Theories of Localised Resource-Based Growth and Development - from Marshall to New Evolutionary Economics

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Abstract

This paper presents a set of theories of localised resource-based growth and development that have helped analysts and policy makers to consider if and how alternative employment can be promoted in relation to the natural-resource-based industries that show a rapid decrease of employment in many regions. Marshall's theory of industrial evolution and industrial districts has especially emphasised that development is primarily knowledge based and only secondarily natural-resource based. It has also helped to focus on the role of localised labour markets and networks of firms. The post-Schumpeterian theories of growth poles and development blocks have helped to promote a closer look at the interfirm linkages that may play an important role in the development process. Recent evolutionary-economic theories have emphasised the role of different technological regimes dominating the innovation process in different industries. It has also focused in the role of linkages between suppliers and users of products in promoting innovation. The problem with most of the theories of localised development is that they are quite difficult to formalise. The paper suggests that this problem has become easier to overcome with the development of evolutionary economics. In relation to the standard evolutionary model of Schumpeterian competition a model is sketched that emphasise the emergence of increasingly complex vertical division of labour – both inside and between firms. It is suggested that such a model will help to understand the processes of localised knowledge-based and natural-resource-based growth and development.

1. Introduction

A traditional principle of economics is that firms and regions should specialise according to their comparative advantages. For instance, a region with rich forest resources should specialise in forestry. However, the consequence of post-war mechanisation of forestry is that such a regional specialisation leads to a rapid depopulation unless alternative kinds of employment are created. In this connection an obvious question is whether new jobs can be created in relation to the region's rich endowment of a natural resource. Increased value added can be placed in the region if e.g. a larger part of the timber chain from forests via saw mills to paper mills or furniture firms are placed in the region. Alternative uses of forests can also be promoted. But such a regional extension of the production chain is not at all automatic. On the contrary, it is often quite difficult to establish down-stream industries. Instead timber is exported in a more or less raw form.

Several theories have tried to take up these issues by modifying Ricardo's principle of comparative advantages. One set of theories have emphasised that although a simple specialisation according to comparative advantages may be hamper long-run growth of a region, there are often chances of growth in related parts of the value chain from natural resources to consumer products. However, such theories do not fit well into the existing economic paradigms. Instead the theories of resource-based growth and development have for a long time existed in the twilight zone between neoclassical economics, Schumpeter-inspired studies and empirically oriented input-output analysis. As a consequence, these resource-based theories within e.g. development economics, regional economics and international economics have not been very helpful for

policy-making. On the contrary, much confusion has been created when it comes to the issue resource-based growth in different regions and countries.

The present paper sums up some of the major theories and tries to demonstrate that the new evolutionary economics can cast new light on resource-based growth and development. One of the conclusions is that the resource that promotes growth and development is knowledge rather than any natural resource. But a natural resource like a special forest product might serve as a starting point for the building of a complex set of competencies. This and other conclusions might promote new approaches to policy making. However, they also demonstrate that the problems for many forest-rich regions are very difficult to solve.

2. Marshall's localised development

Marshall (1949, 225) points out that '[w]hen an industry has chosen a locality for itself, it is likely to stay there long'. To explain this he develops a theory of 'industrial districts', which should be seen as a special case of an overall theory of growth and development. According to this theory, the reason for the long-term localisation of an industry is not the primary resources that might originally have caused the localisation. The firm basis of the industry's competitiveness is rather the set of related skills, the networks of interdependent firms and the supporting institutions. These are the factors central to Marshall's theory of industrial districts characterised by a particular industry or 'trade'.

The most important part of the theory of localised development is that long-term competitiveness is based on the evolution of skills and competencies. In such a district '[t]he mysteries of the trade become no mysteries; but are as in the air' (Marshall, 1949, 225). The fact that there are 'a constant market for skills' motivates training efforts. There is also a demand for improvements of knowledge. In the industrial district 'inventions and improvements in machinery, in processes and the general organization of the business have their merits promptly discussed'. Thus, there is a rapid spread of innovations: 'if one man starts a new idea, it is taken up by other and combined with suggestions of their own; and thus it becomes the source of further new ideas.'

The development of skills and knowledge depends on cooperation as well as competition between firms. This mix is possible because there is much specialisation within and around the industry. An important aspect of this is that the district is not only characterised by its main industry. On the contrary, 'subsidiary trades grow up in the neighborhood, supplying it with implements and materials, organizing its traffic, and in many ways conducing to the economy of its material.' Furthermore, it is characterised by social conditions and institutions supporting the core industry (Marshall, 1949, 226).

To summarise in a metaphorical vein, we may say that Marshall depicts the localised growth and development 'similar to the gradual organic growth of a tree' (Schumpeter, 1934, 216). The tree trunk is the core industry, the branches of the tree are the supplying industries, and the subbranches are the suppliers of the suppliers. It is not only the soil of local resources and global demand that determines the growth of the tree. Just as important are traditions of education, on-the-job training, quality control with respect to interfirm supplies and other local institutions.

The fact that we summarise Marshall's theory of industrial districts by means of a biological metaphor is not accidental. Although Marshall was one of the founding fathers of neoclassical economics, he just saw equilibrium analysis as a starting point for approaching an 'economic biology', which he considered as '[t]he Mecca of the economist' (Marshall, 1949, xii). Large parts of his works deal with economic evolution rather than with the standard issues of

neoclassical economics. But there is a clear difference between the two parts of his work: his contributions to equilibrium theory are supported by a well-assorted tool-box while his contributions to evolutionary theory are verbal and sketchy. As a consequence, his students were quick to dismiss the evolutionary parts of his works and concentrate on the easily formalisable parts (Hodgson, 1995, part IV).

Even if the evolutionary parts are rediscovered over and over again, they are not easy to handle as long as adequate analytic tools are missing. Instead they are used as a background for broad analytical frameworks and related policy recommendations. Such frameworks can be exemplified by Porter's (1985, 1990) theories of the competitive advantage of firms and countries, and by a number of contributions to regional economics (e.g. Storper and Scott, 1995). These useful frameworks emphasise competence-based growth, local labour markets and the establishment of interfirm networks. They are quite useful for changing the perspective from the simple natural-resource-based development to more complex development that is primarily based on knowledge resources. But they offer no tools for handling the analysis of increasingly complex patterns of semi-localised growth and development.

3. Input-output analysis, innovation theory and localised development

Although Marshall emphasises the emergence of auxiliary industries in industrial districts, he does not develop this issue in any detail. Therefore, he has given little help to researchers interested in the development of the division of labour between firms that are directly or indirectly engaged in the processing of a primary product like timber. Such patterns are easily discernible in economic history. Some historians have even developed a theory that describes (Canadian) economic development as the outcome of a division of labour related to regions' export specialisation in their 'stable products', like e.g. timber (Innis, 1956, Watkins, 1963). The question is, however, how to analyse and draw policy conclusions on such patterns of development.

The regional patterns of complex division of labour between firms can be studied from two quite different perspectives. First, one can concentrate on an analysis of the functioning of a system with a given division of labour. This can be done in terms of standard input-output analysis. Second, one can study how this complex system came into being. Here one has to emphasise the sequence of firms' specialisation decisions and innovative activities. However, some of these specialisations and innovations disturb the static input-output patterns in a rather radical way. Such a process of 'creative destruction' is emphasised by Schumpeter (1934).

The two perspectives suggest a split between economists studying the managerial maintenance of static structures and the entrepreneurial creation of new structures (and destruction of old ones). But the sole concentration of one or the other speciality might be harmful to the understanding of the real process of localised development. The difficulties of transcending the dichotomy were explored in the 1950s and 1960s by post-Schumpeterian researchers like Dahmén, Hirschman, and Perroux. These economists tried to develop a concept a sequence of evolutionary steps in which radical innovations are followed by manifold incremental innovations, and non-innovative adaptations. Such sequences of innovations were underlying Dahmén's (1970; 1991) idea of development blocks, underlying Hirschman's (1961; 1987) idea of an inducement of entrepreneurship and investment decisions through the backward and forward linkages from a particular innovative step, and also underlying the growth pole/development pole theories of Perroux (1955; 1988).

The core idea behind all three approaches is taken from Schumpeter's discussion of how an innovation might create the basis for a whole series of more or less adaptive decisions during a shorter or longer epoch. Some of these are performed within existing routines while others are innovative, but of an adaptive and incremental character ('clusters of innovation'). Thus, Perroux considered the apparently natural-resource-based (coal and iron) development of the Ruhr area in the as the outcome of the exploitation of resource-related innovations rather than of the natural resources themselves.

When researchers tried to formalise the post-Schumpeterian theories of growth and development, the underlying assumptions concerning the presence of innovations were often forgotten. Many of researchers were not interested in the causal sequence of decisions about innovations and investments, but rather in the static interdependence between the different parts of the industrial system. For example, many noted that Perroux was developing his ideas in terms of 'industries', and that he suggested to apply the tools of input-output analysis. His theory was translated into an input–output language with (temporarily) fixed input coefficients in the following way: large technical coefficients were taken as proxies for important linkages or propelling forces; industrial complexes were understood as parts of the industrial system connected by strong linkages; the cores of the industrial complexes were partly be found by means of the inverted input-output matrix which shows the direct and indirect inputs used for one unit of output of each industry of the industrial system.

This translation of Perroux's argument is, unfortunately, radically wrong. The tight linking of industries revealed by the input-output tables of the most advanced countries has no necessary connection to growth poles. On the contrary, tight linking probably indicates a mature situation with routine deliveries where there are few possibilities of, and little impetus toward, change and development. Such analytic and policy-oriented work ended in an 'immense confusion', mainly because 'the activity creating a growth pole was essentially a sectoral and geographical disturbance not because of its larger than average size, nor because of its higher multiplier, but because it was an *innovation.*' (Brookfield, 1975, 92 f.)

New evolutionary economics (see below) has provided analytical tools which can be adapted to the task of systematising the idea of 'clusters of innovations', and related ideas on the growth and transformation of complex economic systems, in a way which help to avoid future confusions. More specifically, it has become possible to implement ideas which are summarised by Perroux's (1988, 49) definitions: 'the *growth pole* is a set [of economic activities] that has the capacity to induce [in an innovative way] the growth of another set ...; the *pole of development* is a set ... whose effect is to increase [in an innovative way] the complexity of the whole and to expand its multidimensional return.'

4. The elements of new evolutionary economics

The above account has emphasised the trouble with the available tools for expressing the evolutionary process of localised growth and development. This problem is also obvious for other aspects of the study of development and evolution. Thus, two of the pioneers of the new evolutionary economics (Nelson and Winter, 1982, 29) remark that 'the intellectual coherence and power of thinking about Schumpeterian competition have been quite low, as one would expect in the absence of a well-defined theoretical structure to guide and connect research.'. Nelson and Winter (1982, 19) proposed a solution to the tool problem is based on the assumption that the 'verbal account of

economic evolution seems to translate naturally into a description of a Markov process – though one in a rather complicated state space.' At a certain point of time, *t*, the state of the evolutionary process of an industry is described by the capital stock and the behavioural rules of each firm. This state is used for determining the short-term behaviour of the industry as well as the new capital stock and the new behavioural rules of each firm at time $t + 1$. It is the shift in behavioural rules which gives the overall evolution the character of a stochastic Markov process.

When this process of state transformation is defined, it is relatively easy to translate it into computer models and simulations. This translation is, however, not purely trivial. The reason is that the translation into a programming language makes it possible to treat some of the intricacies of evolutionary mechanisms which were not clearly dealt with (or even imagined) in the original verbal-style account of the evolutionary process. For instance, we do not have to concentrate on the fact that firms are 'naturally selected' by the economic system ; we can also consider many details relating to the fact that firms are influencing their own destiny by modifying their own behaviour through search for and selection of new technologies (or broader: new modes of behaviour).

Through their work Nelson and Winter demonstrate the possibility of overcoming the basic difficulty in studying evolutionary processes, namely the need to combine elements which are normally considered as belonging to quite different areas of investigation. These elements are the processes of transmission, variety creation, and selection. The combination of these elements presupposes two opposing capabilities: an ability to cope with a wide diversity of elements, and an ability to cut out the details and integrate the elements into an initially crude conception of an evolutionary process. The computer helps to organise this synthesising exercise to the very last steps since 'the simulation format does impose its own constructive discipline in the modeling of dynamic systems: the program must contain a complete specification of how the system state at $t + 1$ depends on that at t and on exogenous factors, or it will not run.' (pp. 208 f.) By taking this process to a preliminary conclusion, Nelson and Winter provide a constructive proof of the existence of relatively interesting evolutionary-economic models. At the same time they give an explanation of the weaknesses of the informal approaches to evolutionary processes: these processes are normally so complex that it is nearly impossible to master them intellectually by means of the methods of the old evolutionary modes of thinking.

To see to which extent the Nelson-and-Winter framework helps to overcome the problem, we shall shortly consider their model of Schumpeterian competition which may be considered as their standard model type (chs. 12-14), but we could also have considered the works of some of their followers. The typical Nelson-and-Winter model deals with the evolution of the production techniques and other behavioural rules of an industry producing a homogeneous product (see also Andersen, 1994, ch. 4). From the very beginning it is important to note that this model of Schumpeterian competition is just one simple example of a 'vastly larger' class of Markov models (p. 407). But Nelson and Winter claim that such a simplistic model helps to clarify some of Schumpeter's thoughts. The model describe how the state of the industry in the next period is found when the state (capital stock and productivity) of the present period is given. First, the present state is used to define a short-term economic process in the industry whereby market shares, price, and profits of firms are found. Second, the investment decision is treated: Firms expand their capacity in relation to their profitability – partly with the help of banks. Third, we come to the processes of innovation and imitation. Firms are continually

searching for new production techniques and for copying the production techniques of their oligopolistic competitors. When they are successful, they increase their competitiveness compared to other firms. Innovators may also enter the industry from the outside. If innovations predominate, the result is an increasing concentration while imitation and the monopolistic behaviour of large firms serve to constrain the rate of concentration.

This basic study of evolutionary industrial dynamics can be related to many of Schumpeter's discussions. It can also be adapted to Marshall's (1949, 263 ff.) idea of an industry as a forest of firms where young firms struggle upwards while some older firms become dominant before they succumb because of a lack of vitality. Further possibilities are explored in the post-Nelson-and-Winter literature (see e.g. Saviotti and Metcalfe, 1991, Witt, 1993, Andersen, 1994). These studies include the consequences for diffusion of innovation of the introduction of vintages of capital and embodied technical change, the consequences of the introduction of learning by doing in existing lines of production, the path dependency of the evolutionary processes, the shift in technological regimes and market regimes, the evolution of rules of behavioural strategies like the R&D intensity of firms, etc. Even the issues of entrepreneurial strategies of firms have been dealt with in some depths, although the basic tendency in the research has been to focus on industries or other populations of firms.

5. Evolutionary economics and localised development

There is an obvious need for an evolutionary-economic model that is specially designed to cope with the evolving division of labour between the firms of a region. To construct such a model, we can start from Nelson and Winter's theory of the firm. According to this theory (Nelson and Winter, 1982, chs. 4-5), each firm is based on a large number of interdependent routines or tasks that are performed by the employees. In the Nelson-and-Winter model of Schumpeterian competition, all this intra-organisational diversity has been reduced to a single evolving production technique and a set of fixed parameters of decision-making. But their own verbal account for intra-firm complexity can actually be used in the study of the creation of markets by firms which specialise as a consequence of the evolutionary process. This is the case in Marshall's (1949, 222-231) account for the emergence of 'industrial districts' – but the issue is much more general (see Young, 1928; Stigler, 1951).

The simplest way of formalising Nelson and Winter's theory of the firm in a way which opens up for a subsequent specialisation of firms is to consider the overall task of producing the product on the firm as consisting of a series of subtasks which can either be done in parallel or in series (Andersen and Lundvall, 1996). To simplify we assume that the different production tasks are performed by means of labour alone. For each task of a firm it has in each period a specific production technique which is characterised by its labour coefficient, i.e. the amount of labour needed in this task for the production of one unit of final output. The total amount of labour needed for the production of a unit of output is simple the sum of the labour coefficients of all the n tasks of production.

The firm-level dynamics of the model can be illustrated by a, deliberately naive, case. The firm owns a forest dominated by a species that is not widely exploited elsewhere. The output is timber. Initially the firm only employs all-round workers but gradually it develops a more and more complex division of labour with loggers, transport workers, nursery workers, tool making adapted to the species, etc. Its division of labour is, so to say, developing like a tree with more and more branches. If other firms in the region is developing the same

subdivision of labour, it is clear that there is opening a market for firms specialised in providing some of the supplies in a cheaper way and/or with higher quality than the forest owners are able to provide. When the supplying firms have been established, they will probably look for markets outside the region in order to expand. Since their competence is related to a special species, they might have another approach than is prevalent in their branch of activity. Therefore, they may be able to find special niches or even broader markets.

The case of a regional division of labour based on the forest firms themselves is not necessarily the most important for creating growth and development. Paper mills and furniture factories are probably much better starting points. However, the case will suffice to illustrate the workings of the evolutionary model. This model depicts an industrial sector with a varying degree of economic 'roundaboutness', i.e. vertical division of labour between producers and users of different types of intermediate products that are ultimately used for the production of a single product. Although the model is developed within the Nelson and Winter tradition, the introduction of the 'Austrian economics' issue of roundaboutness implies a major extension of the research agenda, including production-structure innovations, the emergence and functioning of markets for intermediate products, ways of coping with the instability of upstream markets, the spread of the effects of an upstream innovation, and the measurement of the degree of roundaboutness and of overall productivity.

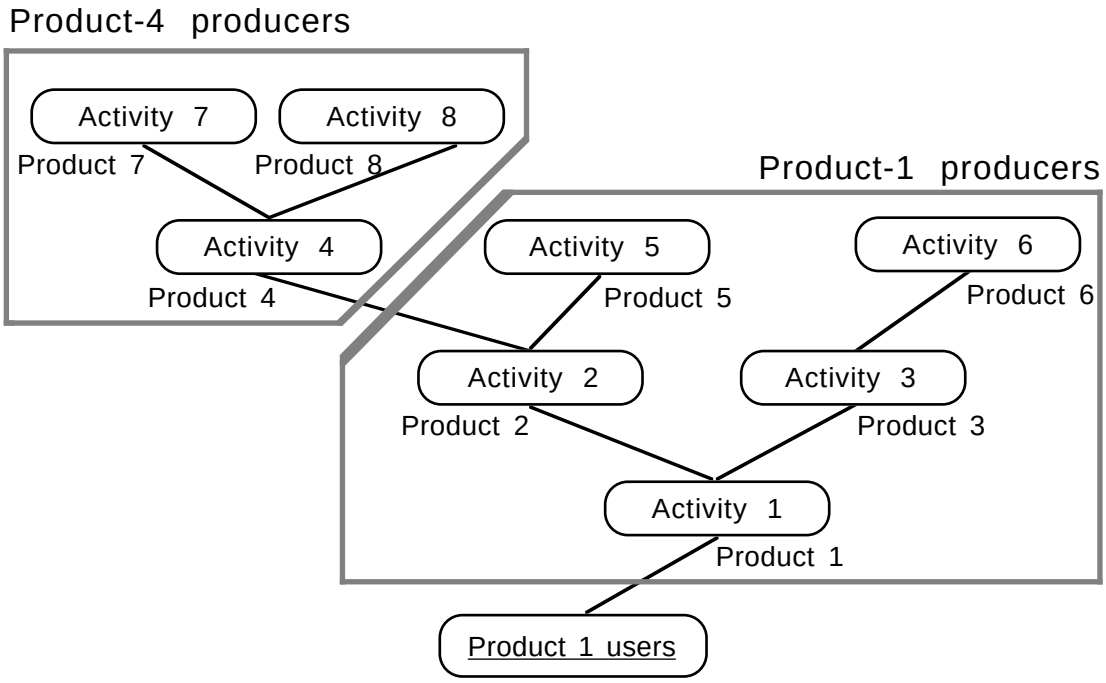

Figure 1. Example of a simple production tree
with a simple specialisation of firms

Figure 1 can be discussed in several ways. First of all, it depicts a simple production tree that is rooted in the users of product 1 (logs, furniture, etc.). From this 'final' product there emerges a division of labour which is more stylised than in the examples. At the stage of evolution depicted by figure 1, 8 distinct production activities have emerged. These activities have initially been performed within each of the firms that product the final product. However, at a certain point of time, a firm has specialised in producing product 4. Its specialisation built upon the willingness of other firms (product 1 producers) to

buy its output. If the market for product 4 is sufficient, there will be several firms producing it.

The question is now why and how interfirm division of labour emerges. Both from the logic of the model and from the viewpoint of post-Schumpeterian theories, it is suggested that a major driving force is innovations with respect to individual products or productive activities. The cause for a specialisation may thus be a process innovation (improvement of labour productivity with respect to the production of an intermediate product), product innovations (improvement of the quality of a specific product) and structural innovations. A structural innovation implies that a new activity as well as a new intermediate product is introduced in the production tree.

The process of creation, development and destruction of intermediate markets implies that the evolution of a roundabout process of production is not a straight-forward process. An entrepreneur that has made a significant product or process innovation (e.g. with respect to activity 4 of figure 1) judges whether or not it is feasible to specialise in an intermediate product which makes heavy use of the innovation. If a specialisation is considered profitable, potential buyers are asked to give maximum prices and the required quantities. If the sum of the demanded quantities is sufficient to use the capacity of the entrepreneur and if the price of the 'last' buyer is sufficient, then specialisation takes place and production is sold at the lowest price. From that time specialisation of the entrepreneur is irreversible, and other firms may enter its 'industry'. The entrepreneur (and its followers) is only able to evolve its subtree (e.g. from product 4 and upwards).

The suggested evolutionary model is the starting point of the study of an industrial dynamics which differ radically from the standard model of Nelson-and-Winter model. In the standard model the firms compete about exactly the same 'niche'. But in order to understand the long-term coexistence of radically different types of economic behaviour, we have to transcend this limited evolutionary model. The introduction of a number of different productive tasks which can be innovated individually creates a multi-dimensional system of competition which allows the survival of a larger number of behavioural variants. The reason is that firms can specialise: when a firm has made an innovation with respect to one of its tasks, it decides whether or not to specialise in pursuing this task. If it does so, it exploits the innovation on a larger scale. However, it has a problem of creating a market for the intermediate product which is the output of its innovated task.

6. Conclusions

Theories of localised resource-based growth and development have played an important role as a supplement to standard neoclassical theories. They have helped analysts and policy makers to consider if and how alternative employment can be promoted in relation to the natural-resource-based industries that show a rapid decrease of employment in many regions. The Marshallian theory has especially emphasised that development is primarily knowledge based and only secondarily natural-resource based. It has also helped to focus on the role of localised labour markets and networks of firms. The post-Schumpeterian theories of growth poles and development blocks have helped to promote a closer look at the interfirm linkages that may play an important role in the development process. Recent evolutionary-economic theories have emphasised the role of different technological regimes dominating the innovation process in different industries. It has also focused in the role of linkages between suppliers and users of products in promoting innovation.

The problem with most of the theories of localised development is that they are quite difficult to formalise. This problem may have been easier to overcome with the development of evolutionary economics. The paper have suggested some directions for a further and more precise formulation of the theories. The creation of large-scale models of localised development has not yet been completed. However, even the systematic reconstruction of the processes of localised evolution in modelling terms has helped to make many things in the theories much clearer. Thus, this kind of work may be of help to the formulation of regional policies.

References

Andersen, E.S. (1994), *Evolutionary Economics: Post-Schumpeterian Contributions*, Pinter, London.

Andersen, E.S., and Lundvall, B.-Å. (1996), National Innovation Systems and the Dynamics of the Division of Labour, DRUID and IKE Group, Department of Business Studies, Aalborg University.

Brookfield, H. (1975), *Interdependent Development*, Methuen & Co., London.

Dahmén, E. (1970), *Entrepreneurial Activity and the Development of Swedish Industry 1919-1939*, American Economic Association Translation Series, Homewood.

Dahmén, E. (1991), *Development Blocks and Industrial Transformation: The Dahménian Approach to Economic Development*, ed. by B. Carlsson and R.G.H. Henriksson, Almquist & Wiksell, Stockholm.

Hirschman, A.O. (1961), *The Strategy of Economic Development*, paperback edn., Yale University Press, New Haven, Conn.

Hirschman, A.O. (1987), 'Linkages', in Eatwell, J., Milgate, M., and Newman, P. (eds.), *The New Palgrave: A Dictionary of Economics, Vol. 3*, Macmillan, London and Basingstoke, 206-211.

Hodgson, G.M. (ed.) (1995), *Economics and Biology*, Elgar, Aldershot.

Innis, H.A. (1956), *Essays in Canadian Economic History*, University of Toronto Press, Toronto.

Marshall, A. (1949), *Principles of Economics: An Introductory Volume*, reset version of 8th edn., Macmillan, Basingstoke and London.

Nelson, R.R., and Winter, S.G. (1982), *An Evolutionary Theory of Economic Change*, Belknap Press, Cambridge, Mass. and London.

Perroux, F. (1955), 'Note sur la notion de pôle de croissance', *Economie Appliquée*, Vol. 8, 307-320 (reprinted in Perroux, 1969, 178-190).

Perroux, F. (1988), 'The Pole of Development's New Place in a General Theory of Economic Activity', in Higgins, B., and Savoie, D.J. (eds.), *Regional Economic Development: Essays in Honour of François Perroux*, Unwin Hyman, Boston, Mass., 48-76.

Porter, M.E. (1985), *Competitive Advantage: Creating and Sustaining Superior Performance*, Free Press, New York.

Porter, M.E. (1990), *The Competitive Advantage of Nations*, Free Press, New York.

Saviotti, P.P., and Metcalfe, J.S. (eds.) (1991), *Evolutionary Theories of Economic and Technological Change: Present Status and Future Prospects*, Harwood, London.

Schumpeter, J.A. (1934), *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle*, Oxford University Press, London.

Stigler, G.J. (1951), ‘The Division of Labour is Limited by the Extent of the Market’, *Journal of Political Economy*, Vol. 59, 185-93.

Storper, M., and Scott, A.J. (1995), ‘The Wealth of Regions: Market Forces and Policy Imperatives in Local and Global Context’, *Futures*, Vol. 27, pp. 505-526.

Watkins, M. (1963), ‘A Stable Theory of Economic Growth’, *Canadian Journal of Economics and Political Science*, Vol. 29.

Witt, U. (ed.) (1993), *Evolutionary Economics*, Elgar, Aldershot.

Young, A.A. (1928), ‘Increasing Returns and Economic Progress’, *Economic Journal*, Vol. 38, 527-542.