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TECHNICAL SOPHISTICATION AND SUBCONTRACTING

Some Pointers from Research in Advanced Economies

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The paper examines the validity of the deterministic proposition that the higher the technical base of an industry, the greater the propensity to vertically integrate all production operations within the factories of large firms. The experience with the new information/computer driven technologies in some industrial economies suggests that there would be an increased role and importance of small-medium production units and homeworking over time due to downsizing of plants as also resurgent subcontracting behaviour of large firms.

I

Technology-intensive Subcontracting

There has been a clear tendency over the 1970s through the 1980s to indicate that for large firms, as they grow and take up complex activities, it would be "economic the spin-off some new specialised work" and sometimes innovation itself to small subcontractors.¹ Technological specialism of small job shops has been in great demand because "the market size is too small for the large company to consider it worthwhile to invest in the necessary technical development."² For example, even for the giant US companies in science-based or high-tech industries such as computers, aircraft, space, nuclear-power, semiconductors/microchips, telecommunications, synthetic materials etc., it is just not possible to keep track of all technical advancements in materials, electronics, hydraulics, refrigeration, manufacturing processes etc. They draw on the specialism of subcontractors in the fields of metallurgy, fabrication, instrumentation, civil engineering, manufacturing machinery etc.

The compelling—do or die—need for specialised subcontracting needs some elaboration.³ Many big firms in science-based industries are usually suppliers to other customers; they undertake large projects for customers such as government agencies or gigantic monopolies. There exists fierce competition between these suppliers so much so that they have to lower their margins to win orders—a process in which some manufacturers reduce the prices to such an extent that they suffer negative cash flows, fail to make provision for the future and thereby become weak, fail to deliver the goods and ultimately collapse. They

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operate in a regime of rapid technological obsolescence making the life-span of products shorter and shorter. To put it differently, this is a regime in which firms emphasise product differentiation. It is a severely punishing regime in which the development costs of a new product increase at an alarming rate but the life of the new product is so short that "the time available to win money from the market place is very short indeed, frequently shorter than the development time."

The supplier has to incur the basic R&D costs of the next generation product within the life-span of the present product. It has to build up highly-paid, powerful multi-disciplined teams and see that they keep track of technological advancements and apply them effectively to the present product without going haywire in diverse directions. Besides R&D costs, it has to incur the costs of bringing the product to the market place and these costs are much more than just the R&D costs. The new product must come to the market at the appropriate time lest its design gets frozen out of the market and thereby the whole effort of the supplier to prove the latest technology in the market becomes worthless. The capitalist game of innovation is thus not merciful. In the words of Maddock, "if a product or technique falls short of what the competitor is able to offer, or if the arrival in the market place is too late, then the project may be wholly abortive. This means failure not only to recover the monies spent, but even worse, inability to generate the cash surplus necessary to fund the next stages of development." As such, there is no partial success in this game; nor is there partial failure.⁴

That is why, suppliers in these technically sophisticated industries, in order to outbid rivals and meet expectations of their customers regarding designs, performance, lead time, and services, rationalise their costs by existing off supplies of specialist components, modules, processes, services etc., from subcontractors within the country or abroad rather than depend on the uneconomical and unmanageable in-house facilities for everything. Also they benefit more from the flexibly innovative outside specialists than from the rigid/frigid inside hierarchical multi-disciplined teams. This technical/social division of labour is prized for its ability to cope with uncertainty, spread the risks, reduce fixed and variable costs and thereby reduce the rates of capacity utilisation at which break-even can occur.

II

Modern Homeworking

Apart from the growth of specialist, technology-intensive subcontracting, there has been a definite resurgence of subcontracting on homeworking or cottage industry basis in Europe, Japan and the US. This has taken place not only in computer industry where software work is farmed out for subcontract to women stationed at their homes—the so-called 'teleworkers' or 'remote workers' or new technology workers—but also in the production of numerous consumer trades.⁵

The final demand for most of the consumer items has become so highly

fluctuating due to frequent changes in tastes or fashion that a highly flexible and innovative productive structure that is responsive to product demand and marketing strategies has become essential for the capitalists.

In the production sphere, the hoary Babbage principle of deskilling comes to the rescue of these capitalists. It is used to readily fragment the work into different stages. Then these fragments of work are taken to the spatially dispersed workers—mostly ethnic minority women in the case of Europe and the US. They are then supervised to vegetate over their particular specialisms at each stage.

In the distribution sphere, new technology in terms of information technology is used to acquire control over marketing and distribution. Information technology analyses changes in the market and thereby permits innovation and market segmentation. The fickleness of consumers, information technology, and production subcontracting are all synergetically inter-linked.

Information technology functions like a synaptic message from consumption to production. As it "improves communication and speeds up the possible response to fashion changes, it becomes imperative for the retailers to have access to suppliers that can modify an order readily."⁶ To illustrate, let us consider how a clothing empire such as Benetton in Italy interfaces consumption with production. Computers gauge the up-market or fashion impulses so as to swiftly satisfy them. They keep track of production and sales. The numerous distribution outlets of the company in Italy and abroad transmit detailed information on sales to the headquarters via computerised channels. The company keeps a minimum stock of undyed clothes and dyes them according to the information from the outlets (for instance, on a particular colour moving well in the market). And to speed up delivery (emptying and loading huge long-distance transport vehicles), it has robotised the warehouse. Alongside centralised managerial control on these lines, it has decentralised its productive structure through splitting up of its production cycle between many spatially dispersed small plants and again subcontracting out.⁷

In the fast-fashion-changing milieu, many big manufacturing companies have become just 'marketers', lifting whole products from subcontractors and selling them proudly as their own. On the other hand, certain large firms in the Italian knitwear industry are found to be vertically integrated; they produce good quality, standardised articles not subject to the capricious demand conditions.⁸ Thus, one may hypothesise, following Friedman, that large firms acquire direct control over all production under stable demand conditions, and flexibility through subcontracting under unstable/unpredictable demand conditions.⁹

An interesting observation here that may be noted is that the connection between information technology and homeworking on subcontract in contemporary period is very much akin to the connection between homeworking and sewing machine—the 'revolutionary' sewing machine, as Karl Marx called it—in the 19th century.¹⁰

III

Industrial Restructuring in Italy

Italy has been perhaps the most fascinating case in the whole of industrial world as regards decentralisation of production by way of reducing the plant size, splitting-up of manufacturing cycle between smaller plants and increasing subcontracting to a vast network of small and microscopic firms, artisans and domestic workers (homeworkers), since the late 1960s or early 1970s.

In Italy, following Brusco, we see 'monocultural' areas—places where firms concentrate according to a particular product, and where "all firms have a very low degree of vertical integration and the production process is carried on through a collaboration of a number of firms."¹¹ We also see a wide geographical dispersal of plants and subcontractors. This no doubt increases transport cost but in the calculus of the firms concerned, this may well be offset by the industrial peace attained due to such fragmentation of work and workforce.

The transformation of industrial structure on these lines has been first a defensive and later on an offensive reaction of the capitalists to the belligerence and disruptiveness of the organised labour in the context of unstable product demand conditions. More importantly, there has been possibility to fragment the production process "without reduction in productivity" or "without having recourse to an inferior technology". For example, in knitwear trade, the technical level of most of the stages of production as carried out by parent firms or subcontractors is found to have been advanced.¹² This point is made clear with another illustration as follows: "The Morino motor cycle plant in Bologna has 100 employees and produces an average of 20 motor cycles per day. Most of the workers in the plant are engaged in assembly, on lines on which the tasks are not very subdivided. Except for the crankshaft and the engine mounting, all of the components are put out: the frame, the tank, the shock absorber, the handlebars, the brakes, the gear and the wheels; almost the whole machine is produced by subcontractors. And the key point is that they are produced with precisely the same techniques which would have been used had the firm decided to make them directly."¹³

As Brusco points out, "with certain technologies there is no advantage in producing all the components of a product under a single roof: whether they produce similar or different pieces, 20 lathes have substantially the same productivity if they are gathered or dispersed in separate buildings. This is what economists mean when they assert that economies of scale should be calculated in the first instance for phases of production; and the economies which result from juxtaposition of similar operations are often negligible. It could be noted, therefore, that generally the sectors in which this type of industrial structure prevails are those characterised by limited economies of scale of vertical integration."¹⁴

The work that is put out and sub-put out in what the Italian bourgeoisie love to call 'diffused factory' ranges from 'skilled well-paid work using advanced technology to dirty, dangerous and deskilled work'. Within the main plants,

computers have restored the power of the top managements over the shopfloor. They have brought about efficient work-flow co-ordination by throwing into the dustbin the rigid hierarchy and cumbersome paper work of the erstwhile Taylorite or Fordist work organisation. An example of a computerised solution: "In one Bologna engineering firm there is a computer terminal for every 13 employees. The terminals are used to both issue orders and to collect, feedback, memorise and co-ordinate information. The course of each part is monitored and information about individual machines and workers, such as worktimes and 'performance' are constantly recorded. Information from the four basic divisions of the factory, production, marketing, stock control and planning arrive at the central computer and data base is recorded and analysed on a day-to-day basis. Information arriving from one department will automatically lead to co-ordination with other departments through the computer's central program."¹⁵

the computerisation of management has in way contributed to the growth of subcontracting networks, compatible with the move towards flexible mechanisation (involving numerically controlled machine tools, robotics and flexible manufacturing systems) in the plants of the large parent firms. For instance, Olivetti has subcontracted out standardised modules involving circuit board assembly and wiring to domestic workers. These modules go through computer controlled testing in the main plant where robots are progressively introduced.¹⁶

The most interesting change has occurred in the automobile industry in the case of FIAT which has dismembered the organised proletariat through flexible automation and productive decentralisation through splitting-up and subcontracting. This is not all. In the early 1980s FIAT embarked on a "devastating rationalisation of outside suppliers, . . . cutting the number of its suppliers by two-thirds and encouraging the survivors to raise productivity and begin to sub-assemble parts in their own firms."¹⁷ This was related to FIAT's reduction of car models from 10 basic bodies to 6, and engine types from 36 to 24. And the cars produced now require fewer parts and fewer welds thereby reducing the break-even level for simpler cars.¹⁸ The simplification of the design structure and the consequent lower component count besides the need for producing the newer parts with very high technical requirements mean that relatively inefficient smaller subcontractors will have to go under or switch over to other customers, if possible.

IV

Japan

In Japan, the so-called 'Mecca of vertical disintegration', it is worth noting how parent firms impose technical progress and price cuts on their subcontractors, ('shitaukes'). Note the following vivid illustration: "Japan's hierarchical system of subcontracting is forcing even smaller companies to automate quickly. At its factory employing 300 workers in the vast industrial sprawl of west of Tokyo, a big supplier of frames for televisions and video recorders called Tensho Electric

has recently installed five painting robots. Tensho Electric has recently installed five painting robots. These have proved cheaper, 50 per cent quicker and more reliable than skilled paint workers, who take three years the train... Every year Tensho is told by its buyers, big companies like electronics maker Victor Co. of Japan, to cut its prices. Tensho passes on the message to its own subcontractors, who make one-third of the final products it sells. So...it persuaded a tiny firm nearby called Plum Electric, employing only 15 people, to buy a painting robot. Tensho sent its own men to show the small firm how to use it. It is pressurising three other similar suppliers to buy painting machines too. Now Tensho thinks it can safely ask for a cut in what it pays suppliers, without jeopardising the quality of what its subcontractors make."¹⁹

Such rationalisation explains the efficiency—cost saving, productivity increases, low rejection rates of parts—and competitive strength of the Japanese industrial system. Also notable is the way the final assemblers keep not only their factories but also their subcontractors in perpetual alert through a system of stock control called 'just-in-time' or 'kamban' or 'supermarket' or 'semaphoric card' system. This system, modified recently by the use of computers, calculates stock requirements on an hourly basis and synchronises the production programmes of the final assemblers with the deliveries of parts of technically advanced subcontractors. The system minimizes or eliminates altogether all waste of time and materials and has made a profound difference in the competitive power of the Japanese plants and the US plants although both of them are said to use similar machines and assembly lines.²⁰

The out-house to in-house ratio of the Japanese car production has been the highest in the world. Unless the makers of the bought-in items supply defect-free, punctual deliveries, systematic flow of final assembly lines is not possible. Hence the above unique system of rationalisation.

When rapid changes in production mix take place at the final assembly plants, necessitating small lot production of different parts for different models with different specifications, the subcontractors cannot cope with this unless they too are flexibly mechanised. In this connection, a survey in 1983 found that many small subcontractors in Japan have attained technical standards "that were either a match...or superior...to those of their principals." More importantly, capital tie-ups between big companies and subcontractors have been on the rise. In some industries, "the capital invested by major manufacturers in subcontractors or other affiliates has come to exceed the value of the parent companies' own capital." This may imply that many 'big boys' or 'fat cats' are fast becoming just marketers, shifting all production to subcontractors by building up their capacities, or that they are financially assisting the 'little guys' or 'puppy dogs' to technically upgrade themselves in terms of computer integrated manufacturing. Another major trend has been the rapid growth in the number of small venture businesses based on mechatronics (i.e. combination of mechanical and electronic technologies resulting in computerised numerical control machine centres and intelligent robots) in step with the new product market conditions. Some of these specialise in product development and subcontract actual production work to other firms which have mastered new production technologies.²¹

Further, this new industrial structural shift, according to the same survey, was proving that the biggest was no longer the best in manufacturing, and that, in a nutshell, the big was indeed being replaced by the small at the leading edge of economic growth.

V

The United States

In America, technological breakthroughs in cutting, sewing and sales and distribution have contributed to centralisation of all production operations by larger garment shops as also international subcontracting of sewing operations.

Computer-guided laser systems and numerically controlled devices are used in cutting. Thread cutters, parts stackers, needle positioners and button feeders have been used to eliminate the most skilled part of the work: guiding the material through the machine at an extremely fast pace which takes 80 per cent of the total sewing time. There is automatic button sewing system. Tape controlled machines have mechanised embroidery. Sonic sewing "where a wheel or 'horn' vibrates the fabrics at such high speeds" has resulted in their fusion. The large companies have used these breakthroughs to integrate production and assembly between their plants themselves, by doing cutting in one plant and sewing in another. There is, therefore, no need for subcontracting—domestic or international—if the sewing is automated but for cotton clothing, this is considered very unlikely.²²

In the US engineering industry, 75 per cent of parts are manufactured by small subcontractors in batches of 50 or less. It is interesting how the choice for a large firm, between in-house numerical control machining on the one hand and subcontracting on the other, is determined, according to a machinist himself as follows.²³ The large shops have subcontracted certain parts "not especially well suited to numerical control techniques". These parts, conventionally machined by skilled operators, are simple parts required in small runs and complex parts in very small runs. As numerical control tools are used for continually producing particular types of parts and because of their large initial costs, smaller job shops do not have such tools. They cannot afford them and they cannot "always predict what kind of parts they will be hired to produce next". So, "in order to compete with numerical control, small capitalists must squeeze more out of their workers, which is easier to do when the shops are non-union. If small capitalists can squeeze the cost of making a part down below that of a part made by numerical control processes, subcontracting becomes an attractive alternative for large manufacturers."²⁴

One of the main reasons why the American automobile makers have lost to the Japanese competition since the 1960s is that they are more vertically integrated than the Japanese rivals, and therefore, they have higher fixed costs, direct labour costs, and inventory-output ratios than that of the Japanese makers.²⁵ But recently, from late 1970s, as the Japanese exports and more so Japanese production within the US had them literally quaking, the American

makers have started taking a number of measures to salvage their unprofitable situation²⁶; the pertinent ones in relation to the discussion here are as follows.

They have increased domestic subcontracting of parts and components, especially for their small subcompact models. In-house production of these is no more viable because while the cost of capacity (net assets employed per vehicle built) has soared, profitability (return on invested capital) has fallen so much so that growth is extremely difficult to fund internally.²⁷ The server resource crunch due to the collapse of gas-guzzling big-car sales and consequent devastation of their profit-structure has created the imperative to subcontract out rather than make in-house. The cash crisis is also due to the massive capital investments required to gear themselves to producing the small models. In this milieu, they have started entering into more durable relationship with the subcontractors so as to draw on their knowhow and make them share the burden of shifting to small car production.²⁸

They have resorted to cost-cutting by also progressively shrinking the car sizes. The automakers (not only in the US but elsewhere) have been "testing a wide array of plastics and metal products and processes to find which are the most cost-effective in the struggle to reduce auto-weight."²⁹ There has been the tendency to take out of the car as much metal as possible and replace it by polymer-based material, and to use simpler, lighter and more efficient engines and transmissions.³⁰ This tendency has progressively eroded the market for the subcontractors' "bread-and-butter items, such as sheet metal stampings and iron castings." Thus, the foundry subcontractors have been adversely affected by the urgent pace of changes as also by the longer learning curves involved in adapting to changes or diversifying.³¹

Though the subcontractors have been given long-term contracts, they have been pressurised to upgrade their operations as also roll back earlier price increases. In fact, the subcontractors are squeezed so much so that only technically advanced, relatively larger and diversified parts-makers could benefit from the 'booming' business in small-car parts.³²

In the light of new product market pressures, the American automakers have also redesigned the final assembly by replacing the Fordist (mass production) techniques by neo-Fordist techniques (flexible manufacturing) of building "a wider variety of cars on each assembly line without creating a parts-flow nightmare."³³

Another point to note here is that the American manufacturers had enjoyed large profits on full-size and intermediate models based on front engine-rear wheel drive designs. But in the highly competitive new era of efficient front-wheel drive small cars, the profit margins are said to be smaller. The trend towards producing highly simplified 'world car' models based on standardized and interchangeable modules would result in the death of many a small subcontractor.³⁴

VI

Britain

In Britain, in industries such as printing and shoe-making, large-scale produc-

tion as well as homeworking have developed. The printing industry has vertically disintegrated due to changes in photo-reproduction, composing and plate-making. Wilkinson observes: "There is now convincing evidence that in Britain at least parts of the industry are being reorganised on a cottage industry basis. Each successive phase of the production process—i.e. design, composing, plate-making, printing and finishing—can be subcontracted to specialised producers, the network being organised by the customer or by a contractor who may not be directly involved in any part of production. However,...developments in photo-composition and plate-making favour large-scale production, and here and in other parts of the industry there are signs of specialised firms growing to a fair size." Also, in shoe-making, "machines small enough to be used by homeworkers are being developed which allow several stages of the shoe assembly process to be carried out as one—though automatic stitches, used to sew the uppers, are only viable with long-runs."³⁵

VII

France

In France, subcontracting is "rapidly increasing despite the fact that surveys show that owners of small firms do not favour a rapid increase in subcontracting because of the dependence it creates and the loss of company identity it implies."³⁶ A much recent empirical study in North East France reveals how changing demand and competitive conditions and restructuring programmes (including flexible mechanisation) of the main firms have badly affected the French subcontractors, for instance, in metal working industry, where foundries subcontracting from automakers such as Peugeot-Citroen and Renault have been hard hit not only by the effects of overcapacity of automakers but also by their reorganisation involving greater internalisation of production chain.³⁷

VIII

Concluding Remarks

The business practice of subcontracting, which explains to a considerable extent the persistence of smaller firms in industrial countries in the post-war period, cannot be considered to be an archaic, technology-retarding or growth-thwarting phenomenon. Subcontracting as a specific form of industrial organisation as such is not becoming *passé* with the onset of new technologies, although there is no gainsaying the fact that those small and tiny subcontractors who cannot upgrade themselves in tune with the product and process changes effected at the larger parent firms, would be out of the new industrial revolution rat-race.

It seems, as of now and for quite some time to pass by, despite there being some exceptions in terms of country, industry, firm, product, market and profitability specificities, there is not really much basis for the deterministic

proposition that the higher the technical base of an industry, the greater the propensity to include all the processes in the factories of large firms. To put it properly, indeed, there is no inevitability for that to take place.

Moreover, surely, the small-medium and tiny manufacturing firms and homeworking are not "anachronistic survivals in a world of a promising technology". They are not "outmoded and a sign of technological and economic immutability" either.

In fact, new literature reveals that the newly emerging information/computer driven technologies are leading to a fairly decisive shift in the size distribution of firms in industrial countries by being more conducive to small-medium rather than large firms. The new technologies are facilitating the strategies of large firms to opt for a new form of industrial organisation involving, *inter alia*, subcontracting, viz. use of networks in production—networks of small plants and firms clustered around particular large enterprises.³⁸ They also facilitate widely dispersed domestic and international subcontracting arrangements.³⁹ They are also giving an immense boost to the 'special advantages' that smaller firms have in terms of fulfilling small batch subcontract orders from larger firms, innovative capabilities, flexibility of production for meeting the demands of special and small segments of the market etc.⁴⁰ These effects of the new technologies are expected to increase the role and importance of small firms in industrial countries so much so that recently the new subject of 'Small Business Economics' came into existence in order to generate a better understanding of the economic role of small firms as also the relationships between large and small firms in the process of modern economic growth.⁴¹

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