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**The Organization of
Industry Re-visited**

by

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Introductory

I published an article in 1972¹ which sought to explain the way in which industry is organised, focusing in particular on the "dense network of cooperation and affiliation by which firms are related", this being a phenomenon which attracted the interest of economists less thirty years ago than it does now. In this further paper I shall endeavour to extend and improve the 1972 analysis, focusing in particular this time on the role played in the working of the system by intermediate output, by the products, that is to say, which firms buy and sell to each other. The two papers differ therefore in respect of the principal feature of industrial organisation on which they seek to throw light, but also, perhaps less obviously, in that the earlier paper endeavoured to explain the structure of industrial organisation at any particular time, whereas this one is concerned with how this structure enables the economy to respond to that most enduring circumstance, ceaseless change. In shifting the analysis from state to process I hope to show how efficient adjustment of the economy to changing conditions is facilitated by the emergence of appropriate intermediate output.²

Modes of coordination

A natural starting point for an analysis of economic organization is the recognition that the division of labour, upon which the wealth of nations depends, creates the need for means of coordination. Adam Smith, in the very first chapter of the *Wealth of Nations* illustrates the complexity of the required coordination by making us vividly aware of the all but limitless number and variety of activities that are involved directly and indirectly

¹ "The Organization of Industry" was first published in the *Economic Journal* in September 1972 and reprinted both as an appendix in my book *Information and Investment*, Oxford University Press, 1990 and in *The Economics of Imperfect Knowledge; Collected Papers of G B Richardson*; Cheltenham, UK: Edward Elgar.

² This paper represents a development of the thinking set out in my 1972 article and earlier work. But I was stimulated to write it by an article by Richard Langlois referred to in the concluding bibliography. I am much indebted to him and also to Brian Loasby who provided me with valuable detailed comment on an earlier draft. Perhaps I should also explain to the reader that I ceased to be an academic economist less than two years after writing the 1972 article and cannot claim to have read all the very extensive literature on industrial organization that has appeared since then. Perhaps my subsequent experience in business, or even my sustained brooding on the phenomena, may offer something by way of compensation

in the "homely production" of a woollen coat.³ The division of labour, he famously maintained, is limited at any one time by the extent of the market, but creates over time increases in wealth, a wider market and, in a never ending process, a further division of labour, continuous organisational metamorphosis and sustained economic growth.

Smith attributes this growth to the increased productivity afforded by specialisation. In his account of the making of pins, he discusses both specialisation within a factory and specialisation among "trades". Specialisation within the pin factory, he relates, by having each worker undertake only one or two of the eighteen or so required operations, yields an output per man of several thousand pins a day, whereas a man working by himself would be hard put to it to make one pin per day. If there were no specialisation among trades, so that "the same person was to dig the metal out of the mine, separate it from the ore, forge it, split it into small rods, then split these rods into wire.... a man could with his utmost industry scarce make a pin in a year."

Both the division of labour within firms, and the division of labour among them, creates the need for coordination. Smith showed, in so far as inter-firm specialisation was concerned, that coordination could take place spontaneously through exchange, this taking the form, in modern economies, of trading in markets. Regarding coordination within a workplace, he has little to say. In the "trifling manufacture" with which he illustrates his argument, one overseer would have been sufficient for the "small manufactory", employing ten men, to which he refers. But if we consider the need to coordinate the efforts of a thousand workers, or even a hundred, a more elaborate arrangement would have to be in place. Most economists seem to have followed Smith in deciding that it was not their province to consider how coordination of this kind could best be achieved or how much it would cost. Many deemed it sufficient to say that within firms, the coordination of activities was obtained through "administration".

³ Very foreign to his thought is the modern concept of a "production function" which purports to show the maximum output obtainable from any "given set" of inputs, irrespective of the total productive context in which any particular process of transformation is embedded.

Planned Coordination

Whatever means are chosen, there is reason to believe that the difficulty and cost of planned coordination is likely to increase, and increase disproportionately, with its scope.⁴ Let us for a moment suppose that scope in this context can be equated with the number of activities to be coordinated. Given three activities, a, b, and c, there are only three distinct relationships that can obtain between any pair of them, these being, ab, bc and ac. With four activities, a, b, c, and d, there are six possible paired relationships, these being ab, ac, ad, bc, bd, and cd. With the ten men in Smith's manufactory, there would be 45 such relationships between them. In a business employing three thousand people, the number would be 4,498,500. In the general case, with n activities, there are $n(n-1) / 2$ such possible relationships.

Of course, the complexity of an organisation, and therefore the difficulty of coordination within it, cannot be appropriately measured by counting relationships in this way. In practice, the complexity of the required coordination is greatly reduced by the fact that not every individual activity need be coordinated with every other. Within the distribution centre of a book publishing business, for example, those working in the warehouse have to cooperate in an organised way; they not each have to deal, however, with individual editors - and much confusion would result were they to do so. In this industry, as in organizations generally, coordination can be achieved through appropriate departmentalisation. Sub-systems are created within which coordination can be brought about, not so much by issuing detailed instructions but by prescribing roles and rules for organized cooperation. Hierarchical arrangements can then be put in place to coordinate the work of these sub-systems. There is, of course, a great management literature about how this may best be done. It is sufficient for my immediate purpose to recognise that arrangements of this kind are by no means costless and never work perfectly. As the

⁴ This circumstance has for long concerned economists as perhaps providing the explanation for "diminishing returns to management" and a limit to the size of a firm. The issue is discussed, for example, in R.H.Coase's famous paper, *The Nature of the Firm*, in which he says that at a certain point "the cost of organizing additional transactions with the firm may rise". And although many economists may limit themselves to saying that coordination within the firm is achieved by "administration", those working in business studies do concern themselves with the organizational arrangements that have to be put in place.

number of departments increases, so also will be the layers of management required. The process, that is to say, necessarily becomes more bureaucratic and any chosen organisation will be a compromise that works imperfectly.⁵

Planned coordination within a firm encounters further difficulties, difficulties other than those associated with the number of activities, or stages of production, within its scope. In the 1972 article I refer to activities as being *complementary* when they are required for the production of a particular product, and as *similar* when their successful undertaking requires a firm with an appropriate *capability*, that is to say appropriate organisation, knowledge, skills, reputation and market connections. A firm will therefore find it difficult to coordinate activities for the undertaking of which its capabilities⁶ are unsuited. It may be able to do so, however, through cooperation with firms that is endowed with appropriate capabilities. The variety of cooperative arrangements available is discussed in my 1972 article.

Further obstacles to planned coordination will, however, still remain. One such is created by differences in the scale at which particular activities can be carried out most efficiently. The activity with the largest minimum economic scale will determine the cost minimizing output for the whole process. If the market cannot support the associated

⁵ This was certainly my own experience when Chief Executive of Oxford University Press. If a publishing house has departments for all broad category of book, each of which contains both editors and marketing personnel, then the ease of interaction between these different staff, and the sense that they are all members of a team, will yield substantial benefit. School text books, for example, will be better adjusted to course requirements and marketing staff better able to promote them. Similar benefits are obtained if, within each editorial division, there are staff responsible for designing the books and preparing them for manufacture. On the other hand, there are some advantages to be had from having all marketing staff, or all those responsible for design and production, together in specialist divisions; in this way staff will be kept more continuously employed as increased demand for their services from one publishing category may be balanced by a reduction in the demand from another. There is no perfect organisational form, as any actual management structure will exhibit advantages in some respects that have been acquired at the cost of disadvantages in others. The reader will have noticed how the advantages and disadvantages featuring in this discussion of inter-departmental specialization echo those relevant to the appropriate degree of specialization among firms.

⁶ Professor Loasby has pointed out to me the importance of bearing in mind that capabilities are subject to change and development and that there is room for conjecture by firms about the new activities for which they may be appropriate. This looseness of connection between capabilities and activities is a source of the variety, and subsequent selection, characteristic of capitalism.

volume of output, so that a smaller output is planned, then one or more of the stages of production will be operating at less than minimum cost.

A further disadvantage of intra-firm coordination arises from the fixed costs incurred at each stage. A firm choosing to undertake a particular stage of production in-house may hope thereby to gain the assurance of having what it wants when it wants it, but at the cost of installing capacity, which, from time to time, may exceed or fall short of what is needed. The greater the number of complementary activities the firm itself undertakes, the greater will its investment in equipment or staffing levels which cannot be scaled up or down in response to changes in demand. Flexibility will have been reduced, and risk increased. Provided that one of the production stages is associated with a vendible good or service, a firm may endeavour to deal with surpluses or shortages by resort to the market. As to do this effectively, however, a firm would have to set up, and meet the cost of marketing and buying departments, both intermittently operating, it may choose, rather than have the worst of both worlds, to abandon planned in-house coordination in favour of coordination through markets. It is to this latter process that I now wish to turn.⁷

Market coordination

The practicability of market coordination depends on the availability of appropriate intermediate products and services, by making use of which, firms can replace stages in

⁷ I was in this matter also deeply influenced by my experience at Oxford University Press. When I became its Chief Executive it comprised the three complementary activities of publishing, printing and paper making. Publishers require a changing variety of printing and binding and of types of paper but neither a printing house nor a paper mill is capable of continuous variation in the kinds and amounts of its fixed equipment. Inevitably, therefore, it was impossible for OUP to keep in-house demands in balance with in-house supply potential. The three parts of the business had drifted apart, the publishing side turning when necessary to outside suppliers and the printing and paper businesses selling a large part of their output on the market. Effectively OUP had become a conglomerate, printing and paper making being obliged to bear the cost of marketing staffs which in any case suffered from the disadvantage that potential buyers of their print and paper could be deterred by the expectation that, at times of shortage, OUP publishing would get preferential treatment. In the language of the 1972 article, moreover, the three activities were dissimilar, requiring different capabilities – in technology, organisation etc – for their effective undertaking. When the business gave up printing and paper making it became able successfully to expand into activities, on a world wide basis, for which its central capability in publishing gave it a comparative advantage. .

the production process.⁸ Thus, in the case of Smith's pin manufacture, neither the digging of the metal out of the mine, nor its separation from the ore, though complementary with the subsequent operations he referred to, are so *closely complementary* with them as to require their joint undertaking as stages in an integrated process; they result in metal that can be bought by those engaged in the subsequent stages of pin making and of course by many other trades. But not all complementary activities can be separated out to provide intermediate output; the heating of the wire in the process of pin making does not result in a marketable good, but must be undertaken together with its drawing and cutting in a joint, planned operation. Frequently, the issue need not be so clear cut. Some competing publishing houses paid Oxford University Press, which had branches in India, to distribute their books in that country, but undertook their own distribution in the United Kingdom. The issue depended on a balance of balance of considerations in each case. The literature about "make or buy" focuses on cases where a difficult balance has to be struck, but for much of the time the choice is clear. No firm would consider integrating in – house more than a small number of the all but limitless number of activities associated with the production of its output. We can be sure, however, that although the development of intermediate goods reduces the required scope of intra-firm, planned coordination, the need for it remains. The invisible hand helps, but leaves work for firms to do.

As we have seen, Smith himself viewed the splitting up or decomposition of the process of production as a continuous and never ending process in which economic growth is both engendered by the division of labour and provides the opportunity for its further development. As part of this process, there will emerge general-purpose intermediate goods which have outlets numerous and varied enough to offer the prospect of scale economies and a predictable sale. The buyers of these goods or service substitute them for activities, probably dissimilar, which would otherwise be part of the process of

⁸ I am indebted to Professor Loasby here also for drawing my attention to Professor Demsetz's observation about "the importance of "encapsulating this [production] knowledge into products or services that can be transferred between firms cheaply because the instructions needed to use them do not require in-depth knowledge about how they are produced" in *Ownership, Control and the Firm* (Basil Blackwell 1988) p159.

production and by doing so reduce the scope of the planned coordination they have to undertake. The producers of intermediate goods may seek a market through the displacement of activities, which potential purchasers already undertake or may introduce new intermediate goods designed to induce firms to bring out new products or change the way in which they make old ones.

Dynamic Efficiency

The emergence of intermediate products yields the scale economies and other direct productivity gains which Smith associated with specialization. At the same time, it facilitates market coordination and thus enables firms to reduce the scope, and therefore the cost, of the planned coordination they are obliged to undertake.⁹ But intermediate products make yet a further contribution not mentioned by Smith and still perhaps given insufficient attention; by giving flexibility to the economic system, they improve its efficiency. Economic theory has used the logic of choice to develop formal conditions for optimal resource allocation and therefore, one might say, for "static" economic efficiency. It has also sought to show that given free competition, and subject to many important qualifications, there would be a tendency for these conditions to be realised. My concern now will be with the efficiency of this process of realisation. I shall seek to show how industrial structure – in particular the availability of general purpose intermediate products - affects the speed and the economy with which output adapts to changes in the pattern of demand, in factor prices or in technical possibility. I shall be concerned, it may therefore be convenient to say, with the *dynamic efficiency* of the system. Efficient adaptation, its speed and economy, requires that the human and material resources released by reducing the output of one commodity can be re-deployed as promptly and fully as possible for the production of others. It requires also that firms are

⁹ The splitting up of productive activity within firms linked through market transactions is in some ways analogous to the departmentalization employed to simplify the process of coordination within firms. In the former case, coordination is achieved through the purchase and sale of a good or service, in the latter, most commonly through the planned coordination of departmental activity but sometimes through inter-trading between departments on the basis of transfer prices. The common factor is the simplification of the process of coordination afforded by the grouping of activities. The important difference, of course, is that independent firms are free to trade as they will whereas the departments of any one firm are not.

able to respond to a profit opportunity with minimum delay and with no more than the minimum necessary resources being put at risk.

This is a matter of some importance. We are obviously not entitled to assume that, say, a change in the pattern of demand will necessarily be followed by a full, timely and appropriate redistribution of the relevant human and material resources. We are not entitled, in other words, to assume that the process of change is costless, without structural unemployment, temporary or permanent. So long as we think in terms of a stationary state equilibrium, then, of course, it does not matter. But in the state of permanent flux, the state in which real world economies find themselves, the costs associated with the process of change become important. From the point of view of investing firms, or indeed for all those who commit resources on a long term basis and specialised form, the issue features in terms of risk. The risk associated with responding to an investment opportunity is increased the greater the volume of resources that has to be committed in this manner.

It is easy to see how general purpose intermediate goods, emerging with or without schemes of standardisation, give an economy the flexibility¹⁰ required for resources to be re-deployed with minimum waste and delay. Such goods, when released by a reduction in the output of one commodity are, by their nature, suitable for the production of a number of others. Firms contemplating an increase in the output of an existing product, or the introduction of a new one, are able, to the extent that they can use such goods, both to benefit from the economies of scale enjoyed by their specialist suppliers and to reduce the fixed equipment that they themselves have to install. As a result, they are more ready and willing to respond to a perceived opportunity. The suppliers of such goods do not have this systemic function in view, but as Smith put it, are "as in many other cases, led by an invisible hand to promote an end that was no part of his intention".

¹⁰ We can think of flexibility, in this sense, as having a role, for an economy, analogous to that which liquidity has for an investor.

In buying general purpose intermediate products, a firm does not merely pass on a risk from itself to its suppliers. As these suppliers, having a number of customers, can benefit from the pooling of risks, the total exposure of users and suppliers combined is thereby reduced. In some circumstances, moreover, a decline in demand from some buyers may itself bring about an increase in demand from others. If one firm's sales rise at the expense of another's in the same line of business, then their combined purchases of an intermediate product need not be affected. And even if all the firms in a contracting industry have to cut back their purchases, a compensatory increase in demand may be forthcoming from industries in expansion. The shock resulting from the cutback may therefore be dampened at this first stage and subsequently further dampened, in a similar way, when the suppliers affected reduce the purchases of intermediate goods that they themselves buy.

Some further reflections

It may be helpful first to recapitulate the argument so far. The division of labour in free enterprise systems results from the search for profit opportunities offered by exploiting the economies of specialization and scale. As an unintended result, there develops an articulated industrial structure which enables firms more readily to respond to perceived opportunities. General purpose intermediate goods which can substitute for particular stages of production are available as and when required, thus limiting the resources that investing firms themselves have to put at risk. The reduction in risk for these firms is not offset by an increase in the risk born by their suppliers, who gain from pooling. The net result is a reduction in risk for the economy as a whole, this being made possible by the loose coupling of productive activities afforded by the availability of general purpose intermediate goods. The economy is better able to handle change by having at its disposal, as it were, a variety of ready made building blocks capable of redeployment and re-assembly.

Almost half a century ago I was much exercised by the question of whether the extent of firms' discrimination against risky returns might cause aggregate private investment to fall short of its socially optimal level. One consideration among many was that the return

from private investment as a whole was, because of pooling, less uncertain than the estimated returns upon which individual investment decisions would be based. I addressed this very complex issue at some length in chapters 9 and 10 of my *Information and Investment*, but failed at that time to take account of how the risk pooling undertaken in the supply of intermediate goods limited the risk born by investing firms making use of them. I did not then appreciate the extent to which industrial organisation develops, through the emergence of these goods, in such a manner as to reduce the resources which a firm has to deploy in order to respond to an investment opportunity.

I have argued that the cost and difficulty of planned coordination will increase disproportionately with its scope and that, for this reason, a firm will commonly find it advantageous to replace stages of production, where possible, through the purchase of appropriate intermediate goods. How then are we to reconcile the resultant division of labour among firms, the disintegration of production, with the evident existence of large scale enterprise ? One explanation is the continuing need, in some processes of production, for the close coordination of a large set of complementary activities, coordination of the kind that cannot be effected through market transactions but which has to be carried out directly within firms or through cooperation between them. But there is another explanation for the existence of large scale enterprise. Firms have an incentive to expand into similar activities, activities, that is to say, which exploit their particular capabilities. The similarity of activities does not give rise to the difficulties of coordination associated with their complementarity; similar activities do, of course, require to be coordinated financially, but the cost and difficulty of doing so need not rise disproportionately with their number. Furthermore, diversification into similar activities, provided they relate to different markets, has the further important advantage that it reduces risk, whereas the integration of complementary activities increases it.

The diversification of firms into similar activities further promotes dynamic efficiency by giving an economy a second line of defense against potentially disruptive change. Unless a new technology undermines a firm's central capability, the loss of a market for any one of its products can be made up by expansion into other similar ones. Any firm moreover

can, and will indeed be obliged to develop its capabilities over time in response to perceived change in circumstance. It is for these reasons that organisations can outlive their current product list, their equipment and their personnel, so that the pattern of relationships which define them, their traditions, attitudes and styles, may, if only diminishingly, persist. This circumstance may of course inhibit an economy's ability to respond to change and there is certainly plenty of historical evidence to show how the conservatism of firms, trades and whole economies can impede their adaptation and bring about their decline. But there is also historical evidence to show that organisations cannot, on a wholesale basis, without loss and damage, be dismantled and costlessly reconstructed to meet every challenge of change. Their creation, maintenance and development takes effort, time and experience and, imperfect though the institutional inheritance of an economy or indeed a country may be, there are times when adaptation is preferable to radical replacement.

I have tried, in this paper, further to explore how market economies really work. In the Walrasian system order is brought about through a hypothetical and complete system of contracting. Contracting does indeed play a part in furthering coordination in the real world, but a part limited by the unwillingness of buyers and sellers to enter into long-term commitments in the face of ineradicable uncertainty. Writers since Walras have sought to save his model by introducing the notion of conditional contracts applying to all possible future states of the world. But by drawing attention to a process of coordination which could never work in the real world, it may cause us to lose sight of one which clearly does. Informed production decisions, in relation to both final and intermediate goods, are made possible, in large measure, by the greater predictability afforded by aggregation. And the important point here, neglected in our formal models, is that the organisation of industry evolves spontaneously to provide this aggregation and predictability. The producers of consumer goods seek a wide market partly in order to realise scale economies but also in order that fluctuations in individual consumer demands can cancel out. And the producers of intermediate goods likewise have an incentive to fit a wide and diverse market. In this way not only the organisation of industry, but the nature of products themselves, adjust so as to provide firms with greater

predictability and to endow the economy with the flexibility that reduces the waste of resources associated with adaptation to change. These indirect systemic effects of individual actions can find no place in models which assume a given market structure and a given list of goods, but they are surely of vital importance to the working of the economy.

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Bibliography

- Demsetz, Harold 1988 *Ownership, Control and the Firm* Oxford :Basil Blackwell.
- Loasby, B.J. 1991. *Equilibrium and Evolution*. Manchester: Manchester University Press.
- Loasby, B.J. 1999. *Knowledge, Institutions and Evolution in Economics: Graz Schumpeter Lectures II*. London and New York: Routledge.
- Langlois, R.N. 2002. *Modularity in technology and organization*. Journal of Economic Behavior and Organization, No.49, 2002.
- Richardson, G.B. 1960/1990. *Information and Investment: A Study in the Working of the Competitive Economy*. (1st/2nd edition) Oxford: Oxford University Press.
- Richardson, G.B. 1972. The organisation of industry, *The Economic Journal*, 1972 (Republished in Richardson 1990 and Richardson 1998).
- Richardson, G.B. 1975. Adam Smith on competition and increasing returns. In A.S. Skinner and T. Wilson (eds), *Essays on Adam Smith*. Oxford, UK: Clarendon Press
- Richardson, G.B. 1960/1990.(Re-published in Richardson 1998).
- Richardson, G.B. 1998. *The Economics of Imperfect Knowledge: Collected papers of G.B. Richardson*. Cheltenham, UK: Edward Elgar.

Danish Research Unit for Industrial Dynamics

The Research Programme

The DRUID-research programme is organised in 3 different research themes:

- *The firm as a learning organisation*
- *Competence building and inter-firm dynamics*
- *The learning economy and the competitiveness of systems of innovation*

In each of the three areas there is one strategic theoretical and one central empirical and policy oriented orientation.

Theme A: The firm as a learning organisation

The theoretical perspective confronts and combines the resource-based view (Penrose, 1959) with recent approaches where the focus is on learning and the dynamic capabilities of the firm (Dosi, Teece and Winter, 1992). The aim of this theoretical work is to develop an analytical understanding of the firm as a learning organisation.

The empirical and policy issues relate to the nexus technology, productivity, organisational change and human resources. More insight in the dynamic interplay between these factors at the level of the firm is crucial to understand international differences in performance at the macro level in terms of economic growth and employment.

Theme B: Competence building and inter-firm dynamics

The theoretical perspective relates to the dynamics of the inter-firm division of labour and the formation of network relationships between firms. An attempt will be made to develop evolutionary models with Schumpeterian innovations as the motor driving a Marshallian evolution of the division of labour.

The empirical and policy issues relate the formation of knowledge-intensive regional and sectoral networks of firms to competitiveness and structural change. Data on the structure of production will be combined with indicators of knowledge and learning. IO-matrixes which include flows of knowledge and new technologies will be developed and supplemented by data from case-studies and questionnaires.

Theme C: The learning economy and the competitiveness of systems of innovation.

The third theme aims at a stronger conceptual and theoretical base for new concepts such as 'systems of innovation' and 'the learning economy' and to link these concepts to the ecological dimension. The focus is on the interaction between institutional and technical change in a specified geographical space. An attempt will be made to synthesise theories of economic development emphasising the role of science based-sectors with those emphasising learning-by-producing and the growing knowledge-intensity of all economic activities.

The main empirical and policy issues are related to changes in the local dimensions of innovation and learning. What remains of the relative autonomy of national systems of innovation? Is there a tendency towards convergence or divergence in the specialisation in trade, production, innovation and in the knowledge base itself when we compare regions and nations?

The Ph.D.-programme

There are at present more than 10 Ph.D.-students working in close connection to the DRUID research programme. DRUID organises regularly specific Ph.D.-activities such as workshops, seminars and courses, often in a co-operation with other Danish or international institutes. Also important is the role of DRUID as an environment which stimulates the Ph.D.-students to become creative and effective. This involves several elements:

- access to the international network in the form of visiting fellows and visits at the sister institutions
- participation in research projects
- access to supervision of theses
- access to databases

Each year DRUID welcomes a limited number of foreign Ph.D.-students who want to work on subjects and projects close to the core of the DRUID-research programme.

External projects

DRUID-members are involved in projects with external support. One major project which covers several of the elements of the research programme is DISKO; a comparative analysis of the Danish Innovation System; and there are several projects involving international co-operation within EU's 4th Framework Programme. DRUID is open to host other projects as far as they fall within its research profile. Special attention is given to the communication of research results from such projects to a wide set of social actors and policy makers.

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