

THE POLITICAL ECONOMY OF INDUSTRY

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1. Introduction

The political economy of industry is here intended as the long series of studies of the relationship between production organisation and the power structure it generates.

The roots of this analysis lie in the First Industrial Revolution. The control of productive organisations determines not only economic, but also political power in societies, through their effects on the division of labour, both within the firm and within societies, and through the learning and status acquisition opportunities they afford to different individuals and social groups. At the same time, changes in the division of labour may also be associated with processes of de-skilling and status loss. The social division of labour had existed in ancient civilizations (Liverani, 2006) and had been examined in detail in Classical Antiquity. Plato and Xenophon highlighted the division of labour between individuals or groups specialising in the production/delivery of specific goods or services that are then traded between the members of society according to their respective needs¹. In contrast to that, this chapter focuses on the ‘technical’ division of labour within productive units working in a competitive capitalist environment. In other words, we examine the organisation of production within

¹ The analytical implications of this view of division of labour are investigated in Luigi Pasinetti’s model of a ‘pure labour economy’ (1993).

specific workshops and factories delivering manufacturing products that are aimed at markets in a conflict-ridden, competitive context where relationships between rivals determine the relative power of different stakeholders (such as firms, industries, and national systems). This type of division of labour has developed since the First Industrial Revolution and is associated with the development of capitalism (Noble, 1984; Poni, 1997, 1998).

The political economy approach to the analysis of industry is characterised by an attention to production organisation and its effects on both productivity and the structural development of the whole economic system. More specifically, production organisation determines division of labour and its effects on the specialisation of workers' activities, creating opportunities for them to apply 'skill, dexterity and judgement' (Smith, 1776) to their working activities and to learn through their working life, with impact on their role in societies, their political power, and their civic development. In a competitive capitalist framework, production involves the creation of organisational processes aimed at transforming some (tangible and intangible) inputs into (tangible and intangible) goods that can be sold on markets. These processes are carried out using knowledge, capabilities and intelligence, which in turn generate added value. This capacity to generate value by combining knowledge, skills and competencies and transforming them into artefacts is where the essence of the manufacturing firm lies and is, according to Smith (1776), what determines the 'wealth of nations'. In other words, the determinants of economic development are not only the raw materials or the land available to an economic system, but also the individual and collective capabilities to transform inputs into outputs; the capability to learn and apply new knowledge to production processes; the competence in accumulating, transferring and organising knowledge by incorporating it into goods that are tradable in markets subject to conditions of competition between rival producers.

This chapter examines this relationship in the works of Classical Economists and applies it to the characteristics of contemporary industry. The chapter argues that the conceptual framework of the

Classical Economists provides the analytical tools needed to explain the current developments in industrial production. Particular attention is given to the contribution of Adam Smith, who provided an important and pioneering insights into the political economy of industry.

The chapter develops a line of investigation started in Bianchi (1984, 1991), where the structural changes in the manufacturing industries of the 1970s and 1980s (and particularly the Third Industrial Revolution switch from Fordism to flexible manufacturing systems) were explained in terms a classical (Smithian) analytical framework. Here we argue that a Classical framework can also illuminate current structural changes in manufacturing, which we can describe as the Fourth Industrial Revolution ².

The chapter highlights the importance of production organization (*manufacturing regime*) to understand structural changes in manufacturing and the evolution of industries driven by firms' search for dynamic efficiency. Section Two examines contributions prior to Smith's *Wealth of Nations*. Section Three deals with Smith's contribution, highlighting not only Smith's focus on division of labour and its effects on the economy and society, but also his view of division of labour as a dynamic process based on learning and innovation. Section Four highlights the relationship between division of labour and power in the work of the Classical Economists. Section Five provides a historical reconstruction of the economists' views of the relationship between production and competition in the period following the Marginalist Revolution of the 1870s and characterised by the progressively vanishing focus on production organisation. Section Six reconstructs manufacturing history since the age of the mass production system, highlighting the variety of forms of production organisation that have appeared in that period (from industrial districts and clusters to modular production networks and global value chains). Sections Seven and Eight provide an explanation of those developments in terms of the classical framework, and outline a political economy of the Fourth

² Bianchi and Labory (2018) provide the analytical reconstruction of the sequencing of industrial revolutions in terms of a succession between different forms of manufacturing organization (*manufacturing regime*)

Industrial Revolution based on that framework. Section 8 brings the chapter to close.

2. The pre-Smithian division of labour

The relationship between production organisation, the extent of the market and power has been central to the work of Adam Smith, whose book *The Wealth of Nations* (1776) is one of the fundamental pillar for the development of Political Economy as a specific discipline of moral sciences.

The study of production organisation, namely of the labour division between individuals operating a common activity but belonging to a single social structure, starts however earlier than this.

The Scottish philosophers, among whom Hutcheson who was a teacher of Smith, had already studied the division of labour as a model of social organisation, and French encyclopaedists had described the types of instruments, tasks and basic knowledge which characterised the various activities of the societies of the time (for instance Diderot).

Different metaphors were used to delineate the organic character of productive organisation, from the mechanics of a clock (Petty, 1671) to bees in a hive (Mandeville, 1714). The example of the pin factory was already present in the *Chamber Cyclopedia* and the *Encyclopedie* of Diderot and D'Alembert, where the different phases of the production process of pins is described.

These studies analysed the division of labour and highlighted its advantages. Thus Harris (1757) and Tucker (1755) examined the productivity implications of the division of labour. Petty (1671) seems to be the first scholar who analysed the details and effects of the division of labour in specific production workshops. He noted that the specialisation of workers' activities allowed by the division of labour contributed to skilful cloth-making. He also examined the benefits of labour division in the Dutch shipyards. David Hume (1739), a contemporary and friend of Smith, referred to the division of labour as the 'partition of employments'.

These studies recognised that the advantages of the division of labour in improving the skills of individual workers and reducing the time and effort involved in switching from one operation to the next, and in facilitating innovations.

Smith realised the convergence and synthesis of this long series of studies, and asked about the possibility to define a descriptive system of social dynamics that would be as strong and predictive as the Newtonian synthesis of the movement of the universe. Smith analysed the Newtonian mechanics in his graduation thesis and highlighted its relevance for moral sciences.

Later he devoted himself to the study of the aggregation modes of human societies, leading to the publication of the Theory of Moral Sentiments, as well as a first draft of the Wealth of Nations, in which he introduced the analytical scheme relating the increase in the extent of the market, division of labour and market power.

After studying the forces driving the composition of social bodies, and after a trip in France, where he met some of the major intellectuals of the time, he completed his most important work where for the first time the implications of the division of labour on economic development and prosperity, in connection to the dynamics of market forces, were highlighted, while previous studies only highlighted the advantages of the division of labour in terms of productivity and learning effects.

3. Division of labour and production organisation in Adam Smith

Smith views the economic system as a set of production cycles that run vertically, and roughly independently from one another, from raw materials to final products. His argument is that the wealth of nations is determined by the division of labour that is induced by the organisation of production in relation to the extent of the market. The division of labour has a technical dimension, related to the division of tasks necessary to produce the good, as well as the materials and components necessary

for its production; it also has a social dimension, in that all individuals in society will specialise in a particular activity, according to their knowledge and competencies, which will determine their role and status in the society.

Smith lived during an extraordinary phase of European life. The birth of manufacturing capitalism took place during an intense phase of scientific research on the dynamism of the universe, whilst philosophical studies were simultaneously underway concerning the organisation of the society and with it, the role of the state. He turned to examine, through various experiments, the fundamental rules of a social system, and discovered its modes of aggregation and competition, identifying the dynamic factors permitting its movement across time.

His book describes the advantages of the modern organisation of production very precisely through the famous example of the pin factory, which is related to the capacity to learn and therefore to accumulate knowledge with respect to a specific activity. Repetition permits task optimisation and enhanced knowledge of materials, hence learning and improvement in the performance of the task(s). Knowledge and competencies could also be improved by innovation, namely the invention and introduction of new machines or new production organisations.

Organisational choices are related to market demand and competition, as stressed in the third chapter of his book:

As it is the power of exchanging that gives occasion to the division of labour, so the extent of this division must always be limited by the extent of that power, or, in other words, by the extent of the market (1776, I, III, p.15).

The organisation of production, namely how the production process is divided into phases performed

by different workers, is limited by the market power of the firm (the power of exchanging) and the extent of the market (how much ‘effectual demand’ the producer must supply). In case of changes in market demand, such as in the example of a public mourning that alters the demand for cloth, rising the demand for black cloth, the firm must adapt its production system, using its technical knowledge and the competencies of its employees.

In addition, the importance of what would today be competencies and knowledge were also stressed, and seen in connection to a market and the capacity to create value through organising production specifically designed for the characteristics of that market.

‘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’ (1776, I, I, p.4).

In such a model, the capacity to create value is clearly related to the capacity to focus human competencies on the production of goods within an organisational model that accumulates and transfers technical, organisational and market knowledge into the productive cycle.

Labour division is a dimension of social conflict. The “power of exchanging” is not only the power of the firm relative to its rivals. It is also the political power that the firm may gain by becoming big and dominant on some market. This market power also provides the entrepreneur with a power over its employees, who must perform specific tasks to get wages, so that the entrepreneur has a political power over them, conditioning their compensations on their efforts that must be done in adequate ways for the firm. Economic, social and political aspects are therefore closely related. This important feature of the political economy of industry will be further discussed in the end of section 6.

This analysis is essentially dynamic. The book starts with a discussion of the division of labour and its effects, which argues that efficiency effects are both static (specialisation allows to save time and improve quality thanks to a more focused job) and dynamic, in that specialisation allows learning and therefore innovation. Innovations are improvements in existing machines and invention of new ones. This technical progress induces price reductions, not because of increasing returns to scale with a stable production technology, but because of the adaptation of the process to changing demand and to technical progress.

Specialisation and complementarity within a dynamic context are key to efficiency. The capacity to design new methods of organisation, to introduce new machines, to identify new needs and to open new markets, constitutes the essential component through which a competitive advantage is created. These innovations are called ‘secrets’, and although they generate higher profits, they also attract new competitors. Whilst trade secrets are difficult to maintain, ‘secrets in manufacturing are capable of being longer kept than secrets in trade. A dyer who has found the means of producing a particular colour with materials which cost only half of the price of those commonly made use of, may, with good management, enjoy the advantage of his discovery as long as he lives, and even leave it as a legacy to his posterity’ (WN, I, VII, p. 53).

However, as already stressed, the sources of innovation do not only lie within the firm, but also outside it, thanks to the work of scientists, namely ‘philosophers or men of speculation’ in the words of Smith. He argued that scientists specialise in research in specific ‘branch’ and can contribute to economic progress thanks to their discoveries and inventions (WN, I, I, p. 10).

Knowledge, learning, and innovation both within the workshop and outside it are therefore sources of what are called today competitive advantages that combine to represent the engine of social development. An economy becomes more dynamic as its knowledge base spreads, and as its

organisation of production is increasingly based on learning.

Fundamental to this process is the interdependence between the units resulting from labour division: between the workers specialised in different tasks, between the firm and its outside suppliers, between the firm and the scientists. The workshop is coordinated by the “manufacture master” (the entrepreneur). This interdependence implies that industries are systems. We will come back to the importance of this systemic view and the networks underlying production processes in the next sections.

4. Production, competition and innovation

Marx also described the advantages of labour division and its effect on the society. Marx made an interesting distinction between heterogeneous and organic manufacturing. Heterogeneous manufacturing represents the case where different independent partial products combine to form the final product (assembly), while organic manufacturing concerns a production process where the same material receives subsequent transformations to obtain the final product.

The analysis by Marx referred to several scholars from the end-18th and beginning of the 19th century. Charles Babbage was one of them, who formulated a principle of proportionality in the allocation of resources and in the manufacturing times, that the production manager must maintain between phases to guarantee the continuity of productive flows and therefore increase productive efficiency (The ‘Babbage Principle’, Babbage, 1832). Marx refers to this proportionality principle: “when once the most fitting proportion has been experimentally established for the numbers of the detailed labourers in the various groups when producing on a given scale, that scale can be extended only by employing a multiple of each particular group” (Marx, 1867). Babbage was a mechanical engineer who focused

his analysis on the factory, while Marx was also interested in the effects of the division of labour on the wider economic system. Marx also pointed out the limits of the division of labour, in that the division of labour produces positive effects up to a point where division would be so extreme that too few skills would be required to perform the tasks and the work would become repetitive, leading to alienation. The worker becomes “depressed spiritually and physically to the condition of a machine” (Marx, 1844, Economic and Philosophical manuscripts). Thus, Marx seems to suggest that the dynamic efficiency effects of the division of labour, namely learning and innovation, would not occur if the division of labour in the factory would be pushed too far.

The topic of labour division remains in the works of authors from Senior (1836) to Mill, with a particular attention to the social impact of labour organisation characterised by the increasing use of machines in industrial activities. From the famous chapter of the book by Ricardo on machines, to the Marxist analysis and the subsequent literature, all stress the growing submission of labour to an organisation which basic element is the machine and the productive line, stylised by Taylor in his scientific organisation of labour, where individual specialisations were cancelled in a repetitive sequence of elementary tasks, thereby eliminating dynamic learning economies, which Smith considered as an essential part of the manufacturing process.

These issues were examined by Sraffa (1926, 1940) and Pasinetti (1999, 2005) and subsequent theoretical papers, which have analysed value creation in production processes that comprise capital and labour. These studies subsequently also have considered the link with organisational and technological innovation and the importance of the quality of the human capital involved in the production process and therefore the role of education systems on the definition of appropriate capabilities to produce added value. Pasinetti (2005) stressed that economic systems must be analysed in a framework of historical time: “Theory should start from facts, hence from history. If the course of history shows dramatic and radical change, theory should follow suit” (2005, p. 844).

The analysis of the proportionality of phases necessary for the continuity of flows and for the minimisation of lead time has been developed by Georgescu Roegen in his ‘fund-flow’ approach to production analysis (Georgescu-Roegen, 1970). His studies provide the basis for different structural approaches to production (Landesmann, 1986; Scazzieri, 1981, 1993; Landesmann and Scazzieri, 1996). In the structural approach to production, productive activities are considered as a major source of uneven change in the dynamics of economies. Different patterns of structural change emerge from the interaction of three fundamental components of production processes: tasks, agents and materials. The interactions between the three elements depend on how they are structured and coordinated. Structural changes involve transformations in the way these three elements are structured and coordinated; some elements may persist, or may create bottlenecks in the capacity of the system to change. New elements may be introduced, implying the need for new skills for agents, as well as new coordination arrangements. According to Landesmann and Scazzieri (1996a, p. 3), “structural economic dynamics may be defined as the analysis of economic transformations that explicitly account for the relative persistence of certain elements or relationships of economic structure while other elements or relationships are subject to change. Structural change may arise in single industries or in the whole economy.”

Developments in the analysis of increasing returns have also been proposed. Thus Scazzieri (2014) provides a deeper analysis of whether a general causal principle may be identified behind Smith’s advantages, and of whether those advantages may be realized independently of specific conditions of the behavioural or institutional type. Scazzieri therefore outlines the fundamentals of a structural theory of increasing returns.

5. The progressively vanishing focus on production organisation

Economics will subsequently develop focusing on the ability of consumers to buy the goods rather than on productive conditions. Senior, already in 1836, puts exchange at the centre of economic analysis, together with the problem of factor remuneration, regardless of productive processes.

The literature that will subsequently develop, following the Marginalist line of investigation, builds an analytical framework where the analysis of production is less and less important while the individual as consumer becomes key: a theory of prices based on individual needs is elaborated in the 19th century, abandoning at the same time the theory of efficient organisation of production.

Smith claimed that: ‘When the quantity of any commodity which is brought to market falls short of the effectual demand, all those who are willing to pay the whole value of the rent, wages, and profit, which must be paid in order to bring it thither, cannot be supplied with the quantity which they want. Rather than want it altogether, some of them will be willing to give more. A competition will immediately begin among them, and the market price will rise more or less above the natural price, according as either the greatness of the deficiency, or the wealth and wanton luxury of the competitors, happen to animate more or less the eagerness of the competition. (WN, 1, VII, 9, p.)

Consumer theory, whereby prices are determined by the subjective needs of individuals and not really by production is developed in the following years, from Mill to Marshall. Marshall provides a producer theory coherent with that consumer theory, which will substitute the analysis of production made by classical economists. Marshall recognised the importance of the classical insights on the division of labour and labour specialisation in his book “Principles of Economics” (1920). However, following the success of the mathematical framework he develops to account for resource allocation, which will become the mainstream neoclassical economics, these insights on the division of labour will be left aside.

Marshall first postulates the pursuit of production efficiency: the producer looks for an optimal allocation of resources to maximise his profit, just like the consumer maximises his utility. The law of decreasing marginal utility is the basis of the demand for a good, like the law of decreasing

marginal returns regulates production. This leads to a universal law that regulates the whole economy: the equilibrium price is determined by the intersection of demand and supply, when competition runs freely and perfectly. If the price is high, demand will fall and supply rise, and if the price is low, demand will rise and supply reduce. This free and perfect competition necessarily drives the price towards equilibrium.

“In the tranquil view which the modern theory of value presents us there is one dark sport which disturbs the harmony of the whole. This is represented by the supply curve, based upon the law of increasing and diminishing returns.” (Sraffa, 1926, p. 536).

Sraffa showed that the weak point of Marshall analysis was the hypothesis of increasing returns, in that a firm able to reduce costs without any limits by raising production would reduce prices up to the point where it would conquer all the market, but then there will be a monopoly and not perfect competition.

The Marshallian theory had to change the consideration of diminishing and increasing returns in the Classical theory: the latter considered that diminishing returns were linked to the determination of rents of land, while increasing returns were related to the division of labour. In Marshall, the tendencies towards increasing and diminishing returns always act in opposite direction, so that it is possible to define a law of non-proportional productivity which makes supply and demand perfectly symmetric.

The great crisis of 1929 induced economists to extend and rethink the Marshallian theory. While Keynes proposed a new analysis of the macroeconomic equilibrium, many economists, in the UK and in the USA, reflected on the contradictory elements of the Marshallian analysis. Thus J. Robinson and E.H. Chamberlin proposed the consideration of product differentiation and imperfect competition. However, Sraffa's point that the hypotheses of increasing returns and perfect competition were not compatible was not taken. For instance, Chamberlin (1933) raised the problem

of competition between a restricted group of producers with different dimensions and different products. As stressed by Stigler (1957), Chamberlin had to introduce questionable assumptions of ‘uniformity’ (‘that both demand and cost curves are uniform throughout the group’) and symmetry (‘that any adjustment of price or of ‘product’ by a single producer, spreads its influence over so many of his competitors that the impact felt by one is negligible) (Chamberlin, 1948, pp. 82-83) in order to make the whole reasoning coherent.

Mason and then Bain emphasised the need to examine the productive structure of industries, considering parameters such as concentration, scale economies, and product differentiation, which contradicted the Marshallian model. From these works the field of industrial organization and industrial economics was created and developed (Bianchi, 2013), but never re-considered Sraffa’s critique. The result is that the concept of labour division and its dynamic adjustments following changes in competitive conditions has remained unexplored.

With the introduction of utility concepts in the late nineteenth century, the focus of analysis shifted to problems of market values and equilibrium, so that the social and political aspects of surplus and distribution became secondary or implicitly resolved.

The problems of the adjustment of productive processes within the firm to changes in competitive conditions are again highly on the agenda today as globalisation and the financial crisis have induced firms to restructure. Hence the reference to classical economists once again does not appear as an archaeological effort but is the expression of a need for new analytical tools today.

6. From mass production to industrial districts and flexible production systems

The long cycle between the 1930s crisis and the 1970s crisis can be identified as the era of mass production. The economic revival of Western countries and Japan after the end of the Second World War has been determined by a strong consumption growth, particularly of durable goods such as automobiles. Demand for cars was easy to forecast and largely based on domestic demand. A national leader or a limited oligopoly could consolidate at the national level. Production was characterised by the Taylorist system, defined by Ford at the beginning of the 20th century, as a continuous sequence of simple tasks constrained by the movement on a specific assembly line where the product is progressively assembled in a standardised good, sold on a market where price competition prevailed. In this system, static economies of scale guaranteed low production costs, and the incumbents could maintain market power by setting a price which kept potential entrants out of the market, according to pre-emption strategy studied by Sylos Labini, Bain and Modigliani in the 1950s.³

This was the era of the ‘modern corporation’ as defined by Chandler (1977). Mass production had evolved since the beginning of the 20th century to produce more differentiated products. The Fordist firm was extremely rigid and could produce a homogenous good. Already in the 1920s the need for more variety was felt and General Motors (GM) introduced a new production system and new organisational form, that Chandler defined as the multidivisional or M-form, in contrast to the unitary form where only one variety of the product could be manufactured, such as the Ford-T. GM created different divisions, each specialised variety of the product and, later on, particular markets. In the automobile industry, there could be different car models with different colours, but differentiation was limited.

This era ended up when demand for mass products reduced on domestic markets because consumers started to look for more differentiated goods. In the car industry example, this meant that consumers asked for higher variety of models, of colours, of engines, of power, and so on. The M-form has limits in producing such a high variety since it still used rather rigid assembly lines.

³ Modigliani (1958), Bain (1959), Sylos Labini (1962).

In the 1970s, the political context also completely changed following the dramatic rise in the price of raw materials and of labour costs (following the Philips curve, as the economy moves closer to full employment inflation rises). Demand became uncertain as a result and highlighted the rigidity of production systems based on static economies of scale where even small changes in the assembly line were costly and time-consuming.

There was therefore a need for production systems that could produce higher variety at limited cost, able to combine economies of scale and economies of scope.

In the car industry, Japanese producers had such flexible production systems and began to expand in Western markets, first in the USA and then in Europe. Given the characteristics of the Japanese market they had developed production systems able to produce a variety of products at low volume and low cost. The main features of this system were management practices such as just-in-time, continuous improvement (kanzen), worker empowerment to learn and make suggestions for improvements. The main source of Japanese firms' competitive advantage was their production organisation (Labory, 2002).

Western firms therefore saw their market positions threatened and had to react.

This reaction took two directions in the end of the 1970s. On the one hand, some firms pushed automation as much as possible to create the co-called unmanned factory. This process also pushed vertical integration to the extreme. On the other hand, some firms operated vertical disintegration, by creating subcontracting networks while maintaining the quality and continuity of production flows.

Extreme automation soon proved to be inefficient, and the dominant trend in the 1990s was outsourcing (Sturgeon, 2002). Outsourcing strategies were first adopted to reduce costs, since the shift of production phases to outside suppliers directly impact on this variable. However, outsourcing became a strategy of firms allowing them to focus on their core competencies and more value-adding activities.

A third 'phase' in outsourcing is off-shoring, whereby production phases are not only outsourced but also delocalised to even distant countries, thereby creating 'global value chains' (Gereffi, 1994

Sturgeon, 2008) or ‘global production networks’ (Coe et al., 2008). This trend is due to globalisation, namely a large increase in the extent of the market following the transformation of formerly planned economies into market economies in the 1990s, as well as the emergence of big players and big markets such as those of the BRIC countries (Bianchi and Labory, 2011).

In recent years however several scholars have highlighted that the trend of off-shoring may be ended and many firms in the world prefer re-shoring (Bailey and De Propris, 2014). The main reason for re-shoring is that the high geographical fragmentation of the production process impedes static (cost) and dynamic (learning) external economies to be exploited, such as the ‘industrial commons’ or ‘industrial atmosphere’ of places where a single integrated firm or different firms from the same industry are in proximity.

This topic of proximity has been widely studied in the 1980s and especially 1990s with reference to industrial districts. After the crisis of the very large, integrated firm in Western countries some new models of industrial organisation emerged such as industrial districts. Such aggregations of SMEs had existed for years, but they turned out to be very competitive from the 1980s onward, thanks to their capacity to produce variety and quality at reasonable costs.

In these new aggregation models the territory and its community of people becomes the common and unifying element of the different phases of the production process managed by different firms.

Becattini (1979) used the analysis made by Marshall (1890) to analyse and identify these industrial districts. These systems of SMEs were characterised by the division of labour across firms, in that each firm in the district realised a different phase of the production process. Their collaboration and embeddedness in a local community allowed the SMEs to exploit external economies while the simultaneous competition arising between them provided the incentives for quality and (incremental) innovation.

Subsequently various authors have developed this model of local cooperation, highlighting the importance of the infrastructure sustaining innovation processes. Porter (1990) developed a more

general approach to production clusters, while more recently the conditions for the cohesion of multiple firm systems have been outlined, mainly centred on the theory of industrial commons, namely of shared knowledge (Pinch et al., 2003; Lessig, 2004).

Various models of the complexity of organisations have been developed since then, beyond the various theories of the firm. The global value chain literature refocuses the analysis on production cycles, showing their articulation in different countries.

Sturgeon calls them ‘modular production networks’ (2002, p.1), whereby the production process is organised in different modules that are realised by different firms, the lead firm focusing on core competencies such as product innovation and design, as well as marketing and commercialisation. Suppliers take growing importance and power in this process, since they produce complete modules for different clients.

However, the evidence regarding the diffusion of this organisational form is based on specific case studies (for instance Sturgeon, 2002, analyses it in the electronics industry) and no systematic evidence exists. Reality appears to be variety since even in the electronics industry some large, vertically integrated firms co-exist with firms organised as modular production networks (respectively Samsung and Apple).

Some attempts at systematically analysing firm organisation have been made, based on survey data of manufacturing firms asking them about various aspects of their organisation: production organisation, hierarchical levels, responsibility of workers and managers at the various levels of the hierarchy, the extent of team work, remuneration schemes, and so on.

These various aspects are so-called ‘human resource management practices’, or ‘new work practices’. The effects of their adoption on productivity and performance have been stressed (Black and Lynch, 2001; Osterman, 1994). However, they also have drawbacks and some studies have pointed to the stress and higher incidence of working diseases and accidents they occasion (Askenazy, 2001).

Overall therefore there is need for more empirical and theoretical studies on these new forms of production and overall firm organisation and their effects on productivity and performance.

In this phase, the industrial economics literature has focused on the role of innovation, intended mainly as production technology first and then extended to organisational innovations, especially those related to ICTs.

In this context the re-discovery of Schumpeterian theses has allowed to define competition processes centred on innovation, with three major theoretical directions: first, the development of national or local innovation systems (Freeman, 1995; Lundvall, 1992); second, competition games based on hypotheses on the innovation capacity of players (Dasgupta and Stiglitz, 1980; Gilbert and Newbery, 1982); and third, the relationship between knowledge creation, innovation and the internal and external organisation of the firm (Nelson and Winter, 1982; Coriat and Dosi, 1999), including local systems and clusters (Porter, 1990; Audretsch and Feldman, 1996).

The topic of industrial organisation has recently been taking growing importance in the phase in which globalisation determines a substantial increase in the extent of the market, namely not only a physical extension of trade but also and mainly the entry of new competitors with a simultaneous re-organisation of productive processes to adjust to the new scale of the market.

The increase in the extent of the market clearly originates from institutional choices related to the removal of barriers to trade. After the period between the two World Wars characterised by an increasing closing of frontiers and trade, after World War II the Bretton Woods Agreement was the start of a liberalisation process. After a long series of negotiation rounds the Doha Agreements were signed in 2001, which have led to the creation of the WTO and to the entry of countries such as China into the world market.

In this context, the GVC approach must be integrated with a more rigorous analysis of the capacity to create value by producing products using various capabilities used by human resources with different levels of education.

7. Dynamic efficiency and industrial systems

The study of industry in Economics has been guided by the notion of efficiency. This is what Adam Smith examined in his book *The Wealth of Nations*, arguing that the capacity to organise production determined the generation of value. Efficiency is both static and dynamic.

Static efficiency is optimisation given resources and given a specific environment. Dynamic efficiency is the capacity to adapt to changing competitive conditions and social and institutional environment, which may bring an increase in the extent of the market or opportunities for the development of new markets. While the neoclassical school has developed focusing on static efficiencies from Walras onwards, taking demand and technology as given, as well as implicitly the social and political institutional framework, the need for a consideration of dynamic efficiency has again and again been highlighted, from Schumpeter and Penrose, to the evolutionary approach of Nelson and Winter (1982) and followers who have stressed that to analyse structural changes it is essential to consider the dynamics of industrial development, which inevitably implies the consideration of dynamic efficiency, technical progress, as well as the institutional context which is not given but adapts and changes through time too.

This is a key issue nowadays where the socio-political context has deeply changed in the last 20 to 30 years, with the end of the bipolar world order created after WWII, the large increase in the extent of the market with the complex phenomenon of globalisation and the new technological opportunities offered by technical progress (ICTs, biotechnologies, nanotechnologies), as well as the pressing question of environmental preservation and the need for a new model of economic development based on renewable and clean energy.

Static efficiency is making the most out of existing resources, in each socio-political context. It is growth following a given path, where resources may increase and feed increases in the growth rate. It is adaptation, if a shock occurs that induces a departure from the growth path, adaptation meaning the capacity to return to the given path.

Dynamic efficiency is the capacity to develop new growth paths, to alter institutions so that the old power relations can be changed and new social relations created to favour learning, knowledge creation and innovation.

Taking the single individual or firm as the unit of analysis which behaviour must be studied is appropriate when the study focuses on static efficiency. When dynamic efficiency is the focus however, it is the system of which the individual or the firm is part that must be considered, because different parts of the system may be changing and the opportunities and choices, as well as performance, depends on the way the whole system is changing.

Starting from the division of labour, and the increase in productivity and innovation (through learning processes allowed by specialisation) it induces, we can examine its effects on the whole economy. The division of labour allows to produce better, to raise the wages of the labourers, who can access to better education and culture, so that their demand change. Changing demand is met by innovation and the production of new goods, feeding a development process by which the wealth of nations increases.

Marshall, despite his theory of resource allocation and representative firm, also has a broad and systemic view of industry: he views industry as an organism, as a system made of different parts that specialise (differentiate in his words) and work in a coordinated manner.

This central unity is set forth in the general rule, to which there are not very many exception, that the development of the organism, 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 between them (Marshall, 1890, IV, VIII, 1, pp. 200-201).

The subdivision of functions is the division of labour and induced development of specialised skills, knowledge and machinery. The different parts however must be well coordinated or ‘integrated’ in

the words of Marshall, where integration means “the firmness of the connections between the separate parts of the organism” (Marshall, 1890, IV, VIII, 1, p. 201).

This leads to another important point. The firm is also a system embedded in a specific institutional framework, which has effects on its strategies and performance but is also impacted by it. In the Classical economists’ approach the institutional framework in which the relationship between labour division, extent of the market and power of exchanging is realised has effects on this relationship. The political context in which the competitive action is realised is not independent of the economic system, but is itself an engine of economic progress. The wealth of nations is based on the division of labour, which can only take certain forms if specific institutional constraints that may limit the natural rights of individuals may be overcome.

Classical Economists highlight that economic growth and development imply structural changes in which the internal structure and relationships of the economic system are changed, so that the process is both economic and political. It is not possible to analyse the expansion of the economic system without considering the transformations in the civil society. In other words, using the words of Dahrendorf (1988), in the classical thinking the development of provisions, namely resources, is based on the development of entitlements, namely of the right to access to production and to the use of resources. Economic growth can only arise if the institutional context can provide individuals with the rights to access resources and their use, freed from the constraints that had structured the previous society.

The elements of this structural dynamics based on efficiency are the market and the firm, which contrast with the feudal system where the social hierarchy and family organisation determined the institutional framework that defined the economic and political situation of individuals. The transition from feudalism to capitalism is therefore first and foremost an institutional transformation, which is legitimised because it frees individuals from pre-existing constraints and therefore activates their

capacity, thereby inducing a collective development.

The entrepreneur organises production in relation to the extent of the market and manages an organisation as an instrument of the specific conflict that is measured in terms of “power of exchanging”. In this conflict, the entrepreneur can also obtain “secrets of manufacturing” and “secrets of trade”, namely production and market innovations, which constitute temporary advantages because they are likely to be copied by rivals (Smith, 1776, pp. 77-78).

This role of the entrepreneur, as an organiser of the division of labour and a market agent, can only be realised in an institutional context, which allows the free exercise of “natural” rights: a situation where perpetual institutional monopolies, such as exclusive rights to exploit commercial routes like the India Companies, are removed, and the temporary monopolies such as the opening of certain trade routes or some large investments are regulated with patents, licences and copyrights specified for a certain duration.

The role of the State is to guarantee the rights of access, generation and appropriability of resources. This public function translates into the defence of individual and collective rights, but also the realisation of public work and institutions that individuals could not activate by themselves, but that are essential to the development of their activities. Efficiency but also rights of access are essential to economic development that must be based on social stability guaranteed by institutions.

Robbins thus argues that political economy fundamentally is the study of the relationships between growth of the provisions and development of entitlements, namely between the types of growth of economic resources (and types of production organisations in relation to the economic conflict that is the engine of growth) and the modes of institutional development, which guarantee to individuals the right to participate in the economic conflict and therefore in the nation’s growth process (Robbins, 1978, pp. 37-38). If provisions grow without appropriate entitlements, inequalities are generated, and if entitlements grow without growth in provisions, instability is generated.

This perspective is lost in the Marginalist analysis, which becomes the science of the maximisation

of provisions, without considering the necessary entitlements. This assumes that the study of the growth processes is possible without considering the institutional forms that historically determine these processes. The result is that the entrepreneur's choices are determined by the criteria of maximisation of individual interests, in a socially neutral context, so that social conflict no longer is the engine of change and development. The elements inducing structural changes, such as technological progress, are even assumed to be exogenous to economic dynamics. It follows that the expansion of the dimension of the economic system occurs without any changes in its internal structural relationships. This general theory of human action, whereby a collective equilibrium can be reached by maximising individuals' preferences, replaces the ethical and historic theory that considers the links between competition and development. This theory explains the homeostasis of the system and derives optimal paths, but explains neither deviation from the optimal path, namely crises, except as pathologies, or jumps to new paths, namely accelerations in development (Bianchi, 1991).

8. The fourth industrial revolution

As stressed in previous sections, industries have experienced substantial structural changes over the last decades: the shift from Fordism to flexible production, Toyotism as in the Japanese model, modularity and global value chains, as well as systems of SMEs like industrial districts, are all examples in a long list of deep structural changes affecting all industries, although to different degrees and extent.

Currently production organisation seems to be experiencing a new industrial revolution: after the introduction of steam engines allowing the first industrial revolution, electricity-powered machines in the second revolution, electronics and computers in the third one, the fourth industrial revolution is characterised by the convergence between industrial production technology and science, and even

their integration, characterising the era of “techno-science”. The main feature of the current industrial revolution is indeed the capacity to induce the convergence of all the technologies that science can develop today to provide a customised answer to large numbers of consumers that constitute a new demand extending to the global market.

There are different examples of this integration of science and technology. The sequencing of human genome has opened new opportunities not only in the health sector. These ‘omics’ technologies allow deeper understanding of the mechanisms with which genes, proteins and enzymes function and therefore more targeted treatments of diseases. Synthetic biology is surpassing the capacity to synthesize artificial cells. Metabolic engineering controls the networks of cell reactions of some bacteria, allowing a new approach to chemical synthesis, including biofuels.

Similarly, nanotechnology is used in various fields of science such as organic chemistry, molecular biology, energy, environment science, semiconductor physics, food safety, etc. Industrial applications are numerous, ranging from developing new materials to direct control of matter on the atomic scale, from improvements in electrical conductors to nanostructured solar cells for energy generation, and so on.

Concerning production processes, the convergence between the real world of industrial plants and the virtual world of internet (the Internet of Things) leads to what has been denominated in various terms, including “smart manufacturing”, “advanced manufacturing”, the “internet factory”, which is the factory transforming into a mixed cyber-physical system, with a complex network of machines, physical goods, virtual objects, computing and memorization structures, communication devices which interact together and with economic operators.

Using sensors and other technological devices the product, which goes through the production process, is not only progressively assembled, it can communicate with machine and indicate them what to do. Because of this technological evolution, the connection and interdependency not only between workers and the network, but also between machines, namely between all means of production, increase in the digital factory. The “firmness of connections”, outlined by Marshall as an

important factor for the efficiency of production, is perfectly established.

Product differentiation can increase at low cost, and moves towards the possibility of the personalisation of products, with high flexibility in the factory. In addition, a real-time dialogue between the market, product development teams, suppliers and production is feasible, with important consequences on the characteristics of plants, of product volumes and product ranges, and the division of labour.

It seems that smart manufacturing will increase the heterogeneity of both products and firms' organisation in markets. A high differentiation of products will be possible, up to personalisation. Regarding firms' organisation, decentralisation and outsourcing may be observed together with vertical integration. Smart manufacturing lowers the costs of organisation as networks, since it is characterised by hyper connection: products, people and machines can be related via the web and interact; it also lowers the cost of organisation as integrated firms, since hierarchies are able to better control all the operations at all levels.

Some firms organise global value chains where not only production but also pre-manufacturing phases are organised as worldwide webs. Numerous subsidiaries are located in different countries in the world, some of them carry out complete production processes for the local markets, others realise some phases of the production process which output is then transported to other subsidiaries in the rest of the world; regarding research and development, centres are often located in different regions in the world, generally one in each of the main continents, and carry out research with local networks (with other partner firms, with universities, public and private research centres, and so on) (OECD, 2014).

The importance of the integration between science and technology is illustrated the recent creation of Manufacturing Innovation Institutes in the USA, since these institutes aim at putting together business, academia and the government to favour the development of these new technologies and their commercialisation. The National Additive Manufacturing Innovation Institute, the Digital Manufacturing and Design Innovation Institute, Lightweight Innovation for Tomorrow, Power

America, The Institute for Advanced Composites Manufacturing Innovation Institute, American Institute for Manufacturing Integrated Photonics (AIM Photonics), NextFlex, the Flexible Hybrid Electronics Manufacturing Innovation Institute, and the Advanced Functional Fabrics of America (AFFOA) are coordinate in the national network in order to develop new technologies and products in the fields of 3D printing, digital technologies, new metals and new materials, semiconductors, advanced composites, photonic integrated circuits and flexible hybrid electronics. These institutes are like the model of Fraunhofer Institutes in Germany which establish a close collaboration between the research and business communities, leading to the development of techno-sciences.

A clear consequence in terms of production organisation will be a continued increase in the knowledge content of products, reinforcing the importance of intangible assets in production. Bianchi and Labory (2011) argued that the increase in the extent of the market induced by globalisation led firms to increase the knowledge content of products, including more innovations, in order to renew them more frequently and take a competitive advantage. They showed that in terms of production organisation this lead to a growing importance of pre-and post-manufacturing phases in production processes, hence the growing importance of intangible assets such as knowledge, innovation and human capital. Technological developments described above make the pre-manufacturing phase essential, because they make product development and prototyping key to get competitive advantages. The capacity to master and combine the new technologies into new products is key for performance, and the integration of production and science is a way a gaining advantage on this aspect. The trends in reduction of employees in manufacturing is likely to continue since machines will replace workers, and the workers remaining will have to have high skills to be able to handle the new technologies.

The division of labour changes in relation to the extent of the market, hence structural dynamics by which the internal structure and relationships of the economic system are progressively transformed.

9. Conclusion

All these structural changes point not only to the need for further industry studies, to better understand the diffusion of organisation forms and organisational innovations, but also to the relevance of the work of classical economists. Two aspects of the classical approach to the analysis of industry appear to be especially relevant nowadays. First, the need for a dynamic approach: industrial development is a process of structural change. Second, industries must be seen as systems: division of labour creates systems of firms, individuals and territories. This implies that the *interplay* between economic, social and political processes must be considered to understand any particular aspect of it. In other words, changes in manufacturing division of labour have implications for the whole structure of the economic system.

These transformations point to the need of multi-dimensional industrial policies. Connections are everywhere, between suppliers and lead firms; between firms, research centres and education institutions; between consumers, product designers and manufacturers; between all energy flows within the network. The integration of innovation, territorial, social and structural policies in the design of new industrial policy, as highlighted in Bianchi and Labory (2011), is thus more necessary than ever before.

Competencies and skills must adapt to the new structure. Human capital policies, education and training have an important role in smoothing the adjustment process. At the same time, one should not forget that the risks of monopolisation are also high. Networks of firms might induce knowledge monopolisation processes, which would have negative impact on social welfare and growth. The large amount of data available to individuals and social groups offers important new opportunities, particularly for product customisation to consumers' needs, but it also raises critical issues for citizens' privacy and security, and the distribution of power in society.

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