The Theory of Economic Change:
A Comparative Study of Marshall
and the "Classics"

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Introduction

The purpose of this paper is to compare a classical and a Marshallian perspective on economic change, referring, in particular, to the analysis of division of labour and increasing returns.

Throughout the paper we mainly deal with static and dynamic definitions of increasing returns and the classical and Marshallian conceptualisations of economic growth. In our words, a *static model* is one that embodies a series of logical possibilities, independent of time. Correspondingly, a static curve represents a series of virtual variations of the phenomena considered; *reversibility* is a necessary property of such a curve. On the contrary, dynamic

analysis isolates certain groups of phenomena in order to explain their relations and their behaviour in the course of time; therefore a *dynamic model* is one in which variables must be *irreversibly dated.*

In our view, within the classical (*e.g.*, Smith's and Babbage's) conceptualisation, the tendency to increasing returns is a dynamic process, behind which we find the division of labour –considered as the main determinant of productivity performance–. By contrast, we try to show that Marshall, while also suggesting an evolutionary conceptualisation of economic change, on a strictly analytic level made considerable efforts to interpret the process of division of labour in such a way as to make it compatible with static assumptions; as a consequence, he was led to considering increasing returns as a reversible relation between factors of production and output (of the industry).[1]

In comparing Marshall and the "Classics" we aim to show that the familiar tools of equilibrium economics (especially the graphical apparatus most economists are accustomed to) are not suited to analyse the processes by which dynamic increasing returns are generated.[2] For this reason the concepts on which the work is built are not the ones to which economists are nowadays used, although, at the same time, they are not new –their origin being traced back to the works of the classical economists.

DYNAMIC *versus* STATIC ECONOMIES OF SCALE

According to the classical economists the concept of division of labour has many dimensions. First of all, we must distinguish two different kinds

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[1] It should be noted that here we are not aiming to provide a fully fledged picture of Marshall's complex, multifaceted thought. Indeed, there is more in Marshall than a static equilibrium analysis. Among the many authors who highlight interesting aspects of Marshall's biological evolutionary conceptualisation, *cf.* Becattini (2000), Brinley (1991), Niman (1991) and the bibliography quoted there. Roncaglia (2001, chapter 13) gives a balanced picture of the complex interrelation between the conceptual and the analytical aspects of Marshall's thought. Toner (1999) provides an interesting discussion on the influential role of Marshall's analysis of increasing returns in the formulation of Allyn Young's growth model.

[2] In this sense, our attempt differs from those of other authors who propose a return to increasing returns in the context of a general equilibrium framework of analysis. *Cf.* J.M. Buchanan and Y.J. Yoon (eds., 1994).

of division of labour: 1) the *social division of labour* or the division of society into occupation and professions, and 2) the *industrial division of labour*, which refers to the different tasks performed within a process of production.[3]

In both its forms, that of intra-firm differentiation of labour and that of inter-firm specialisation of production, the industrial division of labour has the following economic consequences.[4]

- It allows for a faster execution of the various productive operations and, above all, a better organisation of the working process as a whole, including the elimination of unnecessary operations
- It points to a systematic way of studying and organising the labour process, which makes it possible to assign workers specifically endowed with the required skills to the single simple operations, improving performance and reducing costs of production (Babbage's principle of economy)
- It favours the substitution of routine and repetitive human works by machinery[5]

In all these ways it implies increasing productivity. Moreover, it implies a flow of innovations of various kinds (organisational, managerial, technical, etc.), which are stimulated by the increasing rationalisation of the productive process. The introduction of these innovations is bounded by the structural characteristics of the economic system (existing professions and trades, as well as prevailing technologies). However, this 'boundary' tends to shift through time, in so far as economic progress brings into being new products and new methods of production.

According to the classical viewpoint, the advantages of scale do not derive automatically from sheer size, but reside in the potential for task

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[3] On this distinction, *cf.* Corsi (1991).

[4] *Cf.* Corsi (1991). As far as the intra-firm differentiation of labour is concerned, it is important to distinguish between the *subdivision of labour* –i.e., the progressive simplification of the individual activities composing the working process– and the displacement of labour, which refers to the substitution of machines for workers, once the working activity has been simplified enough to be performed automatically.

[5] We refer to dynamic substitution, in the sense that it can only be the result of technological or organisational changes. It differs therefore from static substitution which takes place between labour and capital goods, *given* technology and the organisation of the productive process. *Cf.* Sylos Labini (1984).

specialisation and improved work organisation, in the possibility of using and inventing specialised production equipment, in the acquisition of skill in the manufacturing process.

Extensions of scale beyond the frontiers of current experience patently require searching for additional technological knowledge by considering the possibilities of modifying past practices and evaluating their prospective effects. These may involve altering material specifications, equipment characteristics, input proportions, operating speeds and conditions, labour tasks, maintenance requirements, etc.

These processes are not unidirectional. Improvements in technology also tend to alter the potentials of specialisation and, hence, the prospective benefits of further increases in scale. Moreover such interactions tend to be reasonably continuous because innovations in technology within any subsection of the production process tend to engender accommodating adjustments in antecedent and subsequent subsections in a kind of ripple-effect –as a result of the unceasing pressure to optimise the effective organisation of operations as a whole.
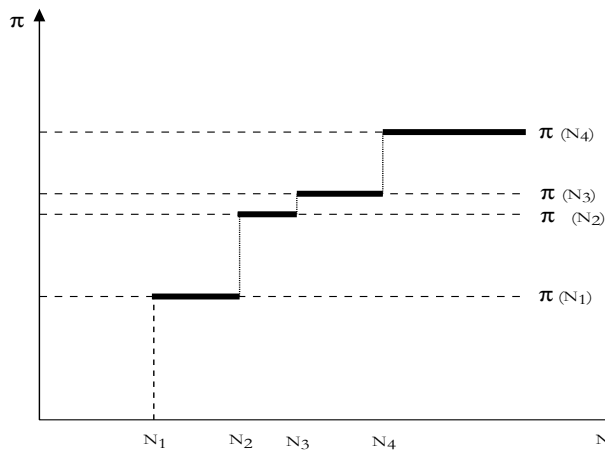
We can synthesise the dynamic nature of the economies of scale generated by the process of 'division of labour-technical change' in defining productivity not as a function of current output (as in the case of static economies of scale), but as a function of cumulative output, *i.e.* the sum of output flows in the past ($N_t = \sum_t q_t$, in discrete time, $= \int_0^t q_t dt$, in continuous time). Cumulative output stands for the element of time in a twofold manner: 1) given that changes are discontinuous and unpredictable, time is depicted as *event time*, *i.e.* in accordance with the pace of the innovation process; 2) to take account of the accumulation of knowledge due to the process of improvement by practice, time is also memory of the past.[6]

In figure 1 we indicate on the x-axis the cumulative output (N_t) and on the y-axis labour productivity (π). In accordance with the above

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[6] While the relationship between productivity and cumulative output is similar to the one illustrated by Verdoorn (1949) and Arrow (1962), the interpretation of this link offered here is a novel one (especially from a graphical point of view).

considerations, the growth of productivity under dynamic increasing returns may be represented by a step function: each time an innovation (organisational, technological, etc.) is introduced, productivity jumps up. In the time gap between two innovations productivity keeps constant, as shown by the dotted horizontal straight lines, each corresponding to a specific structure of technology and, therefore, depending on a specific value of N_t. Each change in productivity is irreversible, given that it corresponds to a change of scale and scaling a process of production up or down does change the physical processes within it, the relationships between its parts and its connections to the rest of the production system, the number of people involved, their tasks, their skills and their relationship with one another.

FIGURE **1**
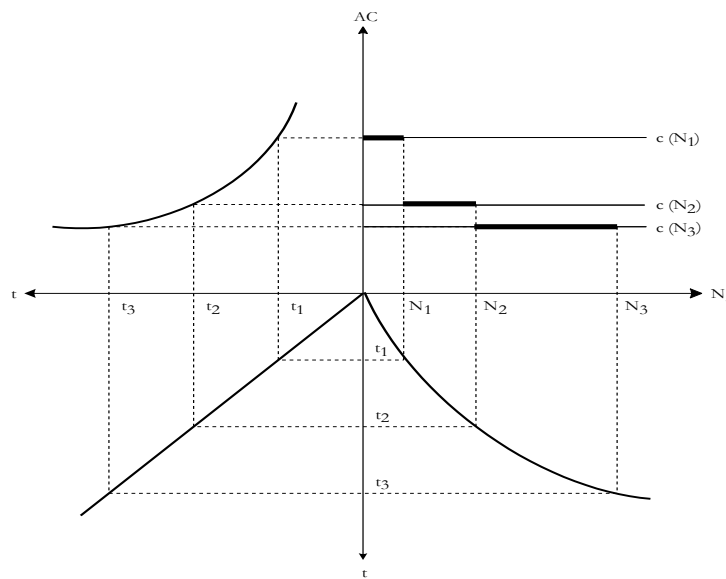***Productivity Growth under Dynamic Increasing Returns***

Classical economist had an unswerving trust in the ability of division of labour and mechanisation to propel society to over higher levels of prosperity. However, they dis not ignore the existence of boundary conditions which might bring the economic system to a stationary state. Existing professions and trades, prevailing technologies, 'vexatious institutions', public mismanagement are all examples of possible limits to growth. In brief, the forces commanding

the process of increasing returns generated by the division of labour are captured by two basic 'postulates':

  1. Productivity is an increasing function of the division of labour
  2. The division of labour is limited by the extent of the market[7]

Since per capita income is basically dependent upon productivity, income becomes a function of the division of labour and the extent of the market, and income growth, *i.e.* economic development, thus becomes a process of expanding markets and dividing labour. The thrust of this argument is illustrated by the curves in figure 2.

Figure **2**
A Graphical Representation of the Classical 'Postulates'

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[7] Using Allyn Young's words 'the division of labour depends in large part upon the division of labour' (*cf.* Young, 1928, p. 533). For a discussion of Allyn Young's article on increasing returns and economic progress, *cf.* Corsi (1991).
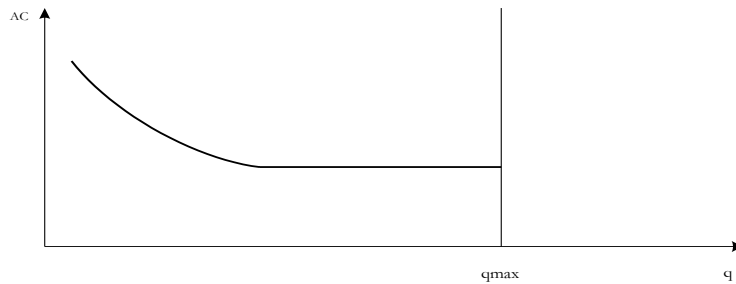
The curves in figure 2 translate the classical postulates in terms of long-run cost curves (quadrant IV) and short-run supply curves (quadrant I). The short-run supply curves in quadrant I are parallel to the x-axis due to the time gap between the introduction of two subsequent innovations. Given the discontinuity of technological changes, costs and supplies change suddenly in correspondence to specific values of N_t.

The process of 'division of labour-technical change' generates a long-run tendency to falling prices as a result of the self-propelling process of structural change (quadrant IV). As we stressed above, division of labour yields not only the static advantages of specialisation, but also dynamic advantages through learning-by-experience and technological improvements. This feature of the process is represented by the relationship between average costs and cumulative output. More cumulative output grows through time less costly the production of current output becomes, being N_t a proxy for experience gained by successive production improvements. The history of production comes therefore to influence the path which costs take.[8]

Considering directly the relation between average costs and current output, the classical postulates imply the existence of a downward sloping average costs curve.[9] This is consistent with Sraffa's (1926) argument that:

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[8] It would be interesting to study what path N_t should follow so as to obtain increasing or U-shaped cost curves. In this perspective, one might be keen to re-examine Sraffa's 1925 criticism of Marshallian U-shaped cost curves. *Cf.* Roncaglia (1978, 1991) and Sylos Labini (1990).

[9] At the level of the individual firm we might imagine that average costs fall until the limit of the plant's capacity is reached:

> Everyday experience shows that a very large number of undertakings and the majority of those which produce manufactured consumer goods work under conditions of individual diminishing costs.[…] Businessmen, who regard themselves as being subject to competitive conditions, would consider absurd the assertion that the limit to their production is to be found in the internal conditions of production in their firms, which do not permit the production of a greater quantity without an increase in costs (p. 543).

THE CLASSICAL DIVISION-OF-LABOUR THEORY

Before summarising Marshall's long-period analysis, we concentrate now on what we name the classical division-of-labour theory, mainly referring to the two major contributions by Adam Smith and Charles Babbage –without denying the relevance of other contributions (*e.g.* by Marx or by J.S. Mill) to which we will often refer.

The importance of Smith's treatment of the division of labour is widely recognised: as Bücher (1907) stresses, the "popularity (of the concept of division of labour) is indeed due in no small measure to the external circumstance that it is presented in the first chapter of book I of his classical work (the *Wealth of Nations*), where it could not escape even to the legion of those who merely 'read at' books" (p. 283). Babbage's discussion, presented in his *On the Economy of Machinery and Manufactures*, reviews the Smithian analysis in the light of the factory system and, in our view, gives an important contribution to our understanding of the social and economic effects of the industrial division of labour (see: Corsi, 1984, 1991).

Adam Smith

The analysis of the division of labour is the starting point of Adam Smith's *Inquiry into the Nature and Causes of the Wealth of the Nations,* and provides the foundation for his model of economic development.[10]

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[10] Referring to the growth model developed for book 1, chapter 3 of the *Wealth of Nations* by Hicks (1965), the rate of growth of output in the economy depends, according to Smith, on three variables: the proportion of productive labour in the total labour supply (the saving ratio), the wage rate, and the level of labour productivity (product per capita). According to Groenewegen (1977) Smith seems to have believed that the scope for important increases in the proportion of the labour force devoted

According to Smith, the division of labour is the organising principle of production. Moreover, it may be regarded as the main determinant of productivity performance:

> The greatest improvement in the productive powers of labour, and the greater part of the skill, dexterity, and judgement with which it is any where directed, or applied, seem to have been the effects of the division of labour (Smith, 1776, p. 13).

In chapter 1 of book 1, Smith describes different kinds of division of labour: the *social division of labour*, or the division of society into occupations and professions, and the *industrial division of labour*, which refers to the different tasks performed within a process of production. In its turn, the latter manifests itself in two ways: *inter-firm specialisation of production* and *intra-firm differentiation of labour*.

Smith illustrates each process by industrial examples and from them deduces the characteristics of the various kinds of division of labour. There is first the celebrated example of the pin manufacture, which refers to the intra-firm differentiation of labour. With the ordinary workman who is not particularly adept at this special production, Smith contrasts the factory in which a considerate number of workmen with divided labour produce similar commodities. "One man draws out the wire; another straights it; a third cuts it; a fourth points it; a fifth grinds it at the top for receiving the head; to make the head requires two or three distinct operations, […]" (p. 15); in this way there result, up to the completion of the pin, eighteen distinct operations, each of which can be transferred to a partial worker. Smith finds that in such a co-operating group of workers the output of each individual, as compared with that of the labourer working separately and producing the whole product, is increased a hundred, indeed a thousand fold.

This example has been repeated even to weariness; it has become, in general, the classic type of division of labour. Many economists, apparently, can conceive of it only in this one form, the form of a manufacture in which

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to productive activities was limited. Thus, given the real wage, a substantial growth rate depends exclusively on rising productivity, through extensions of the division of labour.

the total labour necessary to the production of the ware is divided into as many simple operations as possible, carried on simultaneously by different people in the same establishment.

But, although it is commonly forgotten, Adam Smith has not confined himself to this example. On the one hand, as far as the social division of labour is concerned, Smith considers the instance of the woollen manufacture. In a 'rude' state of the society, he argues, the production of woollen cloth is the work of one man, from the procuring of the raw material till it is ready for use; in every 'improved' society, on the contrary, 'the farmer is generally nothing but a farmer; the manufacturer nothing but a manufacturer'(p. 16). On the other hand, to illustrate the inter-firm specialisation of production, Smith compares three smiths: "a common smith, who though accustomed to handle the hammer, has never been accustomed to make nails"; a second smith "who has been accustomed to make nails", but has not this as his sole or principal occupation; and finally a nail-smith who has never been accustomed to any other occupation (p. 18). He finds that if all three make nails for a definite period the work done increases according as the workman limits himself to the production of one product. Clearly, Smith conceives the whole business of a smith who originally makes horseshoes, spades, etc., as well as nails, as the subject of the process of division. From this comprehensive department of production a line of production is separated, and taken over by a special workman, the nail-smith, while the remaining products continue to form part of the ordinary smith's work. The articles formerly produced jointly in the one business of the smith are henceforth manufactured in two different businesses. In the place of one firm there are now two, and each provides for an individual a separate employment.

Smith ascribes to the various forms of industrial division of labour the same effects: 1) increased dexterity of the workman, 2) saving of time, and 3) the invention of machinery which facilitates labour.[11] Since the division of

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[11] Marglin (1974) has criticised the three grounds on which Smith bases his assertion about the high productivity of the division of labour, attributing this, instead, to the introduction of a 'discipline cum supervision' by the factory employer. Landes (1986) has provided a very convincing reply to Marglin's arguments, and has 'rehabilitated' Smith's point of view.

labour is more easily carried out in manufactures, it is in the manufacturing sector that costs would decline and it is this sector of the economy, therefore, that is linked with increasing returns.[12] These consequences of the division of labour in turn are responsible for the tremendous rise in living standards experienced by civilised nations, "or that universal opulence which extends itself to the lowest ranks of the people" (p. 22).

Chapters 2 and 3 of book I, and the introduction to book II discuss both the prerequisites for and the constraints on the division of labour. According to Smith, the division of labour "is not originally the effect of any human wisdom, which foresees and intends that general opulence to which it gives occasion"; it arises, mainly, from a human "propensity to truck and barter, and exchange one thing for another" (p. 25).[13] Division of labour –considered as the linchpin of productivity performance– is therefore only possible in an exchange economy, and hence is limited by 'the extent of the market': an expansion of the market (*i.e.* of the potential demand for final output) increases the division of labour which can promote, through a cost reduction, the growth of production and a subsequent expansion of the market.

A final requirement for the division of labour is given in the introduction of book II, thereby linking the analysis of capital to that of the division of labour. In the second paragraph of this introduction Smith demonstrates that a prior accumulation of capital must exist when the division of labour is practised, in order to maintain the worker, 'and to supply him with the materials and tools of his work till such time' that the production

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[12] According to Smith, the division of labour in agriculture has a more limited scope than in manufacturing, so that the increase in productivity tends to be slower than in the other sector. However, this is very different from Ricardo's idea of long-run predominance of diminishing returns in agriculture. Indeed, Smith distinguishes two categories of agricultural products –vegetables and cattle– and argues that only the second category is subject to a sort of tendency toward diminishing returns (*cf.* Smith, 1776, p. 259).

[13] Arrow (1979) criticises Adam Smith for regarding exchange as the only means whereby the division of labour can be originated and the co-ordination of different kinds of work achieved. He argues that self-interest and market type co-operation can be effective only in the presence of some 'ethical codes' and stresses the risk of imperfect information and mistrust as consequences of the specialisation of experience. Arrow seems to forget the existence of Smith's *Theory of Moral Sentiments*!

process has been completed and the output has been sold (p. 276). Later it is argued that the extent of the division of labour is in this way limited by the accumulation of capital and, in addition, that such accumulation encourages further division of labour because the capitalist wants to secure a maximum return for his advances (p. 277). The division of labour and the accumulation of capital are therefore strongly interrelated.[14]

Charles Babbage

Charles Babbage's discussion of the division of labour, in his *On the Economy of Machinery and Manufactures* (1832) concentrates mainly on the industrial division of labour applied to each individual working process.

The main purpose of Babbage's interest in the division of labour is to identify rational solutions to minimise costs of production. In chapter XIX, after having defined the division of labour as the organising principle of production, Babbage analyses the advantages related to it, usually seen as factors of increasing productivity. The common characteristic of all these factors is the *reduction of necessary working time* (*i.e.* the direct or indirect labour content of one unit of output). This, with a given total amount of labour time employed, implies an increase in the amount of goods produced. Moreover, the increasing specialisation of operations reduces apprenticeship time, *i.e.*, less time is needed for instructing each individual worker for his specific tasks. At the same time there is also a reduction in the amount of wasted material. When the worker performs only a specific operation, he puts specific muscular strength and attention to use; and this, after a variable period of training, makes it possible to obtain the desired result with maximum efficiency. Obviously, when the worker performs many kinds of operations within a single day, there will be waste of time, because

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[14] Eltis (1975) stresses that the Smithian model of economic growth attributes overwhelming importance to the rate of capital accumulation, which is a function of the ratio of productive to unproductive employment. He argues that, according to Smith, fixed capital rises as the economy grows; thus there is upward or downward pressure on profits dependent on the relative growth rates of capital and output.

of the large amount of time necessary for adapting to the new operation, when the worker has to shift from one kind of operation to another.

The same reasoning holds for the time necessary to prepare instruments and machines for work. Less time is required if the instruments and machines are prepared once and then always used for the same operation. When the worker performs the same operation, with the same instrument, we have the condition for continuous improvement both in the manual execution of the operation and in the instruments.

Smith and other economists after him, had already made these observations starting from the existence of a certain kind of division of labour already operative within the manufacturing system. But Babbage starts by looking for rational patterns that allow for the refinement of the division of labour, optimising its results in terms of increasing productivity. According to Babbage, in order to identify rational patterns in the division of labour, we need quantitative analysis, which allows one to establish the exact amount of strength and skill required by any specific operation.

Using quantitative examples, Babbage introduce the following principle of economy of skill:[15]

> That the master manufacturer, by dividing the work to be executed into different processes, each requiring different degrees of skill or of force, can purchase exactly that precise quantity of both which is necessary for each process whereas, if the whole work were executed by one workman, that person must possess sufficient skill to perform the most difficult, and sufficient strength to execute the most laborious, of the operations into which the art is divided (Babbage, 1832, pp. 175-176)[16]

According to Babbage, this principle is the basis for obtaining the greatest advantages from the division of labour. Indeed, this principle has a general,

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[15] This is just the economic application of a more general principle: "One of the most important processes in all inquiry is to divide the subject to be considered into as many different questions as it will admit of, and then to examine each separately or, in other words, to suppose that each single cause successively varies, while all others remain constant" (Babbage, 1851, p. 4).

[16] In a footnote Babbage argues that he has taken this principle from Melchiorre Gioja, *Nuovo Prospetto delle Scienze Economiche*, Milano, G.Pirotta, 1815.

decisive relevance: it impressed later economists, including J.S. Mill,[17] Marx[18] and Marshall.[19]

In order to clarify this principle, Babbage uses a pin-making example, similar to the Smithian one.[20] He presents a table of the time required by each process, and its cost, as well as the wage of the people who are confined solely to a single process. According to Babbage, this kind of study shows clearly that, if the worker paid with the maximum wage accomplished all the phases of the working process, a part of his working time would be wasted: in fact, even if his productivity were equal to the productivity of the worker specialised in the single operation, the cost would be twice as much,

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[17] In describing the economic consequences of the division of labour, J.S. Mill argues that the "greatest advantage (next to the dexterity of the workmen) derived from the minute division of labour […] is one not mentioned by Adam Smith, but to which attention has been drawn by Mr. Babbage; the more economical distribution of labour, by classing the workpeople according to their capacity" (Mill, 1848, p. 129). In other words, for Mill as for Babbage, the division of labour mainly provides a rational solution to minimise the costs of production. Far from being a process of adaptation of the tasks of labour to the variety of human vocations, the division of labour is conceived by Mill as the adaptation of individual powers to the tasks to be performed, as the continued differentiation of the one and of the other.

[18] Marx quoted what we may call 'the first principle of Babbage' in the first volume of *Capital*, when he analyses the 'organic manufacture' (*cf.* Marx, 1867, p. 469n). However, as far as his analysis of the collective worker is concerned, Marx is influenced by Andrew Ure more than by Babbage:

> Dr. Ure, in his apotheosis of large-scale industry, brings out the peculiar character of manufacture more sharply than previous economists who did not have his polemical interest in the matter, and more sharply even than his contemporaries –for instance Babbage, who, although much his superior in mathematics and mechanics, treated large-scale industry from the standpoint of manufacture alone (p. 470n).

In the light of our interpretation of Charles Babbage's works, Marx is right only when he stresses the scientific superiority of Babbage in comparison with Andrew Ure (*cf.* Corsi, 1984, pp. 100-131).

[19] Marshall, in his *Industry and Trade* (1919) sees American standardised production as an 'unprecedented' application of "Babbage's great principle of economical production"(p. 149). Moreover, discussing the principles of scientific management (book II) he argues that "One of the chief ideas of Scientific Management was worked out a considerable way by Babbage […]; and, for good reasons, he took as his chief illustration the common task of shovelling earth, which Taylor was to use for the same purpose later on" (p. 376). On Marshall's evaluation of the movement for scientific management see Whitaker (1999).

[20] In his *The Exposition of 1851,* Babbage speaks about two men engaged in shovelling earth (pp. 3-4).

because of the higher wage paid to the "general" worker in comparison with the "partial" worker.

Babbage analyses the division of both physical and mental labour. His analysis of working methods concerns the factors which concur in obtaining the maximum effect in each working operation (*e.g.*, in the case of the physical labour, the weight of the arm, the weight of the instrument and the frequency of each operation) and the study of the many degrees of skill required by each operation. As a result of these studies the working process is divided into its primitive elements, which can then be rearranged into the effective working process. This method would later constitute the foundation of the so-called 'scientific division of labour', developed by Winslow Taylor. But Babbage's view is, in a sense, much more sophisticated than Taylor's. In fact, according to Babbage, identifying the primitive operations which make up the working process allows us to identify the possibilities of replacing any single simple operation with certain instruments or machines. According to the above mentioned principle of economy of skill, when the working process is considered as a series of specific operations, it becomes possible to assign all the workers specifically endowed with the requisite skills to the single simple operation, improving the performance and reducing costs of production.

At the same time, Babbage argues that the division of mental as well as physical labour can be sufficiently refined to enable the capitalist to substitute machinery for the routine and repetitive processes, lowering costs even further.[21]

This show that Babbage especially promotes a new industrial organisation of both mental and physical labour, so that workers can be substituted by machinery, for the routine and repetitive processes. Babbage sees this 'co-operative substitution' of workers by machinery as the main factor of increasing productivity. Moreover he believes that the progressive specialisation of productive functions and the introduction of very sophisticated machines

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[21] As an instance of this, and a very relevant one from the contemporary point of view, we can consider the so-called 'computing engines' developed by Babbage himself.

will set the human creative imagination free for inventing new machines and new products. Referring to this point, Babbage seems to agree with Adam Smith, who attributes 'capacity to invent' in a technically progressive society to "philosophers or men of speculation, whose trade it is not to do anything but to observe every thing; and who, upon that account are often capable of combining together the powers of the most distant and dissimilar objects" (Smith, 1776, p. 21).

Babbage –like Marx and Mill later– connects the intra-firm division of labour and the process of industrial concentration. In his chapter 'On the causes and consequences of large factories' Babbage enumerates the conditions which give rise to increasing returns to scale and lower prices for manufactured articles (J.S. Mill's *Principles* contains page-length quotations from this section of *On Manufactures*).

Following Smith, Babbage recognises that 'the division of labour cannot be successfully practised unless there exists a great demand for its produce', and he adds that this in turn 'requires a large capital to be employed in those arts in which it is used'(p. 201; *cf.* also pp. 213-214).

Babbage apparently feels that as long as the division of labour and demand are extended, there is no limit to the size of the firm. With regard to this topic, he introduces the following *principle of numerical proportions*:

> When the number of processes into which it is most advantageous to divide it, and the number of individuals to be employed in it, are ascertained, then all factories which do not employ a direct multiple of this latter number, will produce the article at a greater cost (p. 212).

Here Babbage implicitly refers to the production of a specified good by a number of competing firms. If we assume that the production of any commodity is undertaken by many firms, each of which specialises in some activity, the conclusions may be different. When activities, although complementary, are in general not similar, firms will tend to expand selectively the activities, in which, relative to competitors, they have a comparative advantage, and to rely, to an increasing extent, on sales to or purchases from other businesses.

Babbage discusses several other reasons for the cost advantages of large firms, such as i) the generation of sufficient by-products to allow for their processing and sale; ii) the effects of customers' trust in terms of lowering information costs; iii) the fact that large manufactures can, with their capital, undertake the research necessary to produce new products and lower the cost of existing ones (Babbage, 1832, pp. 217-224).

Babbage feels that, despite the concentration of capital, monopoly can be avoided if consumers have adequate product information[22] and entry is not restricted (*cf.* p. 143). Competition takes the form of introducing new products, production processes, and organisational techniques. Any monopoly rents obtained within this environment are usually temporary in nature due to the dynamic forces of innovation. Implicit in this discussion is the assumption that free entry is normally present and that any attempt to raise prices artificially would bring new firms into the market.

Marshall on Increasing Returns

In his *Principles,* Marshall sought to consider the economic system as an organic whole subject to biological laws. The firm, which can be considered the elementary unit of the system, is subject to a life cycle (birth, growth and death) which is ruled by two factors: 1) the adjustment of the firm to the environment and 2) the state of entrepreneurial faculties.

The division of labour –considered only as intra-firm division of labour– is connected with both these factors:

1. It is willed by the entrepreneur who makes up his mind on the basis of the *actual extent* of the market (*i.e.* current output) and the demand for the particular commodity he/she produces

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[22] According to Romano (1982), Babbage may have been the first writer to include information costs as an element of price and to explain the connection between these costs and price dispersion. He labels the cost to the consumer of obtaining information about a product a 'verification cost' and in his book gives a number of examples where difficulties in obtaining product and price information raise costs and lead to a greater dispersion of prices among sellers in a competitive market.

2. It is a means of adjustment to the environment, since it is the cause of internal economies[23] which allow the firms to improve their efficiency (*i.e.* to survive in their struggle for existence)[24]

The introduction of machinery is part of this adjustment to the environment, but only by cheapening and making more accurate the work which has been already reduced to routine.

Marshall looks for the sources of increasing returns to scale[25] in such phenomena as redeployments and adaptations of factors (especially labour) as well as *minor* improvements. Structural changes in factors or products are completely excluded:

> We exclude from view any economies that may result from substantive new inventions; but we include those which may be expected to arise naturally out of adaptations of existing ideas; and we look towards a position of balance or equilibrium between the forces of progress and decay, which would be attained if the conditions under view were supposed to act uniformly for a long time (p. 460).

In Marshall's attempt to conciliate increasing returns with the partial equilibrium analysis, the distinction between firm and industry levels of analysis becomes particularly relevant. This is true for at least two reasons: 1) according to Marshall, 'increasing return' has a different meaning,

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[23] Marshall calls external economies, those dependent on the general development of the industry; whereas, he calls internal economies, "those dependent on the resources of the individual houses of business […], on their organisation and the efficiency of their management"(p. 266). For a recent discussion of the role of external economies in Marshall's theory of value see Hart (1996).

[24] According to Marshall: "the development of the organisms, whether social or physical, involves an increasing subdivision of functions between its separate parts on the one hand, and on the other a more intimate connection with them. […] This increased subdivision of functions, or 'differentiation', as is called, manifests itself with regard to industry in such forma as the division of labour, and the development of specialised skill, knowledge and machinery; while 'integration', that is, a growing intimacy and firmness of the connections between the separate parts of the industrial organism, shows itself in such forma as the increase of security of commercial credit, and of the means and habits of communications by sea and road, by railway and telegraph, by post and printing-press" (p. 241).

[25] According to Marshall, "the law *of increasing return* may be worded: an increase of labour and capital leads generally to improved organisation, which increases the efficiency of the work of labour and capital' (p. 318; Marshall's italics).

according to whether we refer to the whole industry or to the single firm;[26] 2) determining the normal equilibrium, in Marshall's static method, implies the assumption of 'ceteris paribus', which, given Marshall's concepts, is more adaptable to the industry level of analysis.[27] Problems of adjustment of the individual firm through time,[28] and the inevitable 'decay of entrepreneurial faculties' (implicit in the life cycle analogy) make the rise and fail of individual firms frequent, 'while a great industry is going through one long oscillation, or even moving steadily forwards'(p. 457).[29]

The Representative Firm

In Marshall's 'biological model', every process of structural change needs such a long time that it is almost impossible to analyse its whole result. For this reason, Marshall goes step by step, breaking up any complex question and studying one bit at a time; in breaking it up he can also isolate some tendencies by the assumption 'ceteris paribus' and in this way their 'disturbing effects' can be neglected for a time.

This arrangement of the difficulties arising from the 'element of time' leads Marshall to adopt, in his purely theoretic analysis, a *static* method and

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[26] In Marshall's words: "The tendency to a fall in the price of a commodity as a result of a gradual development of the industry by which it is made, is quite a different thing from the tendency to the rapid introduction of new economies by an individual firm that is increasing its business"(p. 457). Moreover, "the causes which govern the facilities for production at the command of a single firm, […] conform to quite different laws from those which control the whole output of an industry"(p. 457).

[27] For a detailed discussion of Marshall's static method, cf. Pratten (1998).

[28] Difficulties of expanding their own special markets with the consequent slowness or inability to exploit potential economies of scale; technical and organisational problems related to "the length of time that is necessarily occupied by each individual business in extending its internal and still more its external organisation"(p. 500). These factors play an important role in Marshall's exercise of reconciling static increasing returns with some sort of 'competitive' regime.

[29] Marshall's way out of Cournot's dilemma is very 'simple': he states, using a biological analogy, that equilibrium of total output does not in fact require that all firms be in equilibrium. Industry output can be constant through time, even though some firms are being born and growing, and others declining and dying, provided that the gains in output from the one cause are balanced by the losses in output from the other. *Cf.* Flux (1904) for a discussion of Marshall's dynamic theory.

to move the analysis to the industry level, drawing on the notion of the representative firm.[30]

According to Marshall "a representative firm is that particular sort of average firm, at which we need to look in order to see how far the economies, *internal and external*, of production on a large scale have extended generally in the industry and country in question" (p. 318; Marshall's italics).

Such a firm is purely a mental construct and it is not pretended that it is likely to have a real existence, although Marshall occasionally argued that way. It is 'simply' a method of depicting industrial equilibrium in terms of the theory of the firm.[31] Given the size of the industry (in terms of level of output), the representative firm has two main properties: l) its output remains constant (if and only if industry output remains constant); 2) its cost per unit of output is representative of the industry at that level of production. On the basis of these two characteristics, Marshall draws the supply curve for the industry as the locus of points representing the expenses of production of the representative firm for different given levels of output (*cf.* Marshall, 1920, p. 344). Then, crossing demand and supply curves, Marshall determines the 'normal' prices of the commodities, namely those 'average' values, which "the economic forces would bring about if the general conditions of life were stationary for a run of time long enough to enable them all to work out their full effect"(p. 347).

In the long-run the size of the representative firm, by definition, is governed, other things being equal, by the general expansion of the industry. Therefore, a gradual increase in demand increases gradually its size and

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[30] For Joan Robinson Marshall's difficulty in dealing with the 'element of time' was clear from his fuzzy treatment of the long period, for which few precise conclusions can be reached, and where every result has to be seen as provisional or as in the case of the supply curve, non-existent (Robinson, 1953, pp. 13-14). On this issue see Groenewegen (1999).

[31] On this interpretation of the representative firm see Kaldor (1934) and Robbins (1928). *Cf.* Moss (1984) for the development of the theory of the firm at Marshall's time; see also Marchionatti (1992) and Cesaratto (1999) for their discussion of the EJ debate on the representative firm and increasing returns.

its efficiency.[32] "That is to say, when making lists of supply prices (supply schedules) for long periods in these industries, we set down a diminished supply price against an increased amount of the flow of the goods; meaning thereby that a flow of that increased amount will in the course of time be supplied profitably at that lower price, to meet a fairly steady corresponding demand"(p. 460).

This is the reason why Marshall refers to the representative firm in order to draw the long-period 'normal' supply curve for a commodity which obeys the law of increasing returns (downward sloping) [see: figure 3a: p = *expenses of production of the representative firm*; q = *scale of production = 'normal' output*].[33]

This curve, according to Marshall, is really located in three dimensions, representing scale of production, expenses of production and preparation time[34] respectively:

> We could get much nearer to nature if we allowed ourselves a more complex illustration. We might take a series of curves, of which the first allowed for the economies likely to be introduced as the result of each increase in the scale of production during one year, a second curve doing the same for two years, a third for three years, and so on. Cutting them out of cardboard and standing them up side by side, we should obtain a surface, of which the three dimensions represented amount, price, and
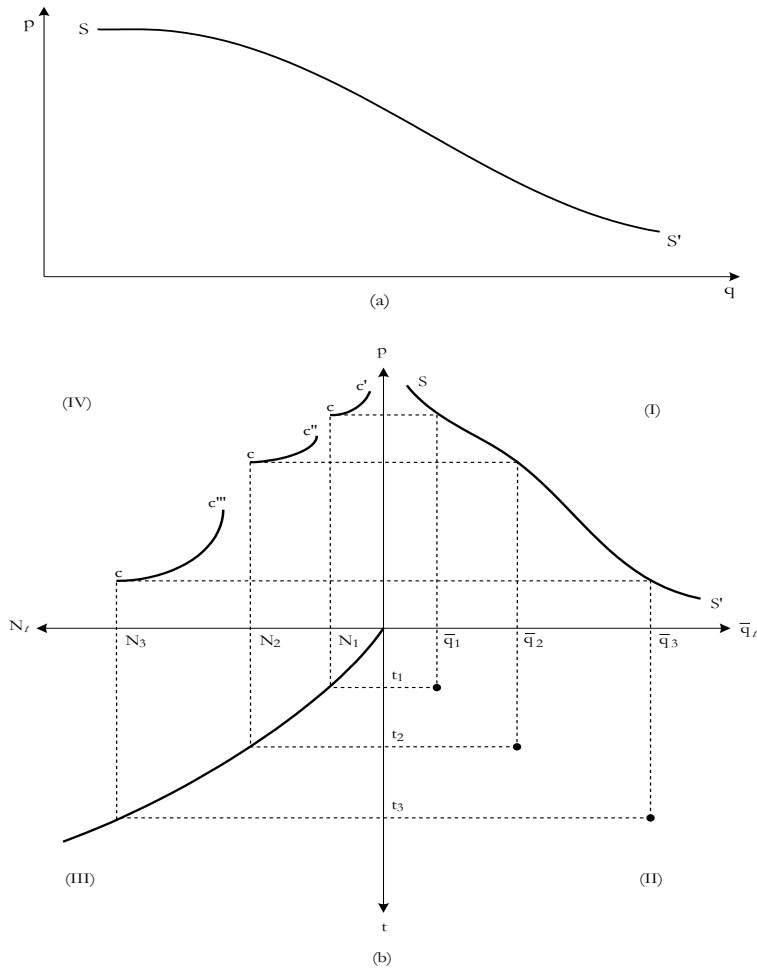
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[32] In Marshall's words: "an increase in the aggregate volume of production of anything will generally increase the size, and therefore the internal economies possessed by such a representative firm; that it will always increase the external economies to which the firm has access; and thus will enable it to manufacture at a less proportionate cost of labour and sacrifice than before" (p. 318).

[33] Let us consider Marshall's way of drawing the supply curve for the industry, adding up the individual supply curves of the firms which compose it. As Sraffa (1925) has stressed, it is impossible to add-up curves which shift because of their dependence on internal and external economics. This is why Marshall ends up by making the equilibrium of the firm depend upon the equilibrium of the industry rather than the other way round. Eliminating the effect of the intra-firm division of labour from the analysis, he can first postulate the conditions of equilibrium for the industry (considering only the external economies) and then create an analytical device –the representative firm– which answers the requirements of the static equilibrium scheme.

[34] By preparation time is meant the time necessary for introducing the economies which an expansion of the scale makes possible. "One difficulty arises from the fact that a suitable time to allow for the introduction of the economies appertaining to one increase in the scale of production is not long enough for another and larger increase, so we must fix on some fairly long time ahead, which is likely to be indicated by the special problem in hand, and adjust the whole series of supply prices to it." (p. 809, n. 2).

time respectively. If we had marked on each curve the point corresponding to that amount which, so far as can be foreseen, seems likely to be the normal amount for the year to which that curve related, then these points would form a curve on the surface, and that curve would be a fairly true long-period normal supply curve for a commodity obeying the law of increasing returns (p. 809, n. 2).

FIGURE **3**

Marshall's 'Normal' Supply Curve under Increasing Returns

(a)

(b)

Let us show the limits of this curve referring to figure 3b. In the four quadrants we have respectively: i) the long-run supply curve; ii) the expected 'normal' output of the year ($\bar{q}_t$); iii) cumulative output (growing through time) as a measure of preparation time; iv) cost curves allowing for the economies of scale likely to be introduced as the result of each increase in the scale of production during a certain number of years (cc' = one year, cc" = two years, etc.). Curve SS' is drawn through time: for each year it is possible to define the expenses of production of the representative firm corresponding to a certain expected level of 'normal' output, bearing in mind that costs diminish due to external economies of scale (given that the representative firm represents the industry it does not have any sense to speak of internal economies, by definition; *cf.* Ridolfi, 1972).

Indeed, because of the way in which this curve is drawn, it seems to stand for a history of the successive attainment of various scales of production, rather than as a range of alternatively choosable, mutually exclusive positions (*cf.* Shackle, 1972). Thus, if the purpose of confronting with each other a demand curve and a supply curve is to exhibit the mode of determination of that price-quantity pair which can represent both demand conditions and supply conditions simultaneously, Marshall's long-period supply curve cannot serve this purpose, since it must call upon a forecast of demand conditions in order that its own shape may be known (see: quadrant II in figure 3b).
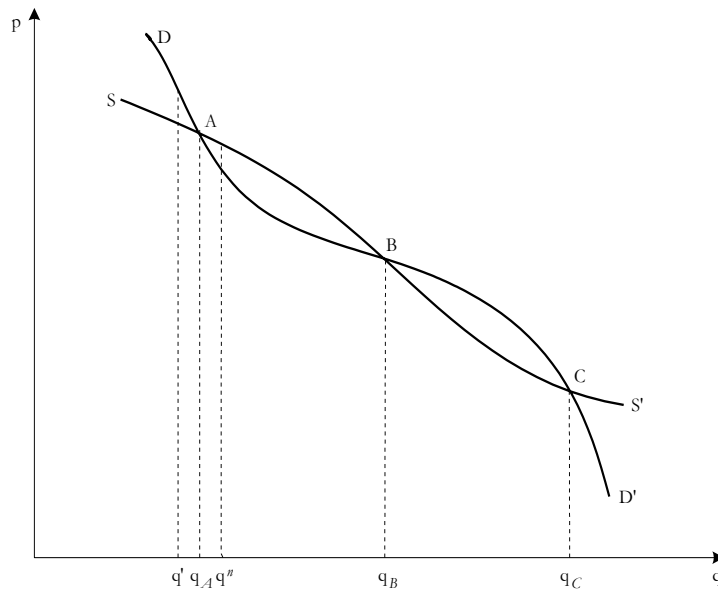
Nevertheless, Marshall uses this curve to determine stable equilibrium between demand and supply (see: figure 4).

Implicit in this scheme of equilibrium, we find a concept of *static reversible increasing returns*, since Marshall assumes that 'if the normal production of a commodity increases and afterwards again diminishes to its old amount, the demand price and the supply price will return to their old position for that amount' (p. 807-808). This assumption is necessary for the existence of two or more positions of stable equilibrium of demand and supply. Let us consider for example, the point of stable equilibrium A, in figure 4. The long-period supply price might be either greater or less than the normal demand price for the corresponding scale of production. In the latter case

(q') "undertakers, looking forward to the life of a firm started in that trade, considering its chances of prosperity and decay, discounting its future outlays and its future incoming, would conclude that the latter showed a good balance over the former. Capital and Labour would stream rapidly into the trade'(p. 806). On the contrary, in the former case (q") capital and labour would avoid the trade.

Marshall is aware that 'this theory is out of touch with real conditions of life', in so far as it ignores that 'when any casual disturbance has caused a great increase in the production of any commodity, and thereby has led to the introduction of extensive economies, these economies are not readily lost' (pp. 807-808). However, most equilibrium theory has been built up on these concepts according to Marshall's belief that the 'statical treatment alone can give us definiteness and precision of thoughts' (p. 461).

FIGURE **4**
Equilibrium of Demand and Supply
under Static Increasing Returns

Conclusions

Briefly, in this paper, we have considered two alternative answers to Smith's question: 'What are the causes of the Wealth of Nations?'

We have shown that, on the one hand, Marshall's equilibrium theory (as distinct for his evolutionary 'vision') focuses on static increasing returns and assumes that the conditions of production and the demand for a commodity can be considered, in respect to small variations, as being practically independent, both in regard to each other and in relation to the supply and demand of all other commodities; on the other hand, in a classical perspective, economic progress consists of a cumulative and self-perpetuating process of change. In this latter perspective, unceasing change results from the fact that the division of labour is at once a cause and an effect of economic progress. Established positions are constantly under pressure, not merely because of autonomous changes in tasks and technique but also by virtue of the fact that at any point of time there will exist unexploited opportunities from the future division of labour and the consequent regrouping of operations.

Marshall's theory of economic change has some harmful implications for the division-of-labour theory:

- It confines the division of labour to the firm level and does not stress positively the importance of the flow of innovations which the industrial division of labour generates
- It plays down the division of labour by concentrating the analysis at the industry level through the device of the representative firm
- It represents the process of increasing returns as a reversible relationship

On the contrary, in a classical perspective, division of labour and technical change are both intimately related to dynamic –therefore irreversible– increasing returns. Economies of scale (where scale stands for the planned production capacity of a line of production) are generated by the progressive task specialisation and improved work organisation, and by the possibility of using and inventing specialised production equipment. They do not derive automatically from sheer size, but from the potential for improvements in organisation and technology which an increase in size brings with it.

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