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The Advantages of Outsourcing in terms of Information
Management

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Abstract - Subcontracting and, more generally, productive outsourcing increasingly characterise industrial organisation. The aim of this paper is to analyse information management in different cases of supplier networks, in order to provide hypotheses on the advantages of networks over other governance forms of suppliers' relationships. We review some empirical literature and compare specific cases. First, networks characterised by a large firm and more or less dependent suppliers is examined, in Japan, France and Italy. Second, outsourcing in systems of small firms, where power is more equally distributed along the productive process, is analysed for the same three countries. Finally, we derive theoretical insights by arguing that the study of information flows is key to explain such phenomena. More precisely, the advantages of outsourcing are due both to the particular way various types of information, on technology or on market conditions, are shared in the network and to the “governance” of the network, that has to be characterised by a more equal distribution of contractual power between suppliers and users.

Keywords: network, information, outsourcing, subcontracting

JEL classification: D23; L11; L22

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1. Introduction

Subcontracting and, more generally, productive outsourcing have been increasingly used in all industrialised countries in the last thirty years. Attention to such phenomenon arose in the field of organised vertical markets in which vertical co-ordination by large firms has been progressively substituted by decentralised network of suppliers, governed by principles of lean production and just-in-time. However, local systems of small firms have also evolved from pure execution of orders by the client firm and high degree of dependence, to strategic partnership relationships characterised by more balanced contractual power and major information exchange.¹ Such tendency has led to the vertical disintegration hence the downsizing of firms and the growth in informative and strategic interdependencies among firms, with many different implications, in particular concerning labour markets and their governance in the territory.

The reasons for the diffusion of subcontracting and outsourcing have been widely studied. The bureaucratic costs of the large, integrated company have been outlined (Chandler, 1962), as well as incentive and information processing costs (especially Aoki, 1988). When products become increasingly differentiated and renewed, it appears that the best strategy is to focus on core competencies and let other firms deal with the production of parts, maintenance of machines, sometimes distribution (Clark and Fujimoto, 1991, Cusumano and Takeishi, 1991). Thus disintegrated firms have been shown to be more efficient (lower cost or higher productivity), by Aoki (1988) and Asanuma (1989) for the Japanese case, Coriat (1991), De Banville and Chanaron (1991) for the French case. However, outsourcing yields other advantages, in particular in terms of product and process innovation. For instance, Clark and Fujimoto (1991) or Michie and Sheehan (1999) show that R&D and product innovation are higher in firms characterised by outsourcing.

Concerning the organisation of production and market structure, such changes mean that the relevant unit of analysis becomes the network of firms rather than the single firm. Hence in order to understand the success of some organisational patterns relative to others it is necessary to go into the black box not only of the single firm but also of the entire network by analysing interdependencies, because each set of transactions depends on how the other transactions are set up. The analysis of subcontracting and outsourcing is a useful tool to perform this task. They are patterns of co-ordination of production activities based on a vertical relationship between separately owned and managed enterprises with distinct economic objectives. The buyer decides not to internalise the development and production of a component (vertical integration: hierarchical type of governance), nor to directly procure it from a spot market (market type of governance). Instead, a specific governance form is created: a sustained relationship, which typically includes the exchange of proprietary information and knowledge between the user and the supplier.

The aim of this paper is to compare specific cases of outsourcing in France, Italy and Japan in order to draw some theoretical insights on firms' networks. We compare different types of supplier networks, namely networks characterised by a large firm and more or less dependent suppliers (section 2) and outsourcing in systems of small firms, where power is more equally distributed along the productive process (section 3). We focus on three country cases: Japan, France and Italy. Japan is an interesting case because supplier networks have always played an important role, Italy is interesting for the predominance of networks of small firms, and France is interesting for being a case "in-between" (with some vertically integrated firms which have decentralised and some recently developed networks of SMEs). In section 4, we analyse the activity of information management in networks of firms and derive a cognitive framework based on collected evidence to

¹ See Aoki (1988), Acs and Audretsch (1993), Storey (1994), Carree and Thurik (1998), Carnazza, Innocenti and Vercelli (2000).

explain the advantages of outsourcing in terms of efficiency (cost minimisation) and knowledge creation (innovation). Section 5 sets out some concluding remarks.

2. The processes of outsourcing of large firms

Following the diffusion of the flexible production system, which combines economies of scale and scope by pushing product differentiation to the last stages of the production process, unlike the Fordist system which exploited economies of scale only,² large firms have progressively disintegrated vertically and established particular relationships with suppliers. Such relationships vary across countries and industries, but some regularities can be identified, into different models of subcontracting by large firms.

The Japanese model of subcontracting has been traditionally seen as based on an asymmetry of bargaining power between a large downstream firms and small upstream firms. The aim of subcontracting for large firms was primarily a way to reduce their investment in fixed capital by shifting it to subcontractors, to exploit differences in wages between large and small firms (higher in the large firms), to reduce procurement costs, and often to try and shift the effects of temporary recessions to suppliers. Such imbalance of power was interpreted as a competitive pressure on suppliers: they have to reduce cost and provide the required quality, otherwise they lose customers. Hence the incentive for performance was much higher than in the case where the supplier was part of a vertically integrated firm, whatever the degree of centralisation of the firm and autonomy of the division producing the parts.

Such relationships between large firms and their suppliers have become more complex and involve more than pressure for performance. For the Japanese case, Asanuma (1985, 1989) provides a remarkable empirical and theoretical work. According to Asanuma, the Japanese subcontracting relationships have four main characteristics. First, such relationships are long-term and duration is determined by the product life cycles. Each time a new product is launched, the large firm makes a sort of call for the best offer from suppliers. At that stage, suppliers are put into competition. However, generally the firm continues subcontracting relationships with the same suppliers from a product to another, so that product change is in fact an occasion to renegotiate the contract. Second, the Japanese subcontracting relationship is institutionalised and hierarchically organised. Subcontractors are differentiated according to the type of product bought by the large firm. The first type consists in traded products, which are bought on the market without any intervention on design by the large firm. In this case, the subcontractors are chosen on the basis of quality, and constitute the most autonomous subcontractors. They are “general suppliers” and “ordinary subcontractors” according to Asanuma’s definition. The second type is made of ordered products, which can be designed either by the supplier or the large firm itself (or jointly). In the latter case, the supplier only executes orders from the large firms according to its indications, and is very dependent on the large firm. Suppliers designing or co-designing the product enjoy more bargaining power. Both cases however constitute the first layer of the hierarchy of subcontractors: first-tier suppliers and associated companies. Third, the Japanese subcontracting relationship is contractual and characterised by specific procedures. According to Asanuma, such procedures unfold as follows. After a supplier is chosen, when the new product is still in the development phase, a basic contract is made, with broad specification (no specification of quantities to be delivered, neither of prices, etc.). The contract is made more precise as decisions on the manufacturing process are made, using complementary contracts.³ Last, but not least, subcontracting in Japan really favours innovation and internalises profit sharing. On the one hand, the large firm asks for flexibility and adaptation to

² See Labory (1997), for a discussion of the flexible production system and associated strategies on product markets.

³ Quantities and prices start to be fixed in a very precise way especially in case of just-in-time production (see Coriat, 1991).

possible changes in the specification of products at any time. On the other hand, in terms of incentives to innovate, Toyota (imitated subsequently by many large Japanese firms) had the habit of letting the subcontractor enjoy the benefits of its innovation for an entire year. If the supplier turns out incapable of reducing costs and adapting to changing specifications, the large firm reduces orders at the next product change.

Therefore, the relationship between the large firm and its suppliers can be characterised by the coexistence of co-operation and competition. Competition prevails in the suppliers selection phase, but also after the contract has been signed. The performance of suppliers in terms of quality and costs are indeed constantly assessed and compared with other suppliers. If the supplier does not perform well, orders are reduced and, in the last resort, the supplier is changed. However, the large firm has also interest in co-operating with the supplier to avoid switching and associated costs (time to learn the specification of the product, the technology of production, time required to set up trust, etc.). Consequently, the large firm also seeks to continuously collaborate with suppliers, helping to resolve problems and exchanging continuously information in order to improve the system. The know-how generated by such a relationship is, according to Asanuma (1989) twofold. On the one hand, it is technical, regarding the product and production system. On the other hand, it is “relational”, due to the incentives and knowledge creation generated by simultaneous co-operation and competition.

Aoki (1988) has extended Asanuma’s analysis by conceptualising the notion of relational rents. According to Aoki, “group-specific returns” are created by the co-operative relationships between the contractor and the supplier. Such benefits constitute a relational rent in the sense that they are generated by the high informational efficiency of the contractual relationship developed within the network. Such efficiency allows to enjoy the benefits of vertical integration (co-ordination) while also enjoying the advantages of markets, in that incentives to innovate are provided. Asanuma (1989) also analyses the way the relational rent is divided among actors in the network.

Hence information flows in the Japanese supply network are intense and complex. Technological and market information are shared so that the co-ordination of the production process and a shared language are established. However, the supplier specialises in an autonomous way and therefore has scope to develop ideas and innovate. One could characterise the advantage of such network as the result of specialisation (dealing with a particular subset of the overall information set related to the development of the product) and sharing of generic knowledge (exchange of information and collective creation of knowledge) which brings both co-ordination and innovation.

In France, the new relationships with suppliers have been defined as “partnership” relationships, characterised by a system of reciprocal commitments, whereby the supplier commits to delivery time, quality and price, while the contractor commits to order time, participation in investment and transfer of techniques and know-how. The transfer of techniques and know-how can take the form of the provision by the large firm of some of its machinery, or the maintenance and interchangeability of tools, and technical co-operation (on manufacturing methods, product specifications and so on).

Until the 1970s, the dominance of the large firm over its suppliers was total: technical, industrial and commercial, and the relationship with suppliers was based on the criterion of minimum price for the specific volume. Delivery time was secondary and solved by stocks. Such Fordist inter-industrial practices (with the division of tasks, specialisation, the separation of conception and manufacturing and one-way – top to bottom – information flows) was characterised by:

- open booking: no contract was signed and the supplier had to face fluctuations in demand with strict price controls;
- high competition: the large firm kept several potential suppliers for each part, so that only the least cost supplier was chosen;

- no autonomy on product development, only execution of orders from the large firm.

Hence the suppliers' scope and incentives to innovate were limited.

After the 1970s, new relationships have progressively been set up, following both the vertical disintegration of large firms and the imitation of the Japanese model. Besides JIT, French firms imitated some aspects of the particular contractor-supplier relationships, such as the already-mentioned pyramidal structure and the both the financial participation in some subcontractors and the establishment of suppliers' clubs, with the first-tier suppliers only. In Japan, such clubs are *kyoryokukai*, which concern the top of the pyramid structure of the network between the large firm and its strategic suppliers. Partnership relationships have several characteristics, close to the Japanese model:

- trust, based in mutual commitment;
- technological expertise of the supplier on its product (not just execution of orders);
- short delivery times (JIT);
- duration: procurement contracts are signed.

In terms of information flows and knowledge exchange, two phases have to be distinguished. In a first phase, broadly in the 1980s, French producers (and all Western producers in general) outsource to reduce costs. Hence relationships remain authoritative, the buyer making precise requirements to the supplier and the supplier having mainly execution tasks. More recently, in what can be called a second phase, broadly in the 1990s, co-operative relationships have been developed with *some* suppliers, involving them earlier in the component design process (Dyer, 1996). Important changes occur: the supplier is involved in product development and has a capacity to innovate; profit gains and technological and economic information are shared. Hence information flows in the partnership relationships are two-way and differentiated, as in the Japanese model: generic information is shared and constitute the common denominator of the network, while each actor specialises in a certain part of the overall information set related to the final product. Such features regard the first tier of suppliers because it is the only tier to be involved in co-design. Information advantages are similar to those of the Japanese case.

One interesting point to note is that such partnership relationships are supported by technological progress. The co-ordination across firm boundaries is indeed helped by the use of information technology, and CAD (Computer Aided Design) systems in particular. Electronic data interchange were first used for structured tasks, such as scheduling, logistics and just-in-time. The development of more involvement of some suppliers in product development is associated with the use of IT for complex and creative tasks, such as joint design and engineering. In addition, IT helps increase the efficiency of network relationships with suppliers since electronic data interchange and industry-wide platforms (e.g. the Automotive Industry Action Group) have been shown to help buyers reduce the costs of finding an appropriate supplier, monitor subcontractors and co-ordinate ordering, scheduling and payment systems (Bensaou, 1999).

Such co-design requires tight collaboration and intense communication between the engineers of the buyer firm and the supplier. As stressed by Bensaou (1999, pp. 5), "the development of a new car or engine model is a large, complex project with several hundred engineers developing many new parts, tools and technologies. Design engineers translate the initial broad design specifications into detailed engineering drawings and/or design data files, which are either sent to subcontractors as the basis for production contracts or become the foundation of engineers' collaboration between buyers and suppliers". Such interactions occur in the context of high uncertainty, time pressure and conflict of interests between engineers so that intense communication is required.

In Italy, most large firms have outsourced by adjusting to subcontractors' characteristics and changing radically their internal organization. For instance, Camuffo and Volpato (2001) describe the case of the car industry, while Crestanello (1999) discusses the textile and clothing industry

case. First-tier subcontractors have tended to become less numerous and to take responsibility not only for the production of specific parts but also for technological innovation and components design. In addition, outsourcing increasingly concerns production services, from those having lower added value and more labour-intensive (security, cleaning and catering) to more complex services such as logistics, computer maintenance, or transportation.

In the case of the textile industry, Crestanello (1999) distinguishes two main types of suppliers according to their degree of autonomy. The first type is the dependent supplier, which just executes orders from the client firm. This kind of relationship is hierarchical, and information flows are typically one-way, from the user to the supplier. The second type is more autonomous and is involved in co-design of products. The subcontractor in this case faces more competitive pressure, from other potential suppliers, but has more bargaining power on the price of the product.

Insights into the characteristics of these relationships in the car industry are given by the example of the carmaker Fiat. Recent works (Enrietti 2000, Volpato and Stocchetti 2000, Camuffo and Volpato 2001) show that outsourcing is relatively common at Fiat, in both production and services. While in the 1970s and 1980s, outsourcing concerned mainly low value added production phases, since the late 1980s it involved important production phases such as the assembly of suspension units and crucial services like plant maintenance and logistics. The most evident measure of the extent of this process is given by the reduction in employment level by 38 per cent from 133,431 units in 1990 to 82,450 units in 1999 despite the maintenance of the same production level.

The downsizing of Fiat has been accompanied by the restructuring of the suppliers relationships. Subcontractors are divided into three groups. The first-level subcontractors are those producing more complex components that are designed in close collaboration with Fiat and that are usually modules to be assembled internally by Fiat. The other two groups produce more standardised components and their activity is relatively more independent from Fiat.

The rationale for outsourcing appears to be the increase in the specialisation of activities. Subcontractors are chosen on the basis of their specific technical knowledge and not to lower labour costs⁴. First-tier suppliers carry out specific tasks that correspond to a module. In order to make the different parts complementary, Fiat has organised the production of cars by arranging the different phases in such a way that the information necessary to produce each of them can be processed autonomously. While in the past car components were designed and engineered by the car manufacturer who led the whole project and suppliers simply manufactured them, the supply chain is now decentralized according the following pattern:

The fundamental aspect of coordination based upon ex ante planning is that any individual operator does not need information on the whole chain of operations. Any chain operator must know only start and end date for a given activity, and must be concerned about precisely meeting its specific deadline. This implies a hierarchical managing of information. But forms of simultaneous coordination on the whole of operations, aimed at compressing chain slacks require on line access to the whole sequence of operations, in order to carry out adaptations any time in which downwards demand triggers a wave of change which involves the whole upward operation chain. In other words, this implies forms of network connections among operators. The decision-making processes related to product development involve both the car manufacturer and first tier suppliers. According to the continuous improvement both in product and process technology, nowadays

⁴ This change of perspective have important consequences for collective bargaining. Trade unions are indeed successful in extending their bargaining power to the subcontractors. For example, an agreement signed in 1998, which externalises logistics from Fiat Mirafiori's establishment to a Dutch multinational, applies all the rights provided by the old agreement (the kind of employment contract, the benefits available in Fiat, the guarantee of job security and insurance for accident) to the new relationship.

the competencies that are necessary in order to manufacture a competitive car encompass a wide range of fields of expertise. As a result, critical decisions might often take place in an inter-firm process and thus an agreement among peers could be required. (Volpato and Stocchetti 2000, p. 9)

The involvement of some suppliers in the product development process implies their access to some strategic information of the large firm. The main consequence is that the supplier gains bargaining power and the relationship between the large firm and the supplier becomes contractually more balanced. Given the possibility of opportunism and resulting hold-up problem, duration is substantial, related in practice to the product life cycle. Even in this case, the long duration of relationships allows to derive some of the benefit of vertical integration, while simultaneously avoiding its drawbacks, such as the lack of incentive for performance for the component maker.

The analysis of these national cases therefore points to a number of important elements:

1. In the car industry, outsourcing is associated with the intensification of competition (globalisation) and competition on mainly non-price factors (frequent product renewal, lead time, quality).
2. Japanese producers have developed pyramidal networks with their suppliers, first tier suppliers being involved not only in cost reduction and time saving in production but also co-design and innovation.
3. Western producers (here, French and Italian producers) have implemented a strategy of outsourcing in two phases. First, outsourcing aimed at cost reduction and therefore suppliers were involved in structured tasks such as scheduling, logistics and JIT. Second, first tier suppliers have also been involved in product development, and therefore have started to share strategic knowledge with the buyer. In the process, information flows between the buyer and the suppliers have shifted from one-way information flows, whereby the buyer gives orders to the suppliers and the latter executes, to two-way communication, since design is a complex and ill-defined task which requires a high level of co-ordination, communication and conflict resolution.
4. It seems that technological innovation (information technology in particular) has been one determinant of the development of partnership relationships between large firms and some of their suppliers. In the car industry case, CAD systems have been shown to improve communication across firm boundaries by providing rich representations of designs and by creating a common language.
5. Co-design seems to increase innovation. However, it also provides suppliers with access to strategic and confidential data of the manufacturer (CAD files, standard part libraries).

This kind of collaboration can be assessed through a theoretical framework that will be the object of the fourth section but, before that, the following section analyses the case of outsourcing among small firms.

3. The processes of outsourcing of small firms

Although the role of large firm disintegration has been important in determining the growth of occupational share of small firms in all industrialized countries, the processes of outsourcing among small and medium firms have also been significant in countries like France, Italy and Japan, where about the 50 per cent of the total manufacturing employment is in establishments with less than 100 employees (Acs and Audretsch 1993). In other countries where the occupational share of large firms is dominant (the United States, the United Kingdom), small firms have also become more important not only for generating new jobs but also for their contribution to outsourcing activity. Similar processes also concern Asian economies, where small firms are often encouraged

by economic policies in order to create entrepreneurship, increase flexibility and decrease labour costs through outsourcing and subcontracting (see, for example, for Indian manufacturing Ramaswamy, 1999).

Carnazza, Innocenti and Vercelli (2000) study the characteristics of the processes of outsourcing among small firms in Italy. Their analysis is based on the distinction between specialised and capacity-based subcontracting. Specialised subcontracting means a relationship between a contractor and a subcontractor where the former continuously relies on the latter for the supply of an input for which there is no in-house supply. In contrast, capacity-based subcontracting indicates a relationship where the contractor hands over supply to the subcontractor only in the presence of temporarily high levels of demand. In many industrial districts small firms have increasingly allocated part of the production process to other small firms, either by providing the financial resources needed to acquire machinery (since owners of the suppliers are often own previous workers), or by moving the isolated phases out of the district. Some empirical evidence on Italian manufacturing industry (Mediocredito Centrale, 1994 and 1997) confirms that small firms outsource more than large firms, thereby supporting the hypothesis that a significant part of the increase in subcontracting relationships in Italy is between small firms belonging to the same local system. In other empirical contributions, Conti and Menghinello (1998), Corò and Grandinetti (1999) give some evidence that industrial districts are characterised by processes of delocalisation, whereby production characterised by low knowledge specificity and intensive use of labour is shifted to low labour costs countries. The latter type of subcontracting is considered valuable if close co-operation between the contractor and the subcontractor is not crucial, so that distance does not matter.

In order to understand the difference between this two typologies of subcontracting, it is useful to sketch the recent evolution of subcontracting relationships in industrial districts. In fact, changes are similar to the case of subcontracting between large and smaller firms. A significant part of the relationships between district firms have changed from one-way relations (execution of orders from the buyer) to two-way relations (co-design). Two major factors explain this evolution. First, the increased technological level of production induces small firms to specialise, implying the creation of more stable relationships among small firms, the multiplication of the tiers of subcontractors and the balancing of contractual power between suppliers and buyers. Second, the final markets in which Italian industrial districts are specialised are increasingly fragmented. It is recognised (Innocenti, 1998) that the production of these local systems is largely concentrated on the high quality segments of three macro-sectors: the so-called "fashion system" (textiles, leather, clothes, shoes, glasses), the goods for the house (wood, furniture, ceramics, accessories) and the production of machinery for the two previous macro-sectors. These production systems have acquired the characteristics of niche markets, where customer needs are deeply diversified and the product life cycle has shortened. Firms' market strategies are increasingly dependent on factors other than price, among which design innovation, product differentiation, customisation and after-sales services, and brand loyalty. These processes are inducing many small firms in industrial districts to intensify the process of outsourcing and specifically specialised subcontracting, asking suppliers to co-develop products or parts.

The "White Paper on Small and Medium Enterprises in Japan" (2001) gives similar evidence for Japan. Supplier relationships have moved from pure cost reduction orientation to more flexible relationships and more product development initiative. Thus, the percentage of subcontractors engaged in exclusive contracts halved during the period 1987-1995, while dispersed and semi-dispersed contracts increased by more than twenty per cent. Such a partial opening of supply chains and the consequent development of productive structures with many apices has led to higher specialisation.

This evolution is also confirmed by the *Survey of the structure of subcontract work* in Japan published by SMEA in 1996. In particular, the requirements of buyers to their suppliers have

significantly changed. The requirements of “greater quality and precision” and “quality assurance” have become the most significant ones, while “stable quantities of parts and finished products”, “fixing delivery time” and “volume production” have fallen toward minimum values (SMEA, 1997, pp. 71-72). Buyers consider “specialist technologies” and “ability to perform technical development” as the most important criteria to select subcontractors, while the proportion of contractors expected to choose their partners on the basis of the “existing business relationship” declines considerably (SMEA, 1997, p. 83). The changing nature of subcontracting relationships naturally led to network structures with more intense communication among small firms, flexibly extending beyond *keiretsu* and rearranging more horizontally the traditional rigid Japanese supply chain (Lakshmanan and Okumura, 1995). The decline in the overall number of subcontractors lead to more concentration and therefore higher bargaining power for suppliers.

This change of attitudes takes us far from the more diffuse patterns of subcontracting relationships of the 1960s and the 1970s, when small firms mainly played the role of suppliers of low cost labour. This population of small firms, mainly composed of capacity subcontractors, had a comparative advantage for the "dualistic" Japanese manufacturing industry (Koshiro, 1999) where "the abuse by large firms of their subcontractors was one of the most significant political issues" (Friedman, 1988, p. 166). The turning point can be dated from the early 1990s, when the high yen crisis, following the 1985 appreciation of the yen, (Glasmeier and Sugiura, 1991) represented an external shock causing a process of selection above all among the capacity subcontractors whose productive activity was reduced in favour of outward direct investment. At the same time, a gradual increase of specialized subcontracting was necessary to cope with the shift of the Japanese system toward productions at a higher technological level. Even if this process had the net effect of reducing the employment of small Japanese firms as a whole, because the shrinking of the large population of capacity subcontractors was only partially compensated by the growth of specialized subcontractors, it contributed to improve domestic efficiency by reflecting the growing importance of technical change in relation to simple cheap-labour advantages of capacity subcontractors. Similarly to the Italian case, market characteristics and technological change explain why outsourcing has become the main pattern of relationships among small firms: specialisation has allowed them to improve their capacity to process information and build contractually more balanced, specialised and innovative partnerships. Finally, this process has increased the impact of industrial clusters of small firms on the whole Japanese industrial system (Yamawaki, 2002)

Concerning French small firms, a number of empirical studies have interpreted the recent restructuring process as a transformation of the industrial organisation towards local systems similar to the Italian industrial districts. This process is in fact a local rooting of production by the setting up of supplier networks between small firms, which origin can be traced back to the evolution of the relationships between small and large firms described in the previous section: the shift towards more involvement of suppliers in co-design and productive innovation has been followed by the small firms and their suppliers. The quantitative evidence can be indirectly provided with data on the degree of vertical integration. According to Arrighetti (1999), the largest decrease in vertical integration has occurred in France (-6,2%), higher than the Italian case (-5,6%). Generally the degree of disintegration in France ends up quite similar to the Italian one, but very different from the other two countries considered by Arrighetti, namely the UK and Germany. The rate of growth of outsourcing in France is also similar to the Italian rate and different from the English and German rates.

Even if this process has mainly characterised systems of firms previously dominated by large firms, it has created subcontracting relationships between small firms operating as subcontractors of first and second-tier. Greenan (1996) and Greenan and Mairesse (1999) show for example that these organisational changes of small firms have been permitted by the introduction of new technologies such as CAM and CAD. Moreover, they are accompanied by higher focus on

quality (importance of quality control) and delivery time, introduction or intensification of team work within the firms, and higher skills required from engineers and technicians.

To summarize the collected evidence, the extension of double-way communication to the processes of outsourcing among small firms has implied the following advantages:

1. Small firms gain autonomy mainly through specialization. The increase in the control of such activities provide small firms with the incentive to both actively participate in the production process and innovate.

2. Although communication costs may be higher in networks of small firms than in hierarchically dominated organisations, horizontal competition permits to safeguard efficiency. Independent small firms tend indeed to base their competitiveness on the dominance of a narrow niche market, where it is essential to maintain monopolistic position. Therefore, small firms are particularly keen on keeping their strategic information and not leaking it to potential competitors. While small firms actively cooperate vertically with other small suppliers and users they compete horizontally for safeguarding its own specificity.

3. In hierarchical systems like those in the Japanese manufacturing industry in the 1970s or the French automobile industry in the 1980s, small firms were dependent on large firms for the access to technologies or markets. Large firms concealed their strategic information in order to maintain their residual right over knowledge and established arms-length contractual relationships with their subcontractors. In the new competitive context, large firms prefer giving access to some strategic information (i.e. information on new products or new productive processes) to their first-tier suppliers and involve them in product development by shifting to them R&D activity on components, so as to increase the probability of innovation on parts (suppliers being specialised on components, they collect more information and gain more knowledge). Consequently, these first-tier subcontractor gradually creates relationships with other small firms in which the same patterns of collaboration are replicated.

4. The network as an information processor

The processes described in the previous sections show how small and large firms share similar patterns in the growth of the processes of outsourcing in countries like France, Italy and Japan.⁵ Independently of firm size, contracting out is increasingly seen as a powerful strategy to address competitiveness. This evolution is characterised by the reduction in the number of subcontractors for each contractor, their closer involvement in the production process, the lengthening of the relationship between contractor and subcontractor, the balancing of their contractual power, the need for autonomous capacity of innovation for some subcontractors. This implies that outsourcing has progressively developed away from its past dependence on sourcing cheaper labour towards speciality subcontracting.

However, these general tendencies hide some divergences. In particular, the need to develop autonomous innovation capacity is not true for all suppliers, but mainly for the first-tier suppliers. Indeed, in the sectors dominated by large firms, such as the car industry or aircraft production, outsourcing has lead to the creation of hierarchical networks of suppliers, where only the first-tier suppliers may be involved in product development hence innovation. Relationships with other suppliers are collaborative too, but focused on cost reduction and quality standard, and tend to exclude co-design. The same feature characterises networks of small firms that involve "second level" subcontractors. In this case low knowledge specificity and lower labour costs are the main factors determining outsourcing. This kind of contracting out is feasible only if equal co-operation

⁵ The same patterns of growth are common for example in the U.S. economy, where outsourcing is no longer assumed to be simply a corporate search for cost savings but the cumulative effect of a number of factors among which the management of information plays a crucial role (Deavers 1997)

between the contractor and the subcontractor is considered unessential and if task assignment is not different from that concerning various establishments of the same hierarchically integrated firm.

Notwithstanding the persistence of arm-lengths relationships, the evidence confirms that the better performance of networks in terms of production quality is correlated to a greater involvement of subcontractors in the management of information that also seems to allow another advantage: a higher and more diffuse rate of innovation. Empirical findings on the effect of co-design on product innovation are rather anecdotal, in the sense that some case studies of firms show higher rate of product innovation after setting-up such partnership relationships with co-design. However, systematic evidence is lacking. At this stage, we can only develop a theoretical argument in favour of such hypothesis.

To make clear our argument, we have to recall some general definitions. First, we assume that knowledge is, to some degree, always tacit, while information is the only part of knowledge that can be transferred. Knowledge can be considered as an infinite set - mainly because it is the outcome of a mental process - that includes information as a closed set (Fransman, 1994). While information can be communicated, knowledge cannot always be communicated perfectly. In other words, information is knowledge made explicit that can be communicated to others. The process of knowledge creation can be described as a sequence where the subject collects information, that is explicit knowledge communicated by others, and combines it with the previously possessed knowledge, which is both explicit and tacit. The outcome is new knowledge that is only partially communicated to others.

We also assume a specific meaning of hierarchy. Aoki (1986) defines hierarchy as "the layering of specialised decision making in order to cope with emergent events for which detailed specification of appropriate actions cannot be formulated *ex ante*". According to this definition, the decision maker typically performs the activity of managing by exception.⁶ Subordinates are assumed not being able to cope with exceptional events. Any problem that is not solvable by ordinary skills of the subordinates is reported to the upper layer who is responsible for finding the solution. Consequently, the larger is the range of activities assigned to each level of the hierarchy, the higher the number of unexpected problems reported to the upper levels.

Hierarchy can also be viewed as a system where "only a few individuals (or only one individual) can undertake projects, while others provide support in decision making", as opposed to a polyarchy, i.e. a system in which "there are several decision makers who can undertake projects (or ideas) independently of one another" (Sah and Stiglitz 1986, p. 716). This definition helps to compare the integrated firm, i.e. a self-contained hierarchical system, with the decentralised network, that is a polyarchy where several independent decision makers autonomously undertake productive projects. By the same token, if the integrated firm is the place where all residual rights of control accrue to the owner, then the decentralised network can be seen as a system in which multiple owners possess rights of control on separate competencies. The choice of an organisational pattern can thus be represented as the selection of a point on the line joining the extreme cases of the fully vertically integrated firm, which includes all the productive units, and the "monadic" network, i.e. a network where each producer is an autonomous decision-maker. In this way outsourcing, which corresponds to the decentralization of decision making, represents a movement along the direction going from the fully integrated firm to the totally decentralised network.

This interpretation points out how networks of firms must solve informative problems similar to those of vertically integrated firms. Both kinds of organisation must indeed co-ordinate in the presence of specialisation. More specifically, the information necessary to make complementary the specialist knowledge possessed by their components has to be diffused and shared in order to

⁶ According to Radner (1992) management by exception indicates "a behavior in which the value of an observed variable or pattern is reported to a superior only when it is exceptional or unusual". It can be thus considered as a powerful device for economizing on the use of information in an organization.

improve the performance of both systems. Co-ordination has to be obtained while minimising knowledge transfers mainly because "Communication, like decision making, is always imperfect. No individual ever fully communicates perfectly what he knows to another." (Sah and Stiglitz 1986, p. 717). The informative efficiency of organisations is the result of the equilibrium between these two opposed forces and depends more on the patterns of information processing and knowledge creation than on the property assets of the firms. According to the definitions given above, the degree of decentralization is indeed given by the assignment of the rights to decide on unexpected event. But this task can be accomplished only if the subject in charge of the decision is able to collect, process and transmit the information pertinent to the decision to be taken. From this perspective, it becomes crucial to analyse the information flows both in the firm and in the network, in order to compare their performance in terms of information processing capacity (static efficiency) and problem-solving capacity, hence also innovative capacity (dynamic efficiency). Apart from the multiplicity of decision makers, what indeed makes a hierarchical firm or network different from a decentralised one? A possible answer hinges on two issues. The first concerns information management, that is, the process through which productive units collect, process and transmit information with the purpose of creating knowledge. The second issue is that of making the different pieces of knowledge created through the management of information complementary.

The management of information can be viewed as being made up of three phases, each defined by its related problems, decisions to be taken and sources of costs (Figure 1).

Figure 1 The management of information

<i>Phases</i>	<i>Main problems</i>	<i>Decisions</i>	<i>Costs</i>
1. Collection of information	Information overload; ability to collect information	Choice of senders	Selection costs
		Criteria for receiving information	Collection costs
2. Processing of information	Matching problem with problem-solver; delay between the collection and the processing of information	Capacity of the processors	Matching costs
		Communication among processors	Communication costs
3. Transmission of information	Tacit knowledge and difficulty of communication; information appropriability	Modalities of transmission	Transmission costs
		Capacity of the Receiver	Appropriability costs

The first phase is information collection. The subject who collects information has to choose the senders to receive and the criteria for receiving information. Both decisions imply costs - selection and collection costs, respectively - that can be lowered through specialisation, mainly because this activity requires a prior investment in a receiving channel (Arrow, 1975; Demsetz, 1991). By contrast, the focus of information collection in too narrow scope can prevent the organisation from taking advantage of the variety of information sources, in particular because absorptive capacity, which influences the process of knowledge creation, can be weakened (Cohen and Levinthal, 1990).

The second phase is information processing. The information collected in the first phase is complemented with the knowledge previously possessed by the decision maker. Costs are given by matching the problem with the problem solver (matching costs) and by the elapsing time between the collection of information and its communication to the decision maker (communication costs). Both costs are influenced by specialisation. In particular, the efficiency of this phase depends on the net effect of the reduction of matching costs due to the narrowing of the range of specialisation of the subjects and of the increase in communication costs necessary for connecting the higher number

of processors (Bolton and Dewatripont, 1994). De Canio and Watkins (1998) prove that an increase in the capabilities of processing allows a flattening of the organisations by decreasing matching costs.

The third phase is information transmission. In this phase modalities of transmission are chosen and channels for communicating with the receivers are created. Transmission costs depend on the ability of the sender to transform knowledge into information. Information transmission may raise a problem of appropriability, whereby the sender has to avoid that the receiver exploit information to create knowledge that can be used to increase its own benefits at the expense of the sender.

By applying this classification, we define the decentralisation of information as an increase in the share of information which is not only collected but also processed by the same unit/firm. In the case of the firm, the decentralisation of information increases when the task of coping with emergent events of a specified activity is transferred hierarchically downwards. This implies that the upper layers do not need to process information related to that specific activity and a greater part of the information is processed directly by the collector. In the case of the network, the decentralisation of information is similarly given by the increase in the share of the information processed by the same firm who collects it. We define a fully hierarchical network as a network characterised by a single firm processing all the information, including that collected by the other firms of the network (the only difference with vertical integration being property, in that the main firm does not own all network members). By contrast, in a fully decentralised network, each firm processes all the information it collects. In any intermediate case, information will be partially transmitted by the collecting firm to another firm for processing it.

In as far as independent decision-making is the outcome of decentralised information processing, the difference to be emphasised is not the one between the firm and the network, but the one between a decentralised organisation, that according to the definition given above is a polyarchy where autonomous firms take decisions on the basis of the information processed by themselves, and a hierarchical organisation, where decisions are taken by the firm which process information collected by others and which "oversees" the production process.

In this setting the relevant problem becomes that of finding some criteria for fixing the optimal degree of decentralisation of the network. More generally, the effects of decentralisation on information management can be discussed by applying the division in phases defined above.

Phase 1. Collection of information. The receiver chooses the senders and the criteria for receiving information. In a hierarchical network, these decision are taken by the firm which collects the information and not by the firm which processes it. The splitting between collection and processing criteria may be a cause of inefficiency. The decentralisation of information reduces these inefficiencies by increasing the quantity of information processed by the same firm which collects it. If the collector and the processor are the same firm selection and observation costs are minimised. Moreover, selection costs decrease if relationships between senders and receivers are long term. As senders are the same and the same criteria are used and improved over time, scale economies in the collection of information can be exploited.

Phase 2. Processing of information. The processing of information consists principally in making collected information complementary to previously possessed knowledge. This process takes place within a network in two sub-periods: the first is the source of matching costs, namely to match the information collected to the firm possessing the knowledge appropriate to solving the problem, the second is the source of communication costs, that are necessary for diffusing the different pieces of knowledge created within the network. The decentralisation of information has two effects. In the decentralised network the matching of the problem with the problem-solver becomes the outcome of competition. Firms belonging to the network co-operate vertically but compete horizontally in order to better perform this matching. The second effect is related to

communication costs that are minimised by transmitting knowledge incorporated in the inputs produced by others.⁷ Real communication is indeed limited to the vertical communication between supplier and user. The proximity of their productive phases enhances their ability to communicate in comparison with the case of a hierarchical network, where order rather than inputs are exchanged between supplier and user.⁸ In this way, matching costs are decreased by reducing the number of problems delegated within the fully hierarchical network, and communication costs are decreased by restricting communication to adjacent productive phases, that are able to better extract tacit knowledge incorporated in the inputs.

Phase 3. Transmission of information. If the decentralisation of information allows for the substitution of direct communication with exchange of inputs, transmission can include elements of tacit knowledge because it concerns adjacent productive units which adopt similar codes of communication. Modalities of communication are consequently enhanced. At the same time appropriability costs are higher only if information is generic. The decentralisation of information increase the number of firms that process autonomously the collected information and take decisions that are incorporated in the product. The process of innovation is therefore based on inputs developed sequentially from the firms making up the productive chain. The selection of the productive paradigm is the result of a decentralised process in which local improvements are not distinguishable from the point of view of the whole productive process. Suppliers perform a specific task corresponding to a module based on exclusive knowledge which prevents other productive units from appropriating the specific knowledge of the specialized unit.

This specific pattern of information management also regards how decentralised information and consequently knowledge is made complementary across the firms of the network. The main problem to be solved in the decentralised network is indeed how to guarantee complementarities among the knowledge created by the various firms without a hierarchical arrangement and at the same time to minimise imperfect communication of knowledge. In our interpretation this task is accomplished by improving bilateral communication between firms. By limiting the activity of co-project to productive adjoining phases and by establishing stable relationship characterised by a continuous and frequent exchange of messages, adjacent firms progressively share a common cognitive frameworks determined by various factors, including the awareness of reciprocal interdependence which implies co-ordination by mutual adjustment (Grant, 1996). This process can be described as a sequence of three phases that differ according to the state of the prominent information:

a) The information is disseminated. The user decides to outsource the production of a new input and addresses a population of potential suppliers with a general idea of the new input. Some suppliers study the feasibility of the product specifying the range of possible investments.

⁷ According to Demsetz (1991, pp. 28-29): "The boundary of firms is shaped by the relative costs and advantages of putting specialised knowledge to use by means of orders or by means of selling goods accompanied by instruction on uses. The latter is advantageous when the best use of an asset does not strongly depend on it being used at a particular time and place. Giving orders and producing goods embodying specialised knowledge is thus two different way of economising with the costs of transferring knowledge. This explanation indicates that a decision to make or buy must also depend on the trade-off between taking advantage of low costs experimentation within the boundaries of a firm and taking advantage of specialised knowledge located in other firms".

⁸ In a hierarchical network the leading firm has to give orders to all the firms located in the lower layers of the hierarchy. These orders have to be given in an intelligible way for the subordinated firms. Therefore, all the subordinates must know the vocabulary and the rules necessary to understand the orders. This implies that tacit knowledge must be excluded from the content of the orders

b) The information is shared. The user accepts some proposals on the basis of an outline of the general characteristics of the product. The user and supplier co-project the prototype of the input and make the investments.

c) The information is modularised. The supplier produces the input and autonomously decides any change to the process that can derive from local shocks and unforeseen contingencies (errors, imperfections, adaptations to its own productive process). The user inserts the input in its product, autonomously introducing only the adaptations that come from unforeseen contingencies relative to its production process. Signals of problems can be derived from the market and are solved in the decentralised mode by means of the relevant information.

The sharing of knowledge between supplier and user in the second phase is crucial to manage the problem of complementarities between the two adjacent production stages. After doing that, the stage of information modularisation allows the balancing of firms' contractual power. If the supplier indeed collects, processes and transmits information, it is also the residual claimant to the rents from his knowledge processing and creation (i.e. innovation). His customer becomes dependent on him. If he is able to develop specific knowledge in the sense of not being easily imitated, this dependency of the user is high. Being able to appropriate the gains from his innovation, his incentives to improve its performance by introducing innovations are high.

More generally, in our interpretation the decentralisation of information, namely the increase in the amount of information processed by the collecting firm, creates better incentives for knowledge creation. By delegating the processing of information to autonomous suppliers rather than keeping propriety or maintaining control over the whole productive chain of the network through the exercise of leadership, suppliers are provided with higher incentives to develop specialised knowledge related to the particular stage of the production process they are dealing with because they are responsible for their performance. However, depending on various factors, such as the specificity of the knowledge developed by the supplier, the bargaining powers of the supplier and of the user vary. By allowing access to some of its strategic information (e.g. on product development), the downstream firm loses bargaining power over the supplier.

The governance form of the production network therefore becomes essential to understand the efficiency of different organizational arrangements. In particular, equilibrium in the power distribution among suppliers and user can be considered as a crucial factor in shaping efficient processes of outsourcing. The more the relations are characterised by reciprocity, decisions are taken in a decentralised way and power is evenly distributed among the firms within the networks, the more the conditions for knowledge creation and autonomous innovation are guaranteed.

5. Concluding remarks

This paper has compared the recent evolution of the processes of outsourcing on the basis of some empirical evidence concerning France, Italy and Japan. The survey has shown how small and large firms share similar patterns in the growth of the processes of outsourcing in the three countries. Independently of firm size, contracting out is increasingly seen as a powerful strategy to address competitiveness that is characterised by the reduction in the number of subcontractors for each contractor, their closer involvement in the production process, the lengthening of the relationship between contractor and subcontractor, the need for autonomous capacity of innovation for a growing part of subcontractors and finally the balancing of their contractual power. Thus, outsourcing can be interpreted as a shift away from the hierarchical paradigm of information management in which all the relevant information must flow to a central processing unit to a decentralised paradigm. In this paradigm, the network plays the role of co-ordinating the information collected and processed by the single firm through bilateral communication between the supplier and the user, while each firm processes autonomously part or all information. If the

same firm collects, processes and transmits information and at the same time is the residual claimant to the rents from innovation because it is protected from being expropriated, it will also have strong incentives to create knowledge and to introduce innovations. This implies that economic policies should consider the balance of contractual powers between suppliers and users as powerful means to create and develop local systems of production. Both for large and small firms, the decentralization of information processing is therefore the means whereby the capability of subcontractors to create knowledge is enhanced. But it is also the way through which incentives are increased because users cannot easily replace suppliers and contractual power is more evenly distributed. For example, the arrival of some large firms in clusters of small firms is often seen positively because the district firms gain access to wider markets and to financial resources. However, our analysis points to the risk that the difference in bargaining powers of the different actors may result in a distortion in information management, and a loss of capacity to create knowledge for small firms. The capacity of the whole network to develop knowledge and innovation might therefore be weakened.

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