced and the relative importance of this sector had shrunk.

Subcontracting in the narrow form of contract work was especially important in a few Norwegian industries, and shipbuilding and manufacture of metal goods were the dominant ones. These two industries were also important subcontracting industries in Denmark, where the subcontractors in the metal working industry acted as vertical capacity subcontractors and the ones in shipbuilding as part-time capacity subcontractors. We did also observe that contract work in the publishing and printing industry was relatively important, and especially the printing was done under a subcontracting relationship. The publishing and printing industry was dominated by many small and medium sized establishments, and 86 per cent of the establishments had less than 20 employees in 1996 (Manufacturing Statistics 1996). This was also one of the most globalised industries among the manufacturing industries measured by foreign ownership, and as much as 42 per cent of the employees in publishing and printing were employed in foreign controlled establishments (Manufacturing Statistics 1996). To sum up, the case of the publishing and printing industry indicates that subcontracting plays an important role for SMEs in value chains and global networks.

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Appendix A Effects on the value chain

In order to purify some of the effects of the splitting up of the value chain has on value added and production value, a relatively simple model is used. The production in a single value chain can be described by this equation:

$$\sum_{i=1}^n X_i = \sum_{i=1}^n E_i + \sum_{i=1}^n H_i$$

X_i is the production value in a link (establishment i) in the value or production chain.

H_i are the input factors (intermediate goods and services) in production of X_i , and the following identity is valid in the conventionalised production chain:

$$H_i = X_{i-1} \quad \text{for } i = 1, 2, 3, \dots, n$$

The complete production of X_i is used as input in the production of X_{i+1} .

X_n is the end product in the value chain and $X_n > X_{n-1} > \dots > X_2 > X_1$, which implies that for each link in the value chain the production value increases and the value added, E_i , is positive for all links.

$$\sum_{i=1}^n E_i \text{ is total value added in the value chain.}$$

Assume that the production of the end product in establishment n is separated and that the new value chain consists of m links where $m > n$ and $m-n$ is the number of links or establishments that establishment n was divided into. No other changes take place and the end production value is similar in the new and old chain, $X_m^s = X_n$ (where s denotes the split up chain). Regarding production value and value added the chains are identical up to establishment $n-1$:

$$\sum_{i=1}^{n-1} X_i = \sum_{j=1}^{n-1} X_j^s \quad \text{and} \quad \sum_{i=1}^{n-1} E_i = \sum_{j=1}^{n-1} E_j^s$$

Technology is also identical and hence the total value added is identical in the two production chains:

$$E_n + \sum_{i=1}^{n-1} E_i = \sum_{j=1}^m E_j^s + \sum_{j=1}^{n-1} E_j^s \Rightarrow E_n = \sum_{j=n}^m E_j^s$$

$$X_n - H_n = \sum_{j=n}^m X_j^s - H_j^s$$

$$X_n - X_{n-1} = (X_m^s - X_{m-1}^s) + (X_{m-1}^s - X_{m-2}^s) + \dots + (X_{n+1}^s - X_n^s) + (X_n^s - X_{n-1}^s)$$

$$X_n - X_{n-1} = X_m^s - X_{n-1}^s$$

Subsequently $E_n > E_m^s$, because we assumed that $E_n^s, E_{n+1}^s, \dots, E_{m-2}^s, E_{m-1}^s > 0$.

Even though the end-production value in the two production chains are equal, the value added is lower in the last link (m) in the new separated production chain than in the original chain because of the split up. The production value in the new value chain has increased compared with the original one.

$$X_n + \sum_{i=1}^{n-1} X_i < \sum_{j=1}^m X_j^s + \sum_{j=1}^{n-1} X_j^s$$

$$X_n < \sum_{j=1}^m X_j^s, \text{ since } X_n = X_m^s \text{ and } 0 < X_n^s < X_{n+1}^s < \dots < X_{m-2}^s < X_{m-1}^s$$

The increase in production value or turnover as a result of more production links leads to increased trade, but with unchanged technology the share of value added as a percentage of total production value has decreased in the value chain:

$$\sum_{i=1}^n E_i / \sum_{i=1}^n X_i > \sum_{j=1}^m E_j^s / \sum_{j=1}^m X_j$$

Incentives to a split up of the value chain is not a part of the above model, but if it was possible to participate in other value chains, i.e. the producers n to m-1 can supply other end-producers in addition to m, potential benefits of economies of scale and scope through flexible specialisation could be realised.

Appendix B Industry classification

Manufacturing and mining- two digit NACE rev.1. (Standard European activity classification)

10, 12-14 Mining and Quarrying

15-37 Manufacturing

15 Food and Beverages

16 Tobacco

17 Textiles

18 Wearing Apparel

19 Tanning and Dressing of Leather

20 Wood and Products of Wood

21 Pulp and Paper

22 Publishing and Printing

23 Coke and Refined Petroleum

24 Chemicals

25 Rubber and Plastic Products

26 Other Non-Metallic Mineral Products

27 Basic Metals

28 Metal Products

29 Machinery and Equipment

30 Office Machinery and Computers

31 Electrical Machinery and Apparatus

32 Radio, Television and Communication Equipment

33 Medical and Optical Instruments

34 Motor Vehicles

35 Transport Equipment

36 Furniture

37 Recycling

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