Some considerations on structure and change

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Abstract

This note attempts to deal with some fundamentals associated with structural change. Two basic approaches are considered: the exchange and the production approach. The existence and the tendency towards a long-period equilibrium are crucial for discriminating between these devices. For theoretical and historical reasons the production approach is found to be more appropriate to deal with structural change. Subsequently, two production models are mentioned: the Leontiev–Sraffa horizontal model and Pasinetti’s vertically integrated model. The former is well suited to capture given structures, the latter represents an ingenious and very simple approach to deal with structural change. On the basis of the vertically integrated model, proportion and scale aspects of economic structures may be considered. © 2000 Elsevier Science B.V. All rights reserved.

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Since the Industrial Revolution of the late 18th century, immense structural changes have occurred. Traditional sectors — for example, agriculture, handicrafts, and recently even parts of industry — have seen their importance diminish. On the other hand, there have been expanding and new sectors — first textiles, then railways, and now computers and services, to mention some salient instances. These economic phenomena were accompanied by profound social changes; some profes-

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sions have nearly disappeared, e.g. the blacksmith, and entirely new activities have emerged, computer engineers and analysts being prominent examples. Since the Second World War, the pace of structural change has accelerated and professional flexibility has become a major issue.

By now, the phenomenon of structural change and its social implications have become so important that the need for systematic treatment spontaneously arose. Within the framework of classical political economy, Piero Sraffa, Wassily Leontief and Luigi Pasinetti developed analytical tools to come to grips with economic structures. Moreover, Luigi Pasinetti dealt with the issue of structural change since the late fifties. His work culminated in his 1981 book which title almost exactly corresponds to the designation of the Journal now celebrating its 10th anniversary — *Structural Change and Economic Dynamics*.

The importance of the phenomenon certainly justifies a closer look at some fundamentals associated with structural change; specifically, to ask about the most appropriate approach to come to grips conceptually with structure and change is a matter of considerable importance. In the following, we consider, first, definitional issues and, second, two basic approaches to deal with structure and change and, third, the selection of the appropriate approach. Fourthly, the presentation of the horizontal interindustry model is, fifth, followed by the vertically integrated labour model. The latter leads, sixth, to considering proportion and scale aspects of economic structures, which, seventh, is followed by some concluding remarks.

1. Structures may be conceived of as permanent or slowly changing orders of different elements. For example, long-period equilibrium prices or quantities might constitute such an order. Differing theories on the causal forces bringing about a structure may coexist. The set of equilibrium prices may be seen as governed by the conditions of production and distribution (Sraffa, 1960) or by a general framework of supply and demand (Walras, 1952). Permanence is an essential attribute of an order, implying that an order should be stable or, eventually, change slowly. Only in this case an order is also a structure. For example, one may speak of a structure of prices of production governed by the costs of production and including normal profits since the technological conditions and the institutionalized distributional arrangements governing costs and prices are persistent or change only gradually; technology and distributional institutions represent more profound structures underlying the price structure. However, the quickly changing market prices would not be called a structure, nor the temporary subjective factors governing these prices, the reason being that the element of permanence is lacking.

Broadly, the causes of structural change are technological and ethical. As a rule, the former affects the material basis of a society, the latter the institutional superstructure, if there is gap between the actual and a desired situation. Structural change, if slow, does not profoundly affect the properties of the structure considered. As a consequence, an analysis of the phenomenon may focus on structures, and less on change. However, rapid structural changes, as occurred during the Industrial Revolution and are taking place presently, may lead to a misfunctioning or even a partial breakdown of the institutional system. Here, the analysis of change and its consequences must move to the fore.
2. Leaving aside the question of structures associated with centrally planned economies, one may conceive of two approaches to tackle the issue of structure and change and, more widely, the great issues of economic theory, for example, value, distribution and employment (for a general synopsis on structure and change, see Baranzini and Scassets (1990), more specifically Bortis (1990) in that volume, pp. 64–92). The first is based upon exchange, the second on production (for an overview of the production–exchange issue, see the contributions in Baranzini and Scassets (1986), particularly the contribution of Pasinetti (1986), pp. 409–431).

[The] typical marginalistic scheme of general equilibrium is a model of what has been called a pure exchange economy. The model presupposes the existence of given natural resources in fixed quantities, and of a given number of individuals (owning the resources) with well-defined utility preferences. The economic problem these individuals have is one of rational choice. They have to find those prices (equilibrium prices) which bring about, through exchange, an optimum allocation of the given resources relatively to their original ownership–distribution (Pasinetti, 1965, p. 7).

Hence, in the neoclassical approach, structures consist in long-period equilibrium prices and (flow) quantities to which stocks — endowments, including of course capital stocks — may be added. These long-period equilibrium prices and quantities represent elements of an order, which is established through the mechanism of supply and demand. Hence in the exchange approach structures result from the persistent or institutionalised, or eventually slowly changing behaviour of producers and consumers. Social relations arise through the interaction between individuals. Competition and substitution dominate.

[In the pure production model,] a central role will be played by the learning process of human beings, in its twofold aspects of technical improvements and of consumers’ preference evolution. Scarce resources will not be considered. [This] means that the theory will be developed independently of any rational problem as to their best utilisation. All commodities considered are produced, and can be made practically in whatever quantity may be wanted, provided that they are devoted to the amount of efforts they technically require (Pasinetti, 1965, p. 8).

It is crucial to note that the industrial process of production is essentially a social process. The notion of the social comprises three elements. First, there is the common aim, i.e. the production of the social product, or, more precisely, of the social surplus over necessary wages in the sense of the classical political economists, mainly Ricardo. Second, complementary functions are carried out by the various
sectors and industries within and between which, third, co-operation and co-ordination is required to reach the common aim. This notion of the social emerges most clearly from the Sraffa model. The relations emerging from social situations are not relations between individuals or groups — as is the case in the exchange approach — but part–whole relationships. For example, wage rates or wages shares in given national income — determined by effective demand — imply relations of individual workers or of the working population to society as a whole.

Hence a long-period equilibrium may be conceived of the exchange or of the production type. Each may be considered a structure. However, it makes sense to analyse these structures and their evolution only if they may be found in the real world, actually, or at least potentially. This issue leads to the next point.

3. The existence and the tendency towards a long-period equilibrium are crucial for discriminating between the production and the exchange approach to tackle the issue of structure and change. The reason is that the prices and quantities associated with long-period equilibria represent structures. In this context it is important to note that

Marshall used the term ‘long period’ in two quite distinct senses, one in which there is time for substantial alterations to be made in the size of the plant, and one in which it stands conceptionally for the Never-never land of unrealised tendency (Robertson, 1956, p. 16).

This passage suggests that there are two notions of long-period equilibrium. According to the first, the long-period equilibrium is in the future and would be reached if a present disequilibrium situation could work out undisturbed, i.e. if stationary conditions prevailed; in the second view the long-period equilibrium is situated in the present and underlies temporary and quickly changing factors which constitute the visible surface of economic reality; prices of production would be part of a long-period equilibrium — the economic structure — and market prices would pertain to the temporary and quickly changing surface elements superseding the structure. The neoclassical exchange equilibrium resulting from the rational behaviour of individuals pertains to the first long-period equilibrium type and the classical production equilibrium to the second. The question of the relation between model and reality now necessarily arises.

The neoclassical exchange equilibrium comprising long-period prices and quantities is of a potential or virtual nature. As such it cannot be found in presently existing reality, but lies in the future. This suggests that building a structural analysis based on this model is likely to be excessively difficult if not impossible. The problem could eventually be solved if a strong tendency towards equilibrium existed and present real world magnitudes (prices and quantities) would be close to the equilibrium prices and quantities (in fact, the representatives of the ‘rational expectations school’ would argue that competitive economies are always in equilibrium, not only close to it). This would also allow us to consider changes in the equilibrium position (structural change) if change was slow and continuous in the
sense of Marshall’s natura non facit saltum (Marshall, 1920, epigraph). The
long-period equilibrium (the structure) would gradually move on and proportions
would change. This is structural change in the neoclassical (exchange) sense. Two
types of forces would govern the nature of the changes. First, changes in the
preferences of consumers would lead to changes in demand curves and conse-
sequently to new equilibrium prices and quantities. Similarly, technical progress
would affect the position and the shape of the supply curves; the nature of the
impact on prices and quantities will, in the neoclassical view, depend upon the type
of technical progress which may be labour saving, capital saving or neutral.

This view implies that, in principle, competitive markets (exchange) co-ordinate
the rational (profit and utility maximising) behaviour in a socially optimal way. The
rational behaviour of the individuals automatically leads to social rationality. In the
neoclassical view this implies that markets not only solve the great economic
problems — value, distribution and employment — but also establish structures
(long-period prices and quantities) and steer structural change.

However, the belief in the self-regulating capacity of markets has been seriously
shattered for historical and theoretical reasons. On the historical level the great
crises of the 19th century, particularly in the last quarter of this century, and in the
20th century — the crisis of the 1930s in the main — have cast serious doubts on
the capacity of markets to generate a tendency towards full employment. On the
theoretical level, Ricardo initiated a discussion on fundamentals in the domain of
value and distribution. If conditions of production are unequal in the various
sectors, value — including of course the value of capital goods — cannot be
independent of distribution, i.e. the rate of profits; moreover, the prices of produc-
tion now deviate from labour values. This issue led to the transformation problem
and culminated in the capital-theory debate in the 1960s. This debate was initiated
by Luigi Pasinetti following up the publication of Sraffa’s *Production of Commo-
169–177). Harcourt (1972) provides an excellent overview of the main issues. Since
capital is not independent of value and distribution there are, in principle, i.e. in
ideal conditions, no regular associations between ‘factor’ prices and ‘factor’ quanti-
ties. This implies that “

marginal productivity theory [...] concerns an economy in full neoclassical
equilibrium [...]. But on the manner in which such an equilibrium is supposed to
come about, neoclassical theory is highly unsatisfactory [our emphasis]. Sraffa’s
work shows that certain simplified routes are very risky and not free from logical
difficulties (Hahn, 1982, p. 373).

This conclusion implies that a long-period equilibrium in the neoclassical sense may
exists. However in case of rapid structural change such an equilibrium would not
even exist which renders the question of tendency meaningless.

Given these historical and theoretical arguments it seems highly unlikely that
markets are able to generate a persistent tendency towards a long-period equi-
librium. Such equilibria may exist and there may be a tendency towards some
equilibrium at times, due to mere chance. Hence market equilibria are, essentially,
of a temporary nature and are, as such, confined to the short run and associated
with different profit rates in the various sectors. Short-term or temporary market
equilibria are a kind of order, but this order cannot be considered a structure
because the element of permanence is absent. This eliminates the exchange ap-
proach as a theory of structure and structural change. The way for the production
approach as a tool to analyse problems of structure and change is open.

4. The social process of production may be conceived of as an interaction
between man (society and the labour force active in production) and nature (land
and the products obtained from it):

The produce of the earth — all that is derived [our emphasis] from its surface by
the united application of labour, machinery and capital, is divided among three
classes of the community… (Ricardo, 1951, p. 5).

This is important for the definition of basics and, implicitly, for basic economic
structures: “Natural resources which are used in production, such as land and
mineral deposits, […] can be said to occupy among the means of production a
position equivalent to that of ‘non-basics’ among products. Being employed in
production, but not themselves produced, they are the converse of commodities
which, although produced, are not used in production” (Sraffa, 1960, p. 74).
However, steel, leather and wheat, which are obtained from land, are basics. In
fact, one can distinguish between three types of basics: intermediate products (e.g.
iron, leather, wheat) are transformed into final goods within industries; machines to
make machines and tools, which represent the modern form of the tool-making
activities of the blacksmith and of the carpenter, assist labour in production; and
necessary wage goods which, although being produced and used, nevertheless enter
the production of all goods through maintaining the productive capacity of labour
which is complementary to means of production derived from land. This comple-
mentarity implies that there are two approaches to analyse economic structures, the
land and the labour approach.

The land approach was developed by François Quesnay and was also used by
Adam Smith in some instances, specifically in his agriculture-industry model
(Smith, 1976, pp. 376–380). A surplus of the land-based activities (agriculture,
mining, etc.) is a necessary precondition for other activities. Quesnay exclusively
considers the activities of the propriétaires to whom the surplus accrues in the form
of rents and who organise the state, bring about a cultural life and provide
agricultural infrastructure. Adam Smith, however, emphasises that, in a commercial
society, the agricultural surplus is, in the main, used to set up an industrial sector;
the agricultural surplus maintains the work force active there. Sraffa (1960) and
Leontief (1941, 1951) took up the land approach. However, since in the social and
circular process of production both, land and labour, are complementary, the title
of Sraffa (1960) should in fact read Production of Commodities by Means of

Land-based social production models of the Quesnay–Sraffa–Leontief type picture how basic intermediate products obtained from land (nature) are transformed into final products, basic and non-basic. These models visualise the interindustry flows of goods between industries within the framework of the social process of production. On the final product level, there are two kinds of basic goods: necessary consumption goods which enable workers to be active at all in the social process of production and tool and machine making machines are also basic goods since they are indispensable in assisting labour in the process of production. The connections between the respective sectors are set forth in Marxian and post Keynesian (Robinsonian–Kaleckian) two-sector models (consumption and investment) which picture the productive exchanges occurring on the level of final goods. If all wages are consumed and all profits saved, the wage sum of the capital goods sector equals the profits of the consumption goods sector.

The prices and quantities emerging from interindustry transactions form the core of the economic structure. In Sraffa models, prices of production depend upon the production coefficients associated with basic goods and a distributional variable, i.e. the uniform profit rate or the real wage rate. The latter complete the socio-economic structure.

In the economic domain, structural change may occur for two reasons, technological progress or changes in demand. The former results in a reduction of most or of all production coefficients of the \( a_{ij} \)-type — relating to intermediate products — in Leontief-Sraffa models and of the labour coefficients. Technical progress results in an outward shift of the wage–price frontier (Pasinetti, 1977, pp. 84–89). Changes in demand bring about changes in the quantities produced in a Leontief model, and thus in the structure of relative quantities (because of differing income elasticities). Changes in the production structure and, eventually, in the distributional variables would result in the variation of the structure of relative prices.

Structural changes, i.e. changes involving proportions, are extremely difficult to capture in an interindustry model. In principle, the evolution of each production coefficient would have to be pictured. The difficulties would become almost insuperable in empirical applications with a large number of sectors. Interindustry models are thus best seen as snapshots of the production structure.

5. Pasinetti’s vertically integrated labour model represents an ingenious and conceptually very simple approach to tackle issues of structure and change. All the interindustry complexities of the land based Leontief–Sraffa approach are reduced to a single magnitude, i.e. labour. Moreover, the interindustry coefficients now have a life of their own and all their changes are, in a way, absorbed by the labour coefficients. Prices are governed by two labour coefficients, representing the direct and indirect labour requirements to produce one unit of the final good and the fixed capital required in its production, the money wage rate, the profit rate and the rate of depreciation of the fixed capital (Pasinetti, 1981, equation systems II.6.3 and
Quantities are determined by demand coefficients (for the most simple case see Pasinetti, 1981, equation systems II.2.5 and II.2.9). Hence the prices of production and the demand-determined quantities represent the structural basis in the production approach.

However, the structural core equation of Pasinetti’s natural system is the effective demand condition (see for example equation II.2.8, p. 32, and its significance, pp. 33–35). This condition pictures the distribution of labour over the vertically integrated sectors (Ni) as a fraction of total labour force (Nf). Each Ni/Nf coefficient is the product of two coefficients, a production (labour) coefficient Ni/Qi which indicates the total (direct and indirect) amount of labour required to produce one unit of good i and a demand coefficient Qi/Nf indicating the fraction of full employment output measured in terms of labour (Nf) spent on good i. With technical progress going on, the production or labour coefficients Ni/Qi change; as a rule most of them will decline; the introduction of new goods may bring new vertically integrated sectors into existence, while traditional ones may disappear. Moreover, the demand coefficients Qi/Nf will vary when income grows (Engel’s law) and consumer preferences change. The production and demand coefficients so defined enable us to deal with all kinds of structural change, slowly evolving or rapid and dramatic.

The changes in the production and demand coefficients will, as a rule, cause structural unemployment which is of two types: technological unemployment because less labour is required to produce given output levels and unemployment due to a changing demand structure accompanied by excess capacities and bottlenecks. Structural unemployment continuously requires measures to restore full employment: for example, reduction of excess capacities, the building up of new productive capacities and vocational training.

Pasinetti considers his vertically integrated model a natural system which pictures how the variables of the system — prices and quantities, and their evolution in time — are governed in principle; as such, the natural system is independent of a specific institutional set-up. Nevertheless, this system, if reinterpreted, provides the analytical starting point for theoretical and historical investigations.

6. In the natural system long-period involuntary unemployment is not considered. The model can, however, easily be adapted to take account of this important aspect of the real world.

In fact, Pasinetti’s vertically integrated labour model deals with proportions, i.e. part–whole relationships and with changes in proportions if there is structural change; relative prices and quantities, distributional shares, the distribution of labour over sectors in relation to the total labour force are all proportions evolving in historical time. As such, the natural system is a piece of classical macroeconomics. Pasinetti explicitly stresses the proportions character of his system:
[...] the systems of equations [...] considered yield solutions for relative prices and relative quantities, which are independent [our emphasis] of the total quantity of labour available (Pasinetti, 1981, p. 23, n30).

This opens the way to introduce a long-period theory of the scale of employment and output which would constitute a piece of Keynesian macroeconomics.

In formal terms, the starting point is a Pasinetti quantity system (e.g. Pasinetti, 1986, p. 422, equation system 15) which pictures an aspect of the economic circuit: direct and indirect labour produces the social product (measured in labour) to which corresponds national income which, in turn, is spent to buy the social product. In this system the quantity vector contains full employment magnitudes: the full employment labour force and full employment quantities of the various goods. The determinant of the coefficient matrix is zero which means that the last of the $n$ equations, the labour input equation, is not independent of the others since the quantity of labour is already determined by the first $n-1$ equations. If now this vector is multiplied by a coefficient smaller than unity all the variables are permanently reduced below the full employment level. The coefficient in question could therefore be called employment scalar.

The supermultiplier equation (Bortis, 1997, p. 146) represents a theory of long-period involuntary unemployment and hence of the employment scalar (pp. 150–151). This relation links the autonomous variables (long-period exports and government expenditures) to long-period output and employment (pp. 142 ff.). Distribution is of particular importance for the determination of the level of employment: a more equal distribution of income — reflected in a lower normal mark-up over normal wages — is associated with a higher level of employment. This implies that real wages must rise if there is technical progress in order to keep effective demand in line with the growing output.

Persistent involuntary unemployment gives rise to new structures, i.e. normal prices and quantities as are associated with normal employment and unemployment levels, strongly influences the social climate and also shapes the socioeconomic structure. As a rule, poverty increases, slums come into being and special measures may be required to maintain law and order if involuntary unemployment reaches substantial levels; the social security system can eventually no longer cope with the fast growing social expenditures which are largely made up of payments to the involuntary unemployed. These are examples pointing to the fact that involuntary unemployment produces alienated-non-natural-structures which lead to a worsening social situation and, in the extreme, may cause a partial or total breakdown of the socio-economic and political structure (Bortis, 1997, pp. 47–53).

Consequently, Pasinetti’s natural magnitudes — natural wages, profits, natural prices and quantities — must be sharply distinguished from the normal magnitudes — normal wages, profits, prices and employment levels — which reflect evolving structural real world elements and are the object of classical-Keynesian political economy (Bortis, 1997, Ch. 4). The normal deviates from the natural, and the deviation could be called alienation.
7. The preceding remarks suggest that the neoclassical exchange approach is not appropriate to deal with economic structures and structural change. For historical and theoretical reasons, it is very unlikely that a tendency towards a long-period market equilibrium exists. Hence the market is not even capable of producing structures. Moreover, even if a tendency towards equilibrium existed, the neoclassical model could only take account of slow structural change, since rapid changes would render the notion of a long-period neoclassical equilibrium meaningless. Hence only the production approach is capable of coming to grips with structures and structural change, whether going on slowly or rapidly. The land-based Sraffa–Leontief model is more of a static nature and is, as such, a suitable tool to analyse, theoretically and empirically, given structures. Pasinetti’s vertically integrated labour model, however, is suited to deal with structural change on a theoretical level and to provide the conceptional foundations for empirical and historical investigations.

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